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HALO FINAL WORKSHOP 2006

Infrastructure Candidate Solutions

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WP 3210/ 3310

Harmonised coordination of the Atmosphere, Land and Ocean integrated projects of the GMES backbone

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Presentation Summary

- HALO Project overview and needs
- HALO study logic
- Networks preliminary studies
- Critical points
- Suggested architecture
- Recommendations

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HALO Project overview :

HALO and WP 3210 / 3310 Objectives

Optimising the efficiency of interaction between the Atmosphere, Ocean and Land IPs by formulating agreed recommendations in areas of GMES.

Recommendation on candidate solutions for:

- Data acquisition,
- Data sharing,
- Data dissemination.

If services are not provided in an efficient manner this is not services but scientific issue.

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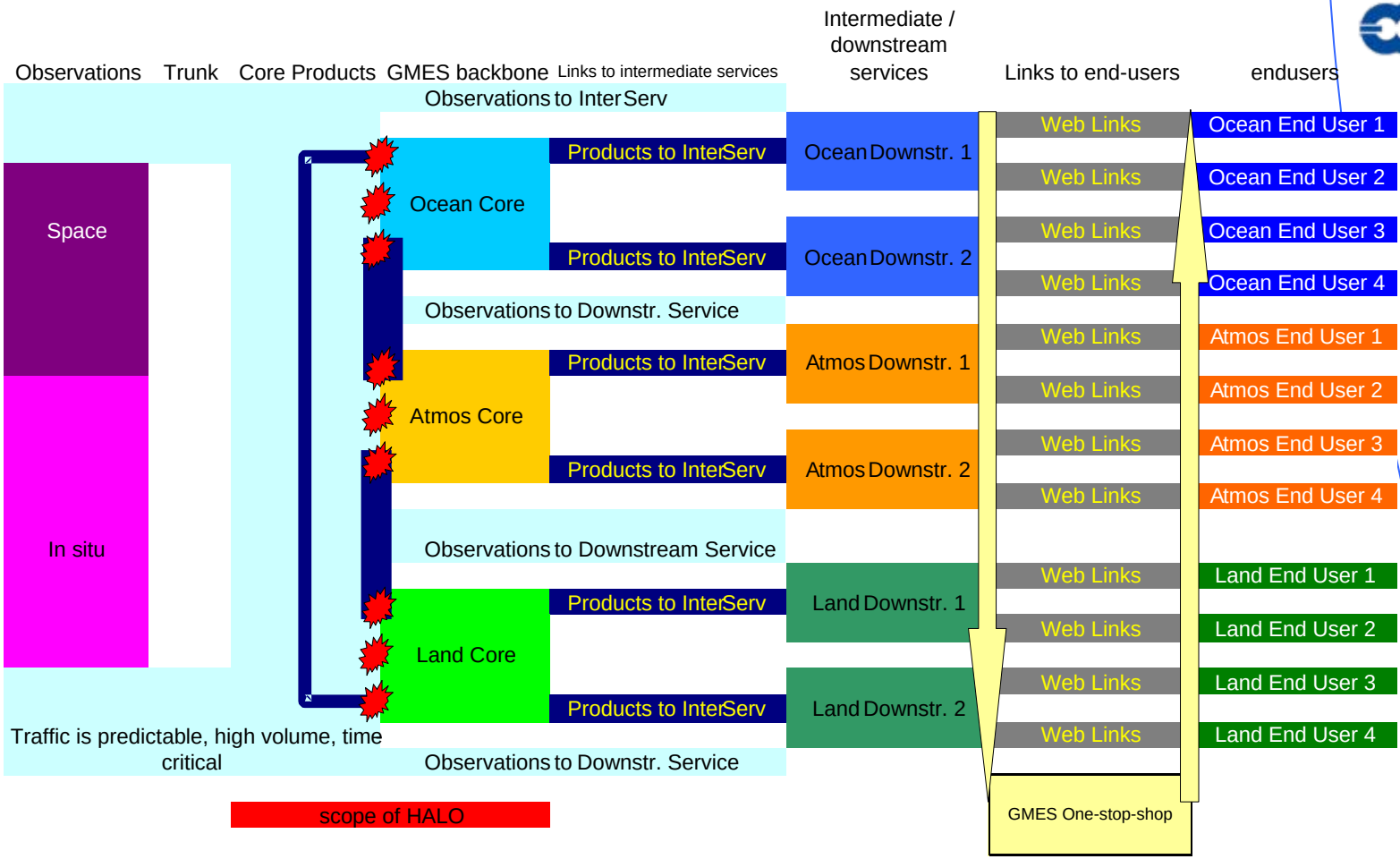
HALO Project overview :

GMES General Data Flows adapted to HALO



Generalised data flow layout in GMES

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HALO Project overview :

HALO Data Flows

- **Satellite Data for MERSEA**

Estimated Satellite Data transfer for MERSEA per Day		
SST	NOAA, ESA, EUMETSAT, NASA	5 GB Atlantic 11 GB for Global
Altimetry	NOAA, ESA, EUMETSAT, NASA	TBD
Ocean Color	NOAA, ESA, EUMETSAT, NASA	2 GB
Sea Ice	NOAA, ESA, EUMETSAT, NASA	TBD
Wave / winds	ESA, EUMETSAT + NWP	TBD
NWP	Assimilation Models	TBD
Meteorological field Data	ECMWF, NWP	TBD
Argo / GTSPP	In-situ TEP	TBD
GOSUD / VOS	In-situ TEP	TBD
Ocean time series/BBCP	In-situ TEP	TBD

HALO Project overview :
HALO Data Flows

- **Satellite Data for GEOLAND**

Estimated Satellite Data transfer for GEOLAND per Day		
Vegetation Products		
	VEGETATION :	2 GB (near real time)
	AVHRR / EPS :	2 GB (near real time)
	MODIS / Terra :	6 GB (near real time)
	ATSR / Envisat :	2 GB (off - line)
	MERIS / Envisat :	50 GB (off - line for the time being, potentially near real time if ESA upgrades its processing center)
Radiation Products		
	SEVIRI / MSG	6 GB (near real time : 12 channels:4 VIS/NIR + 8IR)
	2*GOES	3 GB (near real time)
	METEOSAT 7	1.5 GB (near real time : 3 channels)
	2 others geostationnary sensors	3 GB (near real time)
Water Products		
	Ascat / EPS	50 MB (near real time)
	AMSR / Aqua	50 MB (near real time)
	SMOS	50 MB (off - line)

HALO Project overview :

HALO Data Flows

- **Satellite Data for GEMS**

Estimated transfer to GEMS per Day		
GEMS GHG	Metop-1 (IASI) Envisat (SCIAMACHY)	2.5 GB
GEMS GRG	Metop-1 (IASI, GOME-2) Envisat (SCIAMACHY)	2.5 GB
GEMS AER	ENVISAT (MERIS)	250 MB
GEMS AER	NASA (TERRA-MODIS)	600 MB
GEMS AER	NASA (AQUA-MODIS)	600 MB
GEMS RAQ	model & assimilation regional partners	7 GB

HALO Project overview :

HALO needs

Support the transition of the IPs to operational systems status

Define candidate solutions for both common data needs provision and products exchanges interface between systems.

Respect six operational constraint :

- Real Time access
- Regular access distribution
- Operational services
- On-demand access
- Research mode
- Off-line services

HALO Project overview :
HALO specific needs

The requirements

- Need to do acquisition and transfer of various data types in various fields

In-situ data, spatial products, meteo, climato...

- With various distribution modes

Regular, on-demand, low or fast data delivery

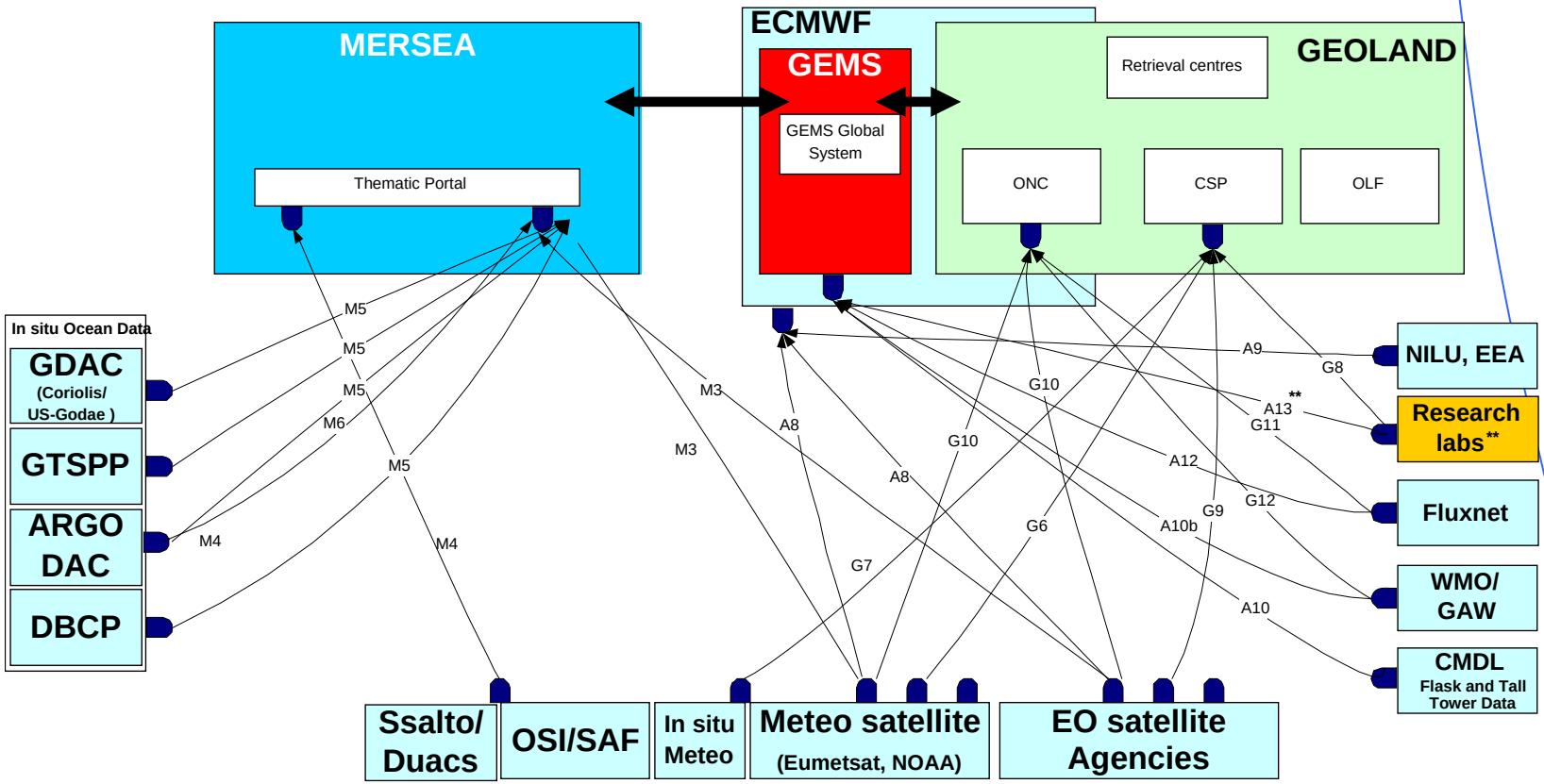
- Need to transfer large amount of data (up to 10 GB per day)

