Satellite solutions for Emerging Countries

Brunella Pavesi

Main subjects

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- TPZ short presentation
- Experience in emerging countries
- Which are the main needs ?
- Needs versus technological solutions
- Satellite use advantages
- Networking, operations and resource managements – the common service platform
- The Pan-african telemedicine program
- Drivers for funding optimization

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Telespazio mission

TELESPAZIO
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World-wide player in

- **Satellite Operations**
- **Services for Earth Observation**
- **Navigation and Infomobility**
- **Integrated and Value Added Connectivity**

Fucino space centre

Toulouse space centre

Matera space centre

leveraging on technological competences, facilities, participation in the main European Programmes (Cosmo SkyMed, Galileo and GMES), and on the “Space Alliance”

Kourou space centre

Scanzano space centre

Lario space centre

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Telespazio: from space to services

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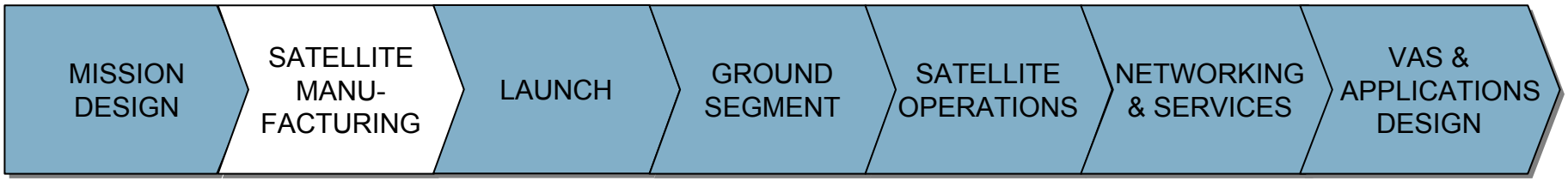

- Studies and analysis for new mission
- "End to end" configurations

- Operations launch bases
- Maintenance levels 1 & 2

- System architecture definition
- Design and implementation of ground system
- System integration and validation

- Control centres implementation
- Launch support (LEOP)
- Telemetry, Tracking & Control

- Networks integration
- Infomobility
- Navigation
- Geo information

- Reselling satellite capacity for TLC & TV
- Trunking services
- Networks management
- Multimedia application

Telespazio has the right competences to be in every phase of a space system based on satellite technology

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Earth Observation Offering:
Telespazio is present along all the value chain

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Technical Scientific Support	Acquisition & Processing Systems	EO Operating Management	Standard Data & Products	Development of applications & providing Products and Services	Monitoring Services & Systems, Forecast and Decision
Consultancy	Planning	Management of Operational Department	Quickbird	Space Map	Analyses Fire Damage
Training	Purchasing		Ikonos, SPOT	GeoData	Oil Spill
R&D	Installation		Landsat, ERS	Thematic Layers	Waste Tips monitoring
	Testing		Ortho-photos	…	Hydro-geological Hazard
					Prevention & Decision Support System
					Agriculture
					Cartography & Cadastral
					Landslide Forecasting
					…

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Examples of Earth Observation Services Offering

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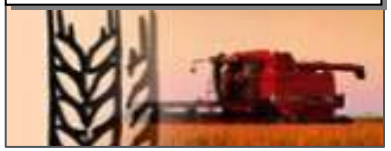
Agriculture

- IACS-GIS Solutions
- Parcel Reference Systems
- Subsidy Controls
- Assistance to Administrators and Farms
- Agro-Risk Management



Forestry

- Forest Mapping
- Forest Inventories
- Biomass and Carbon Stocks
- Biodiversity Inventories
- Forest Management Systems

Geology

- Geological Mapping
- Mining Management
- Hydrocarbon Exploration
- Groundwater Exploration
- Administration Support

Cadastre / Land Mgt

- Land Administration
- Cadastres
- Water Management
- Land Information Systems
- Institutional Land Management

Orthom & Cartography

- Satellite data
- Aerial/satellite orthoimages
- Technical Cartography
- Digital Terrain Models
- Land Use and Land Cover
- 3D models and visualization

Infrastructure

- Transportation Systems
- Utility Management
- Facility Management
- Communication Solutions
- Location Based Services

Risk Mgt, land Protec

- Landslide;
- Forest fires;
- Floods;
- Geohazard;

Environment

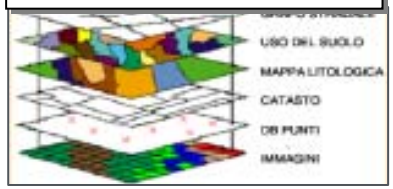
- Environmental quality analysis
- Subsidence;
- Coastal zone management
- Land Use Planning
- Watershed Management
- Disaster Management
- Environ. Capacity Building

Maritime Environment

- Oil spills
- Ship detection
- Marine water quality
- Surveillance of off-shore extraction activities

Geo Info System

- Geographic Information Systems
- GIS Applications for territory management



Security

- Maritime surveillance
- Rapid mapping for humanitarian aids
- Activities Monitoring

Integrated GIS

- On-line access
- Processing of geo-info products
- Platform systems
- e-shop Services

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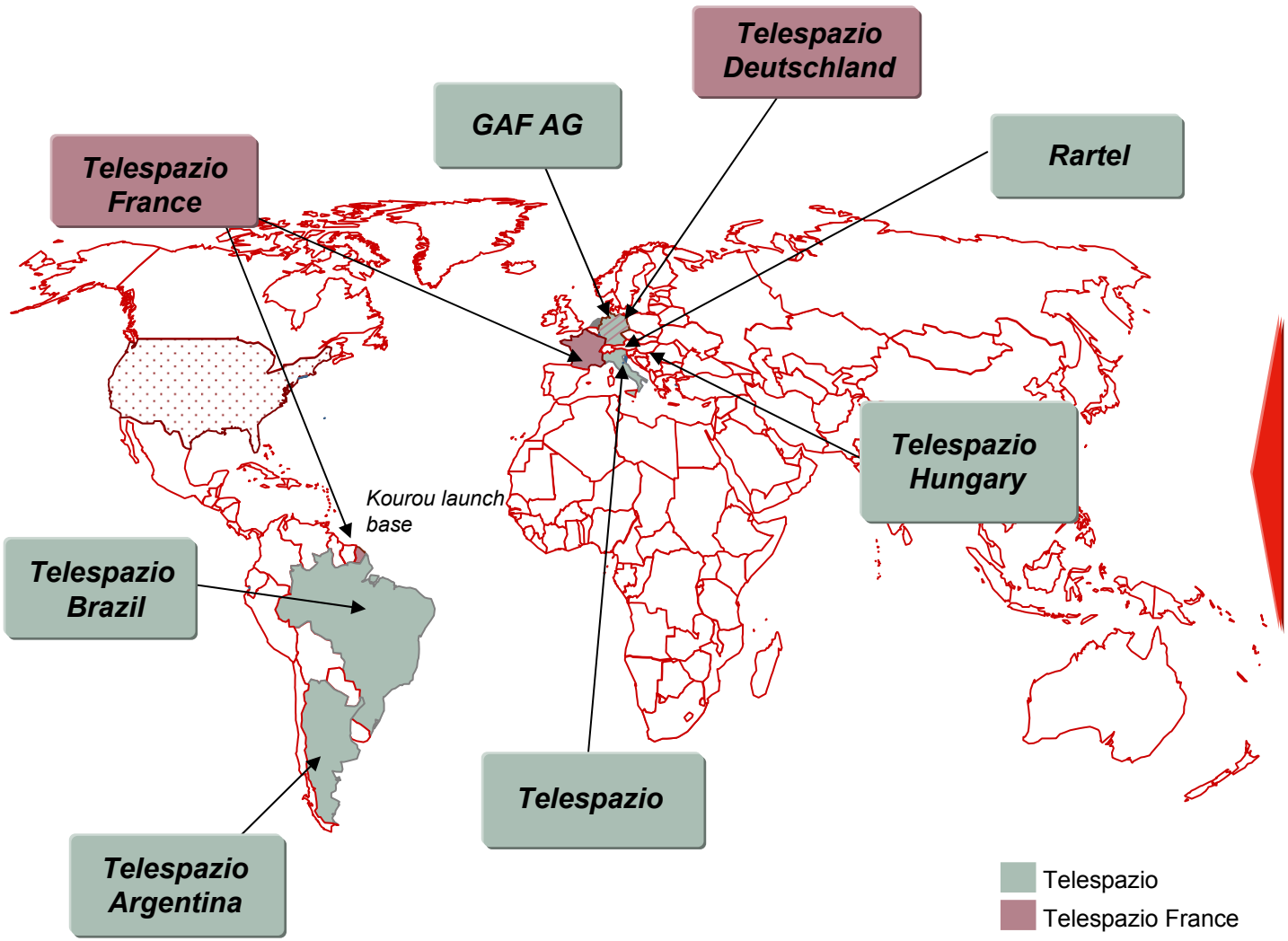
Telespazio presence world-wide



- Wide international footprint
- Strong concentration in domestic markets (Italy and France)

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Programs in Central and South America

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- Brasil
- Argentina
- Venezuela
- Dominican Republic
- Belize
- Colombia
- Costa Rica
- Perù.
- Chile

Main subjects: Land management, cadasters, various applications in telecommunications

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Programs in Asia

- **Afghanistan.**
- **Iraq**
- **Pakistan**

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Experiences in Africa

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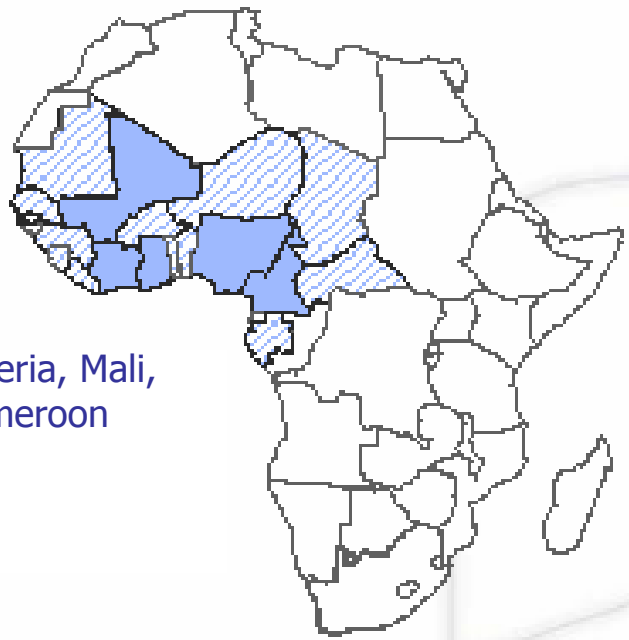
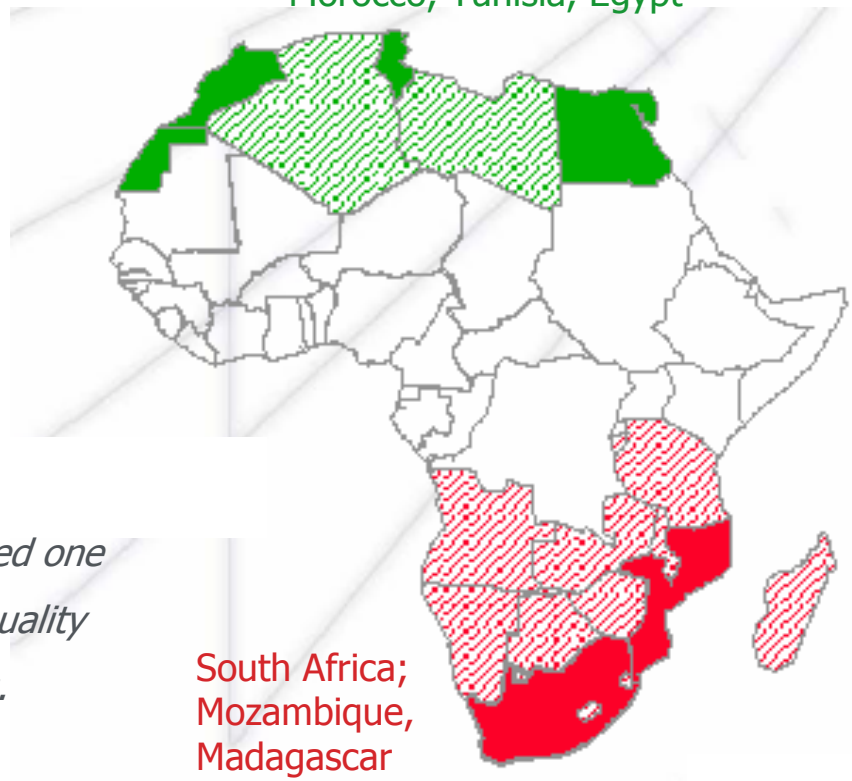
Case and experience for project on national basis as for pilots in some regions



