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

Project Acronym:

HALO

Recommendation Document including Common Interface Candidate Solutions

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Table of Contents

1 Introduction

The objective of this document is to assess and provide recommendations regarding the usefulness of the GTS/WIS and EUMETCAST/ GEONETCAST networks for data acquisition, sharing and dissemination between MERSEA, GEOLAND and GEMS core services.

1.1 Structure of the Document

The document is divided in XXX chapters:

1. XXX
2. XXX

1.2 Reference Documents

Ref	Title	Author	Date
AD1	HALO Part B Forms	HALO team	
AD2	MERSEA Information Management (MIM) High level requirements	IFREMER	11 Oct 2004
AD3	MERSEA data and products for GMES	MERSEA Team	15 Nov 2004
AD4	HALO draft report on interacting parts of GEMS, MERSEA and geoland	ECMWF	7 Jan 2005
AD5	HALO Guideline WP3210 and WP3310	ASTRIUM, ASP, ECMWF	3 March 2005
AD6	HALO Infrastructure Candidate solution overview WP 3210 and WP 3310	ASTRIUM, ASP, ECMWF	9 March 2006
AD7	WMO Information System (WIS)	WMO Dieter C.Schiessl	24 September 2006
AD8	GEONETCast Global Design Document EUM/OPS/DOC/06/1799 v1A	EUMETSAT Lothar Wolf Mike Williams	26 September 2006

2 Candidate Solution Descriptions

2.1 Context and objectives

The meteorological community uses dedicated networks such as GTS and EUMETCast for the operational transfer of both observations and model output.
WMO will expand the GTS with new functions and connectivity to meet wider needs.

GEONETCast is an initiative led within the GEO[1] framework by EUMETSAT, NOAA and WMO to address global dissemination needs of GEOSS environmental data in a coordinated way, GEONETCast will be based on the EUMETCast general framework.

Finally, the High-speed network infrastructure (HiSEEN) Based on the GEANT/NREN connects at high-speed the ESA operational centres and users for large data volume transfer and is fully deployed since September 2005.
It is now being operationally used for all Internet on-line data distribution services via Internet and for the operational replacement of the media circulation between the centres of the ground segment for improving performances and near real time data access.

All these networks have been assessed as candidate solutions for data exchanges between HALO core services. The following criteria have been used:

Political characteristics	Technical Characteristics	Efficiency	Other Characteristics
• Ease of access for European institutions • Global reach • Low cost • Easy implementation of data policies • Flexibility to serve new customers	• Capacity/throughput • Reliability • Adaptability to new requirements/upgradability • Accepted technical standards, globally and within Europe	• Efficiency for HALO/GMES data flows • Efficiency for core product exchange • Efficiency for satellite data acquisition • Efficiency for in-situ data acquisition	• Is the service suitable for operational use? • Can satellite broadcast be extended with terrestrial networks? • Does the service provide dissemination only? • Does the service manage data exchange, user access..? • Maximal data rate? • Does the service ensure secure access to data..? • What are the commitments on delivery time? • Is the data transfer to the uplink station an issue? • Suitability for a small number of core services? • What are the access restrictions? • What are restrictions on data representation (format)?

A graphical representation of the relationship between WIS, GTS, EUMETCast, GEONETCast and others is given in figure below.

[1] The **Group on Earth Observations**, **GEO**, was established by a series of three ministerial-level summits. GEO includes 65 member countries, the European Commission, and 43 participating organizations working together to establish a Global Earth Observation System of Systems (**GEOSS**)

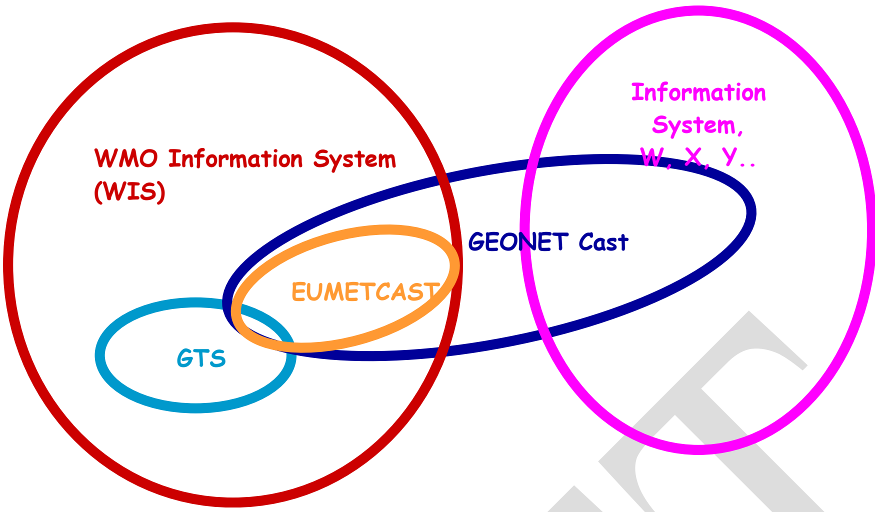


Figure 1 : Interoperability of WIS (> GTS + EUMETCast+ GEONETCast)

2.2 HALO data flows critical areas

Satellite Data for GEMS

Most of the satellite data to be used in GEMS will come from satellite agencies (ESA, EUMETSAT, NASA) and in the case of some products from research centres (KNMI) and universities (Universitaet of Bremen, Heidelberg).

Much of the high volume sounding data required (IASI) is already being received in real-time, or will be received in real-time at ECMWF. The main challenge will be the transfer of MODIS and MERIS radiance data.

Estimated transfer to ECMWF per Day		
GEMS GHG	Metop-1 (IASI)	1500 MB
GEMS GRG	Metop-1 (IASI)	1500 MB
GEMS AER	ENVISAT (MERIS)	250 MB
GEMS AER	NASA (TERRA-MODIS)	600 MB
GEMS AER	NASA (AQUA-MODIS)	600 MB

Satellite Data for GEOLAND

Estimated Satellite Data transfer for GEOLAND per Day		
Vegetation Products		
	VEGETATION	2 GB/day (near real time)
	AVHRR / EPS :	2 GB/day (near real time)
	MODIS / Terra	6 GB/day (near real time)

Estimated Satellite Data transfer for GEOLAND per Day

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

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

2.3 The Global Telecommunication System (GTS)

The Global Telecommunication System (GTS)
The meteorological community uses dedicated networks for the operational transfer of both observations and model output. The main advantages are bandwidth and availability guaranties.
The GTS (Global telecommunication system) consists of an integrated network of point-to-point circuits, and multi-point circuits which interconnect meteorological telecommunication centres. The circuits of the GTS are composed of a combination of terrestrial and satellite telecommunication links. Figure 2 shows the structure of the GTS.

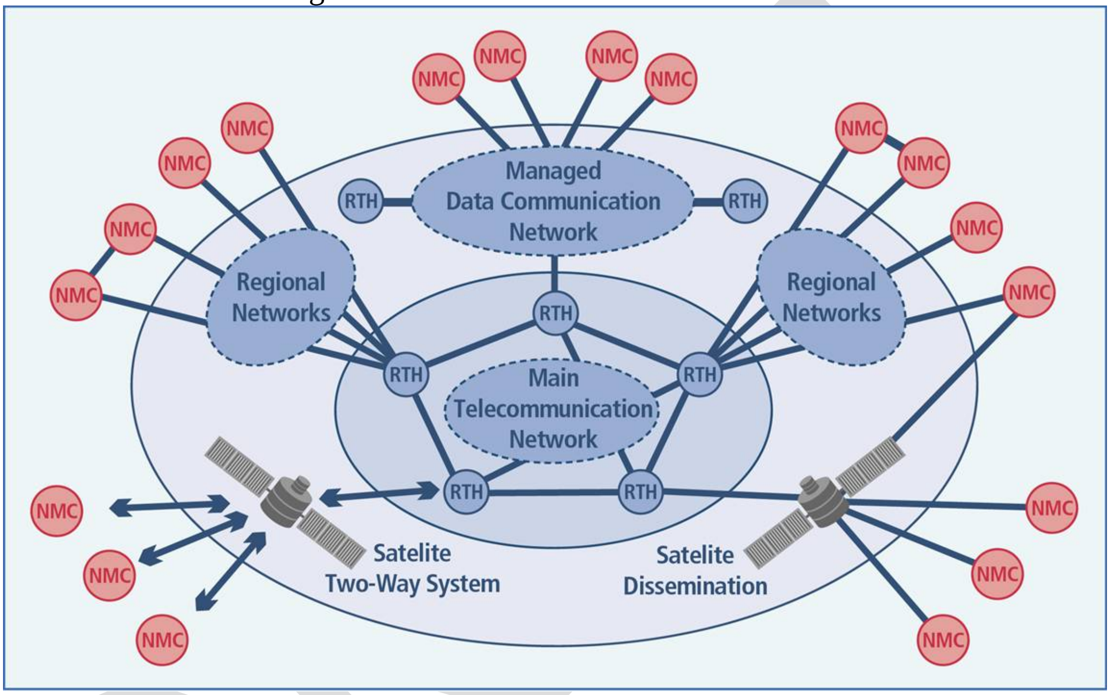


Figure 2 : World Weather Watch GTS - Global Telecommunication System -

The GTS is organised in three hierarchy levels, namely:

a. The Main Telecommunication Network (MTN);

b. The Regional Meteorological Telecommunication Networks (RMTNs);

c. The National Meteorological Telecommunication Networks (NMTNs);

The Main Telecommunication Network (MTN) is the core network of the GTS. It links together three World Meteorological Centres and 15 Regional Telecommunication Hubs. These are:

- NMCs: Melbourne, Moscow and Washington;
- RTHs: Algiers, Beijing, Bracknell, Brasilia, Buenos Aires, Cairo, Dakar, Jeddah, Nairobi, New Delhi, Offenbach, Toulouse, Prague, Sofia and Tokyo.

The MTN has the function of providing an efficient and reliable communication service between its centres, in order to ensure the rapid and reliable global and interregional exchange of observational data, processed information and other data required by Members.

The Regional Meteorological Telecommunication Networks (RMTN) consist of an integrated network of circuits interconnecting meteorological centres, which are complemented by radio broadcasts where necessary. The Regional Meteorological Telecommunication Networks are to ensure the collection of observational data and the regional selective distribution of meteorological and other related information to Members. The RTHs on the MTN perform an interface function between the Regional Meteorological Telecommunication Networks and the MTN. There are six Regional Meteorological Telecommunication Networks: Africa, Asia, South America, North America, Central America & the Caribbean, South-West Pacific and Europe.

The National Meteorological Telecommunication Networks (NMTN) enable the National Meteorological Centres to collect observational data and to receive and distribute meteorological information on a national level.

The RMDCN **E**uropean **R**egional **M**eteorological **D**ata **C**ommunications **N**etwork is part of WMO's Global Telecommunication System (GTS) as the regional network for region VI, Europe.
The RMDCN connect the European National Meteorological Services and **ECMWF**. The dissemination of operational products by ECMWF to its member states is one of the major tasks of the RMDCN. An overview of the connections is given in Figure 3.

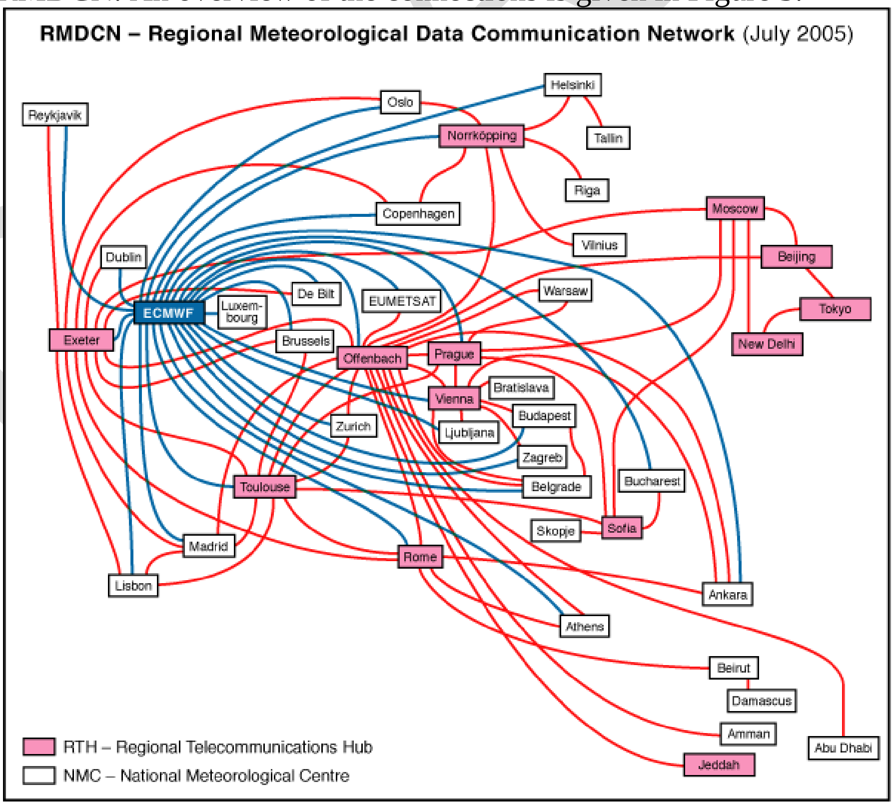


Figure 3: Overview of RMDCN connections (source: www.ecmwf.int)

2.4 The WMO Information System (WIS)

The figure below presents the current situation and bottlenecks of the GTS network.

