EGNOS Message Server (EMS)
User Interface Document

Felix Toran-Marti
Dr. Javier Ventura-Traveset

Prepared by :	Reviewed by :	Approved by :
F. Toran-Marti	Dr. J. Ventura-Traveset	Philippe Michel

Centre Spatial de Toulouse - 18 Avenue Edouard Belin - 31401 Toulouse Cedex 4 - France
Tel. : +33 (0)561 282865 - Fax : +33 (0)561 282866

DISTRIBUTION LIST

GNSS-1 Documentation

EPO: J. Ventura, P. Michel, L. Gauthier, H. Horgen, C. Montefusco, J. Andres-Diaz, J.P. Dupont, H. Secretan, A. Job, D. Brocard, P. Feuillet, F. Toran-Marti.

IMAGE: All partners

ESTEC: J.C. de Mateo, Simon Johns, Michel Tossaint, Jarom Samson, Jonathan Martin, Alberto Garcia, Jean-Luc Gerner.

DOCUMENT CHANGE RECORD

Issue	Revision	Date	Change Status	Origin
1	**Draft**	**21/02/03**	**Draft version of the document**	**FT**
1	**0**	**10/03/03**	**First release of the document after internal draft review**	**FT**
1	**1**	**29/09/03**	**Minor modifications to data record format.**	**FT**

TABLE OF CONTENTS

LIST OF FIGURES

1. INTRODUCTION AND SCOPE

1.1 PURPOSE OF THE DOCUMENT

This Document describes the user interface of the ESA EGNOS Message Server (EMS). This ESA service allows users obtaining the SBAS messages already broadcast by the EGNOS system [RD 20] during a given period of time, via the Internet. This service has a special interest as a complement to the ESA IMAGE project [RD 02, RD 03] providing an alternative source of messages for an independent assessment of the EGNOS system performances. In addition, Service Volume Simulation Tools (e.g. the ESA ESPADA software [RD 18, RD 19]) can be enhanced, being able to connect to the EMS, download message files corresponding to the desired period of time, and finally assess performances using real EGNOS data. The access to the EMS service is based on the well-known FTP protocol [RD 04]. An additional access method, based on the use of the ESA SISNeT service [RD 05 – RD 17, RD 21 – RD 24], is also introduced through this Document. This extra interface is not implemented in the initial version of the EMS service. However, it is described here in detail, since its potential introduction in future versions is under assessment by ESA.

The Document describes – from a high-level point of view – all the details necessary to access the EMS information. In depth details about the DS2DC and FTP protocols are given through references to online documents.

HOW TO GET THE LATEST INFORMATION ABOUT EMS

The official ESA EMS Website is under construction at the time of this writing (September 2003). This site will be available in October 2003 at http://www.esa.int/navigation/ems The EMS website will also be accessible through the "EGNOS for Professionals" section of the ESA Navigation portal, at http://esamultimedia.esa.int/docs/egnos/estb/egnos_pro.htm

1.2 DOCUMENT ORGANISATION

This Document is organised as follows:

- **Section 1** introduces this Document, showing its purpose and organisation, and providing a list of references for further reading.
- **Section 2** provides an overview of the EMS architecture, showing its integration in the context of the ESA SISNeT platform. All the interfaces between the involved sub-systems are presented, highlighting the interface between EMS and users (based in the FTP protocol.)

- **Section 3** describes a potential EMS user interface, based on the utilisation of the ESA SISNeT technology. This interface is not implemented in the first version of EMS. However, ESA is assessing the possibility to introduce this feature in future versions.
- **Section 4** describes the EMS user interface, constituting the core of the Document. That interface is fully relying on the well-known FTP protocol. All the details about file management, access policy, naming conventions, file deletion policy, file format, etc. are discussed in detail.
- **Section 5** provides some explanations on how leap seconds are managed by EMS.
- Finally, **Section 6** provides a brief summary of this Document.

1.3 What's new in Issue 1, Rev. 1

This new release of the Document (Issue 1, Revision 1) introduces the following (minor) modifications:

- Illustration on EMS file organisation added (Figure 6).
- EMS data records are terminated with just a line-feed character, not preceded by a carry-return. This was not correctly documented in Issue 1, Rev. 0 of this Document. The text has been corrected (minor changes). Figure 7 reflects this change.
- The list of references has been updated.
- Some Figures have been updated.
- New Figures have been added.