Nigeria, Mali, Cameroon

Morocco, Tunisia, Egypt



South Africa; Mozambique, Madagascar

- *Validity of Pan African solution seen as a Global integrated one*
- *Fund optimization, financial saving and better service quality*
- *Financial needs for system operations and network mng.*
- *Sharing for different services*

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Which are the main needs?

Primary needs:

- Health
- Education
- Telecommunications

Enhanced service demand:

- Internet access
- Broadband comms
- Dedicated corporate networking

A unified technological solution exists providing:

- *Distance Learning*
- *Telemedicine*
- *Urban and Rural Telecommunication*
- *Internet Navigation*
- *Enhanced IP Multi-videoconference*
- *Corporate networking IP: dedicated bandwidth*
- *Television (integration with existing DVB systems for web and standard Television delivery)*
- *@-government services*

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Technological considerations

- Satellite solutions represent the appropriate instrument to provide connectivity everywhere and guarantee the integration with the existing TLC infrastructure
- On sub-Saharan regions satellite capacities are available and that capacity is growing , both in C and Ku Bands
- In this frequency range there are many potential products that can be utilised for implementing an adequate network.
- Due to the digital divide convergence it is possible to design a unique network able to host different level of connectivity in terms of bandwidth and in terms of hierarchical authorization access.
- The merge between TLC and ICT brings the last milestone for the creation of a solution where different users can access, derive information and process them for different scopes (accessing to info related to the geo-location, the time frame and the identification of the insertion)
- The compatibility and the interface between satellite and terrestrial link is guaranteed, as well as the possibility to adopt GSM, wireless systems where existing as well mobile satellite phone or modem.

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Satellite capacity expected availability

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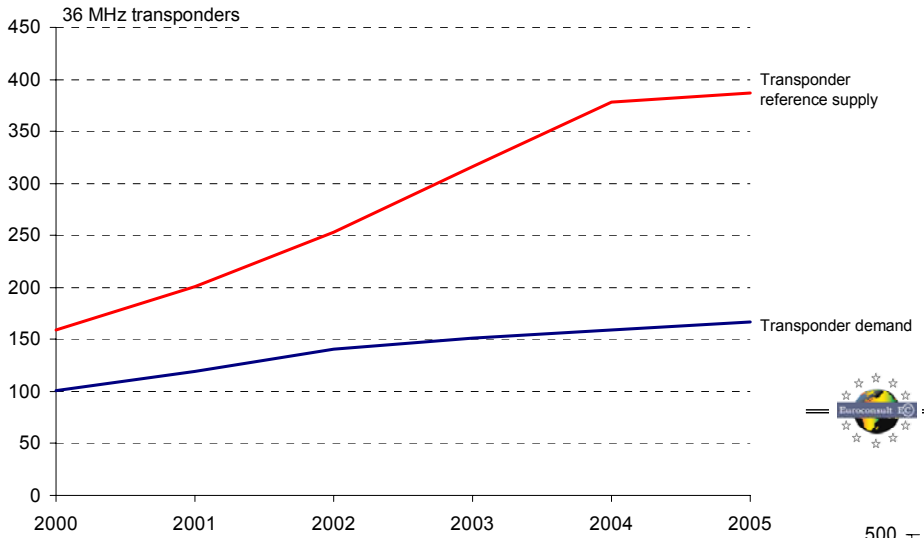
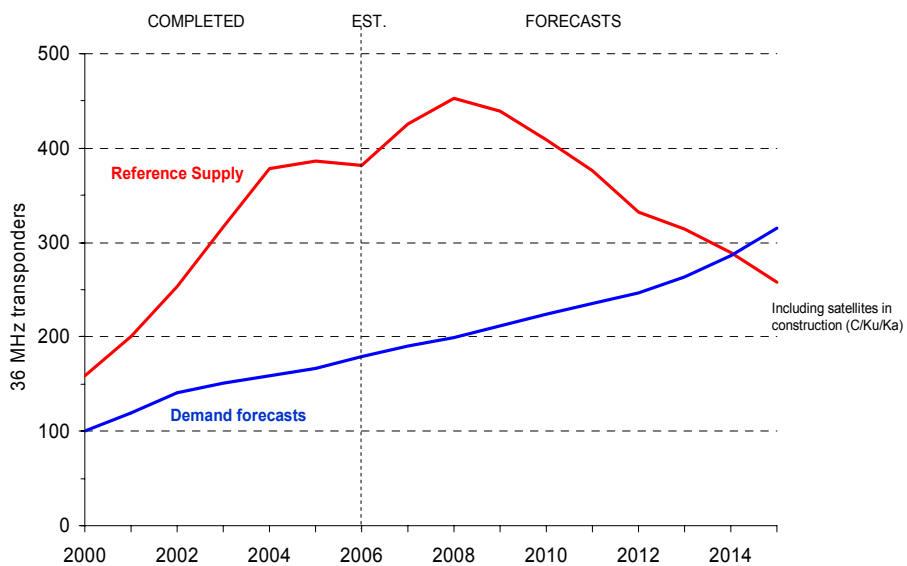
Transponder Supply and Demand in Sub Saharan Africa
(2000-2005)



Data source: Euroconsult rep. 2006

Transponder Supply and Demand in Sub Saharan Africa
(2000-2005 and Forecasts to 2015)



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The integrated services architecture

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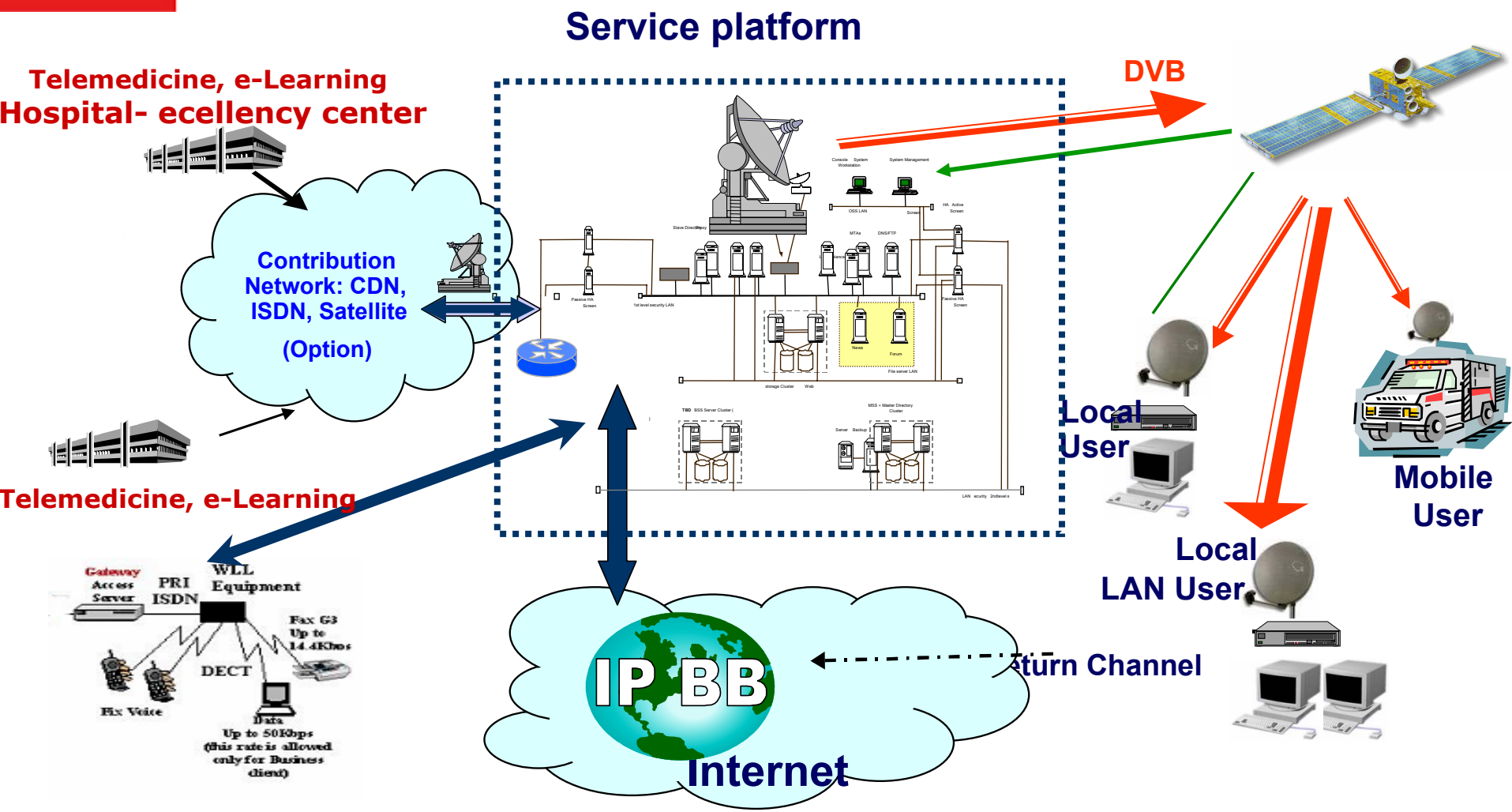

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Network Access Services:
Two Ways Satellite Connectivity

