GEONETCast Global Design Document

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V1 (draft)	21/09/2006		First release
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V2 (draft)	08/12/06		- Inclusion of FENGYUNCast - new assessment on multicast systems
V3	05/07/07		Inclusion of comments from NOAA and WMO

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1 GEONETCAST GLOBAL DESIGN

This document presents a first version of the GEONETCast global design, the comprising entities, responsibilities, functions and services. The document takes into consideration the existing EUMETCast system by EUMETSAT and the NOAA visioning document on an American GEONETCast component and the publications available on FENGYUNCast from the Chinese Meteorological Administration (CMA).

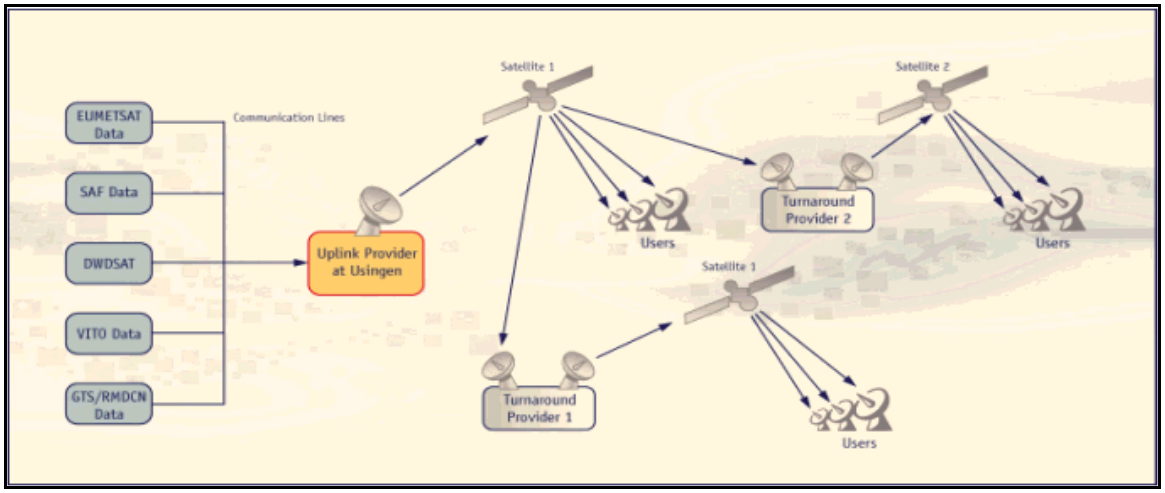
1.1 Introduction

The key base areas in the global GEONETCast design (Figure 4 and 5) are:

- The regional Multicast implementation (Figure 1 and 4)
- The data exchange between the GEONETCast Regional Network Centres - GNC(chapter 3)
- The data discovery and user management functionalities via a distributed portal (chapter 4)

At time of writing the GEONETCast system is technically based on EUMETCast.

Figure 1 Current EUMETCast System Overview



The current coverage of EUMETCast dissemination is shown in figure 2 followed by a possibility of achieving a nearly global coverage by inclusion of the Asia4 (figure 3) footprint as a turn-around satellite for the purpose of GEONETCast.