- Need interoperability, reliability, robustness

HALO Project overview :

HALO specific needs

Considering HALO Themes, Oceano, Land, Atmosphere Various, heterogeneous data types are used per theme



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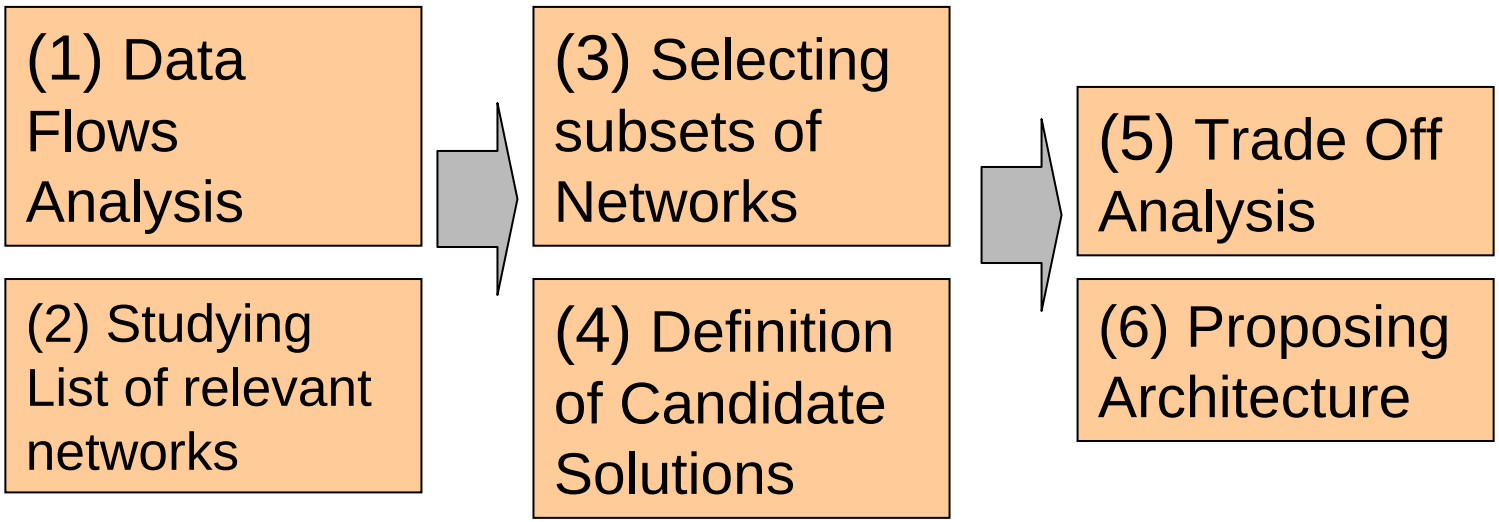
HALO Study Logic

Network Preliminary Studies

Suggested Architecture



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Network preliminary studies :
Networks overview

We will present

- A brief overview of Meteorological and Earth Observation existing networks,

Then,

- An analysis of the following networks:
  - GTS / WIS
  - EUMETCast / GEONETCast
  - HiSEEN / GÉANT

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Network preliminary studies :

Existing networks for Meteorological and Earth Observation

- GTS/RMDCN
- FWIS
- Eumetcast
- GEANT
- ARGOS
- Inmarsat
- Iridium
- FTP/ Opendap
- Geonetcast

Network preliminary studies :
ARGOS

Application to Ocean & Climate for :

- weather forecasting
- climate prediction
- pollution monitoring
- polar research
- ocean circulation research
- equipment safety/reliability monitoring

Global satellite coverage and simple, robust transmission have made Argos the international workhorse for gathering environmental data. Over 3000 Argos platforms are floating, drifting or moored in the oceans, transmitting data and positions to users ashore.

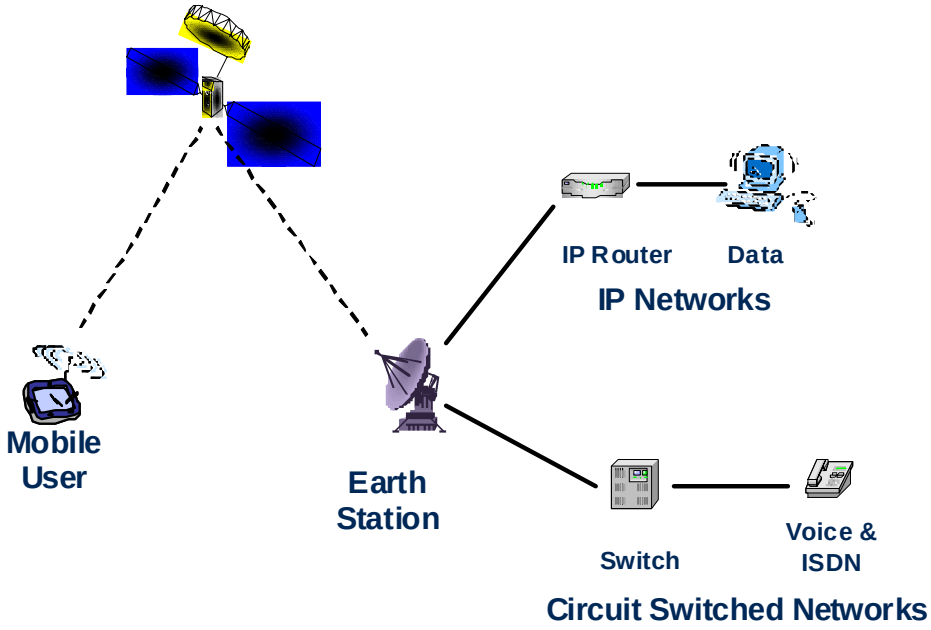
Link with GTS Subsystem

Automatic Distribution Service (ADS)

Network preliminary studies :

INMARSAT

- World Wide Spread Network
- Secured Access
- Low Data Rate Transfer (64 Kbps)
- Broadband Global Area Network (Bgan)



Network preliminary studies :
IRIDIUM

- Applications to maritime, aviation, government/military, emergency/humanitarian services, mining, forestry, oil and gas, heavy equipment, transportation and utilities

- Low power, small antenna, which makes it suitable for small instrumental platforms on the ocean

- Connect by phone to the Internet or a corporate network from virtually anywhere in the world

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Network preliminary studies :

Existing networks for Meteorological and Earth Observation

Data Rate

GTS/WIS	Eumetcast/ GeoNetCast	GEANT	ARGOS	Inmarsat	Iridium
8 to 1024 Kbps	2.5Mbps	34 Mbps to 16 Gbps		64 to 144 Kbps	2.4 Kbps

Domain

GTS/WIS	Eumetcast/ GeoNetCast	GEANT	ARGOS	Inmarsat	Iridium
WMO world	Eumetsat satellites	Research & education	Ocean applications, essentially for tracking	Private telecom operator oriented towards platforms at sea (and airplanes)	Delivers essential communications services to and from remote areas where no other form of communication is available.

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Network preliminary studies :

Existing networks for Meteorological and Earth Observation

Restrictions

GTS/WIS	Eumetcast/ GeoNetCast	GEANT	ARGOS	Inmarsat	Iridium
Restricted access governed by WMO	Used for products from EUMETSAT satellites Additional access to data and services from external data providers.	Reserved specifically for research and education	Very low data rate, low power requirements : data must be severely decimated and compressed.	Operates as a telephone service. Can transmit voice, or e-mails with text. Requires large antenna and power	

Candidate Solution to deliver

GTS/WIS	Eumetcast/ GeoNetCast	GEANT	ARGOS	Inmarsat	Iridium
GTS later replaced by FWIS when available for In-Situ, EO & Meteo data Geoland products to GEMS (ECMWF) GEMS products to MERSEA, Geoland MERSEA products to GEMS	Necessitate usage extension	For specific needs to rapidly transfer large quantities of data. (Layer 2 Virtual Private Networks (VPNs) are used on GÉANT to support projects that have a need for them.) For Geoland **RT** products to GEMS	(**NOAA**)ARGOS data are usually **relayed** onto the **GTS**. Argos established a powerful **Argos/GTS** processing subsystem to simplify the transmission of data directly onto the GTS.	Broadcast In-situ or radar data	Broadcast In-situ or radar data

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Network preliminary studies :

Existing networks for Meteorological and Earth Observation

The Need

1 - To cover all themes, oceanography(WIS), Meteo(GTS/WIS), Land(GEONetCast)

2 - To provide capacity for high data rate (EUMETCast/GEONetCast or GEANT ?)

3 - To access EO(GEONetCast), Meteo Data (GTS/WIS), In-situ data(GEONetCast)

To answer All Needs 1+2+3

EUMETCast only :	Compliant with 2 ?
GEONetCast only :	Compliant with 2
GTS only :	Nothing
WIS only :	Nothing
GEANT :	Compliant with 2

Conclusion

Only possible solution is

WIS(future GTS) + GEONetCast(future EUMETCast) (+GEANT ?)

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Network preliminary studies :
Selected Networks

- **GTS / WIS :** meteorological dedicated networks
  - Operational transfer of both observations and model output
  - Advantages : bandwidth and availability guaranties

- **EUMETCast / GEONATCast :** dissemination networks
  - Environmental satellite and in-situ data/products provision
  - Advantages : broadcast and multicast

- **HiSEEN / GÉANT :** High speed network
  - Multi-gigabit pan-European data communication network
  - Advantages : large data volume transfer

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Network preliminary studies :

Networks justification

The context today :

Several Communities and leading organizations existing quite independently for each field :

- WMO is a leading actor for Meteorology
- JCOMM is a actor for Meteo, Climatology
- Nothing yet for Land !