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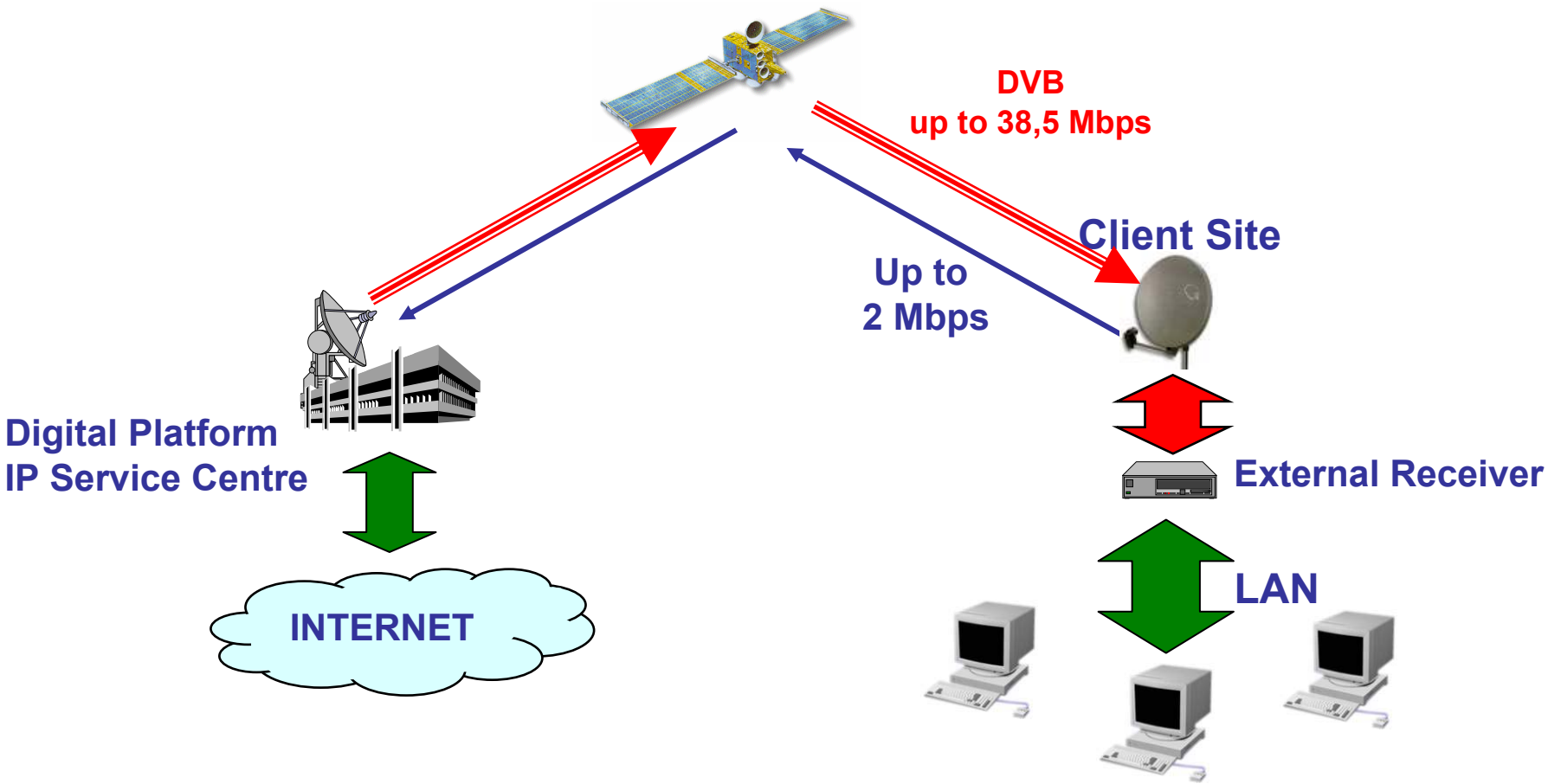

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Telemedicine: fixed and mobile units

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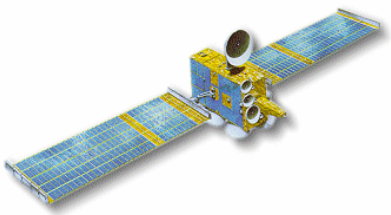

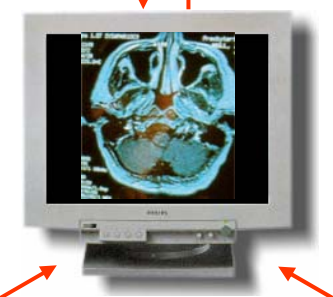

Mobile unit

Hosp 1

Hosp 2

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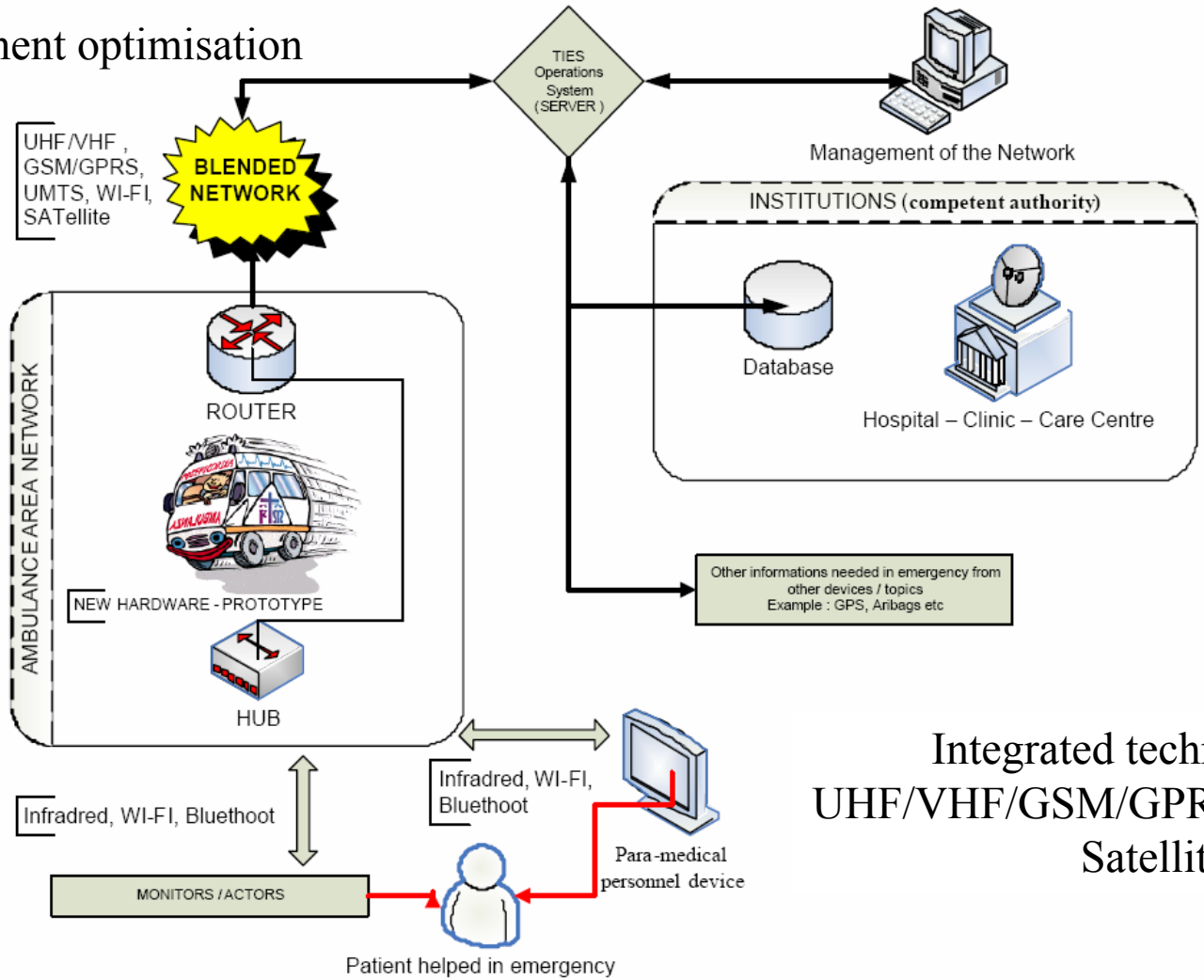
Emergency System

Fleet management optimisation



Integrated technologies.:
UHF/VHF/GSM/GPRS/UMTS/WiFi/
Satellite

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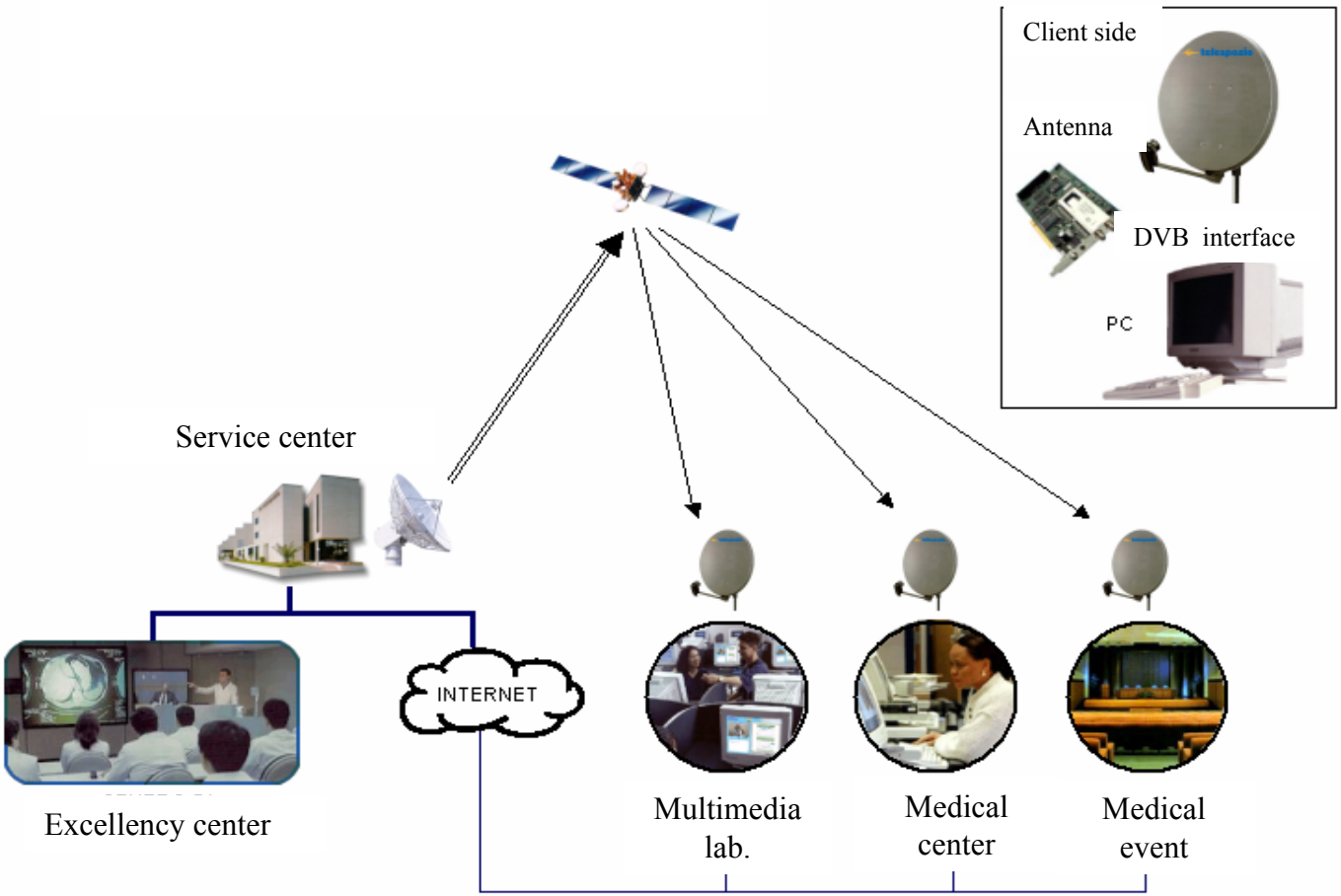
Satellite Distance Learning Service