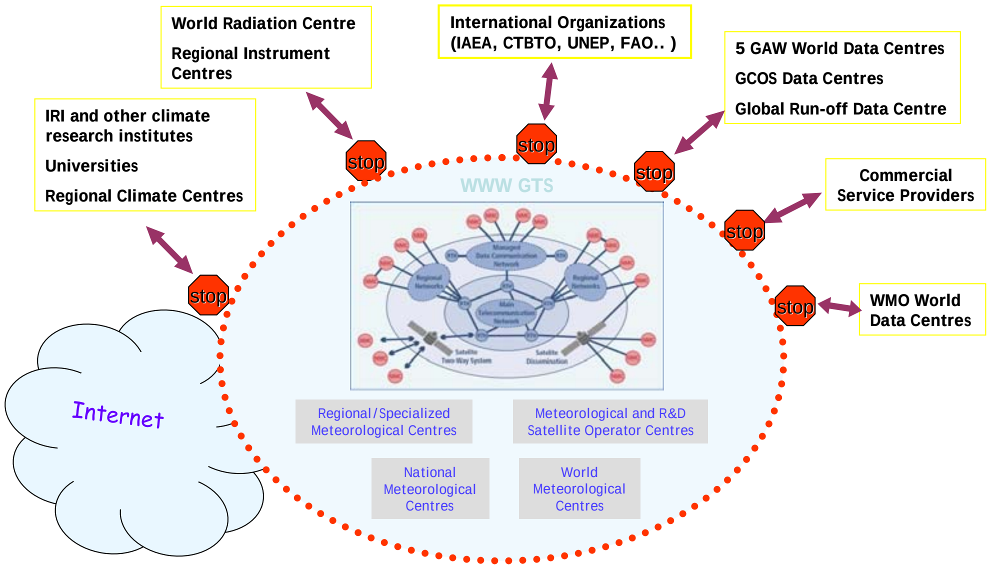


Figure 4 : GTS current situation

The current GTS is:

- Restricted to connectivity within WMO Members with cost-sharing manner;
- Mainly focused on the WWW requirements;
- Mainly based on traditional message switching mechanism by WMO heading scheme.

WMO will expand the GTS with new functions and connectivity to meet wider needs.
WIS will bring new features and opportunities such as

- Interoperable information exchange standards, functions and services through Portal architecture allowing a variety of codes, protocols, and data representation forms
- Inter-disciplinary discovery, retrieval and exchange of information in real and non-real time through a single entry point in each country
- Open to all users for data discovery, to authorized users for data access (according to national data policies)
- 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 inter-operability

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.

2.4.1 WIS services

WIS should provide the following fundamental types of services. Table 1 shows required characteristics of them.

(1) 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.

(2) 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.

(3) 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.

	(1) Routine collection and dissemination service	**(2) DAR service**	**(3) Timely delivery service**
Main use	WWW operation Operation of other WMO and related international programmes	Research use Exploring new data for operation Verification of NWP models	Research use Monitoring and statistic programmes
participants	WMO Members Organizations authorized as NC and DCPC (Non-WMO Members)	WMO Members Organizations authorized as NC and DCPC (Non-WMO Members) WIS individual users (persons and institutions)	WMO Members Organizations authorized as NC and DCPC (Non-WMO Members) WIS individual users (persons and institutions)
Timeliness	Severe real-time (e.g. global exchange within 1 min)	Human tolerable level (e.g. portal initial response within a few minutes)	Dependent on specific user requirement (e.g. delivery within 5-10 minutes)
Traffic predictability	Predictable by analysis of requirements	Unpredictable except statistic prediction by monitoring	Predictable by analysis of requirements
Reliability	Extremely required (e.g. coordinated backup scheme for 24x7 no-interruption)	Generally required (e.g. short or partial service suspension is allowable)	Required (e.g. alternative remedy for recovery)
Security	Indispensable (introducing security measures in every aspect)	Indispensable (data integrity, preventing attack of denial of service)	Indispensable (data integrity)

Table 1 : Required characteristics of WIS services

2.4.2 Functional structure of WIS

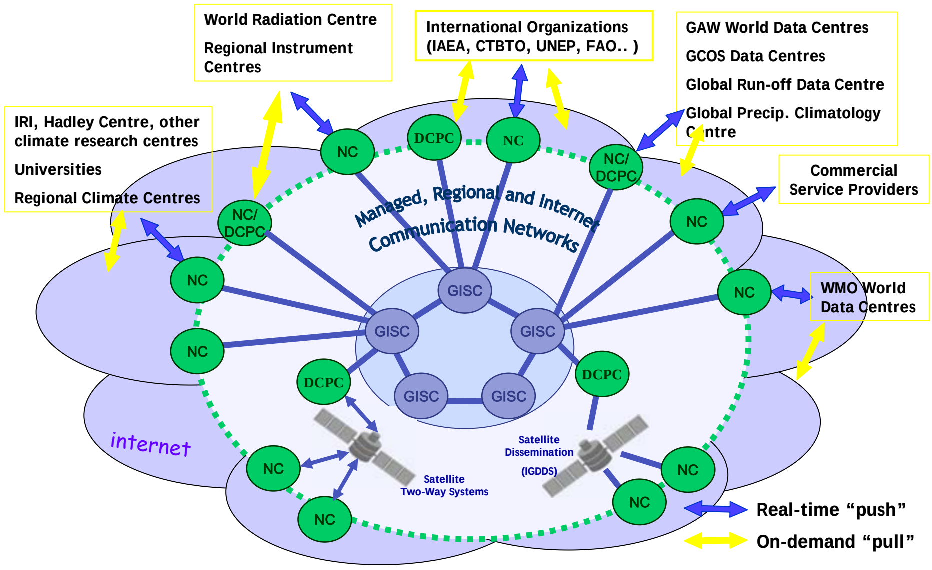


Figure 5 : Functional structure and user community of WIS

The main functional components of WIS are: **NC** National Centres, **DCPC** Data Collection or Product Centres, **GISC** Global Information System Centres and the data communication networks connecting the components. These are the functional components and not the foreseen organizational entities.

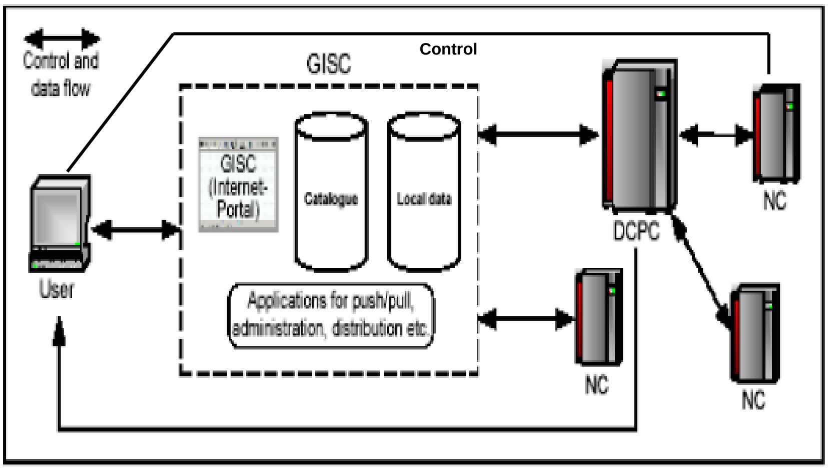


Figure 6 : Structure of WIS

The roles of the various WIS components are summarized below:

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 responsaible GISC or DCPC.

If so decided by the national policy, more than one NC can exist in a country. The NC operated by the National Meteorological and Hydrological Services (NMHS) would coordinate and authenticate access of the other NC centers.

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 node centres called GISC. There will be less than 10 in total, they collect and distribute the information for routine global dissemination, and in addition they serve as collection and distribution centres in their areas of responsibility and provide entry points for any request for data held within WIS.
Similar to DCPCs, they maintain metadata catalogues of all information available within WIS and provide a portal for data searches.

Data communication networks

The WIS data communication structure 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 as follows:

- **Core network**

  A core network is literally the core of WIS data communication structure and closely links a small number of GISCs together.
  Indispensable requirements of the core network are predictability and stability in available throughput (bandwidth and network delay time), reliability for continuous operation on 24x7 basis without interruption data integrity and security against malicious attacks such as intrusion, denial of service, tampering, spoofing and snooping. To meet the requirements, not the Internet but closed network services on SLA (Service Level Agreement) should be used. The Improved GTS/MTN currently consists of two closed network clouds by SLA based services and it should evolve into the core network in common understanding.
- **Trunk and Branch links**
  - A trunk link is a joint segment between a GISC and a DCPC.
  - A branch link is a leaf node segment between a GISC/DCPC and an NC/user.

  Some options of telecom means should be prepared for trunk and branch links to adapt to various data exchange requirements and different conditions of local infrastructure. Available options are a GTS circuit, other terrestrial dedicated circuit, the Internet (VPN and non-VPN), a satellite based telecom circuit (1-way and 2-way VSAT) and so on.

Most of NCs are likely to implement plural telecom means as a branch link with a GISC/DCPC, for example, the GTS dedicated circuit for time-critical operational data, the Internet VPN link for near real-time products and the Internet access to a portal for ad hoc request/reply.

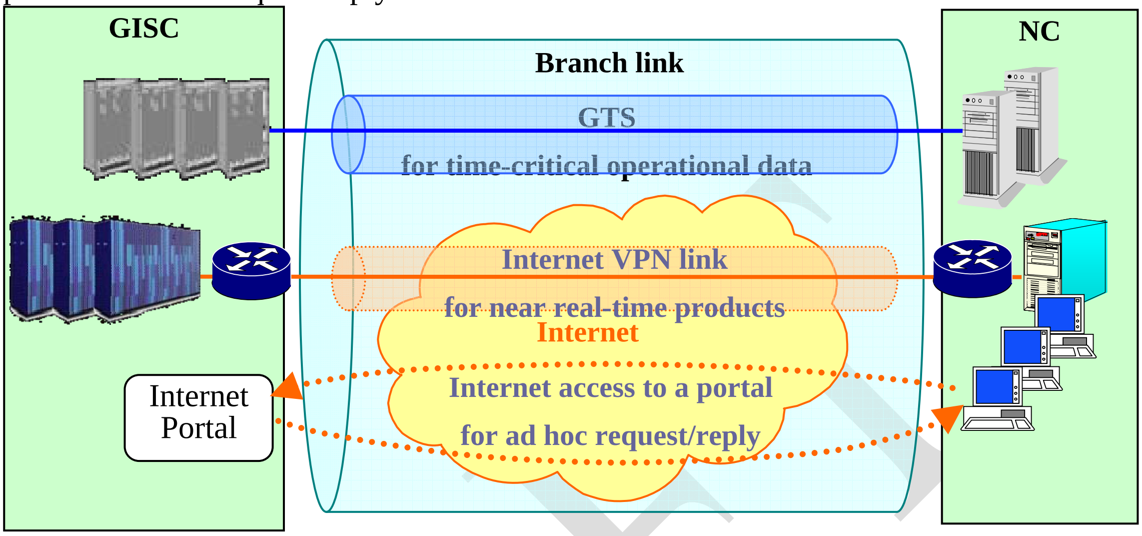


Figure 7 : Example of a branch link by plural telecom means

Since a lot of branch links will be connected with a GISC/DCPC, it is essential for a GISC/DCPC to seek cost-effective options to minimize their recurrent costs as well as an NC. Reasonable link options are definitely designed on the Internet basis. Although most promising option is an Internet VPN link, complement options such as HTTPS Web data ingest, FTP ingest and e-mail data collection/distribution should be prepared as a GISC/DCPC function.

- **Multicast/broadcast**

Multicast/broadcast is a direct dissemination element from a GISC/DCPC to wide-spread NCs/users.
Multicast/broadcast element should be carefully designed from the stand point of recipients, keeping balance of costs, availability and utility. Large volume of data set required routinely with common interests of NCs and authorized users should be distributed efficiently on multicast manners. Two possible options of multicast are Satellite-based communication systems and Internet-based distribution mechanisms.
The standard DVB-S multicast technology allows use of off-the-shelf inexpensive V-SAT equipment. EUMETcast, which is one of successful examples, is already in operation by using commercial telecommunication satellites. It covers Europe in Ku-band and Europe, Africa and Middle-East in C-band.
A typical example of the Internet-based distribution mechanisms is Unidata IDD (Internet Data Distribution) for dissemination of earth observations from multiple data sources to the Unidata community (mainly universities in US) through the Internet on near real-time basis. The IDD Cluster, routinely relays data to about 300 downstream connections at an average rate of approximately **170 Mbps** (~1.8 TB/day), with peak rates routinely exceeding 290 Mbps (~3 TB/day). Lately

NCAR, UPC (Unidata Program Center) and ECMWF have tested the IDD Local Data Manager (LDM) software for data collection activities in the THORPEX Interactive Grand Global Ensemble (TIGGE). During the testing, the LDM was demonstrated to be able to relay over **17 GB/hour** in a single datastream from ECMWF to NCAR.
Technically Internet-based distribution schemes like the IDD are extremely promising. Early coordination with appropriate community bodies is required.