Networks exists for each field at various scales (Local, European, International) with different architectures

- GTS international network for Meteorology, depending on WMO, point-to-point oriented architecture
- EUMETCast for spatial product dissemination, broadcast oriented architecture

Multiple sensor networks and in-situ monitoring systems

Capacity of Networks not always compliant with data rate expectation (e.g data rate for VGT exceeding GTS capacity)

Data policy of Networks are not in adequation with data type (e.g Land for GTS network)

Network preliminary studies :
WIS Data Communication Networks (1/2)

WMO will expand the GTS to WIS with new functions and connectivity to meet wider needs :

- **Interoperable** information exchange standards, functions and services through portal architecture allowing a variety of codes, protocols and data presentation forms,
- **Inter-disciplinary** discovery, retrieval and exchange information in real and non-real time through a single entry point in each country,
- Open all users for data discovery, to authorized users for data access,
- Data are described in on-line catalogues using metadata based on ISO 19139,
- Industry standards and off-the-shelf hardware and software systems to ensure cost-effectiveness and interoperability.

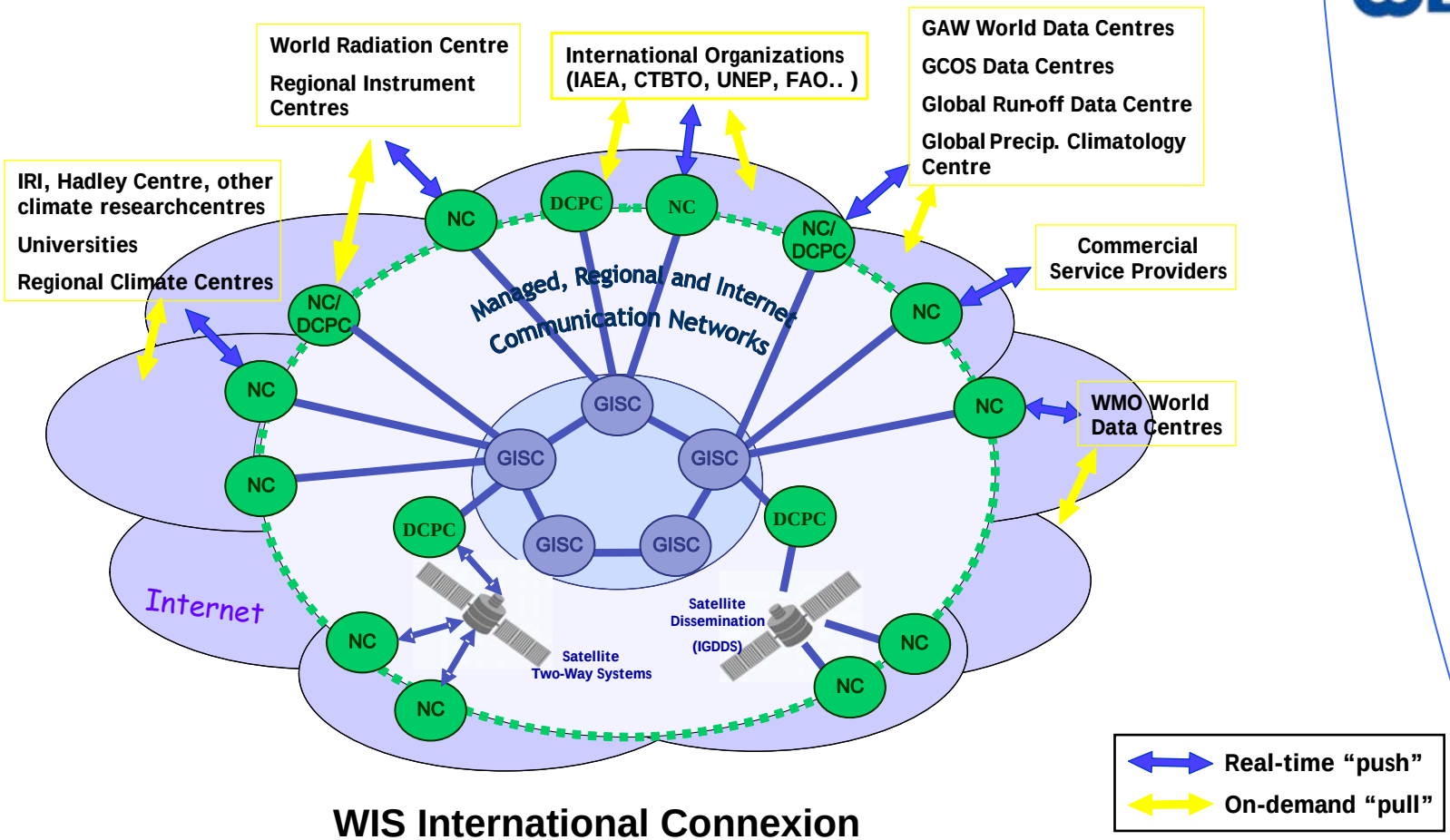
The WIS will be based on an improved GTS and integrated satellite two-way systems, alternative dissemination services provided by environmental satellites and/or Internet.

Network preliminary studies :
WIS Data Communication Networks (2/2)

WIS should provide the following fundamental types of services :

- Routine collection and automated dissemination service for time and operation-critical data and products. This service is based on real-time “push” mechanism including multicast and broadcast.
- Data Discovery, Access and Retrieval (DAR) service for all data stored regardless of location. This service is based on request/reply “pull” mechanism with sophisticated data management and standardization.
- Timely delivery service for high volume data and products. This service is based on delayed mode “push” mechanism with trigger functions such as scheduling by timetable and monitoring the accumulation amount of required data.

Network preliminary studies :
Main Functional Components of WIS (1/2)



WIS International Connexion

Network preliminary studies :
Main Functional Components of WIS (2/2)

NC : National Centre

- The NC is responsible for collecting and distributing observational data and products on a national basis and for providing those data requested for global or regional distribution to their responsible GISC or DCPC.

DCPC : Data Collection or Product Centres

- Centres that fulfil an international responsibility for the generation and provision and/or archiving services of data, forecast products or value added information.
- DCPCs also provide basic WIS functions such as metadata catalogues, internet portals and data access management.

GISC : Global Information System Centre

- The regional and global connectivity of the WIS structure is guaranteed by the existence of a small number of this node centres.

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Network preliminary studies :
WIS Characteristics

The WIS data communication networks should be considered as an appropriate **combination of various communication means** such as dedicated circuits, managed data communication services, satellite based communication systems and the Internet.

The WIS structure contains **four communication elements**:

- **Core Network**
- **Trunk** and **Branch Links**
- **Multicast / Broadcast**

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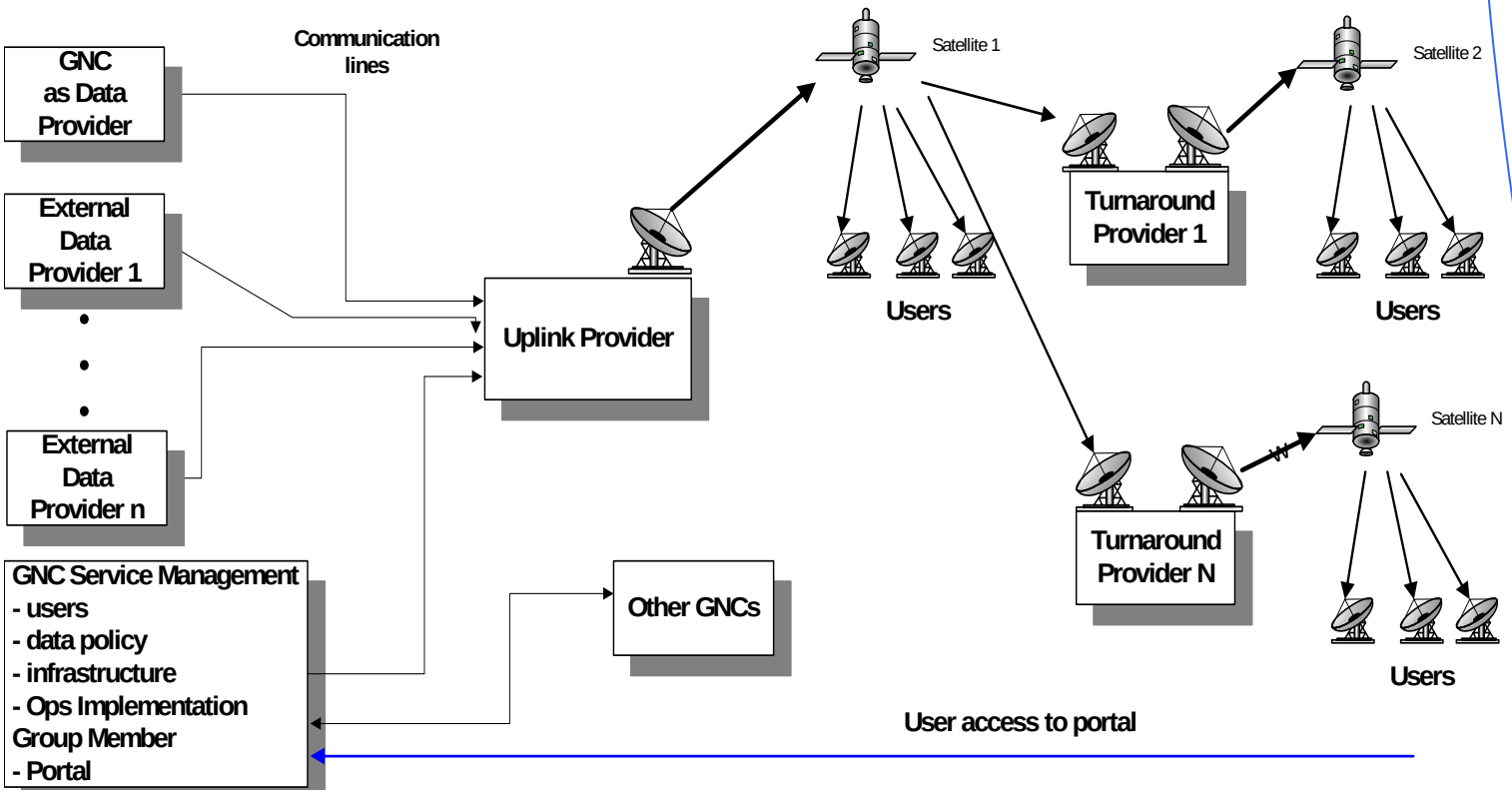
Network preliminary studies :
GEONETCast Data Communication Networks

- GEONETCast is the evolution of EUMETCast which is primarily used for the distribution of image data and derived products from EUMETSAT's own satellites.
- In addition, GEONETCast give access to services and data of several external providers.
- GEONETCast use existing dissemination infrastructure provided by environmental satellites operator.
- Provision of environmental satellite and in-situ data and products to users on a worldwide, operational basis.
- Regional centres implementation for regional dissemination system.