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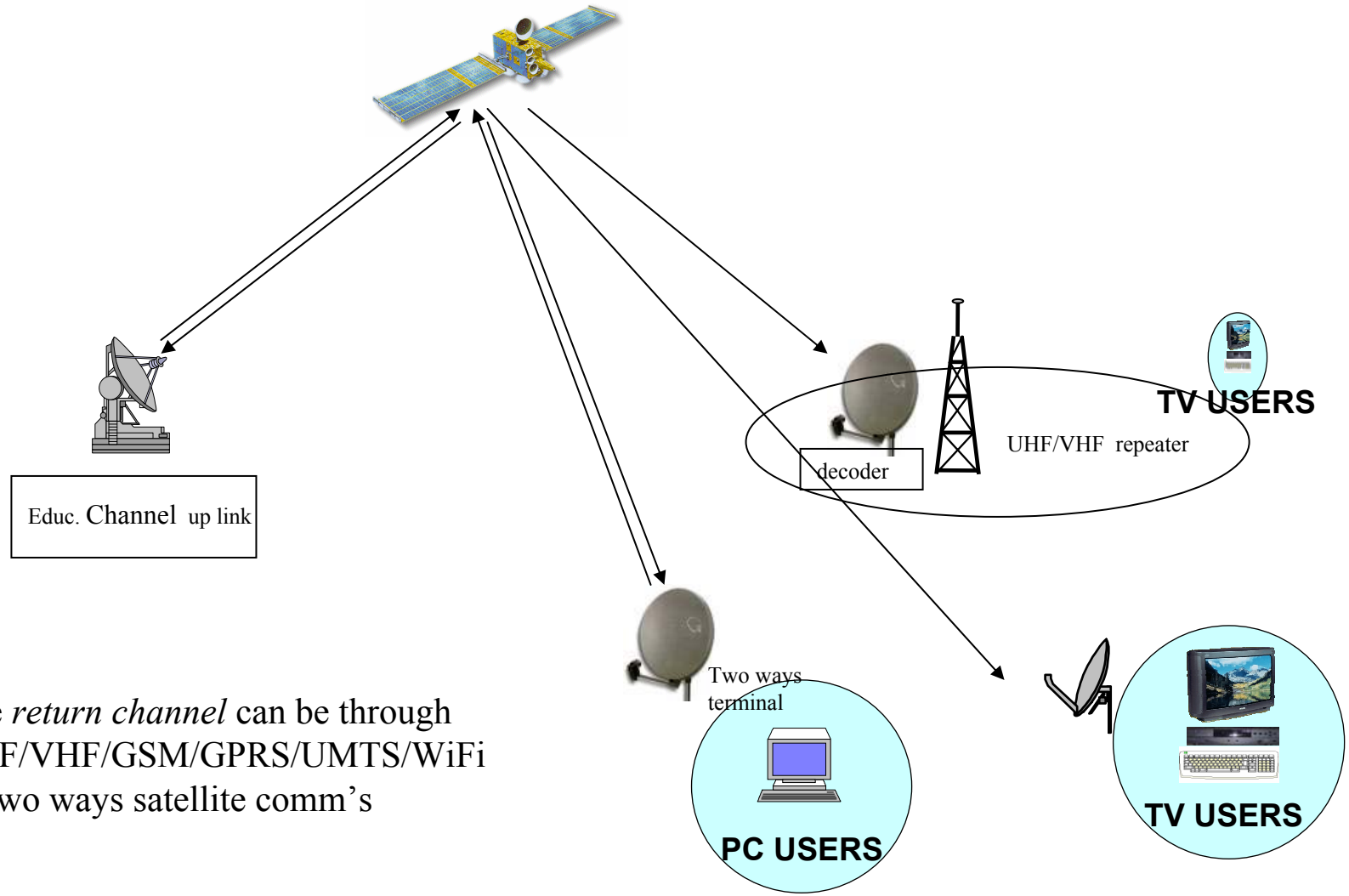
distance-learning



The *return channel* can be through UHF/VHF/GSM/GPRS/UMTS/WiFi or two ways satellite comm's

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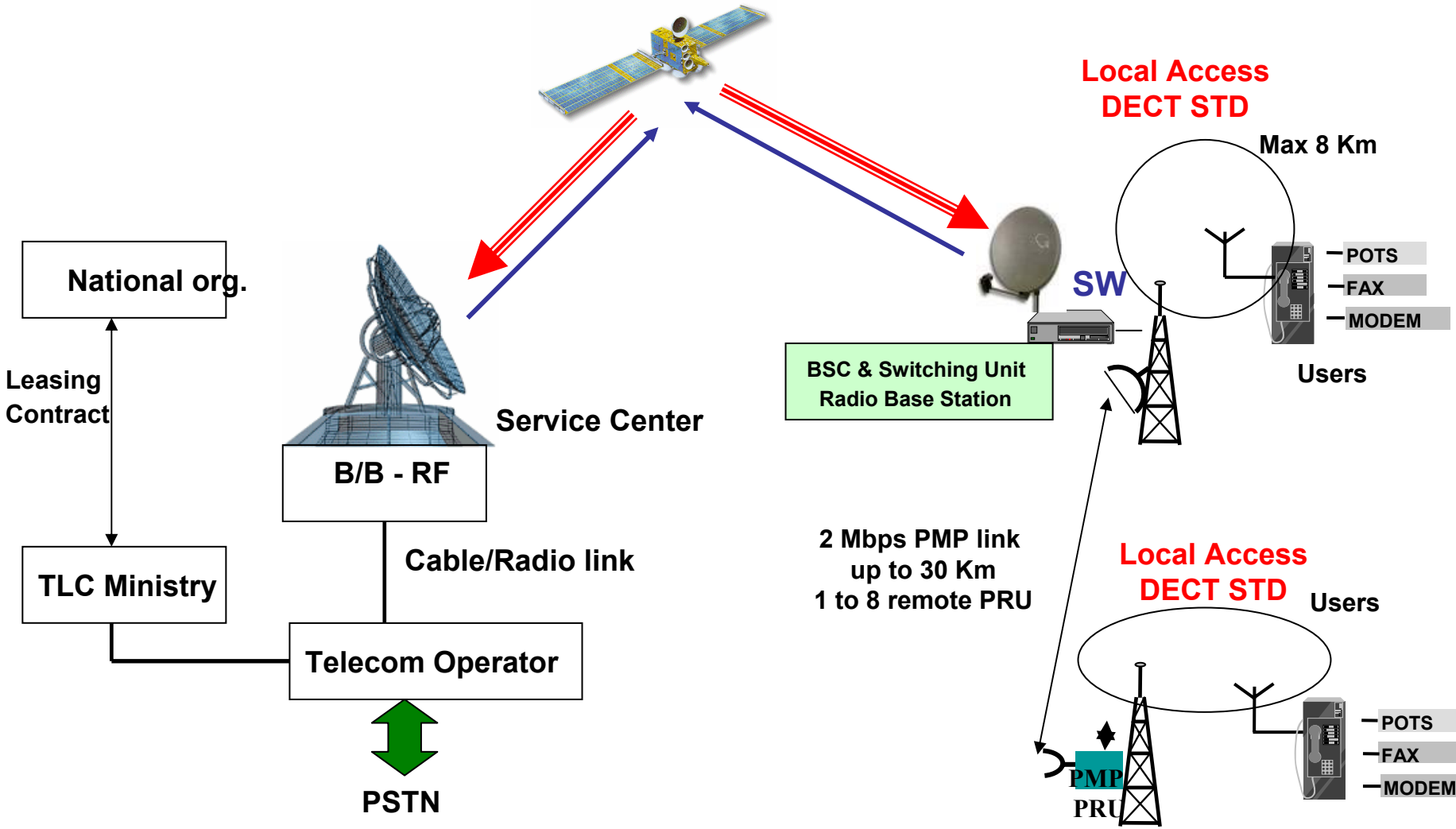
Rural Telephony



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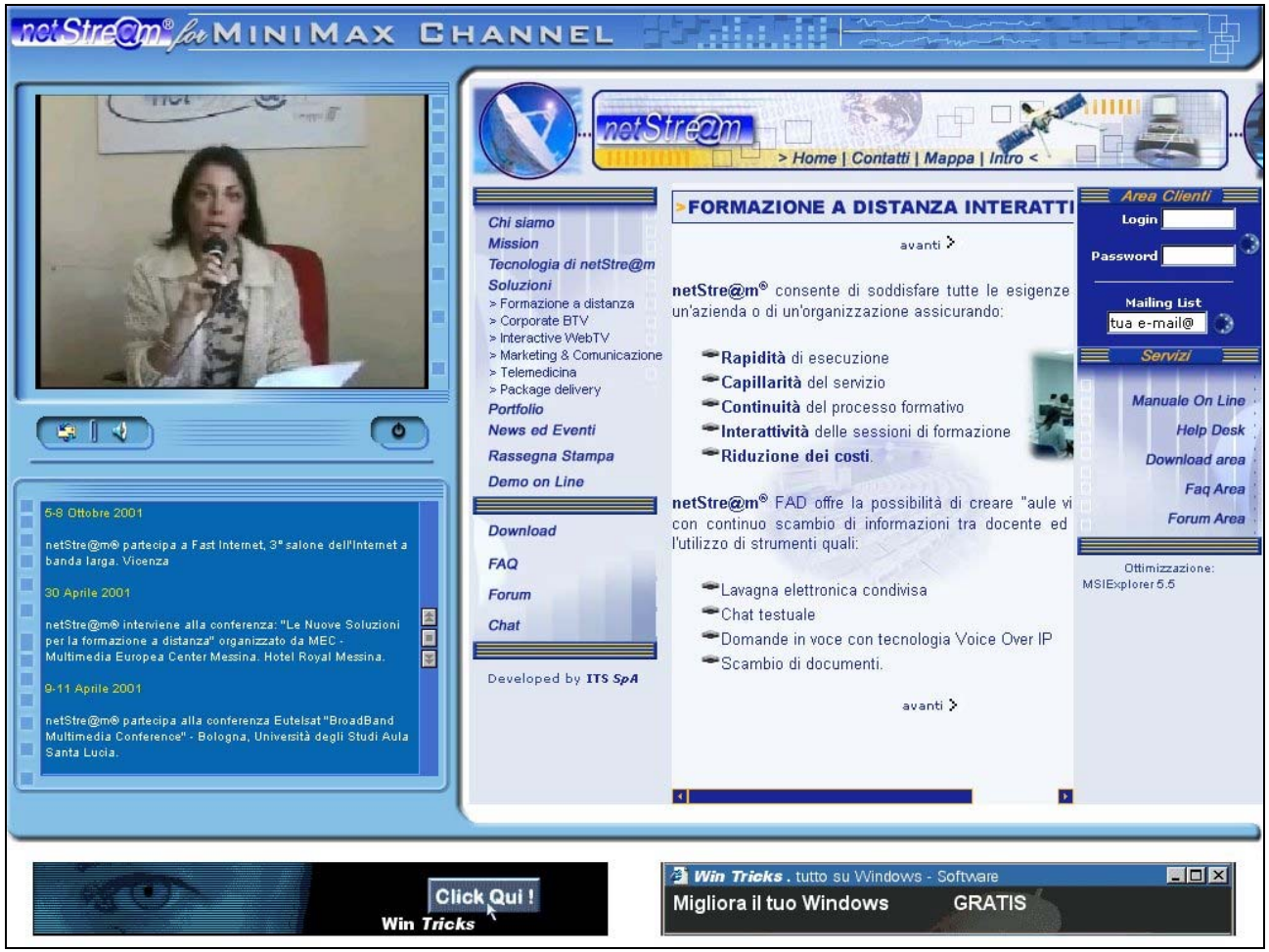
Interactive IP- TV



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The example:
Pan-African Telemedicine program

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Needs versus technological solutions for the medicine

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Needs:

- Communications among hospitals
- Communications between expert centers and clinics
- Communications among mobiles(ambulances or equipped mobile clinics) and Hospitals even in remote areas
- Communications for remote checks to main hospital

Technological Solutions:

- Broadband bidirectional exchange among fixed points
- Medium band two ways comms between fixed and mobiles
- Narrow band mobile –fixed comm's

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What are the possible connectivities ?