Figure 2 Current EUMETCast coverage

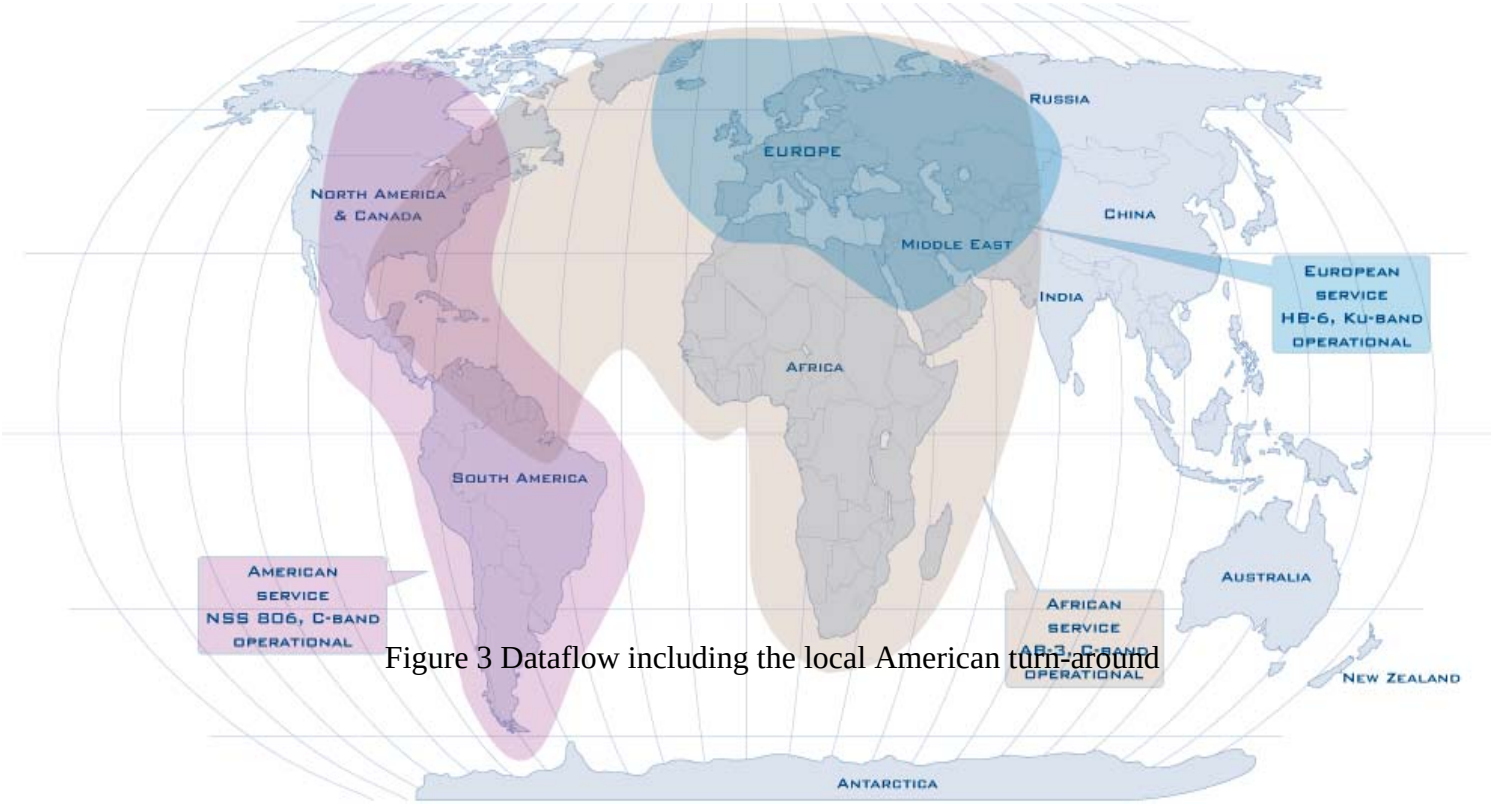