Network preliminary studies :
Main Functional Components of GEONETCast



GEONETCast Regional Network Centre - GNC

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Network preliminary studies :
GEONETCast Characteristics

- Generic, multi-mission dissemination systems based on standard DVB multicast technology,
- Use of commercial broadcast channels on TV, DTH telecommunication satellites,
- Use of off-the shelf, commercially available reception equipment,
- Use of IP over DVB standard coding,
- Transparent transfer of files, i.e. site receives files exactly as sent,
- Use of standard formats/encoding - XRIT, BUFR, GRIB, HDF ...
- Secure control of access at individual file and group of Users level,

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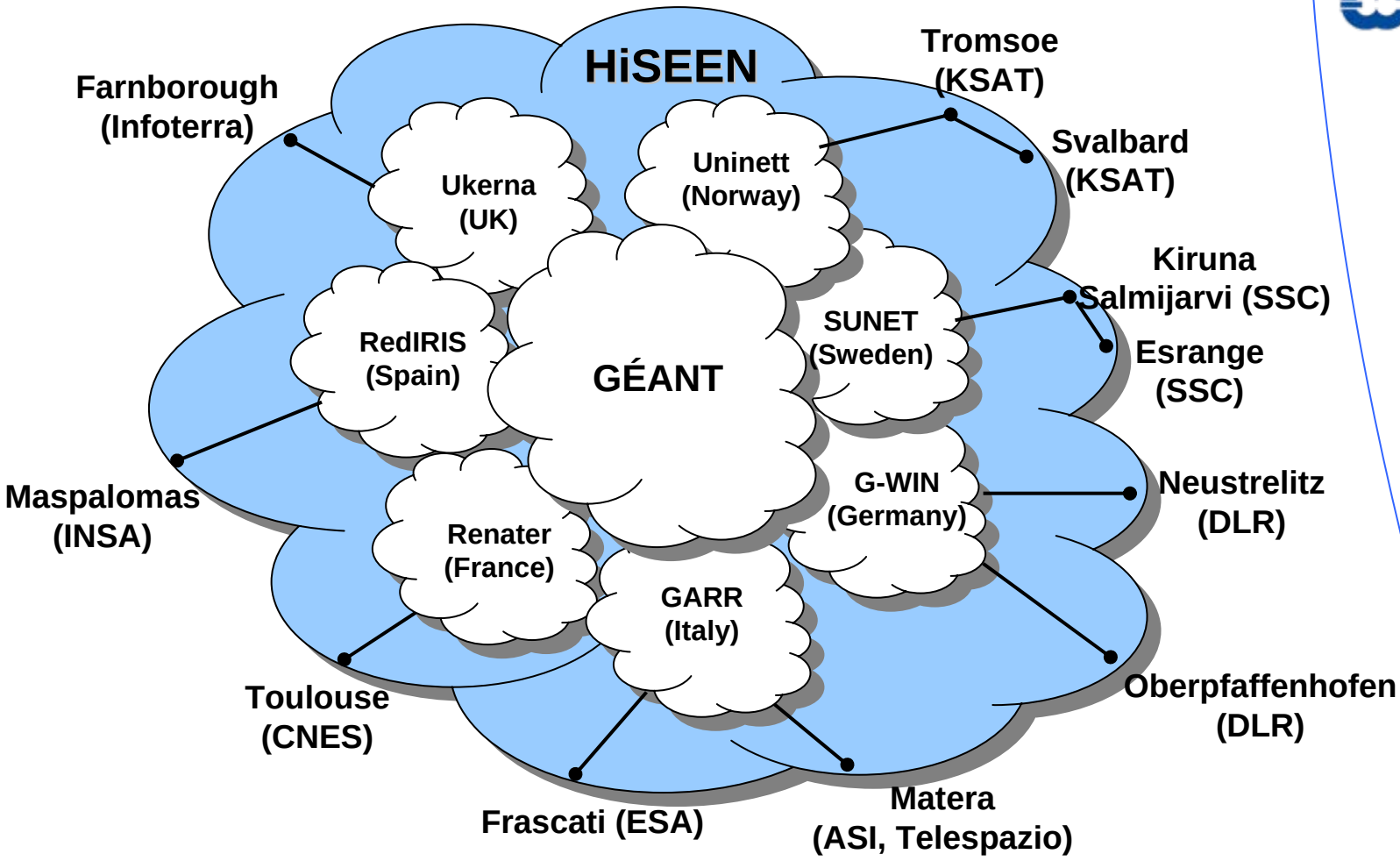
Network preliminary studies :
HiSEEN / GÉANT Data Communication Networks

- GÉANT is based on the HiSEEN (High-Speed Network Infrastructure),
- GÉANT Network is a multi-gigabit pan-European data communication network,
- The new generation of GÉANT, GÉANT2, will connect 34 countries through 30 NREN,
- The topology will have a total of 44 routes, using mixture of dark fibre and leased circuits

Network preliminary studies :

Main Functional Components of HiSEEN / GÉANT



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Network preliminary studies :
HiSEEN / GÉANT Characteristics

- GÉANT supports researchers by allowing them to:
  - Rapidly transfer large quantities of data at up to 10Gbps
  - Make use of advanced network applications such as grid computing
  - Collaborate on research projects in real-time
  - Perform previously unimaginable cutting-edge research

- Many types of research activity are facilitated by the GÉANT network. Some examples are:
  - DNA sequencing, where the network is used to transfer the huge amounts of data generated by gene sequencing, helping to speed up the notoriously slow process of developing new drugs and therapies.
  - Distributed (or 'GRID') Computing, in which GÉANT plays a significant role.

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Critical Points :

Network candidate solutions trade off

GTS (future WIS) Candidate Solution : Up to 11GB per day

- Restricted access to GTS by WMO
- Point to point access
- International network

EUMETCast (future GEONETCast) Candidate Solution : Up to 27GB per day

- Primarily used for spatial data dissemination
- Designed for broadband distribution

GÉANT Candidate Solution : Up to 127.8TB per day

- Used for research and education
- European network

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Critical Points :

From network trade off

After preliminaries studies, it appears that these networks answer to HALO needs in terms of data transfer with acceptable infrastructures and different channels opportunities,

BUT,

There is an expressive lack of joint and federated architecture for access through portal.

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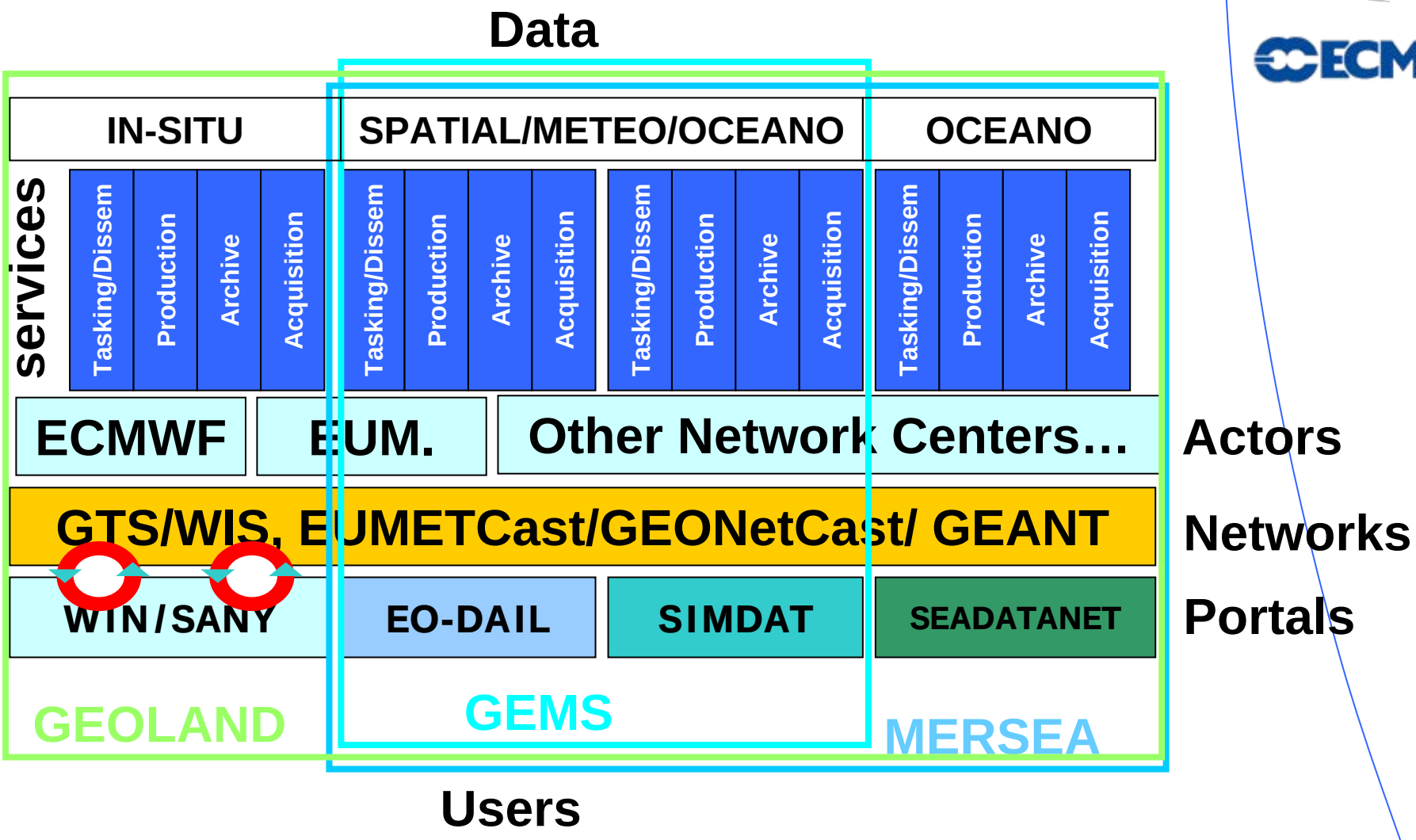
Suggested Architecture