1.4 REFERENCES

Reference	Title
RD 01	F. Toran-Marti and J. Ventura-Traveset, "*SISNET User Interface Document,*" ESA Technical Document, Issue 2, Revision 1, Ref. E-RD-SYS-E31-010. Available at http://www.esa.int/navigation/sisnet.
RD 02	H. Horgen, P. Michel and J. Ventura-Traveset, "*IMAGE: Independent Monitoring and Assessment of GNSS Signal-In-Space Emission,*" Issue 1, Rev. 0, 08/10/2002, Ref. E-SW-OPS-E-027-ESA.
RD 03	S. Lafont, "*Description of Server Needs for IMAGE,*" CNES Technical Document, Ed. 1, Rev. 1, 23/01/2003, Ref. DSO/RC/NL/3-006
RD 04	J. Postel and J. Reynolds, "*File Transfer Protocol (FTP),*" Ref. RFC 959, October 1985, available at http://www.faqs.org/rfcs/rfc959.html

Reference	Title
RD 05	F. Toran-Marti, J. Ventura-Traveset and R. Chen, "The ESA SISNeT Technology: Real-Time Access to the EGNOS Services through Wireless Networks and the Internet," *ION GPS 2002*, Portland (Oregon), USA, September 2002.
RD 06	F. Toran-Marti, J. Ventura-Traveset and de JC de Mateo, "Satellite Navigation and the Internet: Introducing SISNET Technology," *Dr. Dobb's Journal*, March 2002. Featured article, available online at http://www.ddj.com/documents/s=4069/ddj0203a/0203a.htm
RD 07	F. Toran-Marti and J. Ventura-Traveset, "The ESA SISNET Project: Real-Time Access to the EGNOS Services across the Internet," *2nd ESA ESTB Workshop*, Nice (France), November 2001. Available at http://www.esa.int/navigation/sisnet
RD 08	F. Toran-Marti, J. Ventura-Traveset and de JC de Mateo, "Internet-based Satellite Navigation receivers using EGNOS: the ESA SISNET project," *ESA Workshop on Satellite Navigation User Equipment Technologies (NAVITEC)*, Noordwijk (The Netherlands), December 2001. Available at http://www.esa.int/navigation/sisnet
RD 09	European Space Agency, "SISNET: Making EGNOS Available Over the Internet," *ESTB News*, ESA Newsletter, Issue 2, page 4, September 2001.
RD 10	European Space Agency, "SISNeT: Enhancing EGNOS for Land-Mobile Users," *ESTB News*, ESA Newsletter, Volume 2, Issue 1, page 1, May 2002.
RD 11	F. Toran-Marti, J. Ventura-Traveset and JC de Mateo. "The ESA SISNET Project: Real-Time EGNOS Services through the Internet," *ESA Journal Preparing for the Future*, January 2002. Available at http://www.esa.int/navigation/sisnet
RD 12	F. Toran-Marti, J. Ventura-Traveset, and JC de Mateo, "The ESA SISNET Project: Real-Time Access to the EGNOS Services across the Internet," *7th International Workshop on Digital Signal Processing Techniques for Space Communications*, October 2001, Lisbon (Portugal). Available at http://www.esa.int/navigation/sisnet
RD 13	F. Toran-Marti and J. Ventura-Traveset, "*SISNeT Brochure*," ESA Brochure, June 2002. Available at http://www.esa.int/navigation/sisnet
RD 14	European Space Agency, "*Navigate via the Web with the SISNeT Receiver,*" ESA Press Release, 06/09/02, http://www.esa.int/export/esaSA/ESAW0OZPD4D_navigation_0.html
RD 15	European Space Agency, "*Signal-in-Space through the Internet,*" ESA Press Release, 19/09/02, http://www.esa.int/export/esaSA/ESAFXRZPD4D_navigation_0.html
RD 16	European Space Agency, "*Space Technology to Help the Blind,*" ESA Press Release, 30/12/02, http://www.esa.int/export/esaSA/ESAKN58708D_navigation_0.html
RD 17	European Space Agency "*Toulouse Bus Test-Drives European Satellite Navigation,*" ESA Press Release, 14/02/03, ESA news on Satellite Navigation, available at http://www.esa.int/export/esaSA/SEM4HZ1A6BD_navigation_0.html
RD 18	F. Toran-Marti, J. Ventura-Traveset and JC de Mateo, "ESPADA 3.0: An innovative EGNOS Simulation Tool Based on Real Data," *ESA Journal preparing for the Future,* January 2002.
RD 19	F. Toran-Marti, "*Advanced Simulation Tool for Satellite Navigation: from Radio Frequency to Positioning Using Real Data*." Research Essay. Supervised by Dr. Javier Ventura-Traveset (ESA) and Dr. Diego Ramirez (University of Valencia), July 2001.
RD 20	L. Gauthier, P. Michel, J. Ventura-Traveset and J. Benedicto, "EGNOS: the first step of the European contribution to the Global Navigation Satellite System," *ESA Bulletin,* No. 105, February 2001
RD 21	F. Toran-Marti, J. Ventura-Traveset and R. Chen, "Handheld Internet-Based EGNOS Receiver: The First Product of the ESA SISNET Technology," *GNSS 2003 Conference*, Graz (Austria), April 2003.