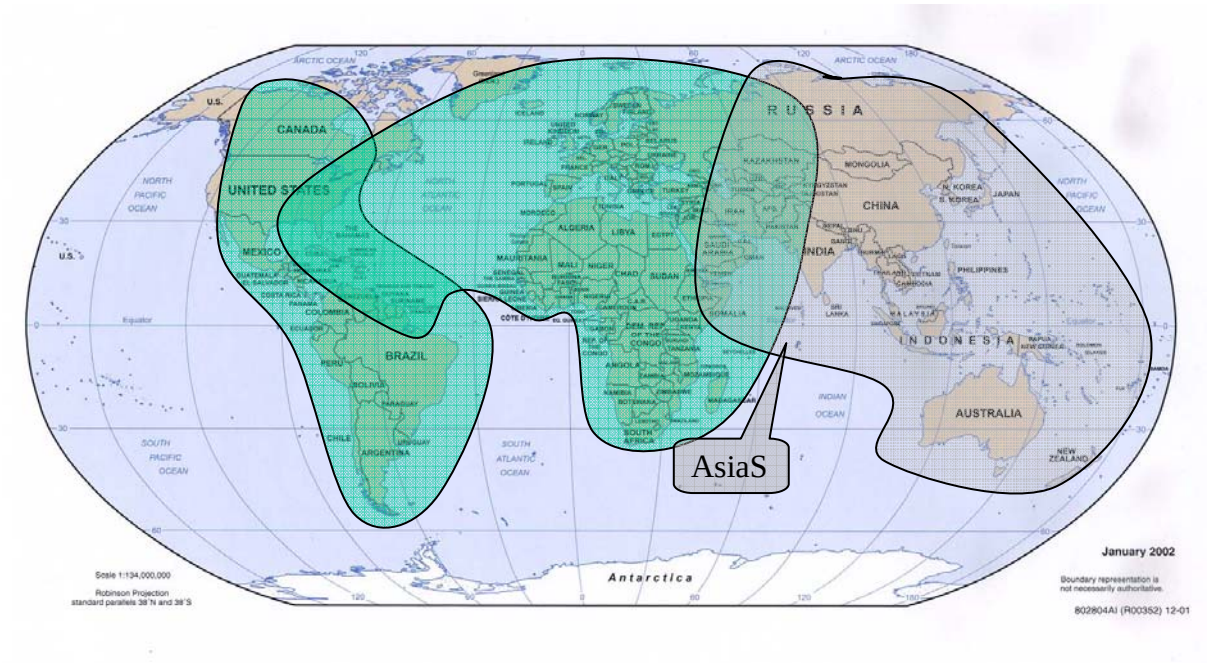