Architecture Layers Presentation

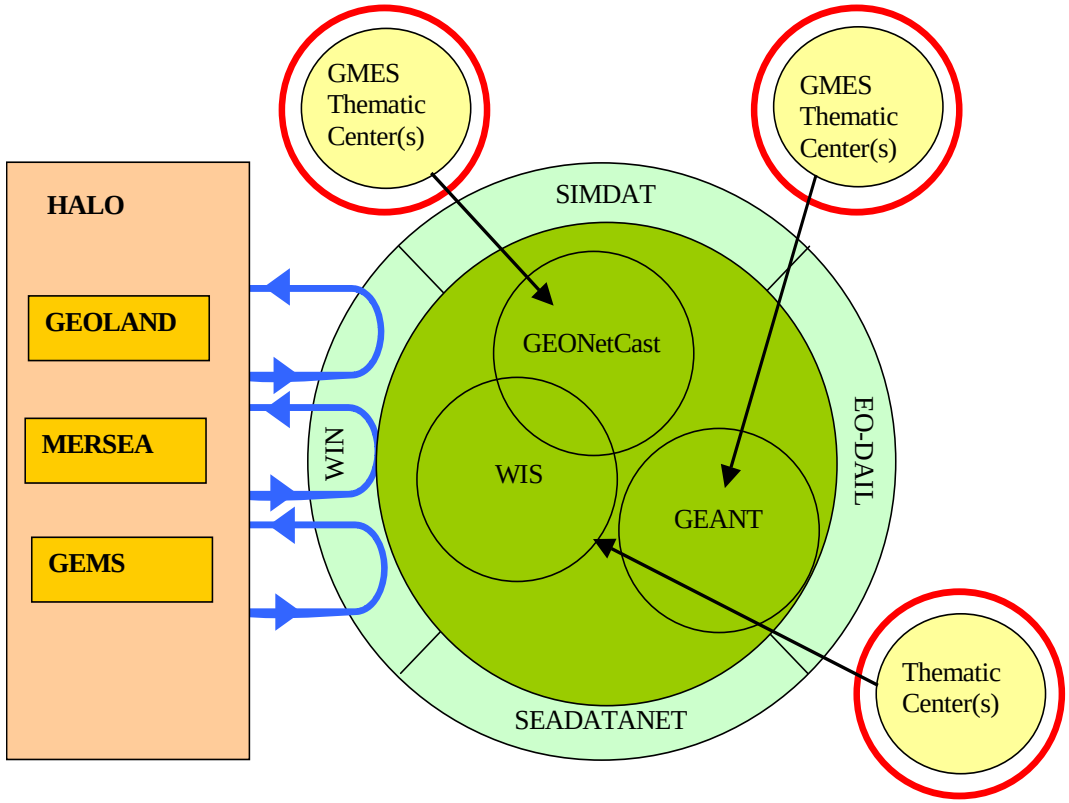


Suggested Architecture

Architecture Actors Overview : Thematic Centres

Exchange between Land, Ocean and Atmosphere IPs...

- Trough existing on-going networks,
- Using existing and on-going thematic portals.



Suggested Architecture

Architecture Actors Components :

Thematic Centres

- **World World Meteorological Organization Information System :**
  - National Centres,
  - Data Collection or Product Centres,
  - Global Information System Centres.

- **WIS Services :**
  - Routine collection and automated dissemination service for time and operation-critical data and products (meteorological, forecasts and warning..). This service is based on real-time “push” mechanism including multicast and broadcast.
  - Data Discovery, Access and Retrieval (DAR) service for all data stored regardless of location. This service is based on request/reply “pull” mechanism with sophisticated data management and standardization.
  - Timely delivery service for high volume data and products. This service is based on delayed mode “push” mechanism with trigger functions such as scheduling by time-table and monitoring the accumulation amount of required data.

Suggested Architecture

Architecture Actors Components :

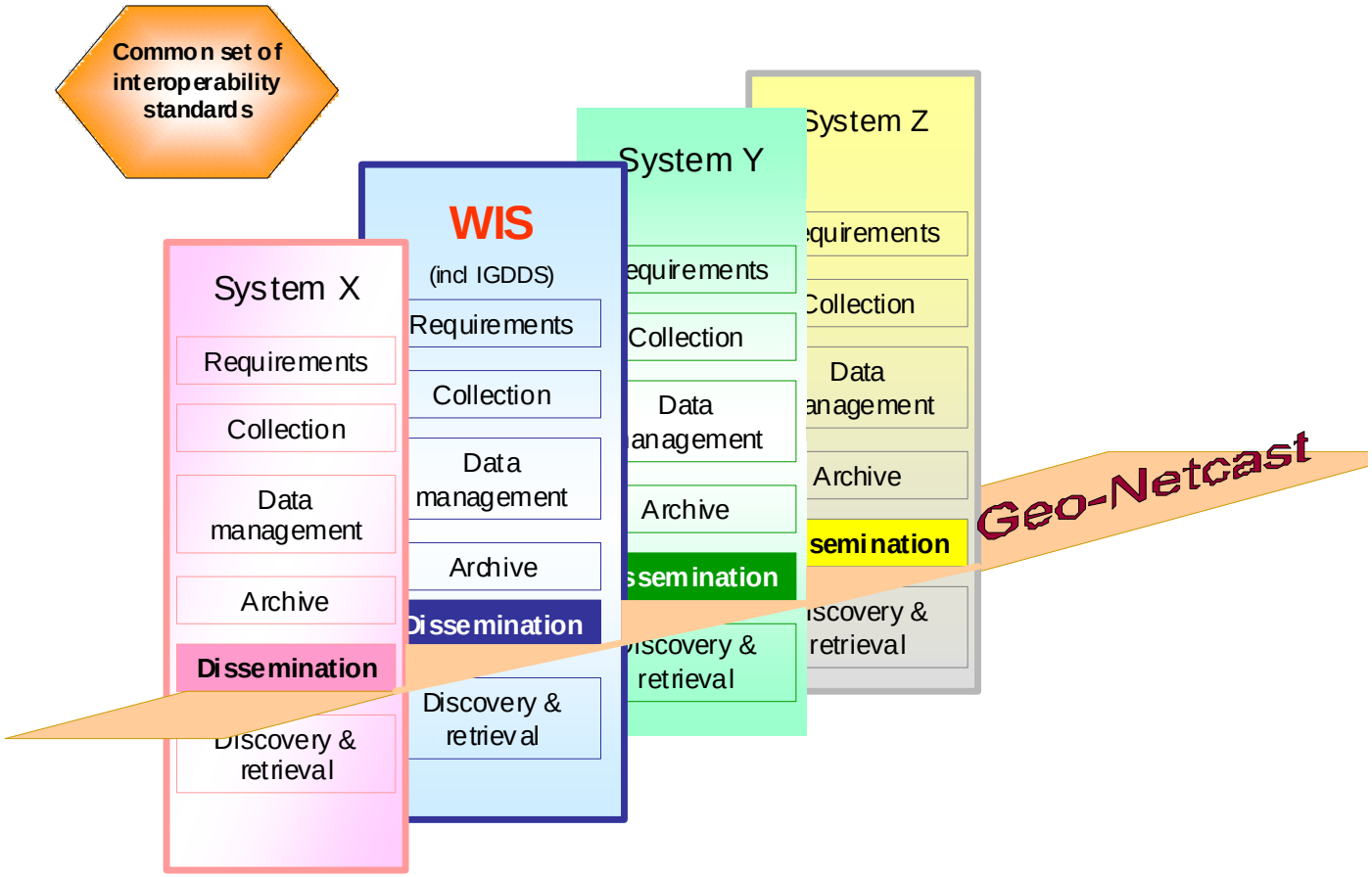
Thematic Centres

- **GEONETCast :**
  - GEONETCast Regional Network Centre

- **GEONETCast Services :**
  - Data discovery (searchable) on global and regional products and services.
  - Links to the regional service performance indicator and news messages;
  - Links to the help-desk services;
  - Links to the GEONETCast subscription service;
  - Web links to the regional archives of the various data providers.

Suggested Architecture

Architecture Actors Components : WIS and GEONETCast interaction



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Suggested Architecture
Architecture Components : Thematic Centres Trade Off

How many Thematic Centres per Network for GMES

Which Thematic per centre, Oceano, Land, Atmosphere? And which location?

How many national TC, international TC for WIS, GEONETCast ?

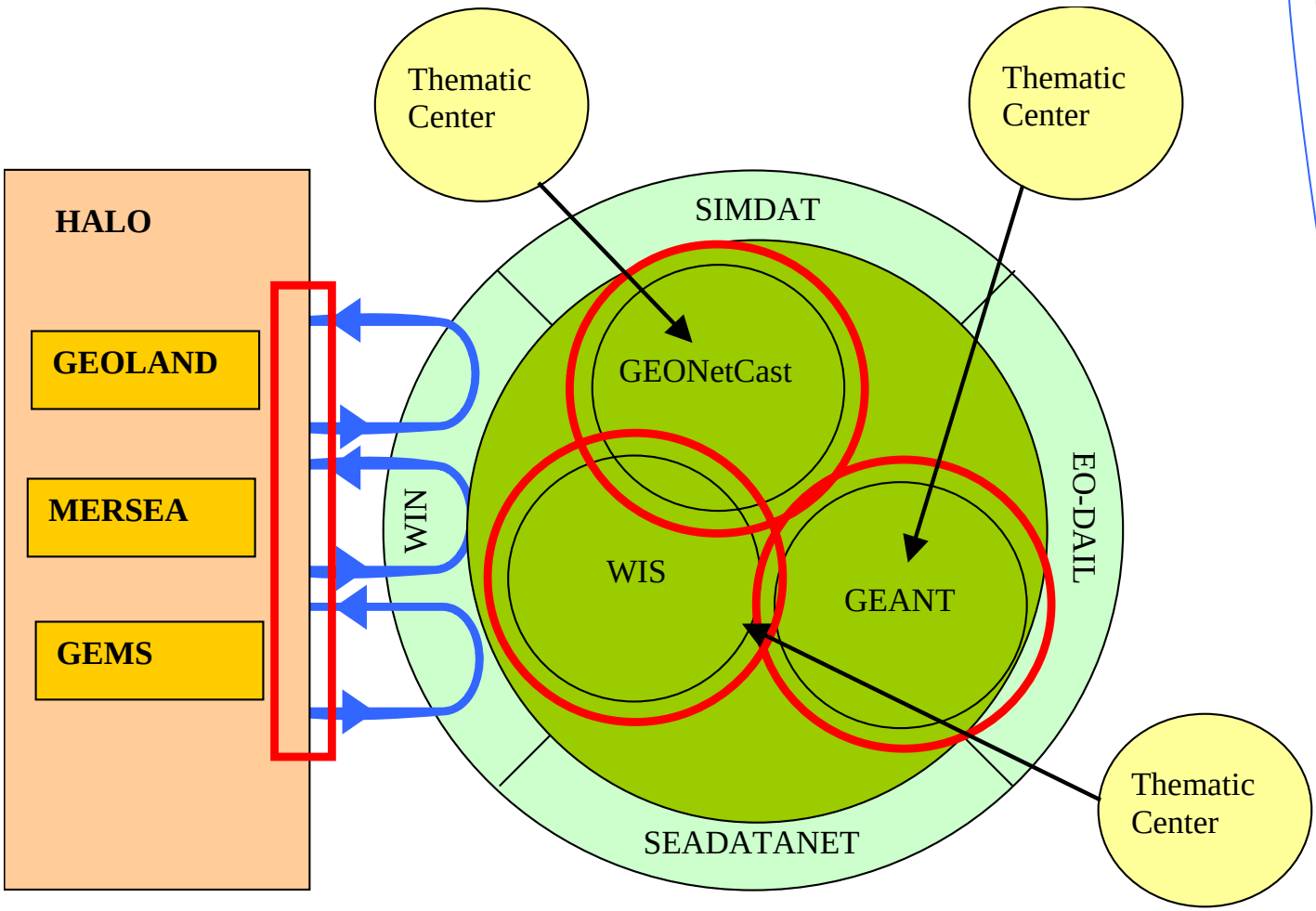
Interconnection between WIS, GEONTCast and GEANT thematic centre