2.4.3 Fundamental components supporting WIS services

Figure 8 and Figure 9 shows an outline of relation between WIS services and fundamental components. It should be considered how to cover the following parts of services:

- Data access, on request, allowing data discovery and delivery to authorized users;
- Routine collection and dissemination services for NCs and DCPCs operated by non-WMO Members
- Timely delivery services for NCs and DCPCs operated by non-WMO Members
- Timely delivery services for individual users (persons and institutions)

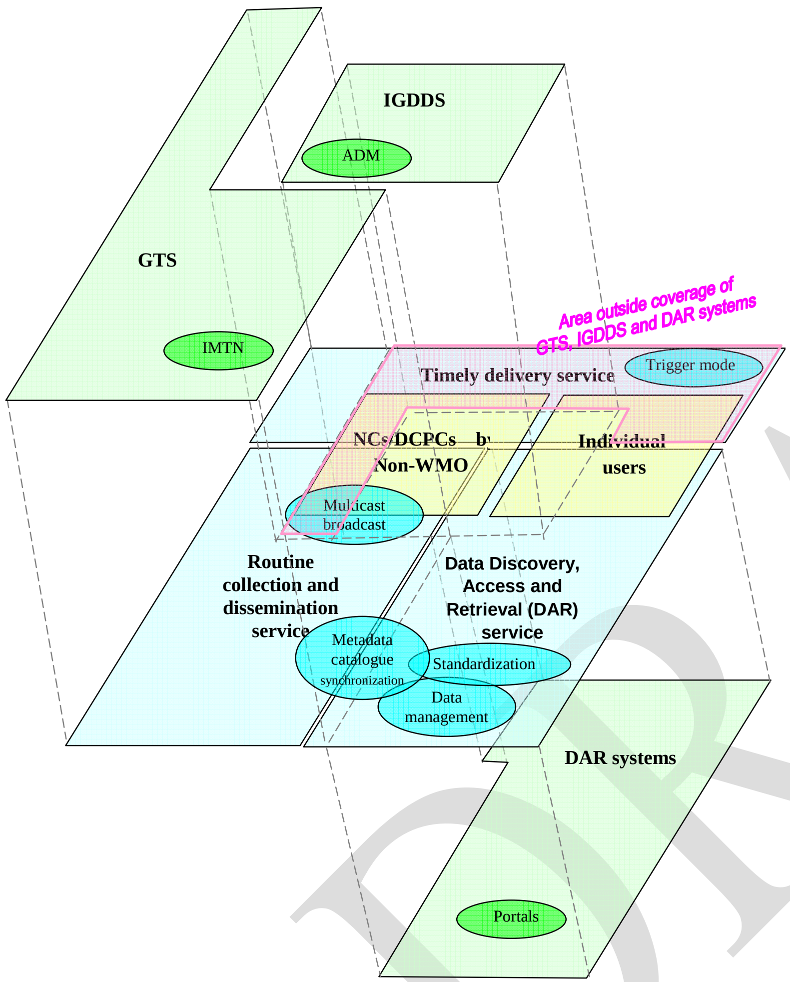


Figure 8 : WIS services and fundamental components

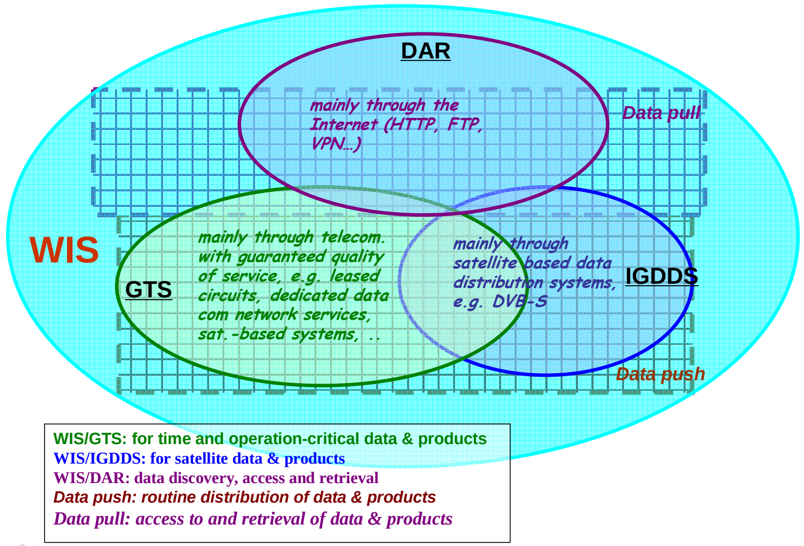


Figure 9 : WIS data communication implementation

GTS

The GTS, including satellite-based data-distribution systems and the Improved MTN, would effectively contribute to the WIS implementation as the core communication component for exchange and delivery of time and operation-critical data and products.

WIS and the and Integrated Global Data Dissemination System (IGDDS)

The IGDDS, as a system, is the circulation scheme of space-based observation data and products for WMO programmes. The Advanced Dissemination Method (ADM) within the IGDDS is dissemination services other than through direct broadcast for satellite sensor data and products. The ADM system includes the use of data relay between satellite systems, the use of commercially provided higher data rate services, and the use of services such as the Internet. The IGDDS addresses different functions, as required for a consistent approach:

- Data acquisition (raw data from satellites, higher-level products, inter-regional data exchange);
- Data dissemination (via telecom satellite broadcast, via Direct Broadcast, or, via point-to-point networks);
- Data access, on request, allowing data discovery and delivery to authorized users;
- Data and user management including user requirements review, interoperable catalogue, ensuring service quality and user support.

It is expected that the IGDDS would be for not only WMO Members but also non-WMO Members.

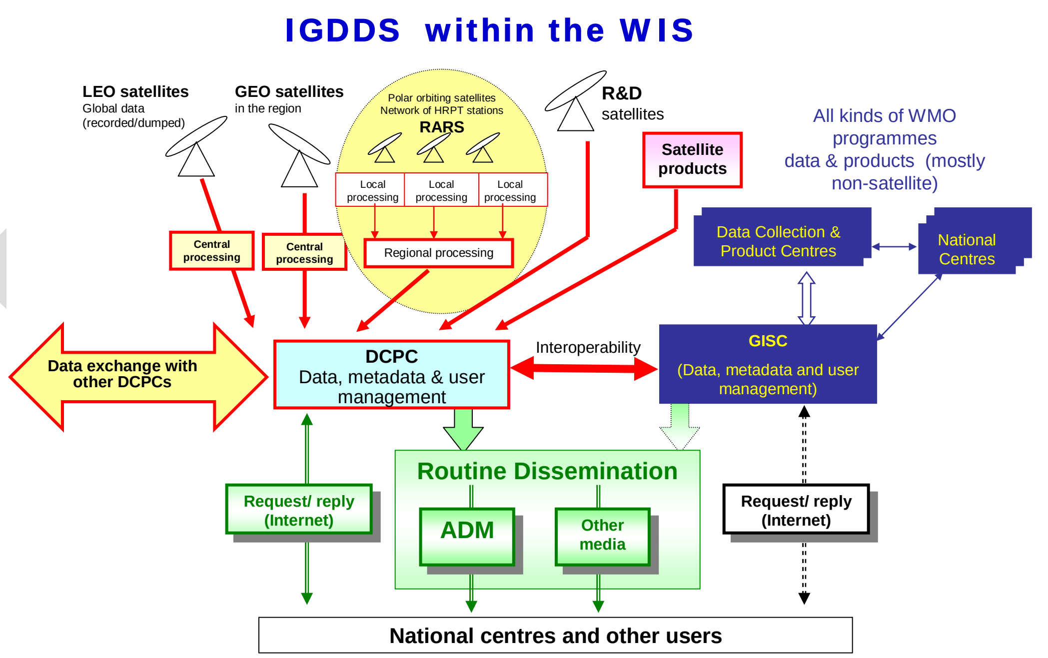


Figure 10 : IGDDS within WIS in each region

Data Discovery, Access and Retrieval (DAR)

Some prototypes and pilot projects will evolve into sophisticated WIS data Discovery, Access and Retrieval (DAR) systems which consist of Internet portals and diverse data sources with standardized metadata catalogues and collaborative data management.

2.4.4 WIS Implementation

A series of pilot projects under the auspices of several WMO technical commissions, have been implemented by several volunteering WMO Member countries. Several WIS functions, including the core services to be provided by WIS centres, are being tested and evaluated in the course of 2006. By the end of 2007 it should be possible to achieve, in a few countries, a smooth transition from the current GTS-based systems to the new WIS structures running in a semi-operational or even operational mode. The targeted functions include:

- Reference implementation WMO Core Profile version of metadata;
- Integration of metadata structures into pilot GISCs and DCPCs;
- Internet portal;
- Basic data acquisition using metadata;
- Data discovery service;
- Agreement on specification of data access rights;
- Data distribution service: push and pull services;
- Exchange of monitoring information in agreed format.

2.5 EUMETCast

Eumetcast is primarily used for the distribution of image data and derived products from **EUMETSAT's own satellites**. In addition, EUMETCast provides access to data and services provided by several external data providers.
To gain access to these services, potential users are required to operate a **EUMETCast reception station**:

- A typical EUMETCast reception station comprises of a standard PC with DVB card inserted and a satellite off-set antenna fitted with a digital universal V/H LNB for Ku-band, or fitted with a circular polarisation feedhorn, bandpass filter and special LNB for C-band. To decode and decrypt the DVB signal, EUMETCast Client Software and in some instances, EUMETCast Key Unit (EKU) are also required.
- The cost of EUMETCast reception station is kept to a minimum by utilising industry open standards to the maximum extent possible thus resulting in an adaptable front-end solution to users' applications.

Within the current EUMETCast configuration, the multicast system is based upon a client/server system with the server side implemented at the EUMETCast uplink site and the client side installed on the individual EUMETCast reception stations.

Files are transferred via a dedicated communications line from EUMETSAT to the uplink facility. These files are encoded and transmitted to a geostationary communications satellite for broadcast to user receiving stations. Each receiving station decodes the signal and recreates the data/products according to a defined directory and file name structure.
A single reception station can receive any combination of the services provided on EUMETCast. Data, for which access is restricted in accordance with EUMETSAT Data Policy, is made secure by the USB decryption scheme.

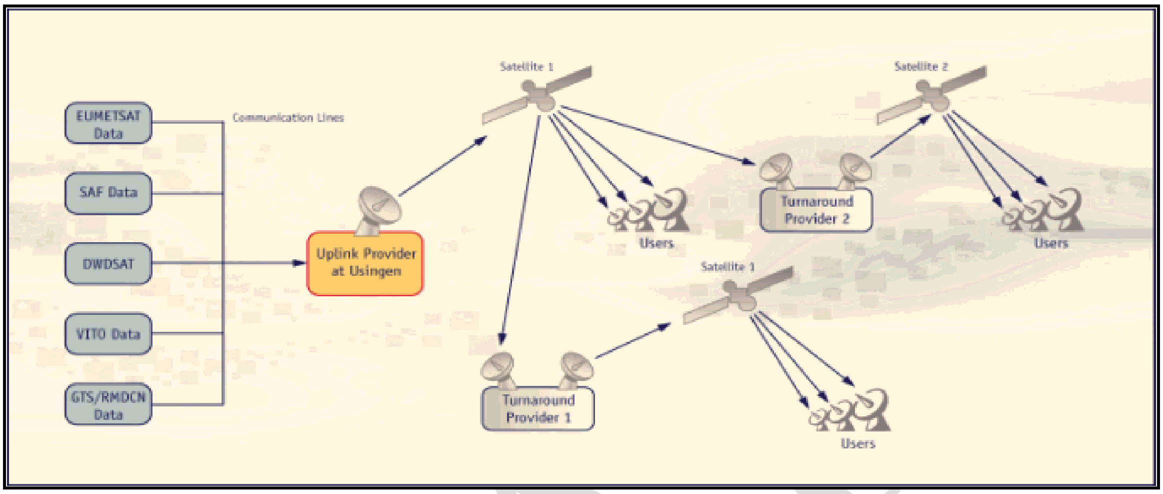


Figure 11: Current EUMETCast System Overview

The current coverage of EUMETCast dissemination is shown in the Figure bellow.