Figure 3 Dataflow including the local American turn-around

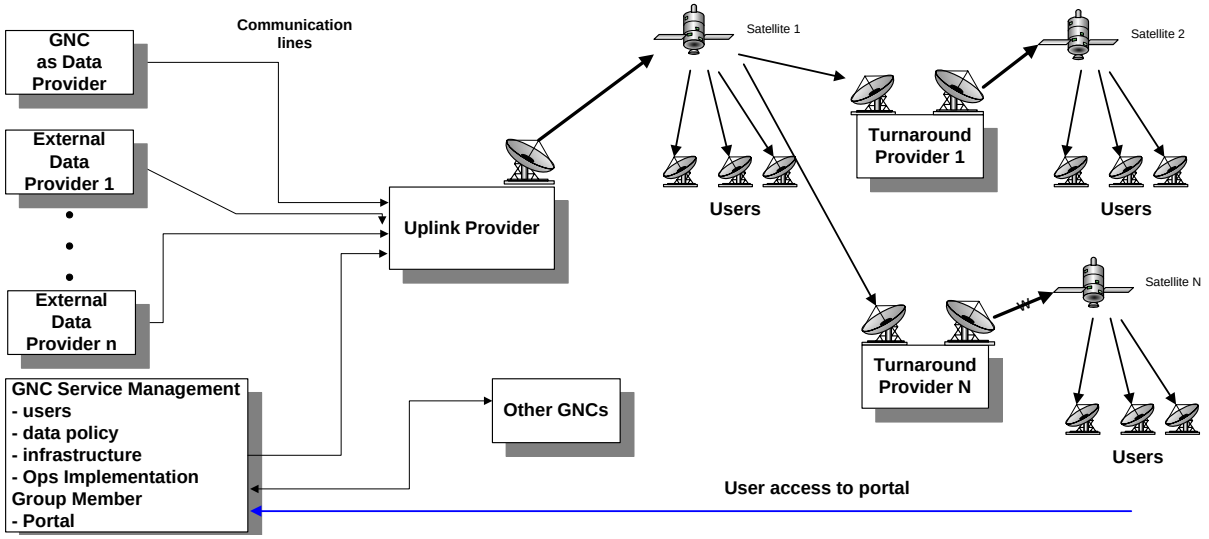
Figure 3 GEONETCast Evolution



1.2 The Global Design

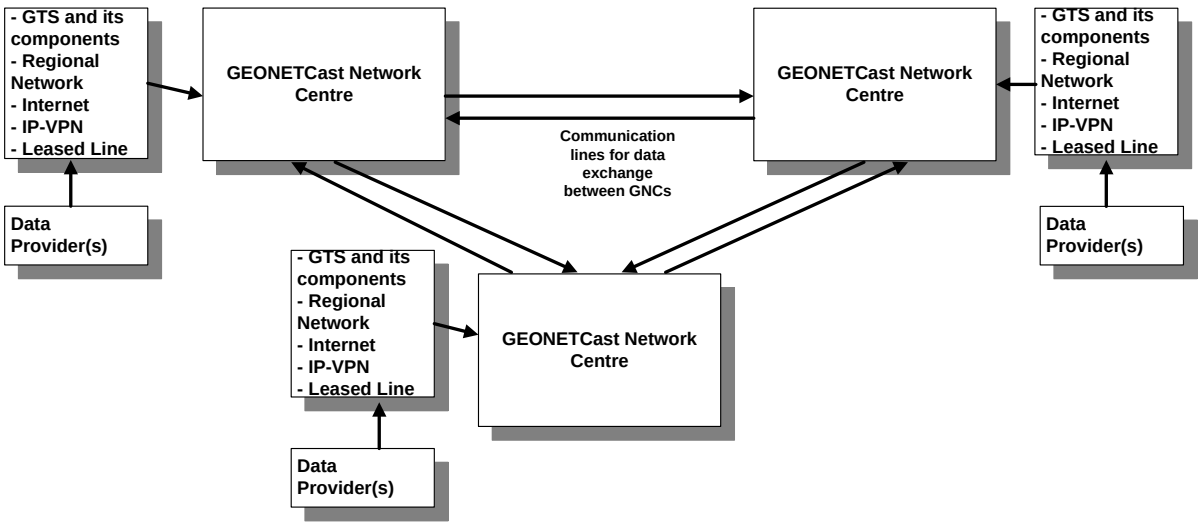
The conceptual idea of a global GEONETCast implementation is that several regional centres take on the responsibilities for establishing a satellite based regional dissemination system - based on the EUMETCast general framework (Figure 1) – and provide the same services to the common user community. The concept of interconnected regional GEONETCast Network Centres (GNC) would allow such an implementation.

Figure 4 GEONETCast Regional Network Centre - GNC



Each GNC would comprise the same components of 1) Data acquisition, 2) Service management, 3) Uplink provider, 4) Turn around providers and 5) User community (figure 4 above) and additionally 5) cooperates with the partner GNCs over communication links.

Figure 5 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 (Figure 1 and 4). 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

(figure 5). All GNC are for the purpose of GEONETCast management and administration loosely coupled in an Implementation Group. The GNC- Implementation Group with its distributed infrastructure, responsibilities and services will allow the end user and data providers a single point of entry. This concept of a multilateral service-level based business-to-business relationship forms basically a GEONETCast virtual organisation. 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.

A fundamental premise in the design of a GEONETCast capability for interoperability is that the regional systems are as loosely coupled as possible to maximize each region's flexibility to implement optimal solutions based on its own unique regional challenges. However they must possess common interfaces standards and processes and service level based business-to-business relationships that facilitate exchange of data in both directions in a way that minimizes (but not necessarily eliminates) burden on participants, including infrastructure providers, data providers, and end users.

The rules for joining the GNC-Operations Implementation Group for GEONETCast will be specified in a specific interface description which outlines the minimum requirements each organisation must fulfil in order to join. A proposed set of interfaces is specified in chapter 4.

Assuming a common methodology in data exchange between the regional centres, the actual multicast scheme could differ between the regions. Based on the geographical location each user would get the responsible GNC assigned during registration for a service via the common distributed portal.

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 its own infrastructure e.g. observing satellite of Internet, private networks, Internet protocol Virtual Private Networks (IP-VPN), Regional Meteorological Data Communication Network (RMDCN) and the Global Telecommunication System (GTS). The concept allows full conformity with the ideas of interoperable data exchange in the context of the Global Earth Observation System of Systems (GEOSS) and the Integrated Global Data Dissemination System (IGDDS).