- NC DCPC GISC (from WIS)
- GNC (from GEONetCast)
- TC from GEANT

To be discussed …

Suggested Architecture

Architecture Overview : Infrastructure, Network Layer



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Suggested Architecture

Architecture Components : Infrastructure, Network Layer

For Atmosphere and Oceano

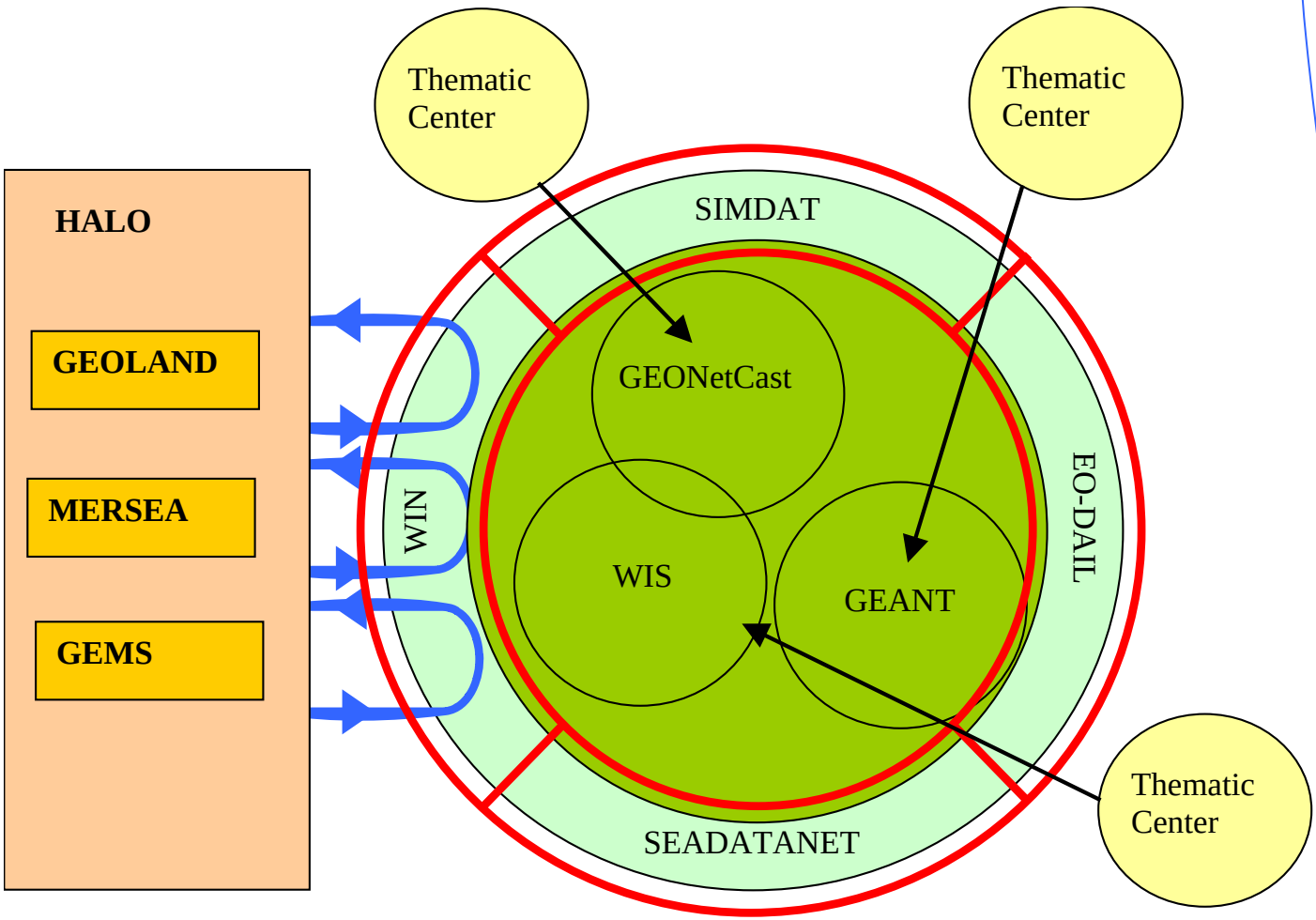
- Access to EO : WIS (depending on JCOMM)
- Access to In-situ Data : WIS or GEONetCast

For Land

- Access to EO Data
- Access to In-situ Data : GEONetCast

Suggested Architecture

Architecture Overview : Interoperability Layer



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Suggested Architecture

Architecture Components : Interoperability Layer

Use portals

- EO-DAIL for EO Data
- SEADATANET for Ocean
- WIN for In-situ Data Access
- SIMDAT for EO data Access

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Suggested Architecture

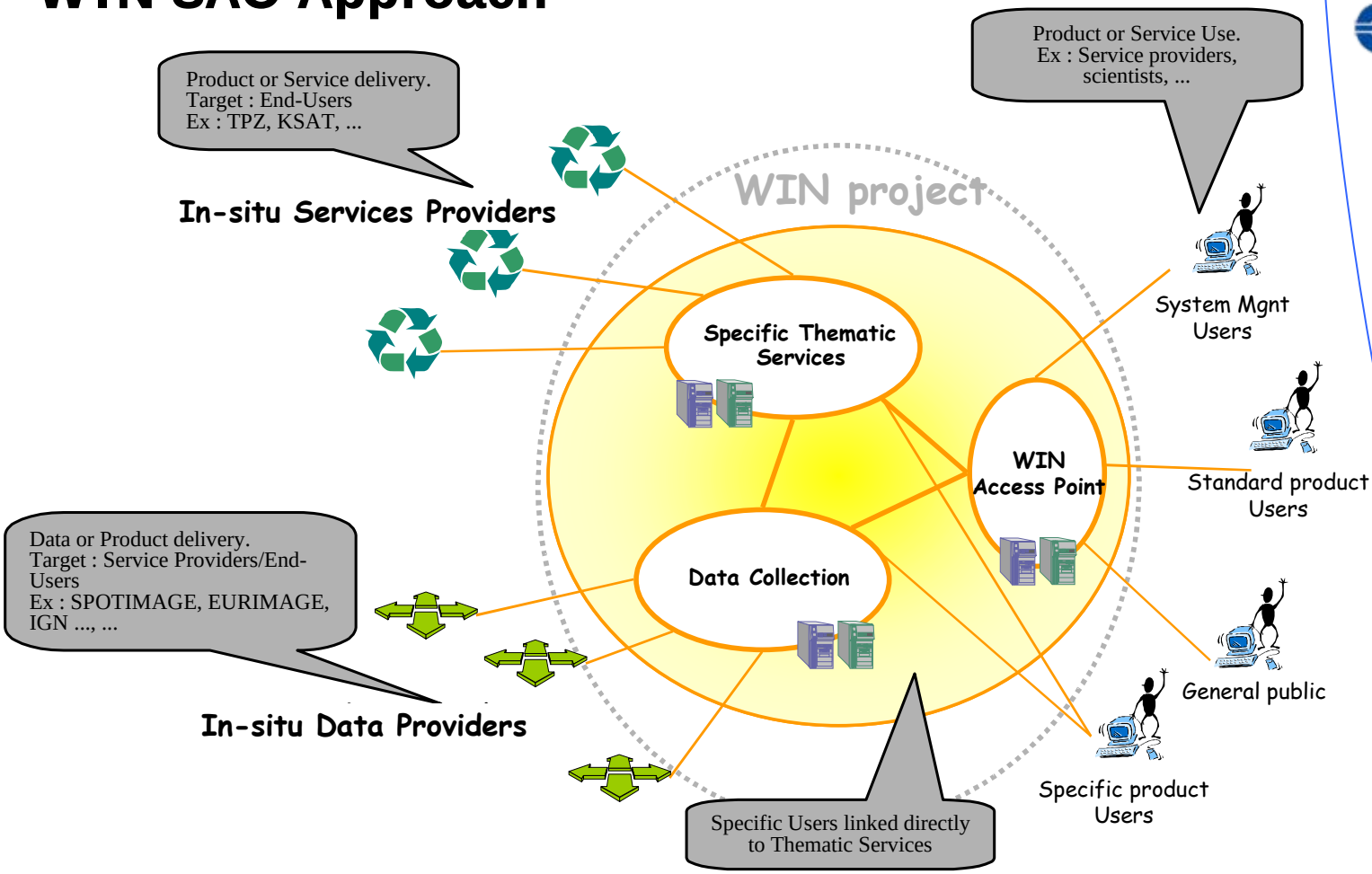
Architecture Justification :

WIN

- As an interoperability solution between In-situ user's networks,
- Built with a SOA based on SOAP/http Protocol,
- WIN proposes CIP (Common Integration Point) available for all In-Situ clients also offering Common Accesses Services,
- Contracts are possible with all In-situ Clients through SLA (Service Layer Agreement).