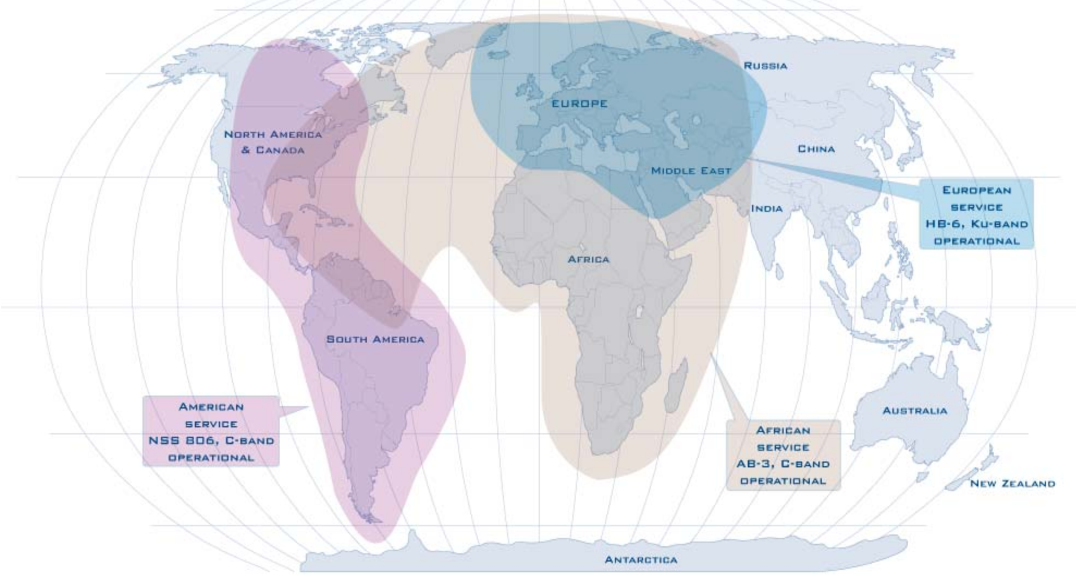


Figure 12: Current EUMETCast Coverage

The following list gives a quick overview of EUMETCast existing capacity through operational services.

EUMETCAST Services

Service	Format	Originator/Satellite	EUMETCast band	Licensed/Essential/Restricted
High Rate SEVIRI	HRIT (PDF, 1661 KB)	Second Generation - Meteosat-8 onwards	Ku-band Europe & C-band Africa, C-band Americas	Licensed for 15-min, 30-min, 1-hrly, & 3-hrly. Essential for 6-hourly.
Low Rate SEVIRI	LRIT (PDF, 1661 KB)	Second Generation - Meteosat-8 onwards	Ku-band Europe & C-band Africa	Licensed for 30-min, 1-hrly, & 3-hrly. Essential for 6 hourly.
High Resolution Image (Indian Ocean Data Coverage)	OpenMTP (PDF, 180 KB)	First Generation - Meteosat-5,-7	Ku-band Europe & C-band Africa	Licensed for 30-min, 1-hrly, & 3-hrly. Essential for 6 hourly.
Rapid Scanning	OpenMTP (PDF, 180 KB)	Meteosat-6	Ku-band Europe only	Licensed
Meteorological Products	GRIB-2 / BUFR	Meteosat Second Generation - Meteosat-8 onwards	Ku-band Europe & C-band Africa	Essential
Satellite Application Facility (SAF) Products	Native[4]	Meteosat Second Generation - Meteosat-8 onwards	Ku-band Europe & C-band Africa	Essential
EUMETSAT Advanced Retransmission EARS-ATOVS	AAPP / BUFR	NOAA satellites	Ku-band Europe only	Essential
Basic Meteorological Data[3]	Native	WMO	Ku-band Europe only	Restricted
Meteorological Data Dissemination[3]	Native	WMO	Ku-band Europe & C-band Africa	Restricted
Data Collection Service	Native	Authorised DCP operators	Ku-band & C-band	Restricted[5]
Other geostationary satellite data	Native	GOES -E/W & MT-SAT	Ku-band Europe & C-band Africa	Essential
DWDSAT[1]	Native	DWD	Ku-band Europe only	Licensed
VEGETATION[2]	HDF	VITO	Ku-band Europe & C-band Africa	Restricted
Service Messages	Textual format (.txt) and XRIT (PDF, 1661 KB)	EUMETSAT	Ku-band Europe & C-band Africa	Essential

[1] The content of this service is subject to change by Deutscher Wetterdienst (DWD), terms and conditions of access apply.
[2] The content of this service is subject to change by the data provider VITO, terms and conditions of access apply.
[3] The content of this service is subject to change by the data provider the World Meteorological Organization (WMO), terms and conditions of access apply.
[4] Native represents a variety of formats used by the external data/content providers, including WMO formats
[5] DCP Retransmission service available to DCP operators and their partners only

Channel	Name Function	Data Rate (kbit/s)
TSL Announcement Channel	Announcement channel	300
EUMETSAT Data Channel 1	EARS & RSS data	512
EUMETSAT Data Channel 2	High Rate SEVIRI Image Data	1420
EUMETSAT Data Channel 3	Multi-service Channel[1]	338
DWDSAT	DWDSAT service	1536
BMD-RA-VI	BMD RA-VI Data	64
SAF-Europe	LSA SAF products	max 80
EUMETSAT Data Channel 5	MSG-2 High Rate SEVIRI commissioning	max 1420
EUMETSAT Data Channel 6	MSG-2 Low Rate SEVIRI & Meteorological Product commissioning	max 338
EPS-5	*MetOp GOME*	*4634*
EPS-10	*MetOp AVHRR*	*4489*
EPS-11	*MetOp IASI*	*3255*

[1]Multi-service channel services include:

- Low Rate SEVIRI Image Data
- High Resolution Image (HRI) data
- Indian Ocean Data Coverage (IODC)
- Data Collection and Retransmission (of DCP data)
- Meteorological Data Dissemination (MDD)
- Meteorological Products (including Satellite Application Facility products)
- EUMETSAT ATOVS Retransmission Service (EARS)
- NOAA and JMA geostationary satellite data
- Vegetation data

[2]Multi-service EUMETCast services include:

- EUMETSAT Meteorological Products (CLM, GII, AMV, CLA)
- GOES image data

2.6 GEONETCast

The conceptual idea of a global GEONETCast implementation is that several regional centres take on the responsibilities for establishing a satellite based regional dissemination system - based on the EUMETCast general framework and provide the same services to the common user community. The concept of interconnected regional GEONETCast Network Centres (GNC) would allow such an implementation.

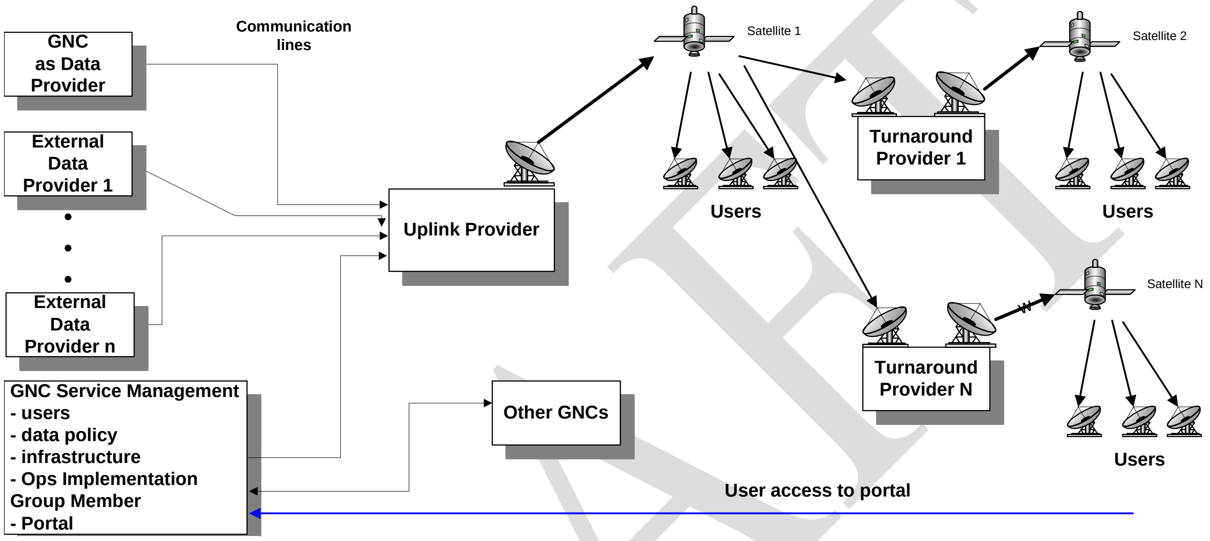


Figure 13: GEONETCast Regional Network Centre - GNC

Each GNC would comprise the same components as shown in figure above and in addition cooperates with the partner GNCs over communication links.

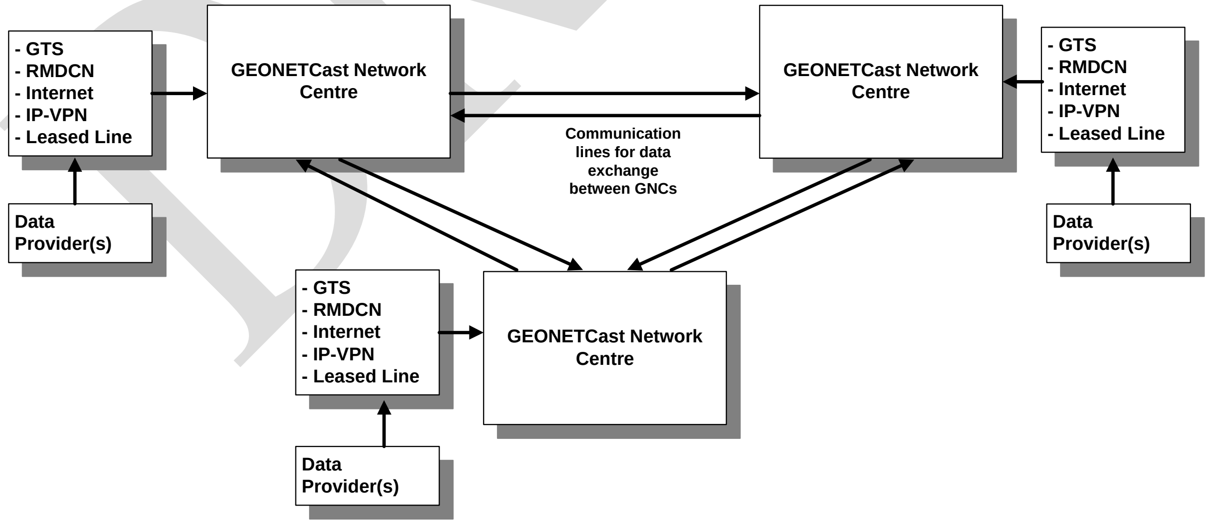


Figure 14: High level design of GEONETCast implementation via interconnected GNC

Each GNC has the same functionality, services and obligations and is based on the same technical framework. The GNC caters for the needs of the users in its regional responsibility and exchanges those with the other centres to reach a global visibility. All GNC are for the purpose of GEONETCast management and administration loosely coupled in an Operations Implementation Group. The GNC-Operations Implementation Group with its distributed infrastructure, responsibilities and services will allow the end user a single point of entry. A pre-requisite for a GNC-Operations Implementation Group is the definition of a governance framework which defines the trust relationships and responsibilities between the GNCs.
All GNC would share a common distributed portal to allow a consistent way of data discovery, presentation of services and user management (registration, help etc.).
The data acquisition part would be conceptually the same for all GNC. For EUMETSAT GNC this is a combination of own infrastructure e.g. observing satellite, Internet, private networks, IP-VPN, RMDCN and GTS. The concept allows full conformity with the ideas of interoperable data exchange in the context of **IGDDS**.
One of the essential parts of the global GEONETCast design is the architecture of the interoperability of the GNCs, in particular the data exchange for global and local dissemination and the administrational data such as user and data policy information and the Meta data description of the products to be disseminated.
The overall purpose of the GNC dissemination exchange is to achieve the actual dissemination of data for a global audience and for regional audience at the same time. This is a core element in the overall GEONETCast design allowing the essential GNC interoperability.
Two potential options have been identified:

- Multicast: Stand-alone GNC systems are exchanging all data via multicast listen-in (Turn-around-daisy-chaining). This concept is based on the assumption that all data which is included into the global GEONETCast service is made available for dissemination to each GNC by the usage of overlapping footprints in a turn-around daisy chain. This system assumes the availability of all hops at all times. If one hop should be unavailable the entire chain is broken. In order to avoid this SPF a second loop would be needed on which data flows into the other direction. This is considered very costly. Furthermore this system assumes the availability of convenient overlapping footprints. Such convenient footprints would have a beam into the area where the partner GNC uplink station is to avoid addition terrestrial forwarding costs. Such a system would only cater for the mission dissemination data but not for the exchange of administrational data such as the web portal related traffic for which still a traditional network would be needed.

- Private Network: N-N Inter-connected GNC systems. The concept is based on the assumption that each GNC is connected in a bi-directional setup to each other GNC. For the current version of GEONETCast this would involve around 3-4 centres. The very first implementation however is currently only EUMETSAT and NOAA (which already have those high bandwidth networks between each other). This private network would cater for the exchange of all data for global dissemination, the user data and any other administrational data including the exchange of product describing Meta data for the distributed GEONETCast portal.

Conclusion:

- Depending upon the footprint coverage and existing network and dissemination infrastructure both options can be considered as complementary to each other and could exist in parallel.
- The implementation effort of a N-N network is clearly smaller, easier to upgrade and requires no special pre-requisites
- Bi-directional traffic is an advantage for the N-N network because it reduces a single point of failure in case one GNC is not available and caters for the dissemination of (ad-hoc) user data as well as the routine dissemination contents

Both solutions are valid options and they comprise complementary implementation solutions.