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- Hospital to exellency point (specialised hospital abroad)
- Hospital to hospital on national basis in order to use all the know how available, and allow a support of specialist diagnosis
- Clinics from/to hospital for the provision of tele-consultation and for the access to all those info that could be very useful for a more complete diagnosis in particular for difficult cases
- Mobile solution for the acquisition of the main life parameters that could be done even by paramedical personnel and then can be transmitted in real time in a place where the appropriate group of doctors can address the personnel to the primary intervention (for example in emergency situation);
- Mobile solution equipped with different sensors and instrument can be used for a capillary verification of the status of diffusion of dangerous virus or infections or endemical diseases

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What are the possible connectivities ?

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•Transportable solution allows to move, through a small truck equipped with a particular specialised equipment and instrument, a complete small clinic, in order to provide, even in places completely lacking of infrastructure , appropriate basic medical care .

•Transportable solution can be equipped with specialised instrument for medical support for specialist disciplines. This solution foresees the presence of a medical personnel, that can directly utilise the instrument, but for all the special diagnosis can be assisted by the hospital of reference.

•Single user home-care that is a solution to support patient with very critical conditions (but this is not an high priority service for the developing countries)

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Why Telemedicine applications?

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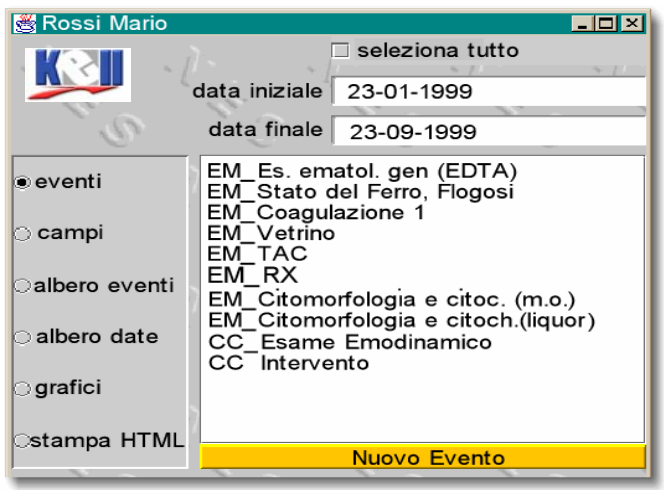
Possible standardization of patient information and data collection in adequate distributed but accessible databases with immediate support for medical diagnosis

- Every laboratory result or patient contact (ECG, RX, etc.) is converted in electronic format and properly stored.
- The medical equip, even if located in different physical places, can easily retrieve the general situation of the patient health status, according to the different access profiles and medical specialisation's.



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The main services for a unified concept

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•Tele-consultation: specialized centers receive clinical data from peripheral structures for interactive discussion and/or experts consultation

•Tele-diagnosis: specialized centers receive clinical data from remote centers to monitor and control patients located in rural or under-served areas.The common data base concept can be adopted

•Tele-training: Distance learning can allow the access to the information in ICT network and permit through videoconference training for different level of students or even upgrading of high professional courses

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Rationale

In order to face the needs of the health community an appropriate design of a unified pan-african project derives based on:

- Design of an appropriate “service” allowing the different level of health organization to see the system just as a facilitation for their means and not a difficult instrument to manage.

- Create an architecture with minimum cost and the possibility to satisfy, in some perspective, a sustainability criteria. (The infrastructures are easy to be financed, but the recurrent cost are always the criticality)

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Objectives

- Design an optimised solution allowing improvement in health operations, research, data collection homogeneity, assuring wide coverage and real time access, able to maximize the possible integration with the existing infrastructures, allowing implementation through a capacity building process.
- Build a system that allows savings
- Allow certain level of sustainability: how.

Definition of open architecture able to support:

- ***Telemedicine in broad sense***
- ***Medical information / pathologies and researches***
- ***Learning***
- ***Capillary communications***
- ***Social assistance services***
- ***Emergency***
- ***Early warning***

- ***Rural telephony***
- ***Internet access***
- ***Broadband CUGS***
- ***TV distribution***
- ***E-government***

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Savings

- Direct income…. Using the network for "paying" services
- Saving through the efficiency optimization respect to the public expenditures , improving health service quality and geographical availability and temporal continuity
- Saving minimizing the movement of the patients that can be treated on their places
- Saving optimizing the organization costs
- Saving in minimizing the loss of medicines, due to an adequate distribution network piloted by an expert system that accommodate dynamically the requests
- Saving in the education programs, enabling the distance learning with all the interactive process required , as well allowing the exchange of movies and large bulk of data
- Saving in the on-line response, accessing in real time all the excellence centers
- Saving in prevention, monitoring and attach in case of epidemic diseases
- Saving during the vaccinations campaign

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The organization and the functions

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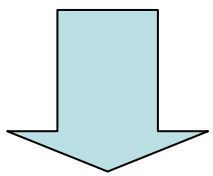
The problem of system dynamic evolution, the update of contents, the alignment of specialist information implies an efficient organization that regulates the adjustment of the networks (for management, for technology and for deployment), permits the system usability, at different levels and settles the access



Identification of high level authority for implementation guidelines

Design of a unified system

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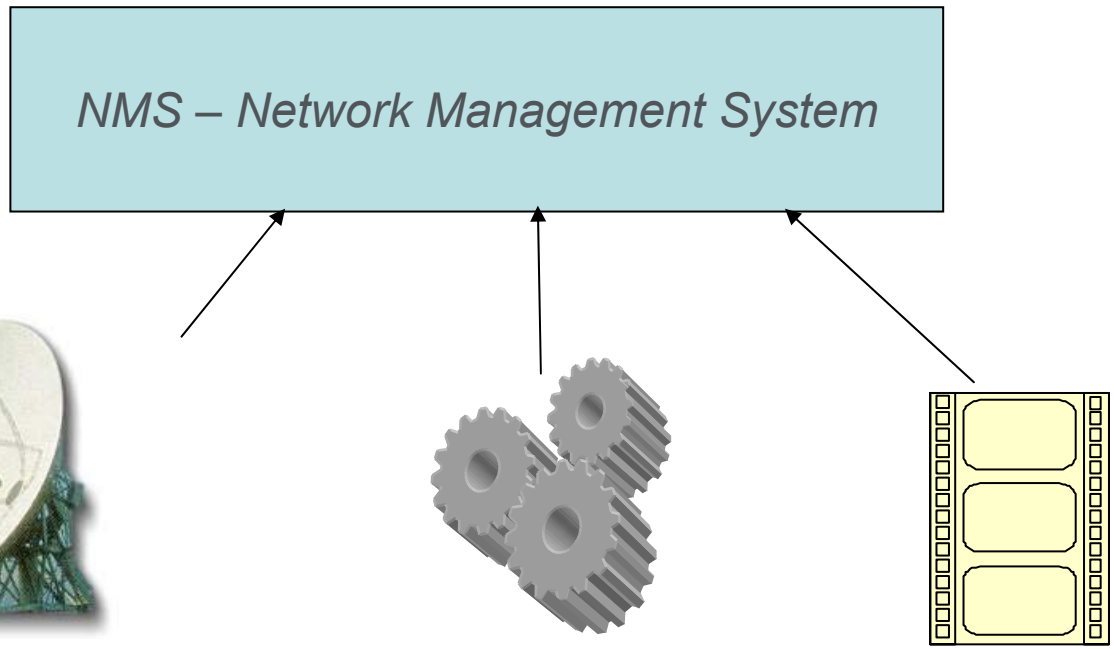
The unified system



TLC network:
with PSTN, WLL, ADSL, satellite mobile link

Data base and information kernel:
- The medical protocols,
- the Dicom stnd. for data exchanges,
- the finger print for ID,
- the protection of the info,
- the responsibility for data introduction

Content:

Provided by different sources, accessible on demand, for remote training, integrable with other data inserted in DB for pathology, treatments and...