Suggested Architecture

Architecture Justification : WIN SAO Approach



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Suggested Architecture

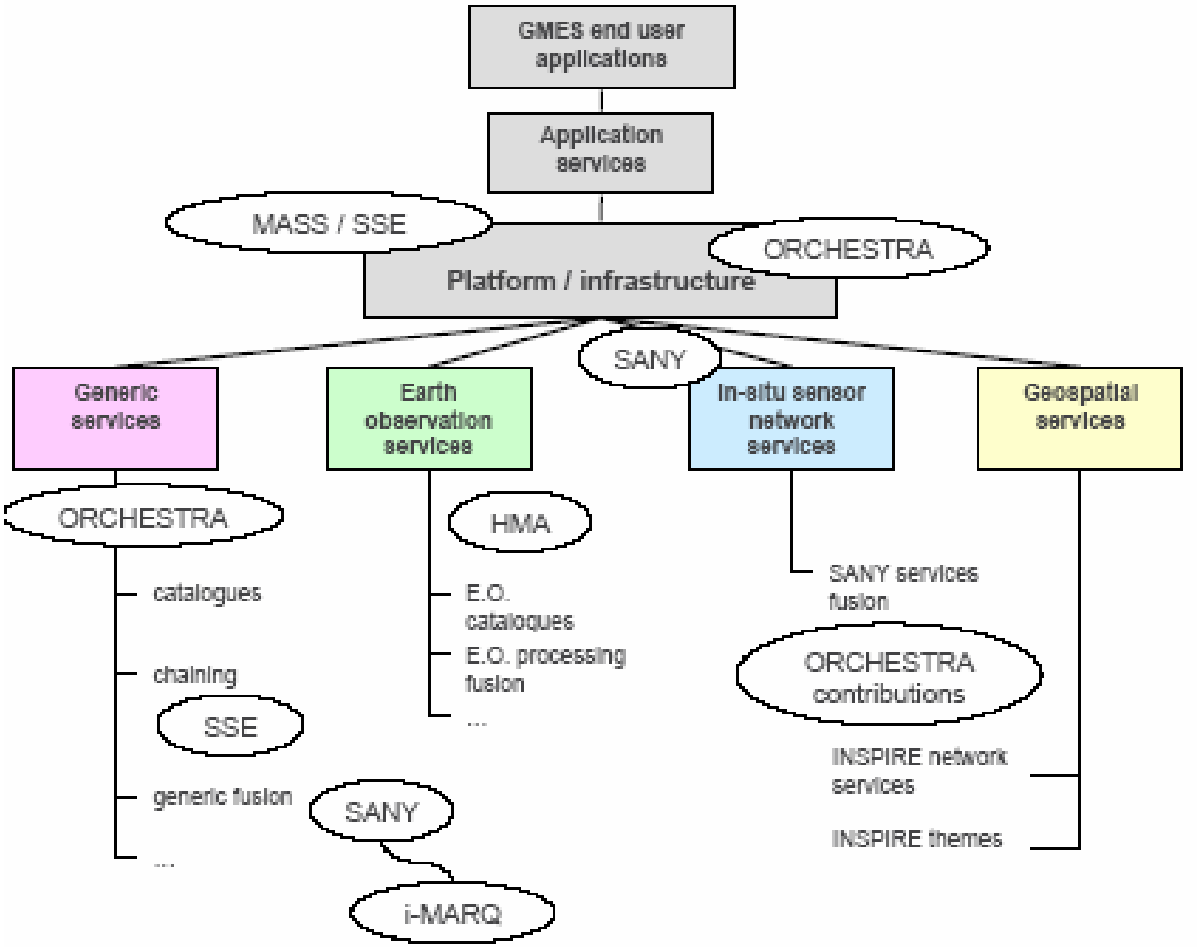
Architecture Justification :

WIN Services

- Provide an Access Point,
- Users Management,
- Services and Products registry management,
- Access Management to Services and Products,
- Management of the Data Storage node and data dissemination,
- Interface with Legacy Providers.

Suggested Architecture

Architecture Justification : SANY (1/2)



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Suggested Architecture

Architecture Justification : SANY (2/2)

SANY aims to specify the standard for all kinds of sensors and sensor networks, develop generic fusion and basic Decision Support System components for environmental risk management and validate the architecture in air pollution, marine, and geo hazards domains. Technical approach to sensor integration is inherited from ORCHESTRA

- Specify a standard open architecture for all kind of fixed and moving sensors and sensor networks,
- Develop standardized advanced data fusion and DSS services,
- Assure that a reference implementation of the architecture is operational as GMES building block in 2008,
- Assure that the outcome of SANY is accepted by end users and international organisations to a future standard applicable to GMES.

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Suggested Architecture

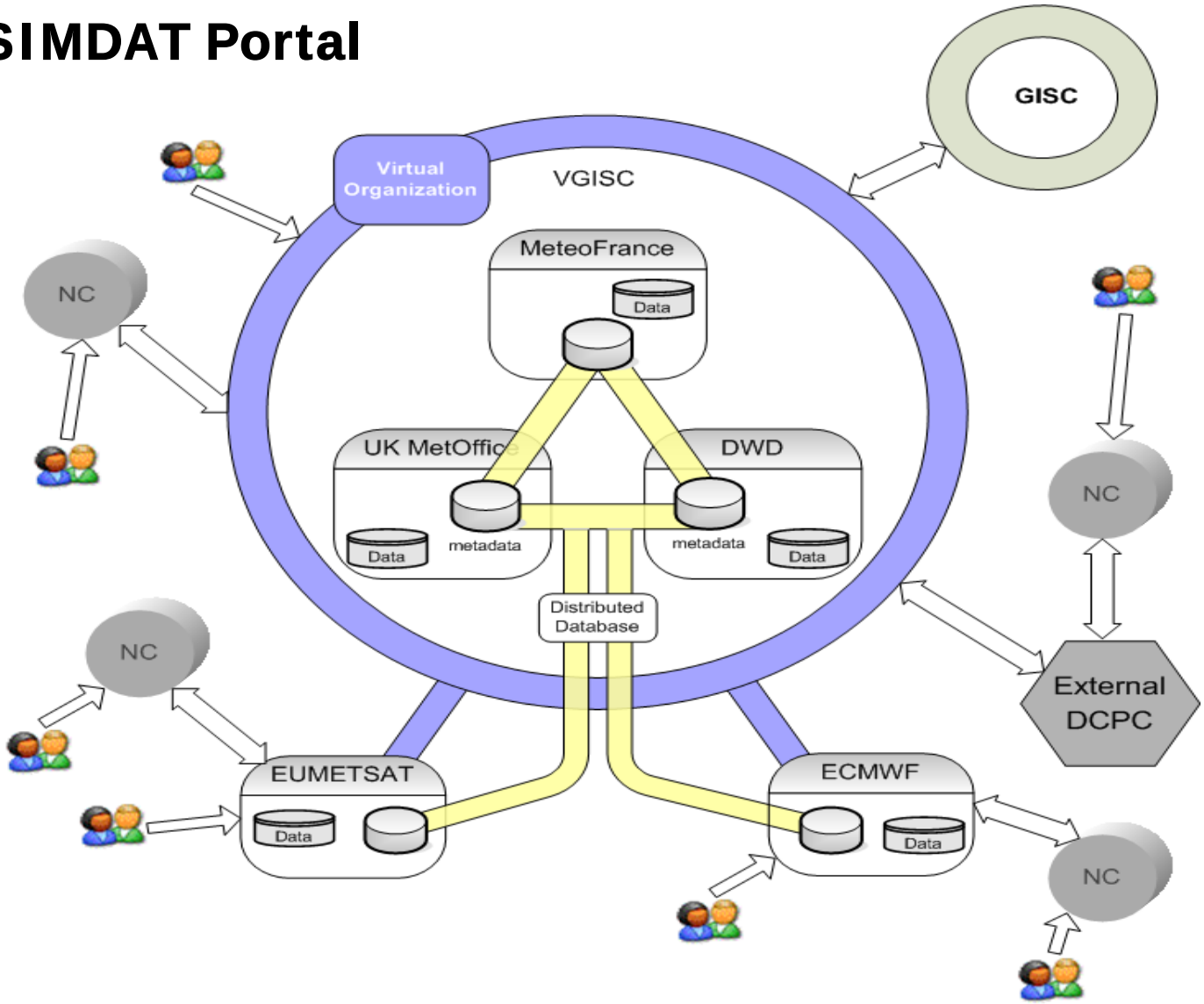
Cf. previous presentation from RAOULT, ECMWF

Architecture Justification : SIMDAT

- test and enhance Grid data technology for product development and production process design,
- develop federated versions of problem-solving environments by leveraging enhanced Grid services,
- exploit data Grids as a basis for distributed knowledge discovery,
- promote de facto standards for these enhanced Grid technologies across a range of disciplines and sectors,
- raise awareness of the advantages of Data Grids in important industrial sectors.

Suggested Architecture

Architecture Justification : SIMDAT Portal



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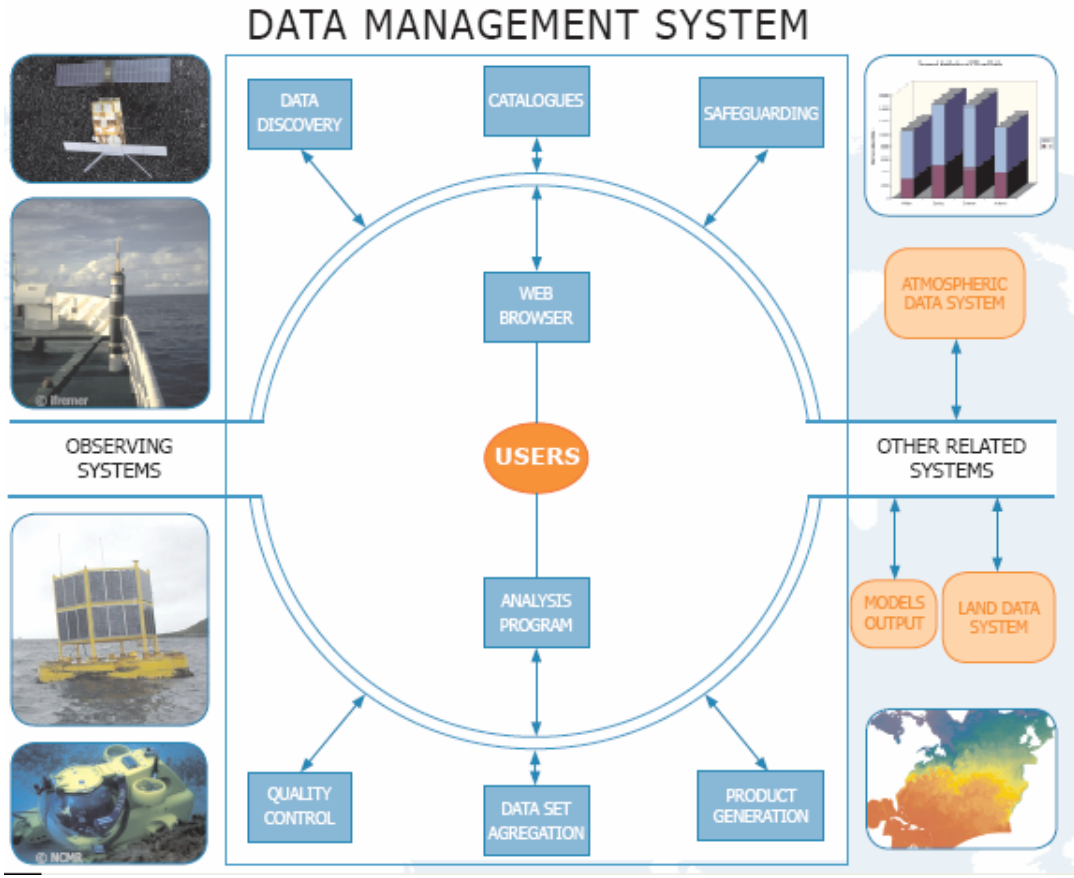
Suggested Architecture