2.6.1 Distributed GEONETCast portal

Each User accesses in the first instance a central GEONETCast portal (one stop shop).
Based on the input of the geographical information the user is then re-directed to the regional responsible GNC which hosts the regional implementation of the portal.
There the user can access services for:

- Data discovery (searchable) on global and regional products and services. The data and service discovery is an essential service to the user which will allow access to information on all disseminated products, type, contents, format and usage descriptions of each product and service in conjunction with small static sample data sets.All data types which are disseminated on GEONETCast (regional and global) should be described with standardised Meta data information. The current standards are the WMO Core Meta Data Standard and ISO 9011. The WMO standard is currently implementing the related ISO standard. This will allow the unified description of all data to be disseminated be it of meteorological, oceanographic or other environmental nature. Each data provider is responsible for the provision of the Meta data description of its own data.The Meta data repository will be replicated and synchronized across all GNC. This distributed option allows better scalability, redundancy and an overall better service to the user.
- 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

2.6.2 User Management

Each regional GNC maintains their local user services and keeps records of the related user information. The exchange of user information is not directly necessary unless a data policy shall be applied to a user such as data denial. It is recommended to keep the amount of exchanged user information to a minimum limited to the users in a geographical location with overlapping footprints or the ones to which a data policy shall be applied on instruction of the responsible data provider or regional GNC.
The local user services contain as a minimum:

- A call-desk
- Information knowledge base on GEONETCast (HW, SW, configuration etc.)
- User registration services
- Provision of access to related technical documentation

- Provision of a problem call handling system

2.6.3 GEONETCast services

GEONETCast will include new Datastreams addressing other applications/User communities.
For the moment, it consists of a merged stream of NOAA/US and EUMETSAT/Europe sourced data and products;
Following table show an example of datastreams

Datastream/product	Coverage	Freq/day
Met-8 SEVIRI	Full Disc	96
GOES-E IR,Vis,WV	Full Disc	8
GOES-W IR,Vis,WV	Full Disc	8
Met-8 meteorological products CRM,AMV,GII,CLA	Full Disc	96,24,24,8
MODIS chlorophyll alpha	Global	1
LandSAF SA,LST,DSSF,DSLF, SC,FVC,LAI	South America	1,96,96,48, 1,1,1
LandSAF SA,LST,DSSF,DSLF, SC,FVC,LAI	Northern Africa, Southern Africa	1,96,96,48, 1,1,1
VITO/Vegetation	Africa	10 day
VITO/Vegetation	South America	10 day

2.7 WIS and GEO-Netcast

The GEO-Netcast multicast capability allows different data sets to be handled in parallel regardless of the source. The use of a key access capability enables to respect the data policy of each data provider and to target the distribution at individuals or groups of users as appropriate, within the footprint of each satellite.
GEO-NETCast will have certain components in common with WIS:

- IGDDS/EUMETCAST is a contribution to GEO-NETCast & WIS
- use of common data management standards

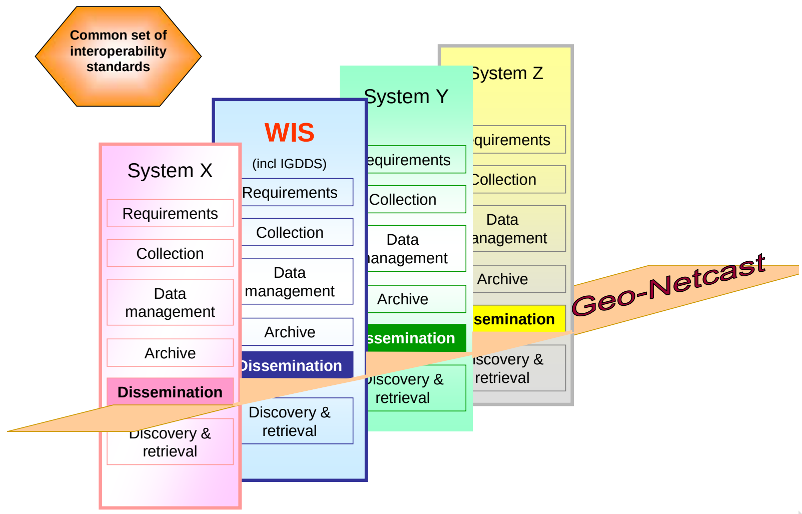


Figure 15 : GEO-Information Systems within GEOSS

Users would benefit from a single access to data from all providers through unique interface

To be continued

2.8 GEANT/HiSEEN

The GÉANT network is a multi-gigabit pan-European data communications network, reserved specifically for research and education use.
GÉANT2 is the seventh generation of the network, successor to GÉANT and officially began on 1 September 2004. The two projects ran side-by-side until June 2005.

The GEANT2 network will connect 34 countries through 30 national research and education networks (NRENs).The topology will have a total of 44 routes, using a mixture of dark fibre and leased circuits.

Network design for GÉANT2 is focused on maximising operational and service flexibility. Handling the evolution of traffic patterns will be crucial to the success of the network.

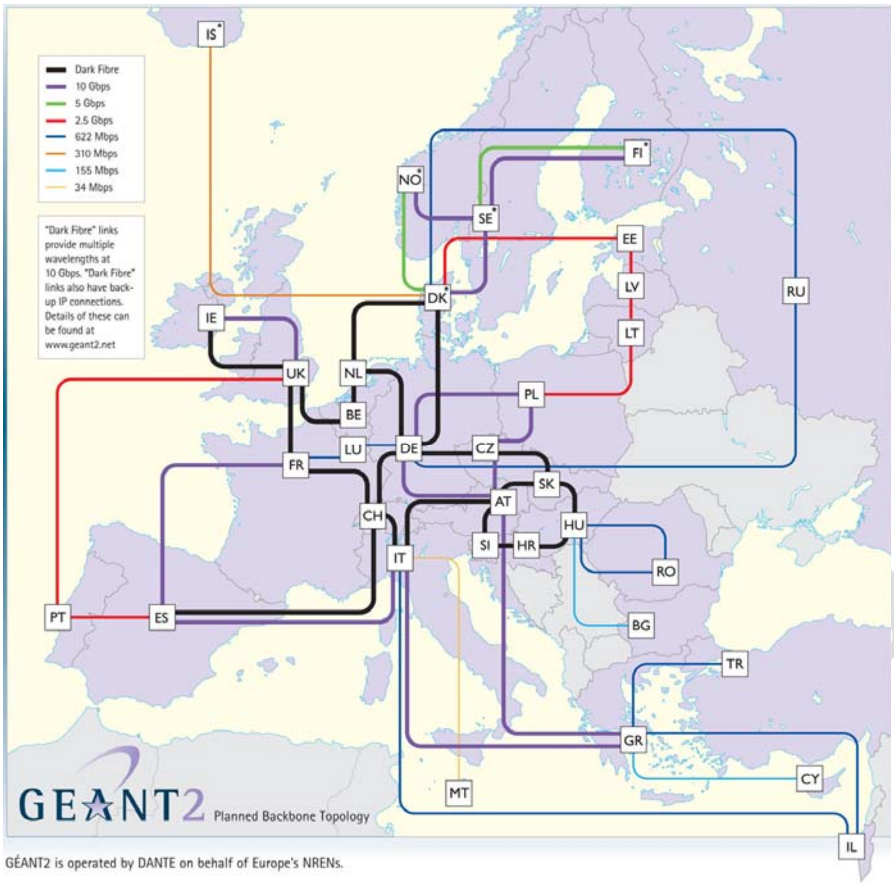


Figure 16: GEANT2 planned backbone topology

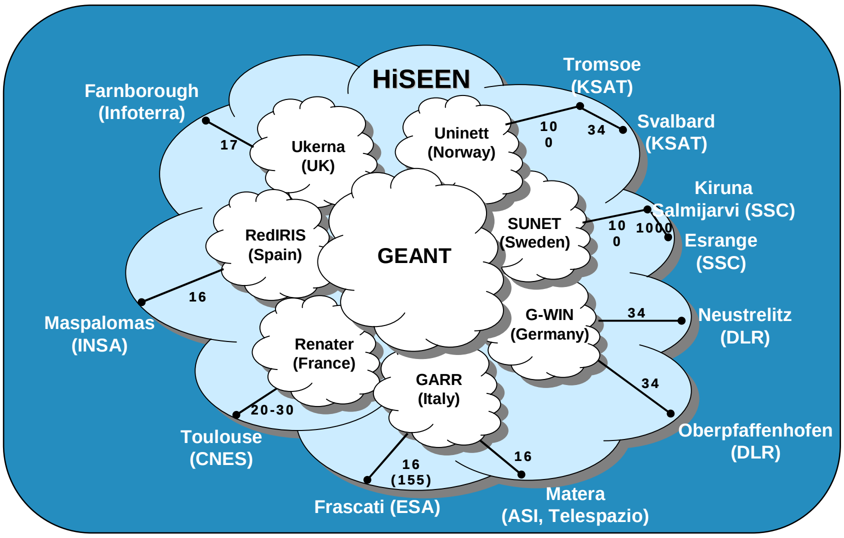
Until the GÉANT2 network comes into operation, service will continue to be provided to Europe's NRENs over the existing GÉANT network.

The European Space Agency distribute Earth Observation data around the world using GÉANT2 (and several of Europe’s NRENs)

The High-speed network infrastructure (HiSEEN) Based on the GEANT/NREN connects at high-speed the ESA operational centres and users for large data volume transfer and is fully deployed since September 2005. During the reporting period, the network has provided a very good performance, with an availability of the whole network with 34 Mbps links higher than 99 % of the time.

It is now being operationally used for all Internet on-line data distribution services via Internet and for the operational replacement of the media circulation between the centres of the ground segment for improving performances and near real time data access.

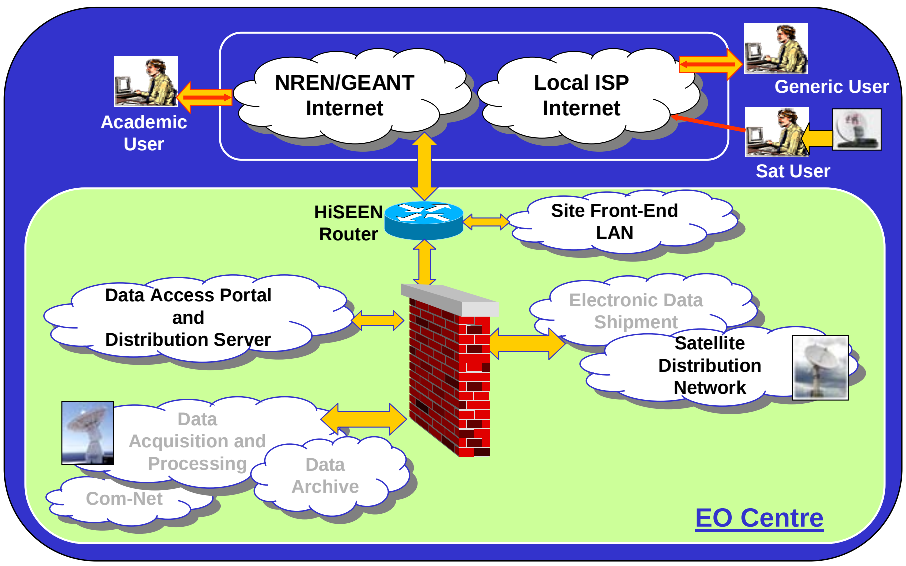
To be continued



Based on the GEANT/NREN

Country	Site	NREN	Bandwidth [Mbps]
Italy	Frascati	GARR	8 (16)
	Matera		16 (24)
Sweden	Kiruna Salmijarvi	SUNET	34
	Kiruna Esrange		34
Germany	Oberpfaffenhofen	DFN	34
	Neustrelitz		34
UK	Farnborough	UKERNA	17
Norway	Svalbard	UNINETT	34
	Tromsoe		34
Spain	Maspalomas	RedIRIS	16
France	Toulouse	Renater	16

HiSEEN User Scenario



3 Comparative Assessment

	WIS/GTS	EUMETCast/GEONetcast	GEANT
Political(Ease of access for European institutions?)	WIS and GTS are WMO programmes, and all European countries are WMO Members Hence, the access to GTS is restricted and governed by WMO rules. One needs authorization from one of the National Weather Services to access the data, or to inject it onto the system. Data format is somewhat rigid and not practical for specific data extraction. Data accuracy is limited to two decimal point. There is no quality control on the data, although data providers are supposed to inject only QC 'ed data.	Very easy to access Eumetcast is primarily used for the distribution of image data and derived products from **EUMETSAT's own satellites**. In addition, EUMETCast provides access to data and services provided by several external data providers.	Reserved specifically for research and education use enabling them to share and distribute research data faster than ever before.
Global reach?	All the 187 WMO Members participate in GTS, and in WIS eventually. The GTS has a worldwide coverage The regional and global connectivity of the WIS structure is guaranteed by the existence of a small number of node centres called GISC. There will be less than 10 in total, they collect and distribute the information for routine global dissemination, and in addition they serve as collection and distribution centres in their areas of responsibility and provide entry points for any request for data held within WIS. Similar to DCPCs, they maintain metadata catalogues of all information available within WIS and provide a portal for data searches.	Nearly global reach In the context of the 10-year strategic plan for the Global Earth Observation System of Systems (**GEOSS**), GEONetcast" is a major initiative to develop a worldwide, operational, end-to-end Earth observation data collection and dissemination system, using existing commercial telecommunications infrastructure. The conceptual idea of a global GEONETCast implementation is that several regional centres take on the responsibilities for establishing a satellite based regional dissemination system - based on the EUMETCast general framework (Figure 1) – and provide the same services to the common user community. The concept of interconnected regional GEONETCast Network Centres (GNC) would allow such an implementation.	Limited to Europe
Low cost?	GTS is actually implemented and operated by WMO Members (NMSs), using the most cost-effective means	Yes	
Easy implementation of data policies?	WMO data policy: free exchange, conditions on some data for re-imported services	Yes, and this is up to the GNC-Operations Implementation Group for GEONetcast Decision	
Flexibility to serve new customers?	The current GTS interconnects National Meteorological Services right now. GTS later replaced by FWIS when available for In-Situ, EO & Meteo data Geoland products to	yes	