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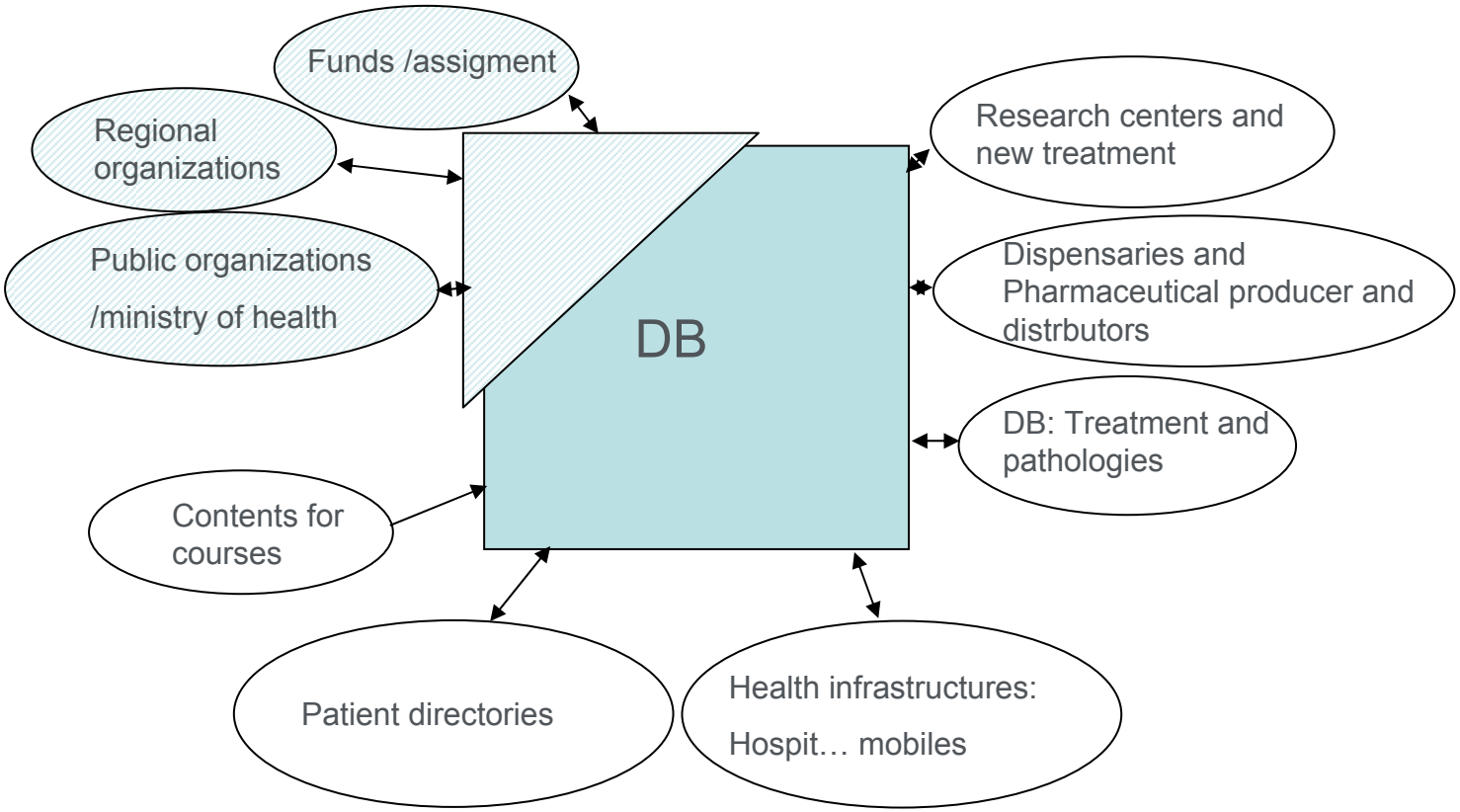
Example of system utilization



DB called: **A.S.I.S** African Safety Information System

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E-Health Network Implementation Plan

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The technology solution for E-Health network foreseen the implementation of a Pan-African integrated network.

The two main elements of such Integrated Network are:

✓ A Satellite telecommunications Infrastructure capable to support a common platform for Narrow up to wide band and to integrate that with other existing systems UHF/VHF/GSM/GPRS/UMTS/WiFi

✓A Information Technology Infrastructure in charge to assure the Medical content share, the information and the data elaboration and management within a common distributed data bases

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Integrated system goals

- Health Care Information gathering
- To Define a population health condition analysis
- To Assure Health Infrastructure operational service capabilities in any condition to support population health improvements
- To optimize financial resources utilization through the use of specific population planned prevention and care activities

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Functionalities

- Using the web technology to create a very innovative Multi Channel – Multimedia Information System to fully support all on field health activities and infrastructures
- To create an integrated Health Care DataBase able to collect all different kind of information concerning Health Care capabilities, services, facilities, infrastructure, to optimize decision making and first aid
- To record every health visit and analysis, to produce a real updated African Health condition state of the art. Create a real time ASIS picture.
- To provide a decision making support system for strategic and tactical plans, including resources optimization and Health risk analysis for prevention and epidemic reduction

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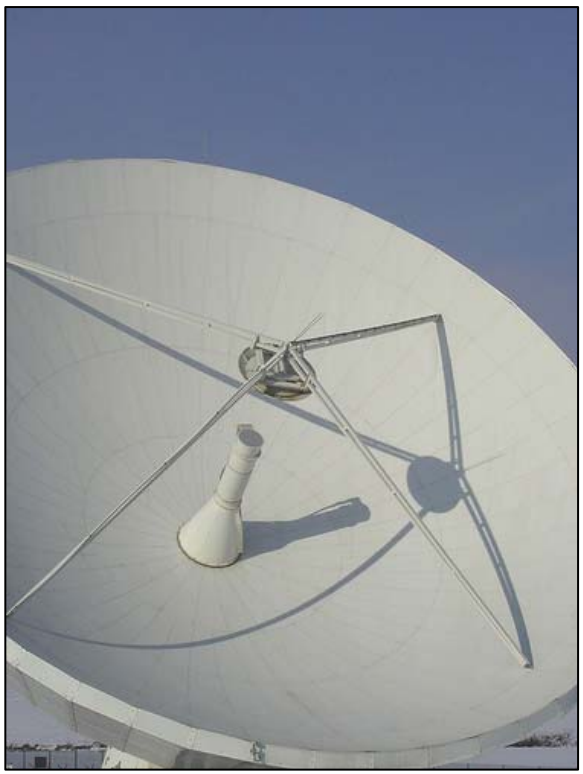
Main Features



- **DBMS data entry, filling and population**
  - All geographical entities
  - All known pathologies, treatment / applicable care and related information
  - All known medicines and drugs including Related information
- **HEALTH CARE SERVICES**
  - Health care operators and patients identification
  - Information Gathering and info search
  - All docs and reports Display (visualization) and printing
- **DATA ANALYSIS, MERGING AND SORTING**
  - Health care applications, examinations and diagnosis full archive
  - Health care information full index
  - Health care information graphical representation
- **ASIS SYSTEM ADMINISTRATION**
  - Health care operators, patients, drugs, medicines and health cares applications detailed data including personal data
  - Health care analysis and reports
  - Business Continuity services
  - Multilanguage support
  - Full Web Based

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Telecommunications Infrastructure Selection

- ✓ The Integrated solution should assure, within a framework of economic sustainability, the gap filling of the existing telecommunication infrastructures over the immense territory of Africa
- ✓ A centralised Network Control Centre (NCC) co-located or close to the Central Main Hub Station should manage the Network
- ✓ An evolutionary approach should be adopted for the implementation:
  - initially one gateway for each Regional organisation, that means Gateways should be placed at Regional level (CEMAC; EAC; ECOWAS; SADC)
  - afterwards …up to one gateway for each country, placed where national excellence centres are present
- ✓ The national and regional gateways will communicate with each other via satellite if ground infrastructure with broad band capabilities are not available (technology neutral solution)
- ✓ User satellite terminals are foreseen available at Local excellence centres, Local dispensaries, remotely dispersed surgeries and advanced mobile telemedicine systems

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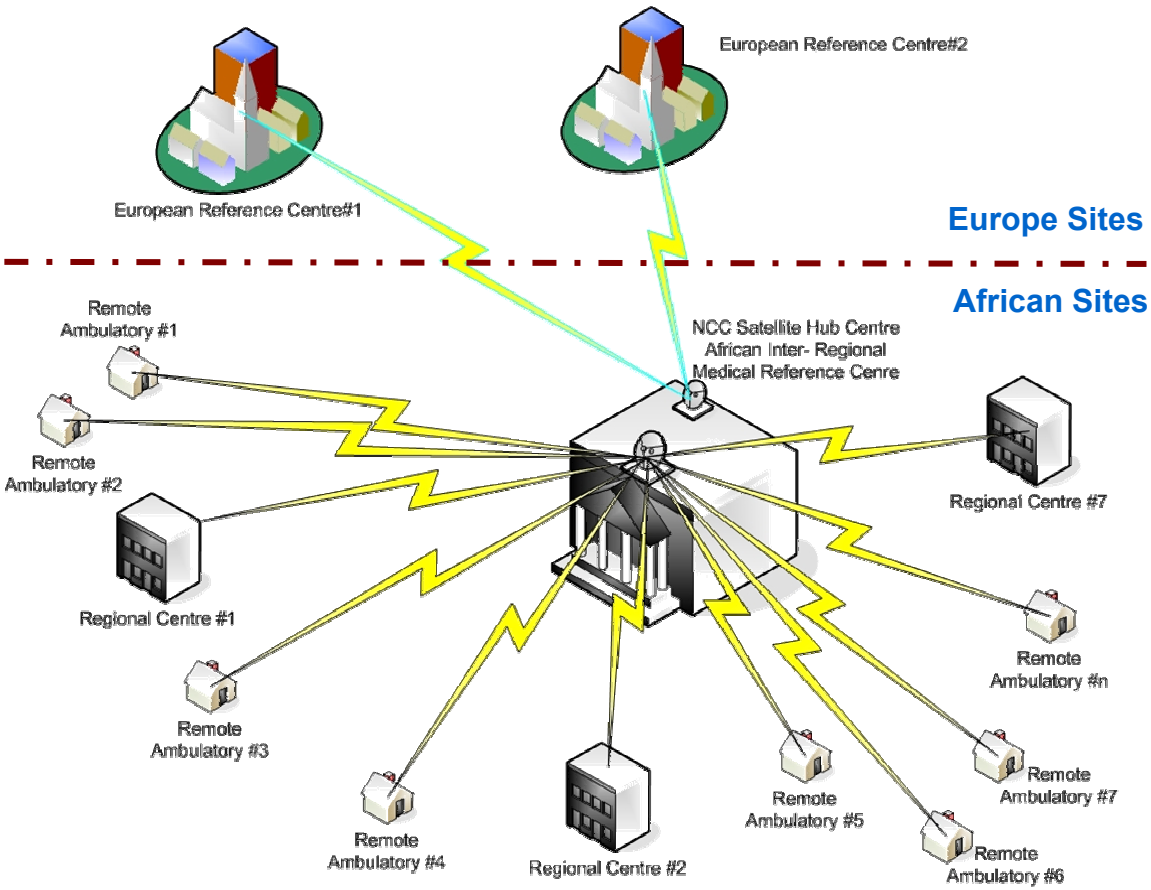
TLC Infrastructure – General Architecture



Connection With European Excellence Centres

- Meshed Network
- MFTDM/MFTDMA Technology
- C-BAND (not mandatory , but avoiding cross trapping capacity for KU band)

Connection With African Centres

- Star Network
- DVB/RCS 2 Technology
- Ku-BAND

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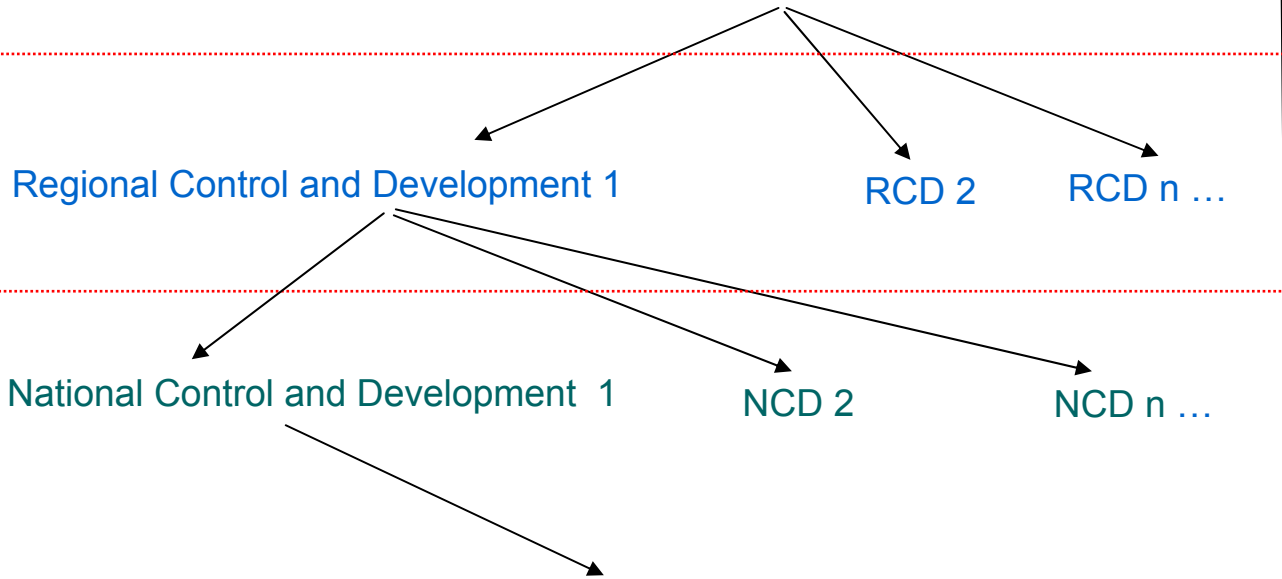
TLC Infrastructure - Hierarchical Organisation



National Network

- Hospital - Excellence Centres
- Local Hospital
- Remote Fixed sites
- Remote Mobile sites
- ……..