Furthermore, a data exchange concept between the GNCs (around 3-4) for the exchange of data for the global GEONETCast service is part of the design. One possibility is the usage of overlapping footprints and a "turn-around-daisy chaining;" another would be an n-n private network which could re-use already existing bi-lateral infrastructure. In this context data for a "global" GEONETCast services means all non-local/regional data which is meant for world wide dissemination.

The data exchange options are discussed in chapter three.

2 THE GEONETCAST OPERATIONS IMPLEMENTATION GROUP

The GEONETCast Operations Implementation Group builds up on the existing structures to decide on the high level topics of GEONETCast.

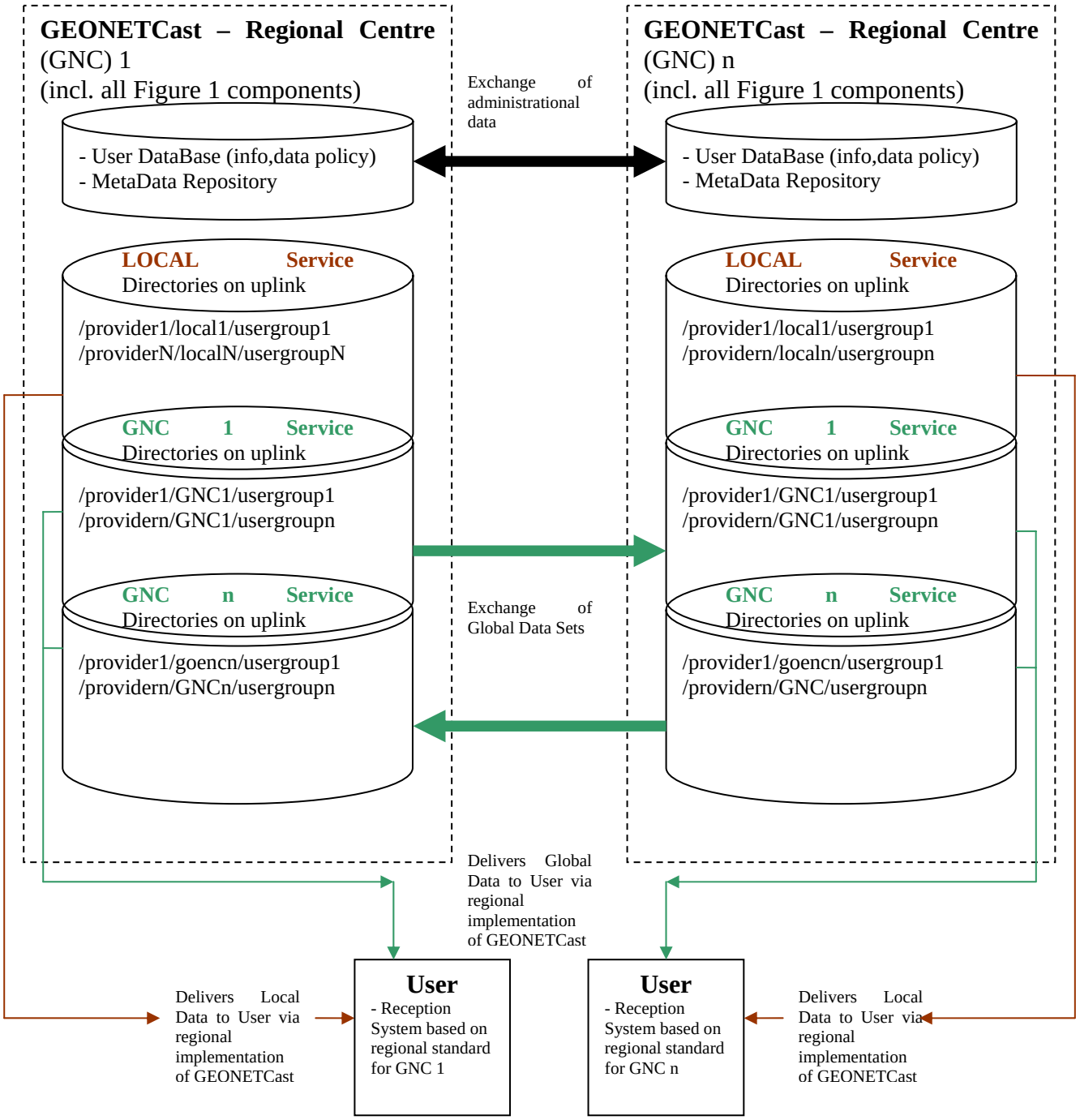
- Structure
- Composition
- Roles
- Processes
- Services