	WIS/GTS	EUMETCast/GEONetcast	GEANT
	GEMS (ECMWF) GEMS products to MERSEA, Geoland MERSEA products to GEMS (TBC)		
Technical (Capacity/throughput?)	GTS: Limited (64Kb/s to 1M)but dedicated to operational exchange WIS: complementary use of Internet and other nets	High capacity is available, up to 2.5Mbps	34 Mbps up to 16 Gbps 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.)· (TBC) Geoland RT products to GEMS (ECMWF)
Reliability?	GTS:High reliability WIS: high reliability of WIS centres; access dependant upon Internet,…	Very reliable	
Adaptability to new requirements /upgradability?	Upgradability of GTS through WIS	Upgradability of EUMETCast through GEONETCast. Use of GNC, Regional Network Centers	
Accepted technical standards, globally and within Europe?	WMO standards and international ICT standards (TCP/IP, FTP …) Reference implementation WMO Core Profile version of metadata	Fully supports use of standards	
Efficiency(Efficiency for HALO/GMES data flows)	Through internet upgrade, the maximum rate will be upgraded.	Highly efficient	
Efficiency for core product exchange?	Baseline usage for Meteo, Marine, ocean Data	Good for core product transmission	
Efficiency for satellite data acquisition?	Already used for Meteo, Marine, ocean Data	Good for sat data acquisition	
Efficiency for in-situ data acquisition?	Already used for Marine, ocean	Good for in-situ transmission	
Other characteristics (Scalability)	High	High	Limited to Europe
Is the service suitable for operational use?	GTS: dedicated for operational-critical exchange; WIS: meets other requirements	yes	
Can satellite broadcast be extended with terrestrial networks?	GTS and WIS uses terrestrial and satellite-based nets	The satellite broadcast can be extended with terrestrial networks. But it makes more sense to regard the satellite broadcast as an extension of the terrestrial networks	
Does the service provide dissemination only?	no	yes	
Does the service manage data exchange, user access..?	GTS: NMSs only WIS: yes, with metadata catalogues, portals, discovery, access and retrieval services	GEONETCast manages user access to the data in accordance with the data providers wishes.	
Maximal data rate?	GTS: see above WIS	The GEONETCast transponder has a maximal data rate of 40 Mbit/s. 30-35 Mbit/s are achieved in real	

	WIS/GTS	EUMETCast/GEONetcast	GEANT
		operations. Hiring additional transponders is possible but expensive.	
Does the service ensure secure access to data..?	GTS: yes WIS: yes depending on user/data	yes	
What are the commitments on delivery time?	GTS: few minutes wolrdwide	GEONETCast guaranties the timeliness of the data transfer. Delivery of the highest priority products, Meteosat satellite observations, is guarantied within 5 minutes after the observation.	
Is the data transfer to the uplink station an issue?	GTS actually contains DVB-S for inter-continental exchange when required, for instance for linking Europe and Africa.	Not so far The GTS is normally used for the data transfer to the uplink station. This solution is stable.	
Suitability for a small number of core services?	Dedicated to core services for meteorology and oceanography (JCOMM from OMM and IOC), for example ARGOS. GEOLAND not in OMM Water Weather Climate.	Yes The question whether a broadcast service is suitable for the communication between a small number of core service centres is just a question of the financial trade-off between this service and others.	
What are the access restrictions?	GTS; NMSs WIS: authentication via NMS	EUMETSAT approval	
What are restrictions on data representation (format)?	WMO data representation forms, also including NDCF, etc	None – any file format can be used	

4 Recommendations

4.1 Introduction

HALO includes operational or non operational fluxes
Most representatives and dimensioning operational HALO fluxes are listed in Annex 1 and can be confronted with limit rate of existing network solution.
There the user can access services for:

- 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

We shall distinguish Common data needs and Direct product exchanges between IPs

- **Common data needs**: satellite, in-situ
  Data can be regularly transferred through core stream services or transferred through on-demand services

  Although Systems use often the same instruments, the approach of the IPs towards satellite data processing differs.

  For instance, a common approach for the use of operational meteorological satellites of the MSG, MetOp, MTG, NPP and NPOESS series might be beneficial.
  All IPs use in situ data to validate the modelling and retrieval activities. The challenge of the in-situ data is their collection from a **large variety of data providers** with different operational commitment.
  (The HALO report on GEMS lists about 40 different sources for in-situ data used in GEMS.)

- **Direct product exchange** between IPs
  Coordinating envisaged direct product exchange between IPs has the highest priority within the HALO activities. Direct product exchange solutions should be scalable to enable creation of new multi-IP products/services in the future.
  A good example of the inter-dependencies of the IPs is their contribution to the carbon cycle as presented in the interacting part of GEMS, MERSEA and GEOLAND" report.

Depending on the Volume, HALO is compliant with GTS or not.
Depending on data type, HALO can interface directly with WIS or EUMETCAST.
Since WIS, as well as GTS, depends on the JCOMM host users for none WWC services (Water Weather Climate), Land Data might not be able to access to both GTS and WIS.
Hence, GEOLAND users have to interface directly with EUMETCast (right now or GEONETCast tomorrow) for Land Data core Services.
The following figure illustrates such a future functional architecture.

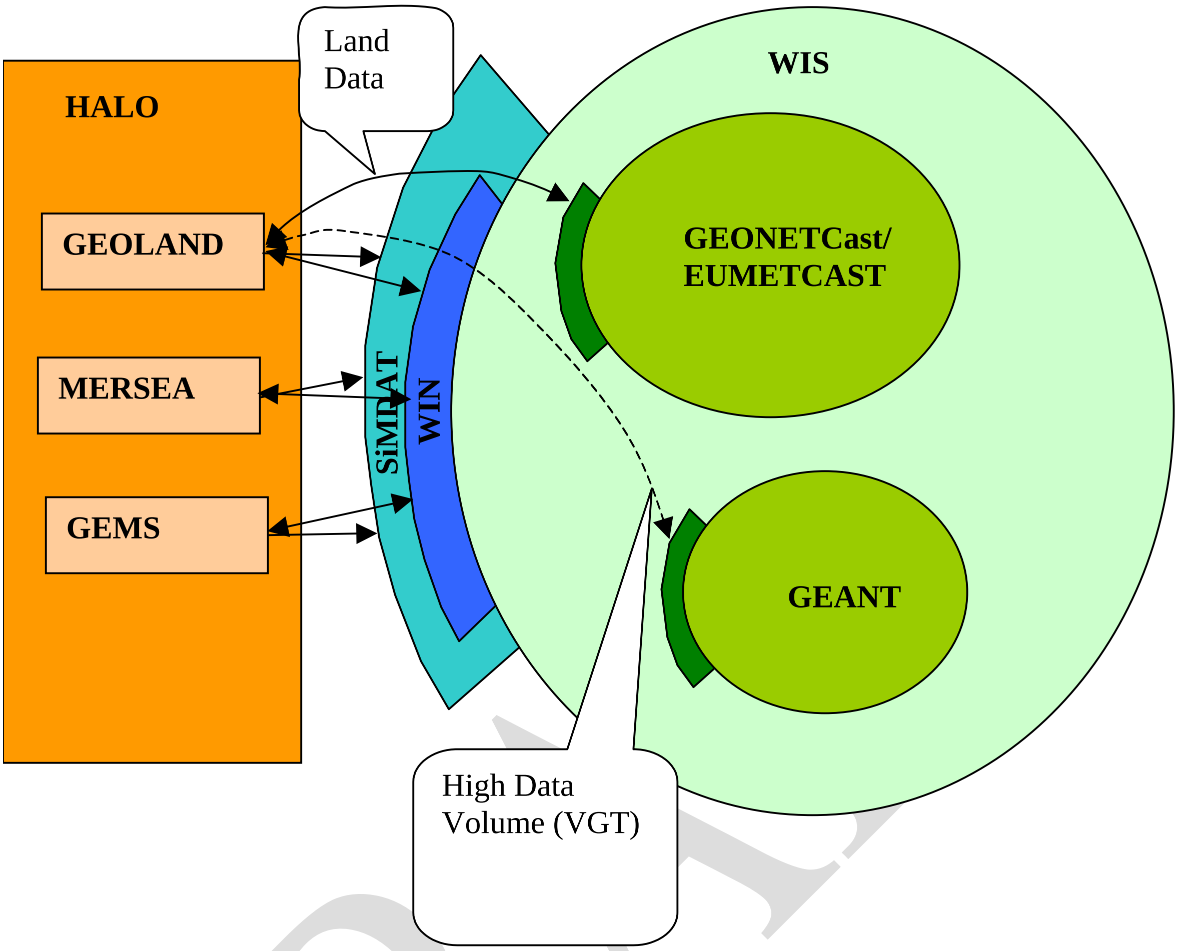


Figure 17: Interface between HALO, GEONETCast/WIS

4.2 Recommendations

HALO shall be considered in the context of EUMETCast and GTS today, then GEONETCast and WIS tomorrow.
Considering the scope of HALO, it is more suitable to imagine HALO for tomorrow.
However, this is quite complex to foreseen something like an infrastructure for tomorrow, considering all the unknown parameters for future deployments of GEONETCast and WIS.
So, in order to be coherent with the existing context for any recommendations on next possible existing HALO infrastructure, we shall absolutely consider, not only the relevant EC Projects, but also European and international relevant organizations.

HALO has to cope with European and international relevant organizations

We shall consider primarily:

The **JCOMM** which is the joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

The JCOMM is an intergovernmental body of experts, which provides the international, intergovernmental coordination, regulation and management mechanism for an *operational oceanographic and marine meteorological observing, data management and services system. JCOMM is supported by a joint Secretariat, in WMO by the Marine Meteorology and Oceanography Programme and in IOC through the Global Ocean Observing System (GOOS) Project Office and the International Oceanographic Data and Information Exchange (IODE) Secretariat. Marine Meteorology and Oceanography Programme is under the responsibility of the Ocean Affairs Division of the Applications Programme Department (APP) of WMO.*

The **OMM** which is the "Organisation Météorologique Mondiale" for Water Weather Climate.

The objective of OMM is to ease mundial cooperation for meteorology observing and related services, and to foster fast exchanges of meteorological information, normalisation of meteo observations and dissemination of data and statistics

Both JCOMM and OMM are of major importance for the development of future infrastructures, and HALO has to be cope with it.
Anyway, today, there are some known parameters concerning the topics of both systems WIS and GEONETCast.
Today, GTS is dedicated to core services for meteorology and oceanography (JCOMM from OMM and IOC), and is accessed for meteorologists.
Tomorrow WIS through VGISC will be accessed by OMM community and even more, for instance Land actors, **but** still **only data dedicated** to OMM activity will be ingested and disseminated through WIS, even if none OMM actors will be able to subscribe to WIS under the condition they use OMM data.
With such a topic, MERSEA and GEMS are fully compliant with WIS and WIS can host them. However GEOLAND is not at all in the scope of WIS, while using data not dedicated to OMM.
It is also not possible today, and it won't be possible tomorrow to consider a direct access to WIS for Land Data exchange and then for Land Data in GeoLand.
However, it will be possible through GEONetcast to provide dissemination of Data outside of WWC context.

HALO has to cope with European infrastructure projects

Many pilot projects are on-going about GMES infrastructure, data normalisation, like SIMDAT, WIN, SANY, SEADATANET.
Some examples of infrastructure projects are listed hereafter

4.3 Example of infrastructure Projects

4.3.1 Example of pilot project: SIMDAT Virtual GISC project

SIMDAT (EU-funded project IST) is a technique that facilitates the synchronized interconnection of several computer centres within a grid with a view to optimizing load sharing and data interoperability.
A **SIMDAT portal** will be installed on each site and gives users a single view of all the data available at the participating centres. This capability makes SIMDAT potent solution for WIS.
The objective of SIMDAT for the meteorology sector is to develop a virtual and consistent

view of all meteorological data distributed in the real-time and archived databases of the partners and to provide a secure, reliable and efficient mechanism to collect, exchange and share these distributed data, in order to support research and operational activities of the meteorological community.