Architecture Justification : SEADATANET

See Y.Desaubies for more details

Pan-European Infrastructure for Ocean and Marine Data Management (www.seadatanet.org)



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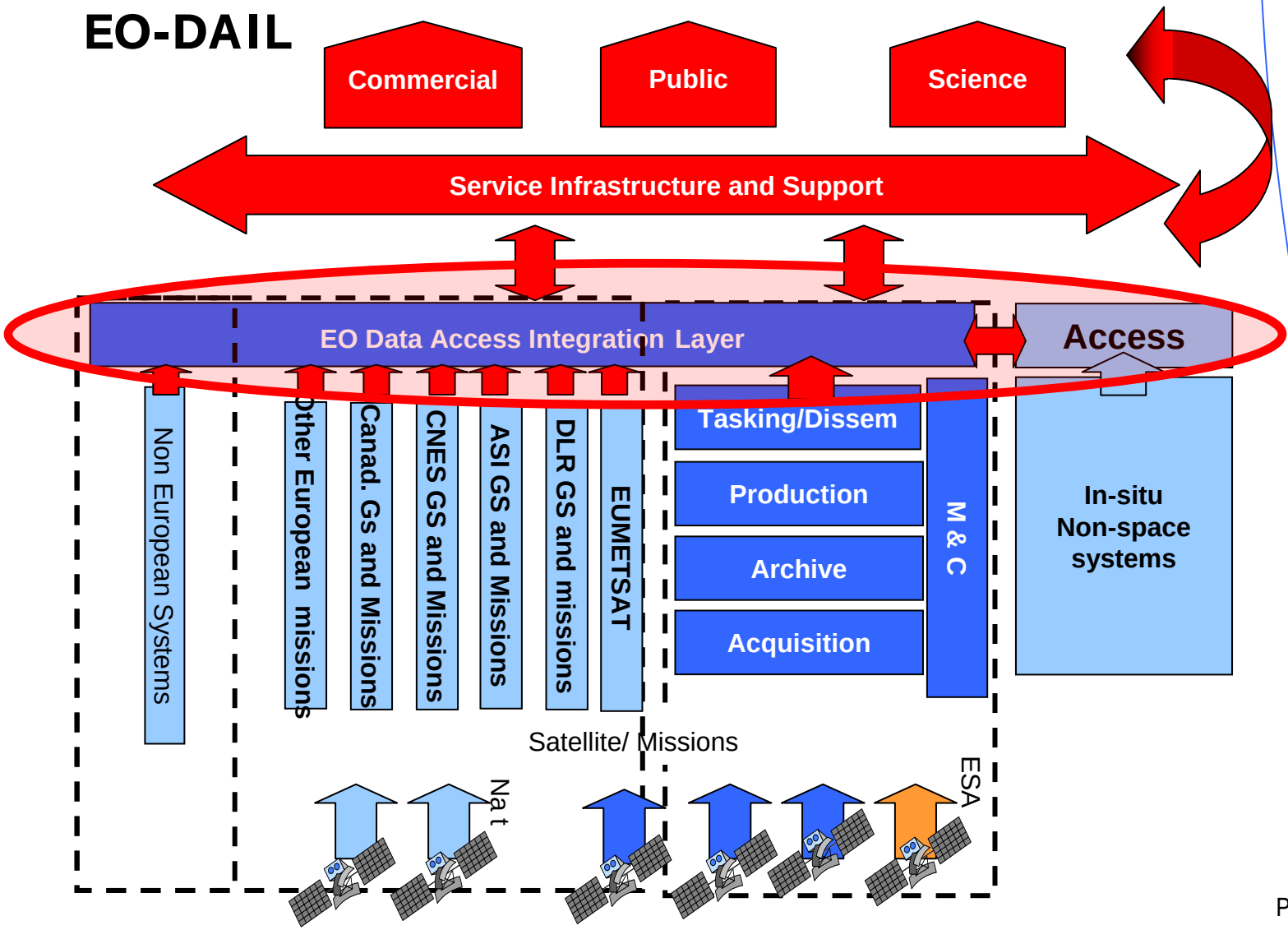
Suggested Architecture

Architecture Justification : SEADATANET

- A perennial data archiving infrastructure supported by 40 major marine institutes,
- A Virtual Data Centre providing integrated on line access to data, meta-data and products from the distributed databases via a unique internet portal,
- Interoperability of the data centres developed by using common standards and adapted technology for data QC and communication,
- Progressive networking of the data centres to the Virtual Private Network,

Suggested Architecture

Architecture Justification : EO-DAIL



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Presentation Summary

- HALO Project overview and needs
- HALO study logic
- Networks preliminary studies
- Critical points
- Suggested architecture
- Recommendations

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RECOMMENDATIONS

Implementation Overview

Objectives

- To propose recommendations for improving data acquisition and dissemination
- To improve interoperability between IPs at local, regional and international level
- To consider and benefit from European and International context (Multiple on-going infrastructure projects)
- To favour the use of previous selected networks for ocean, Meteo, EO, in-situ fluxes

- To take into account HALO recommendations in on-going and future infrastructure projects

RECOMMENDATIONS

European and international Context
Key Driving rules that should be considered

- For Meteorology, Oceanography
  - **WMO** World Meteorological Organization
  - **JCOMM** Joint WMO IOC Technical Commission for Oceanography and Marine Meteorology
  - **WWC** Water Weather Climate
  - **EEA, ICES, EMMA, GEOSS**

- For Land
  - No federating organization
  - Multiplicity of Networks

- For GMES
  - **INSPIRE** The Infrastructure for Spatial InfoRmation in Europe

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RECOMMENDATIONS FOR IMPLEMENTATION

- Take into account inheritance from previous work (e.g. the FP6/ESA architecture studies),
- To be compliant with relevant organizations, European and International (cf previous slide)
- To anticipate network capacity in the future (WIS for GTS and GEONETCast for EUMETCast)
- Always keep in mind some redundant alternatives (e.g GÉANT as an alternative to EUMETCast or WIS)

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RECOMMENDATIONS FOR IMPLEMENTATION

Data Networks

- HALO ask related projects to confirm the needs of critical data volumes transfer (e.g. for GEOLAND, VGT (2GB per day), MODIS (10 GB per day), MSG (4 GB per day))

- HALO shall automate access to on-demand fluxes as far as possible

- HALO shall consider WIS portal for WWC data and GEONETCast portal for other Data

- **HALO shall contribute to WIS, GEONETCast, GÉANT networks evolution**.

RECOMMENDATIONS FOR IMPLEMENTATION

Interoperability

- **How to cope with existing standards and procedures ?**
  - Participate actively to INSPIRE and OpenGis Consortium (OGC)
  - Submit to provider's community charters for data quality, certification.

- **How to automate the access to in-situ data ?**
  - Define mechanisms and interfaces allowing knowledge and access to in-situ data and networks
  - Use SOA Architecture (for instance e-business, BPEL)
  - **In-Situ Portal/ Data Warehouse** providing knowledge about existing sub-network and standards/protocols to access to In-situ sub-networks.

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RECOMMENDATIONS FOR IMPLEMENTATION

Data Policies – Today requirements

- Data providers need to control or track who has access to their data and how it is used.
- The incentive structures implicit in "library systems" may be an appropriate model for motivating data producers, collectors and traders to document, share and otherwise disseminate their geodata.
- The INSPIRE/DPAG GMES initiative supervise all the different project in order to converge in the same data policy.
- The OGC GeoDRM working group mission is to coordinate and mature the development and validation of work being done on digital rights management for the geospatial community.

RECOMMENDATIONS FOR IMPLEMENTATION

Data Policies - Recommendations

- Provide practical experiences where data access has inhibited or restricted progress on the thematic projects to INSPIRE/DPAG.
- Provide information and view to INSPIRE/DPAG on the key question: What problems, obstacles or difficulties have we found in our project in the following topics?
  - Ownership, privacy and confidentiality,
  - Intellectual property rights and associated legal frameworks,
  - Standards and metadata,
  - Licensing, distribution and dissemination,
  - Pricing policy,
  - Archiving policy.
- Enable business models for web-based geospatial services by identifying or developing a trusted infrastructure for purchasing and protecting rights to digital content
- Check evolution of the OGC DRM working Group.

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RECOMMENDATIONS FOR IMPLEMENTATION

Networks Implementation

- WIS Implementation
  - 2006 : Several WIS functions, including the core services to be provided by WIS centres, are being tested and evaluated,
  - By the end of 2007, transition GTS -> WIS.

- GEONETCAST Implementation
  - Preparation of an operational prototype installation of all regional functions of a GNC including the high level GNC-Operations Implementation Group functions,
  - Presentation of the operational prototype to the user community and administrations,
  - Agreement of an ICD on “How to join GEONETCast as a GNC”, describing the pre-requisites each GNC must fulfil before they can join the interconnected GNC with the required SLA and standards.

- GÉANT Implementation
  - Openness toward GMES Data distribution ??

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RECOMMENDATIONS FOR IMPLEMENTATION

General

- To participate to WIS, GEONETCast and GÉANT development through relevant organizations

  E.g : JCOMM, OMM ("Organisation Météorologique Mondiale")

- To introduce HALO concepts inside on-going infrastructure projects SIMDAT, WIN, SANY, SEADATANET

- To implement HALO concepts through GMES on-going program (FP7, DUE)

- To identify suitable Thematic Centres in HALO GMES context

- To ease subscription access to NC

A Mou to be held at the end of HALO to implement previous topics

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Candidate Solution Synthesis / Conclusion