The final setup for this group is TBC.

3 DATA EXCHANGE DESIGN DISCUSSION

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 (figure 6).

Figure 6 High level concept of GNC data exchange



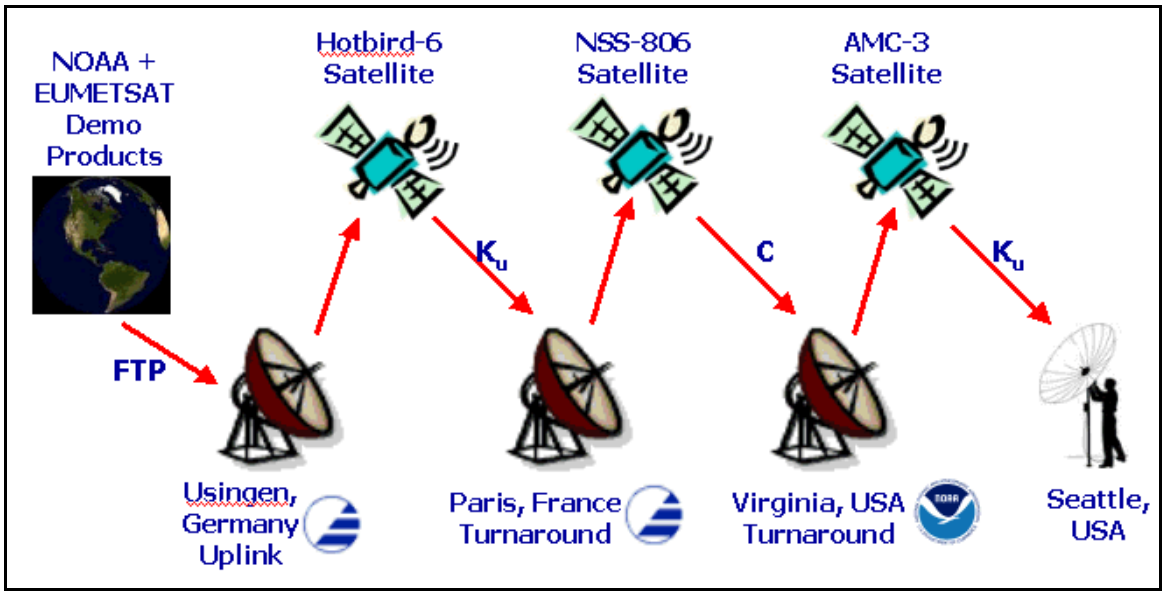
The overall purpose of the GNC dissemination exchange is to achieve the actual dissemination of data for a global audience and regional audience at the same time. This is a core element in the overall GEONETCast design allowing the essential GNC interoperability. Based on the above design concept (figure 6) two potential options have been identified to date, which are discussed in the following sections.

3.1 Multicast: Stand-alone GNC systems are disseminating data via multicast listen-in (Turn-around-daisy-chaining)

This concept is based on the assumption that all data that 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.

The current first version proof-of-concept prototype is such a system (figure 7). All data that is to be disseminated into a region is recorded from a “local” receiving ground station which forwards the data to the “local” dissemination satellite.

Figure 7 Multicast daisy-chains



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 Single Point of Failure (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 additional terrestrial forwarding costs.