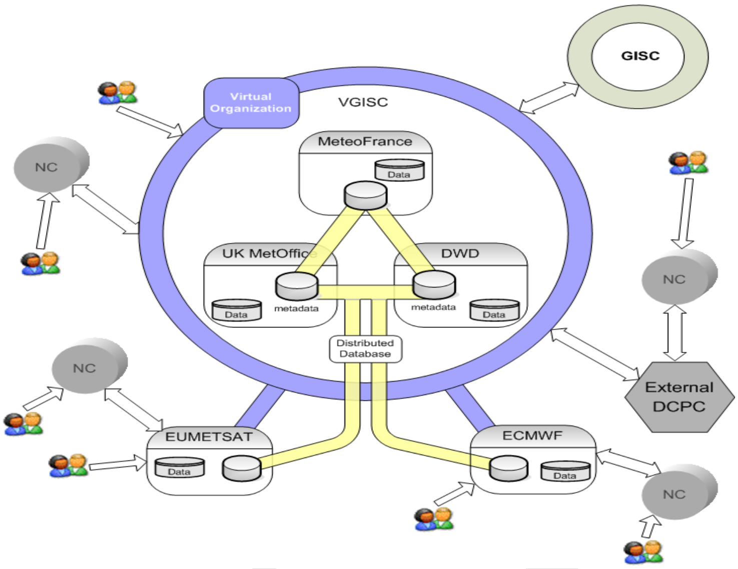


Figure 18 : VGISC Data Communication Infrastructure (2 DCPCs: ECMWF, EUMETSAT)

The V-GISC partners will form a cluster, with partners enjoying equal rights and supporting one another. By the use of SIMDAT software and techniques, as well as standards for metadata, data discovery, transport and on-line browsing, the V-GISC infrastructure will improve the load distribution and availability of the system and provide a uniform external interface to the users allowing them to easily locate, access and use the diverse distributed forms of data and their associated metadata.

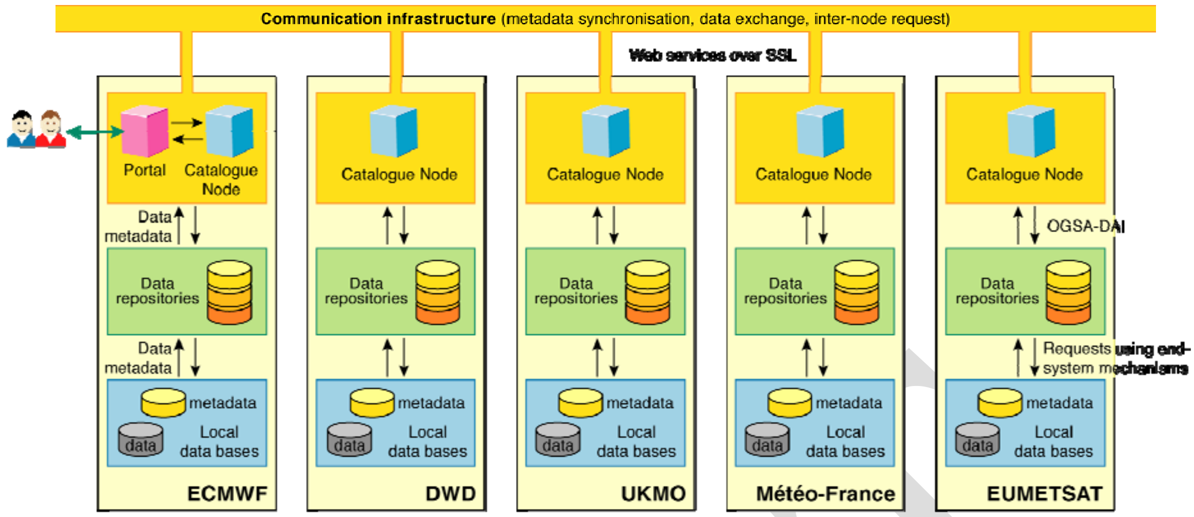


Figure 19 : VGISC Architecture

A Portal is **deployed on each site** and offers a unique view of all the datasets available
Portal offers discovery mechanisms to the users

- Full text, temporal and geographical search (google-like)
- Directory browsing (yahoo-like browsing)

Portal provides request handling mechanisms to the users

- Submitted requests can be asynchronous to manage long-lived requests
- A user can manage its requests (check status, delete them …)
- A user retrieve the associated data when the request is complete

Portal uses the information contained in the metadata to create the data sub-selection forms

- The metadata/data providers define how to access its datasets

4.3.2 Example of WIN project for in-situ data access

WIN system aims to be a backbone data infrastructure to interface Services & Products providers, Data providers, End users and other stakeholders for risk management purpose.
WIN system is composed of a set of generic functions or components which are implemented in a Common Integration Point (CIP) that can be instantiated for any community of users.
The following scheme shows the main exchanges between WIN system and communities of actors involved in the Risk Management.
The links between WIN and external entities as EOLI, SSE or VTMS show that WIN aims to co-operate with other stakeholder organisms.

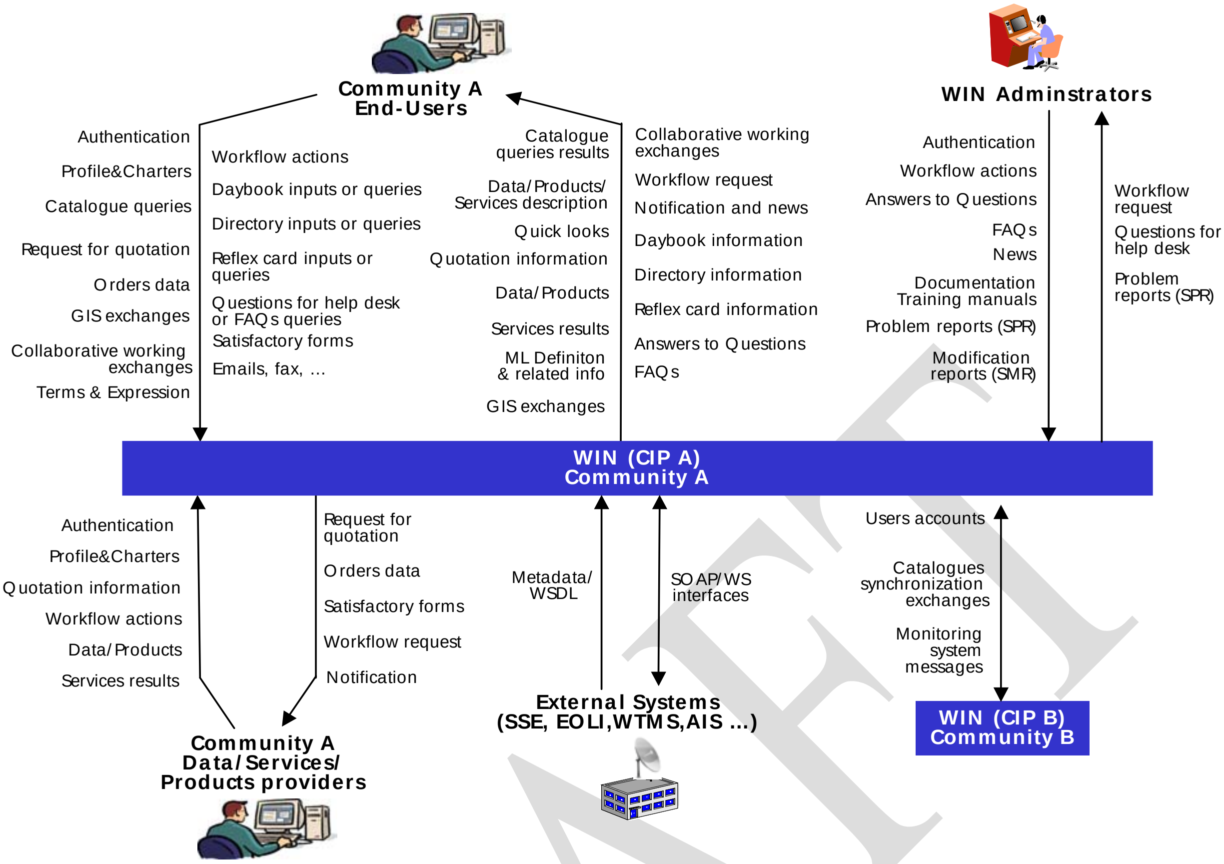


Figure 20: Contextual diagram

The functional components of WIN Common Integration Point (CIP) are presented in the following scheme.

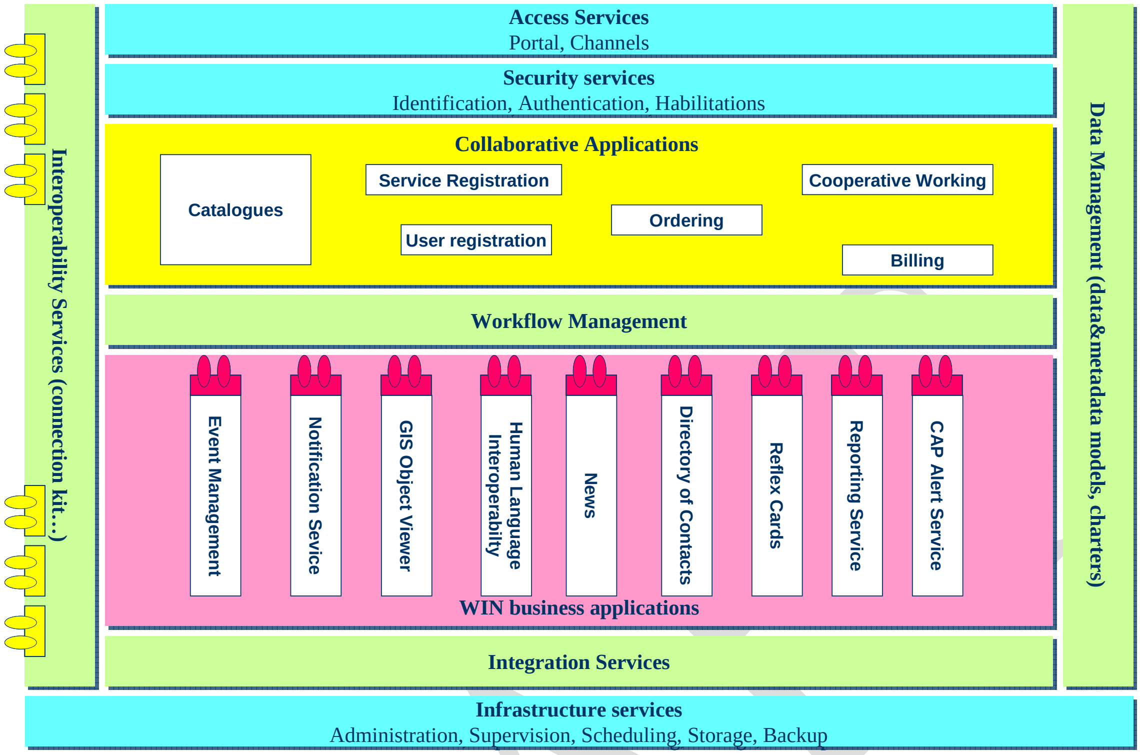


Figure 21: SOA Model

High level guidelines for developing the CIP components are summarized here after :

- To be based on Internet technologies notably "Web Services" standards (soap, xml, …).
- To implement standards (Protocols, Format, Data models, Security ..)
- To use as far as possible Open Sources and/or Public domain software
- To ensure security, confidentiality, availability
- To provide efficient and secure communication means
- To be interoperable
- To adapt itself to user's roles and crisis phases.

4.3.3 Example of SANY project

WIN project is complementary to SANY an other European projects as shown in the following scheme. SANY aims at inventorying various in-situ sensors dedicated to monitoring and WIN aims at proposing basic tools for collecting all the related data in a common, interoperable way. WIN can also be used at several CIP (Common Integration Points) as a in-situ data portal or instance. Interconnection between WIN and other programs (EOLI, SSE, VTMS,…) is in the baseline target of WIN.