Level 1
- Directives
- Regulatory

Level 2
- Implementation Directives
- Regional Coordination

Level 3
- Infrastructure Implementation
- Operative Direction
- Infrastructure Management
- Infrastructure Development

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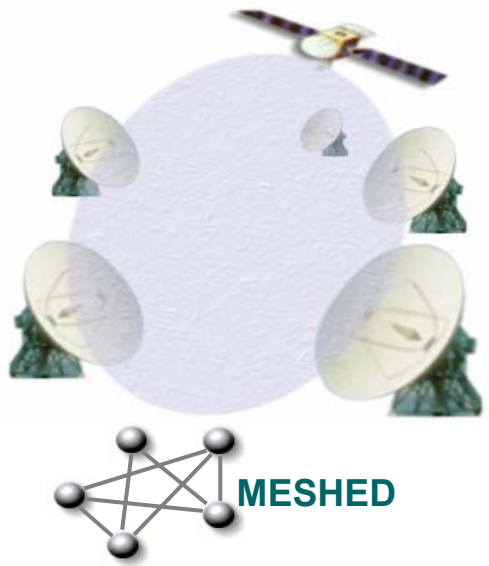
Telecommunications Infrastructure Characteristics

Connection Infrastructure with European Centres

- C - Band
- DAMA Network
- MFTDM/MFTDMA Technology

- Assumption for Satellite Characteristics
  - Link Availability: 99,9 %
  - EIRP > 38 dBW
  - G/T : -3 dB/K
  - margin > 2dBi

- Ground Station Characteristics
  - Antenna Diameter: 3,8 m
  - HPA Power: 20 W



In order to enhance the quality of the link, in the network Ground station where is located the NMS it can be foreseen the use of an antenna with diameter of 6 m and 50W HPA.

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Telecommunications Infrastructure Characteristics (2)

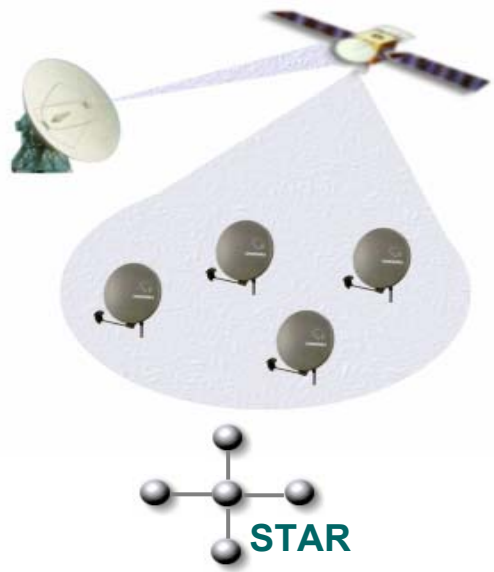
Connection Infrastructure among African Centres

- Ku - Band
- Star Network
- DVB/RCS 2 Technology

- Assumption for Satellite Characteristics
  - Link Availability: 99,5 %
  - EIRP > 48 dBW
  - G/T : -7 dB/K
  - margin > 5dBi

- Ground Station Characteristics
  - HUB Antenna Diameter: 7 m
  - HUB HPA Power: 100 W

  - Users Stations Antenna Diameter : from 1,2 m to 1,8 m
  - Users Stations HPA Power: from 2W to 5W



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National Telecommunication Network Implementation
Selected Technology Solutions

Ground Stations Configurations Typology

- Large Station
- Medium Station
- Mini Station
- Mobile Stations
  - Portable
  - Data
  - Truck mounted
- Dissemination Station
  - One Way Station
  - Return Channel station

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HUB Station – Technology Solutions

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HUB Station Configuration

- **Information Technology Interface Center**
- **PSTN/GSM Interface Center**
- **Network Management Centers (for DAMA and Star Networks)**

STAR Network

Star Network – Regional Hub

Technology:	MF/TDMA inbound DVB-RCS-S2 outbound
Frequency band:	Ku
Data Rate:	inbound - up to 4 Mbps outbound - up to 32 Mbps
Antenna Diameter:	from 6 to 7 m
TX power:	100 W
Devices:	2 PC with ADSL/WLL Connection Store capacity for Data backup Database Management LAN Management Secure access
Connection:	ADSL (with E.C.), WLL (LAN) Via satellite 512 Kbps (with E.C if necessary)

Cost: From 1,2 to 2 Meuro

Meshed Network

Meshed Network – Regional Station

Technology:	MF/TDMA inbound MF/TDM outbound
Frequency band:	C
Data Rate:	inbound - up to 4 Mbps outbound - up to 32 Mbps
Antenna Diameter:	from 3,8 to 6 m
TX power:	from 20 to 50 W
Devices:	2 PC with ADSL/WLL Connection Store capacity for Data backup Database Management LAN Management Secure access
Connection:	WLL (LAN)

Cost: From 400.000 to 700.000 euro

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Large Station - Technology Solution

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Large Ground Stations Configuration

- Star Network - User Station

- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
  outbound - up to 512 Kbps
- Antenna Diameter: 1,8 m
- TX power: 5 W

- Workstation: 2 PC with ADSL/WLL Connection
  Store capacity for Data backup
  Database Management
  LAN Management
  Secure access
- Connection: ADSL (with Hub)
  WLL (LAN)
  Via satellite 512 Kbps (with Hub if necessary)

- Cost: From 8.000 to 14.000 euro

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Medium Station - Technology Solution

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Medium Ground Stations Configuration

- Star Network - User Station

- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
  outbound - up to 348 Kbps
- Antenna Diameter: from 1,2 to 1,8 m
- TX power: 2 W

- Workstation: 1 PC with PTSN & WLL Connection
  Store capacity for Data backup
  LAN Management
  Secure access
- Connection: WLL (LAN)
  PTSN

- Cost: From 4.000 to 5.500 euro

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Mini Station - Technology Solution

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Mini Ground Stations Configuration

- Star Network - User Station

- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
  outbound - up to 256 Kbps
- Antenna Diameter: 1,2 m
- TX power: 2 W

- Workstation: 1 PC with PTSN Connection
  Store capacity for Data backup
  Secure access
- Connection: PTSN

- Cost: From 3.000 to 4.500 euro

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Mobile Station – Track Mounted -Technology Solution

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Mobile Station – Track Mounted

- Star Network - User Station

- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
  outbound - up to 358 Kbps
- Antenna Diameter: Deployable 1,2 m
  Automated Pointing Mechanism
- TX power: 2 W

- Devices: 2 PC with Redundant Connection
  Store capacity for Data backup
  Interface management with medical equipment
  Medical Equipments
  Secure access
- Connection: Satellite Phone or Data transmitter (BCK)
  GSM

- Cost: From 95.000 to 115.000 euro

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Mobile Station – Portable -Technology Solution

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Mobile Station – Portable

- Network User Station
- Data Rate: from 40 up to 384 Kbps
- Devices: Autonomy - 2 hours
  Charge from AC 110-250 V, CC 12 – 24 V
  Data Exchange - store and forward
  Attached document size 50-500 KB.
  PC with Man Machine Interface & Applications
  GPS receiver for Localisation
  Attachment : pictures (dermatology, ECG, Blood Pressure, Oxygen Saturation, T°, pulse etc…)
  Medical Equipments Interface management
- Connection: Satellite Phone or Data transmitter
  GSM/GPRS
- Cost: From 10.000 to 12.000 euro

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Mobile Station – Data Compact -Technology Solution

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Mobile Station – Data Compact

- Network User Station
- Data Rate: from 10 up to 154 Kbps
- Devices: Autonomy - 2 hours
  Charge from AC 110-250 V, CC 12 – 24 V
  Data Exchange - store and forward
  Attached document size 5-20 KB.
  PC with Man Machine Interface & Applications
  GPS receiver for Localisation
- Connection: Satellite Phone or Data transmitter
  GSM/GPRS
- Cost: from 5.000 to 7.000 euro

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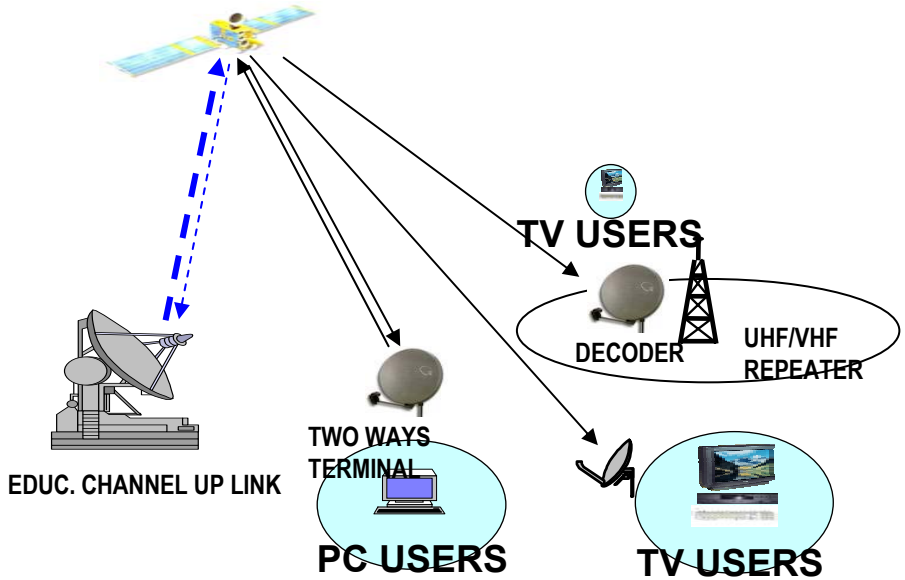
Dissemination Station - Technology Solution

Dissemination Station Configuration



One Way – DTH Type

- User Station - TV Decoder (DVB/RCS 2 Receiver)
- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
- Antenna Diameter: from 1,2 to 1,8 m

- Devices: TV set
  Keypad set for interaction (optional)
- Connection: PTSN/GSM/GPRS (optional)