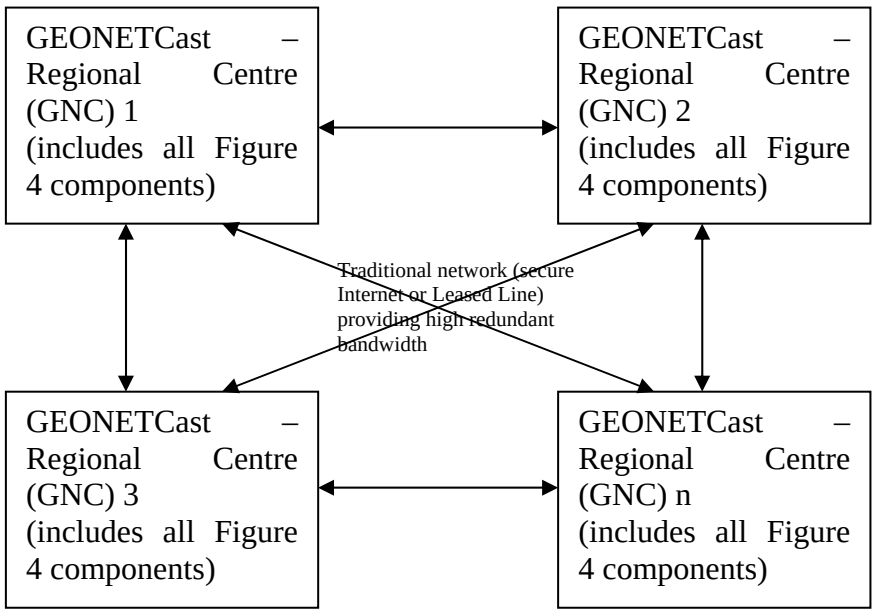
Such a system would only cater for the mission dissemination data but not for the exchange of administrative data such as the web portal related traffic for which still a traditional

network would be needed. The reliability of "Turn-around-daisy-chaining" depends on the availability for all hops at all times and the availability of convenient overlapping satellite footprints. It also does not easily permit the distribution of limited subsets of a given region's broadcast data stream to another regional GEONETCast Network Center (GNC).

3.2 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 (figure 8). For the current version of GEONETCast this would involve around 3-4 centres. The very first implementation however is currently EUMETSAT and NOAA (which already have those high bandwidth networks between each other) and EUMETSAT and CMA (which is using Internet for data exchange).

Figure 8 Traditional N-N networks



This private network would cater for the exchange of all data for global dissemination, the user data and any other administrative data including the exchange of product describing Meta data for the distributed GEONETCast portal.

3.3 Scope of Dissemination

It needs to be noted that not all data of all regions needs to be disseminated in all regions. This sub-setting of products being pushed between regional GNCs is necessary to alleviate the need for all GNCs to acquire enough transponder bandwidth to carry all regional products from all GNCs across the globe. For each region, therefore, the operator of the GNC decides what products are to be broadcast in that region.

3.4 Comparison Matrix of Data Exchange Options

The matrix below (table 1) is a first qualitative assessment of the two options for data exchange which would need to be reviewed after a detailed market, cost and effort survey and analysis.

Table 1 Comparison between data exchange methods

Element	Multicast Daisy Chain	N-N Network
Support to high data rates	**yes**	**yes**
Data flow bi-directional	**no**	**yes**
Scalability	**high**	**high**
Interoperability to existing infrastructure	**high**	**high**
Admin effort	**high**	**medium**
Single Point of Failure	**yes**	**no**
Cost	**low * - high**	**medium**
Implementation effort	**low * - high**	**low**
Pre-requisites	**Availability of overlapping footprints across the globe**	**no**
Terrestrial line connection	**May be required**	**Yes**
Allows selection of specific products for exchange	**No (if packet based) Yes (if file based)**	**Yes**

* If overlaps are already existing as part of the regional mission

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 to 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.

The ideal path to exchange data is if each GNC can “listen in” to the multicast of the other GNCs and then re-broadcasts this traffic on the regional GNC footprint.
An example of this implementation would be the “listen-in” of the Chinese EUMETCast reception system in Kashi to EUMETCast transmissions. Kashi then forwards the data to GNC Bejing via land line. GNC Bejing then re-transmitts this traffic via FENGYUNCast over the entire Asian footprint.