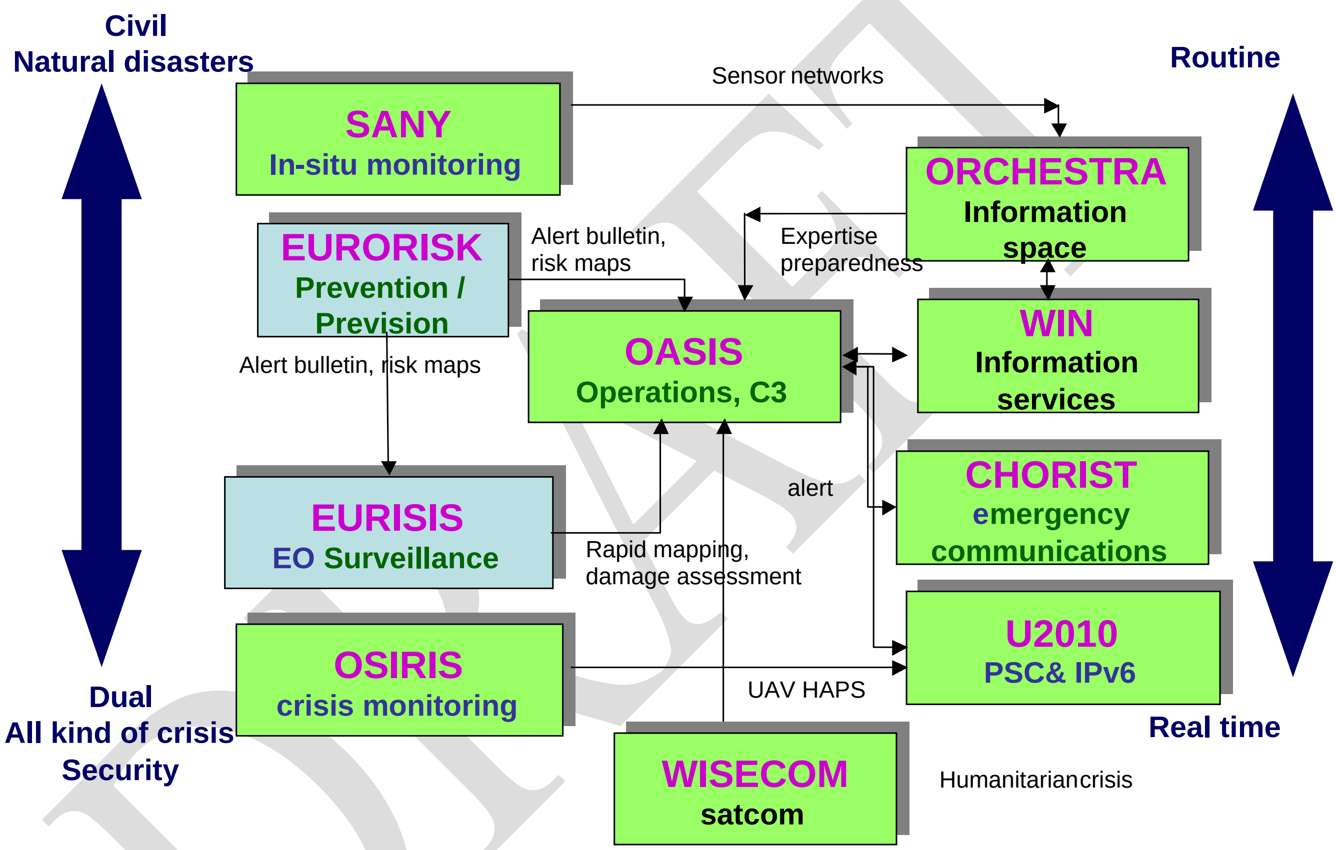


Figure 22 : European infrastructure risk projects overview

4.3.4 Example of SEADATANET, infrastructure project for Ocean

SEADATANET is a Pan-European infrastructure for the development of Ocean & Marine Data Management.

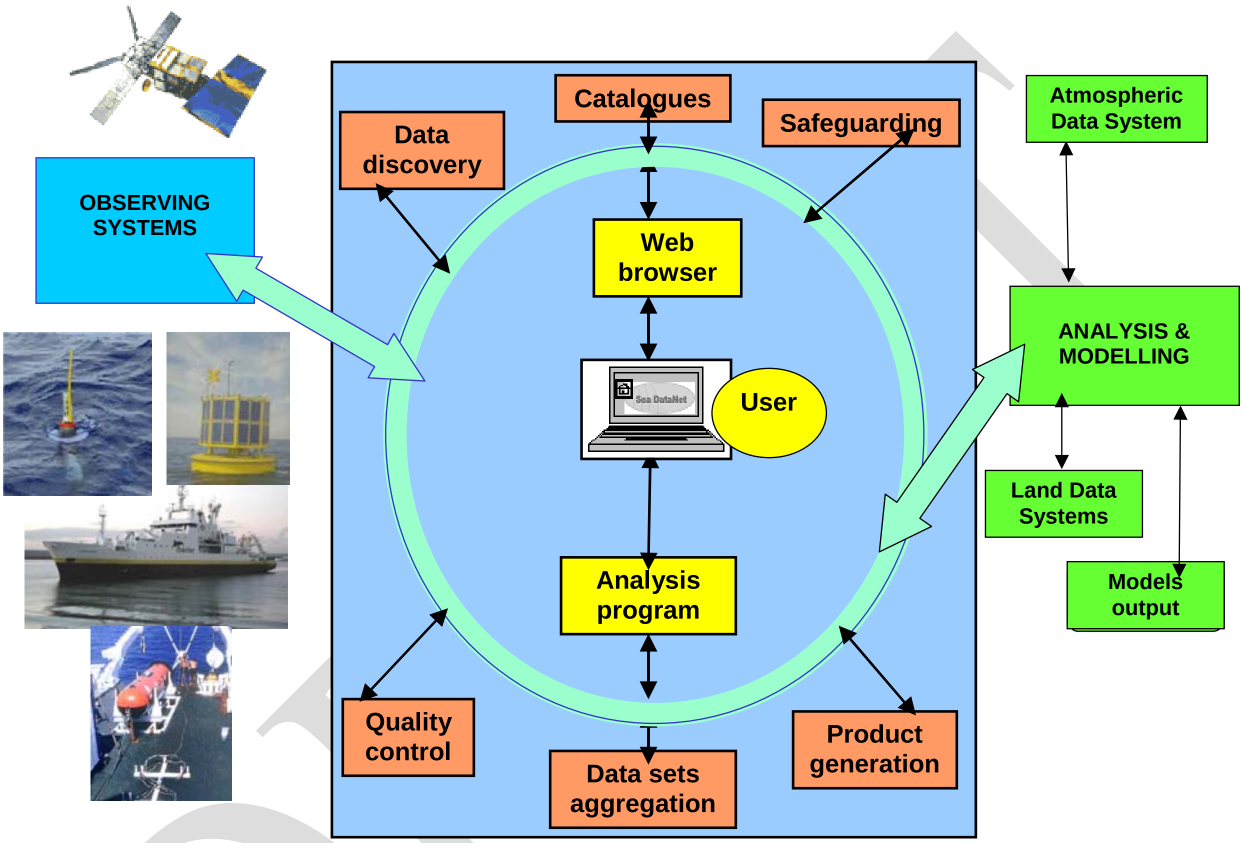
The basic objective is to develop an efficient data management system for the present and future ocean observing and forecasting programmes such as MERSEA, able to handle the diversity and large volume of data collected via the Pan-European oceanographic fleet and the new observation systems.

SEADATANET includes

- 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

The distributed system accelerates the development of standards, the release of more data for public use, improve the **security** of the data for the future and helps to increase the overall financial and human support for the data management.
SEADATANET aims to provide the **basic infrastructure for the on-going projects** and **optimise the costs** of data management, avoiding to redevelop new heterogeneous data structure for each project.



SEADATANET Consortium represents a unique group of 49 partners: experienced National Oceanographic Data Centres, Satellite Data Centres and Modelling Centres hosted by major oceanographic institutes of 35 countries bordering the Baltic, the Black Sea, the Mediterranean and the North-East Atlantic, and the international organisations IOC and ICES

4.4 Data fluxes considerations

Considering the various type of fluxes (see Annex 1)

- In-situ Data fluxes
- Regular NRT High Volume data transfer
- On-demand Data transfer
- Regular NRT low Medium Volume data transfer

4.4.1 In-situ Data fluxes

HALO shall consider in a normalized way access to in-situ data

The topic of SANY project in addition with WIN should help that Way,
So HALO has to follow issues of these two projects for in-situ data normalization

4.4.2 Regular NRT High Volume data transfer

HALO shall decrease as far as possible critical volumes

This mainly concerns GEOLAND, where VGT data volumes may be critical, requiring access through GEANT capacity, even while considering VGT product Level 2 or level 3.

In order to match with existing EUMETSAT capacity, compression of these data or investigations on explicitly required information shall be led in GEOLAND context.

4.4.3 On-demand Data transfer

A lot of data are accessed through manual way, using Ftp, with heterogeneous format, tools and so on.
By automating access to these data, using standard tools like SIMDAT for instance, it would be more easy to access, transfer and share these data to a broader community.

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

4.4.4 Regular NRT low Medium Volume data transfer

Depending on the type of data, this shall be accessed through WIS portal, e.g. SIMDAT for instance or WIN for in-situ data.

HALO shall use WIS portal for WWC data and GEONetCast portal for other Data

4.5 Potential for Future Developments of GMES and WMO Information Systems

- HALO recommends optimisations for the interactions between the GMES atmosphere, land, and ocean monitoring systems, which are mainly the global modelling and data assimilation activities.
- The EU-funded SIMDAT/MET software will be used by WMO partners to implement Europe-wide WIS capabilities
- The EU-funded SIMDAT/MET software can also be used by GMES partners to implement WIS-like capabilities for GMES
- Substantial benefits for all users could be achieved thru direct collaboration between GMES & WMO on a shared system
- WMO welcomes collaborations with communities such as GMES to share / develop WIS capabilities
- A joint effort by GMES partners and European WIS partners would accelerate the implementation of a joint Europe-wide GMES/WIS information system.
- Such extensions will require
  - Negotiation of certification with WMO system
  - New software (adapters) to provide access to own data repositories

- Implementation of metadata standards to describe data and data policy
- Implementation of virtual organisation to address security issues – authentication, authorisation, data policy…
- Implementation of physical infrastructure to connect to GISC
- …..

To be continued

Annex 1 : Data and Product Fluxes

Data / Product ID	Origin	Local, Regional or Global	Temporal Coverage	Spatial Coverage	Access Delay	Revisit Delay	Data rate Per day
MERSEA/ SST	NOAA, ESA, EUMETSAT, NASA	Global, with regional products	2000 to present	Global to regional	daily	daily	5 GB Atlantic 11 GB for Global
MERSEA/ Altimetry	NOAA, ESA, EUMETSAT, NASA	Global, with regional products	1992 to present	Global to regional	daily	Daily to 10 days (for merged products	TBD
MERSEA/ Ocean Color	NOAA, ESA, EUMETSAT, NASA	Global, with regional products	2004 to present	Global to regional	daily	Daily to 10 days, but cloud dependent	2 GB
MERSEA/ Sea Ice	NOAA, ESA, EUMETSAT, NASA	Polar regions	?	Polar regions	daily	3 to 10 days	TBD
MERSEA/ Wave / winds	ESA, EUMETSAT + NWP	Global, with regional products	Real time	Global to coastal	6 hrs	6 hrs	TBD
MERSEA/ NWP	Assimilation Models NWP	Global, with regional high resolution	ERA- 40 (40 years)	Global, with regional high resolution	6 hrs	6 hrs	TBD
MERSEA/ Meteorological field Data	ECMWF, NWP	Global, and regional	ERA-40 (40 years)	Global, and regional	6 hrs	6 hrs	TBD
MERSEA/ Argo / GTSPP	In-situ TEP ARGO GDAC	Global	Since 1992	Global	24 hrs	10 days	TBD
MERSEA/ GOSUD / VOS	In-situ TEP GOSUD, GDAC	Global + regional	Since 1985	Global + regional	24 hrs to weekly	monthly	TBD
MERSEA/ Ocean time series/BBCP	In-situ TEP OTS , GDAC	Global, regional	Since 2001	Point observatories	24 hrs to weekly	daily	TBD
GEMS/ GHG analysis + forecast	Metop-1 (IASI)	global	starting 2008	global	RT		1,5 GB
GEMS/ GRG analysis + forecast	Metop-1 (IASI)	global	starting 2008	global	RT		1,5 GB
GEMS/ AER analysis + forecast	ENVISAT (MERIS) NASA (TERRA-MODIS) NASA (AQUA-MODIS)	global	starting 2008	global	RT		250 MB 600 MB 600 MB
GEMS/ RAQ analysis + forecast	model & assimilation regional partners	regional		regional			TBD
GEOLAND-CSP/ Leaf Area Index (LAI), surface albedo, surface reflectance	VEGETATION AVHRR/NOAA - VIR/NPOESS	Global	1980 up to present	8km/ 1 Km	1 day	10 days	2 GB
GEOLAND-CSP/ Down-welling Short/Long-wave Radiation flux, Land Surface Temperature	METEOSAT, GOES, GMS, FY_2, INSAT, NOAA/AVHRR				1 day	4 to 10 days	TBD
GEOLAND-CSP / Burned areas/ Active fires	VEGETATION	Global	1998 up to present	1 Km	1 day	10 days	2 GB
GEOLAND-CSP/ Rainfall, soil moisture	Ascat / EPS AMSR / Aqua SMOS	Global	1998 up to present	5 Km to 50 Km	1 hour	1 day	50 MB/day
GEOLAND-OSP snow wetness	MODIS				1 hour	1 to 3 days	6 GB

Data / Product ID	**Origin**	**Local, Regional or Global**	**Temporal Coverage**	**Spatial Coverage**	**Access Delay**	**Revisit Delay**	**Data rate Per day**
GEOLAND-OSP	SPOT-LANDSAT				1 month	5 to 10 years	TBD
GEOLAND-OWS	MERIS LANDSAT SPOT				1 week	1 to 3 years	TBD
GEOLAND-OSP	LANDSAT SPOT				3 to 6 months	1 to 3 years	TBD
GEOLAND-OFM	ERS-scatterometer Meteosat Meteosat VGT ERS-scatterometer Meteosat VGT/AVHRR				within 3 days after acquisition	10 days	TBD
GEOLAND-OFM	MERIS/MODIS/VGT				within 1 week after acquisition	monthly	TBD
GEOLAND-OLF	VEGETATION				2 days after the end of acquisition period; 30 years archive	10 days	TBD