- Cost: From 1.000 to 1.500 euro

One Way - Analogue Type

User Station - TV Analogue Receiver (Trough Repeater)
Frequency band: UHF/VHF
Antenna: standard Yagi
Devices: TV set
Modem + Keypad set for interaction (optional)
Connection: PTSN/GSM/GPRS (optional)

Cost: From 300 to 800 euro

Two way – Mini station

- User Station – Star Network
- Frequency band: Ku
- Data Rate: inbound - up to 32 Mbps
  outbound - 64 Kbps
- Antenna Diameter: 1,2 m
- TX power: 1 W
- Workstation: 1 PC with PTSN Connection
  S/W applications
- Connection: PTSN PTSN/GSM/GPRS (optional)

- Cost: fro 2500 to 2.900 euro

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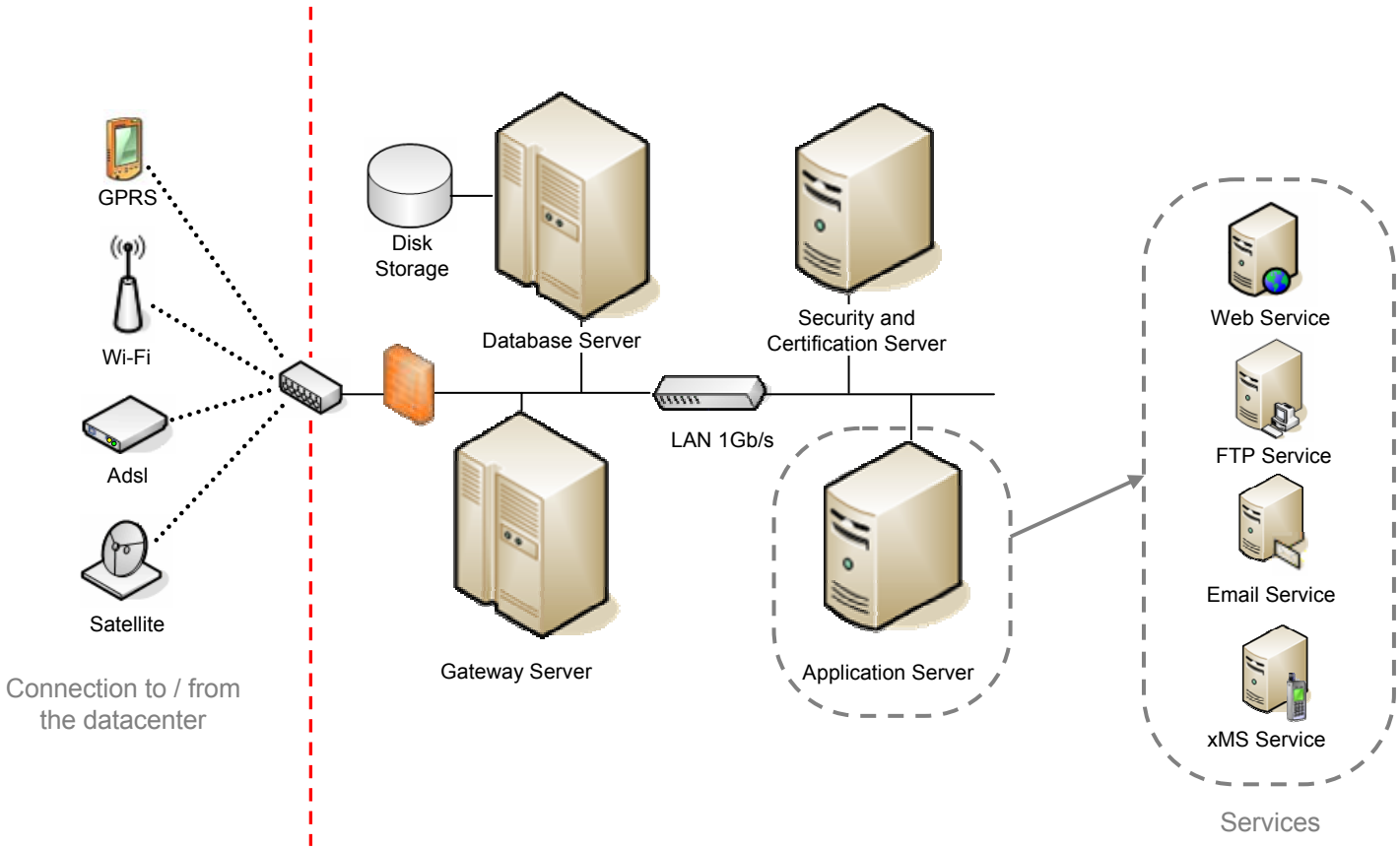
DATACENTER



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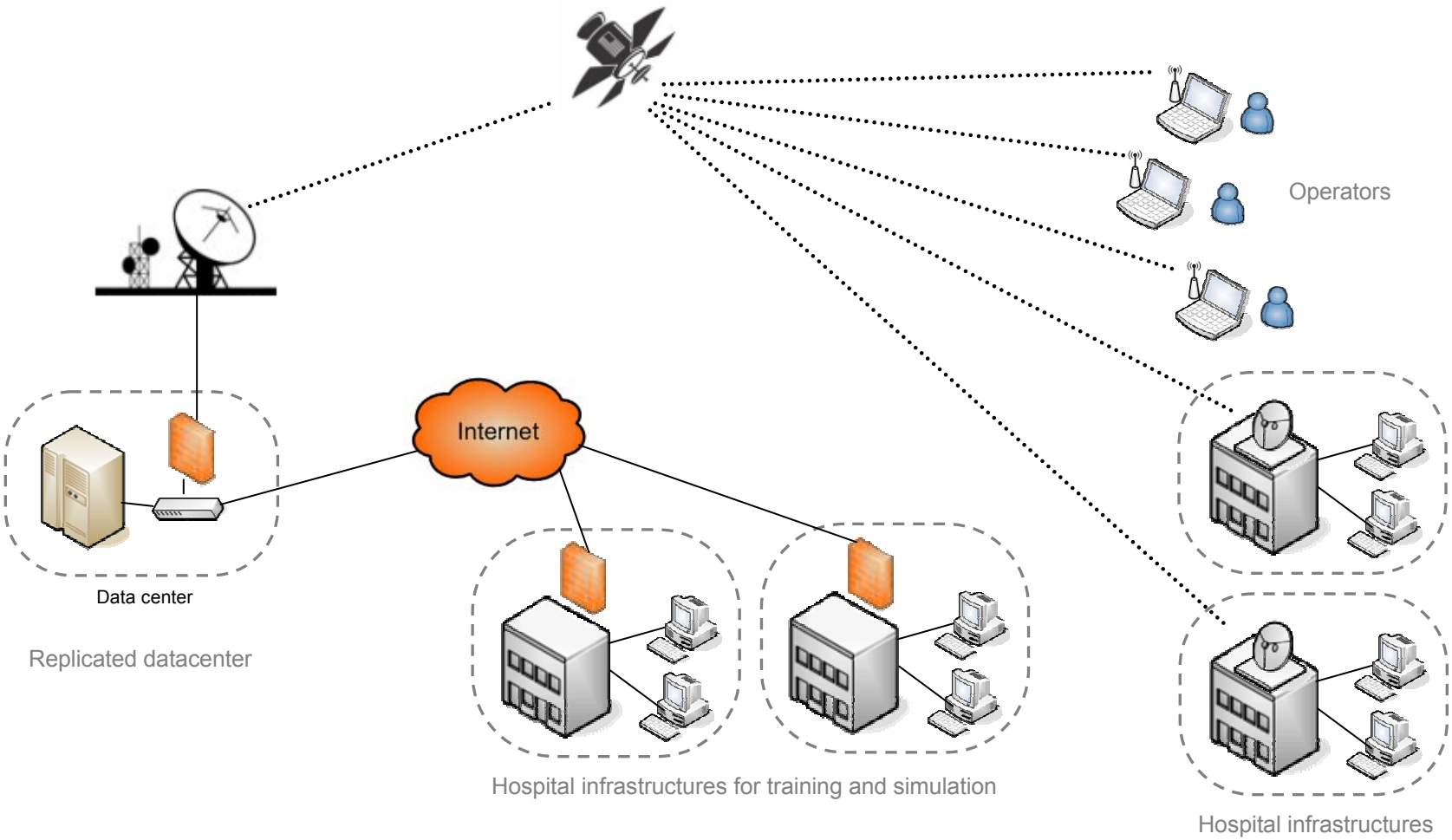
A.S I.S – Functional Schema



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A.S I.S

African Safety Information System

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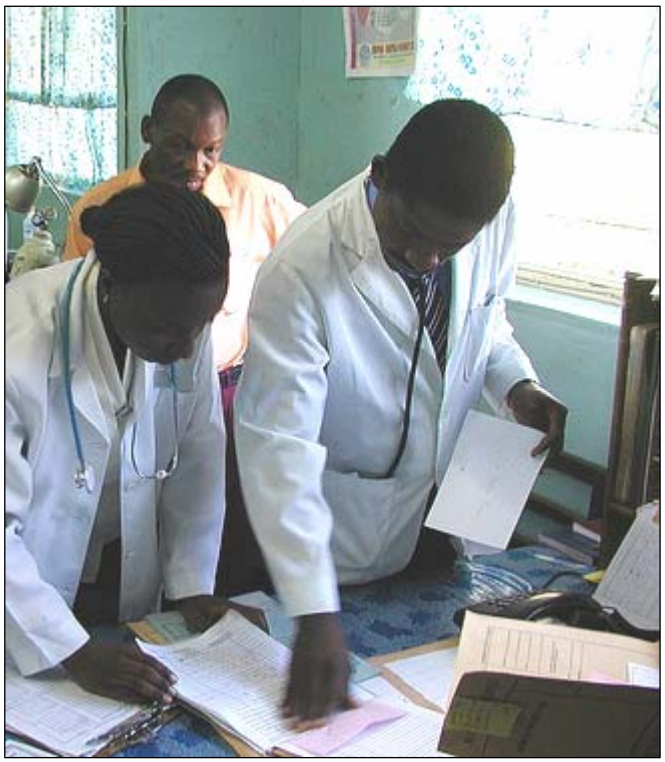

- HEALTH CARE OPERATOR SERVICES
- HEALTH INFRASTUCTURES DATABASE
- PATHOLOGY DATABASE
- HEALTH CARE TREATMENTS-APPLICATIONS DATABASE
- PATIENTS DATABASE
- DATABASE INFORMATION
- SAFETY, SECURITY AND CONFIDENTIAL WEB BASE SYSTEM
- “EXPERT SYSTEM” FOR PATHOLOGY STATE OF THE ART ANALYSIS AND PREDICTION
- AUTOMATIC EVOLUTION PREDICTION
- AUTOMATIC RISK ANALYSIS
- WEB GUIDED TRAINING PATHS

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Fund Subjects

- Many donors addressed funds and are supporting projects in Africa:

Development Banks, EU, EDF, USAID, National Governments, WHO, etc…..

- Fund distribution mechanism follows individual strategies:
  - International Organization
  - Regional Organization
  - National ministry of health
  - Private organization and/or NGO

Importance to reach a critical mass to create a Pan African program

Possibility to optimize precious resources avoiding pulverization in small episodic projects

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