4 DISTRIBUTED GEONETCAST PORTAL

Each User accesses in the first instance a central GEONETCast portal on http://www.geonetcast.org (one stop shop).
Based on the input of geographical information, the user is then re-directed to the responsible regional 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;
- 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

Implementations of such distributed portals are widely available. It is pre-mature to discuss now the actual portal technology to be used for GEONETCast; the only important aspect for now is the requirement that the portal technology and implementation of its services should follow recognised international standards.

4.1 Data Discovery (online and offline)

The data and service discovery is an essential service to the user which will allow access to the Meta-data information on all disseminated products-, type-, contents-, format- and usage-descriptions of each product and service in conjunction with small static sample data sets.

Essentially there are two implementations of this data discovery:

- Online implementation. This requires Internet access of the user to the distributed GEONETCast Portal which hosts all of above services
- Offline implementation. This is the static version of the data discovery service (all descriptions, pages, samples etc.) which is disseminated via GEONETCast. It allows each user access to and browse capability for the essential information about GEONETCast products and services on the local reception station without the necessity of Internet connectivity.

4.1.1 Standardised Meta Data description for dissemination products

All data types (not the instances) which are disseminated on GEONETCast (regional and global) should be described with standardised Meta data information. The current standards are the series of ISO 19100 standards and WMO Core Metadata Profile of the ISO Metadata Standard. 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.

In a further step the repository is being disseminated on GEONETCast on a dedicated global news/information channel. This allows each user access and browse to the essential information about GEONETCast products and services on the local reception station without the necessity of Internet connectivity.

4.2 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

5 MINIMUM REQUIREMENTS FOR A GEONETCAST GNC

Table 3 contains the high level requirements (HI-[number]) each organisation must fulfil in order to join GEONETCast as a regional GNC.

Table 3 Minimum Requirements for a GEONETCast GNC

High Level Requirement	Description
HI-010	Capability to endorse Data Policy on individual level
HI-020	Capability of Denial-Of-Service
HI-030	Provision of a Management Layer participating in the GNC Operations Implementation Group including the agreement to a trust relationship.
HI-040	Ability to manage and disseminate data which goes beyond the standard responsibilities of a regional organisation in order to serve a global audience.
HI-050	Implementation of a regional GNC service as specified in the GNC description and the common service Service Level Agreement (SLA)
HI-060	Implementation of User services
HI-070	Implementation of the regional part of the shared GEONETCast portal
HI-080	Capability to exchange selected global dissemination products in data exchange between the partner GNC
HI-090	Provide sufficient IT-security to assure data integrity
HI-100	Provide a mechanism for adapting data content to user requirements
HI-110	Provide specifications for widely available user receiving devices
HI-120	Provide coverage of a substantial geographic region such as at least a continent

6 CONCLUSION

The presented design allows GEONETCast implementation on the basis of proven technologies and expertise, modern concepts of inter-organisational cooperation, and high user friendliness and user services for relatively low implementation and operation costs.

7 INPUT TO GEONETCAST IMPLEMENTATION PLAN

In order to progress with GEONETCast technical implementation, several steps are necessary for overall GEONETCast coordination. The highlevel items are described in the GEONETCast Implementation Plan.

- Agreement on the overall high level global design
- Gathering and consolidation of high level user requirements (regional and global) which are addressing administrative services and also technical preferences.
- Description of all regional services (administrative and data/product services)
- Agreement on the data exchange technology
- Agreement on a project plan for the implementation of an operational prototype in accordance with an agreed SLA
- Implementation of regional GNC including procurement of the related infrastructure
- Implementation of global services e.g. the distributed GEONETCast portal but also of GNC- Implementation Group services (user registration, data denial concepts, overall cooperation agreements)
- Preparation of an operational prototype installation of all regional functions of a GNC including the high-level GNC- Implementation Group functions
- Presentation of the operational prototype to the user community and administrations
- Agreement of an Interface Control Document (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.

Above tasks are only outlining some high-level activities and will require detailed project planning and the availability of the necessary cooperation agreements, funds and resources.