Reference	Title
RD 22	E. Gonzalez, M. Toledo, A. Catalina, C. Barredo, F. Toran, J. Ventura and A. Salonico. "Proposal of an Internet-Based EGNOS Receiver Architecture and Demonstration of the SISNET Concept," *ION GPS 2003*, Portland (Oregon), US, September 2003.
RD 23	M. Toledo, E. Gonzalez, F. Toran and J. Ventura, "Proposal of an Internet-Based EGNOS Receiver: Architecture and Demonstration of the SISNET Concept." *To appear in 11th IAIN World Congress*, October 2003, Berlin (Germany).
RD 24	R. Chen, F. Toran and J. Ventura-Traveset, "Access to the EGNOS Signal-In-Space Over Mobile IP," GPS Solutions (2003), Vol. 7, No. 1. Article available online through http://www.springerlink.com
RD 25	RTCA, *"Minimum Operational Performance Standards for Global Positioning System / Wide Area Augmentation System Airborne Equipment,"* Ref. RTCA/DO-229B, October 6, 1999
RD 26	European Space Agency, "ESA SISNeT Specialist Website," available at www.esa.int/navigation/sisnet

1.5 LIST OF ACRONYMS

ASCII	American Standard Code for Information Interchange
BS	Base Station
CNES	Centre National d'Etudes Spatiales
DS	Data Server
DS2DC	Data Server to Data Client protocol
EGNOS	European Geostationary Navigation Overlay Service
EMS	EGNOS Message Server
EMS2DS	EMS to Data Server protocol
EMS²	EMS Software (EMSS)
EPO	EGNOS Project Office
ESA	European Space Agency
ESPADA	EGNOS Simulation tool for Performance Assessment and Design Analysis
ESTB	EGNOS System Test Bed
ESVS	EGNOS Service Volume Simulator
FTP	File Transfer Protocol
GB	Gigabyte
GEO	Geostationary Earth Orbit
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile-Communications
IMAGE	Independent Monitoring and Assessment of GNSS Emission
ION	Institute Of Navigation
IP	Internet Protocol
KB	Kilobyte

RTCA	Radio Technical Commission for Aeronautics
SBAS	Satellite Based Augmentation System
SINCA	SISNET Compression Algorithm
SIS2DS	Signal-In-Space to Data Server
SIS2EMS	Signal-In-Space to EMS
SISNET	Signal-In-Space through the InterNET
SW	Software
UAS	User Application Software
UID	User Interface Document

2. EGNOS MESSAGE SERVER (EMS) OVERVIEW

The EGNOS Message Server (EMS) is a new Internet – based service, which provides access to an archive of messages, previously broadcast by the EGNOS system [RD 20] through GEO means.

The EMS concept is highly linked to the ESA SISNeT project (for extensive information on this ESA initiative, the reading of [RD 05 – RD 17] is strongly recommended.) In fact, EMS is a component of the SISNeT platform, and it has been exclusively designed to work within that system. The EMS functionality has a special interest as a complement to the ESA IMAGE project [RD 02, RD 03].

The rational behind this SISNeT – EMS link is the following: the SISNeT platform is able to broadcast the EGNOS messages through the Internet in real-time and, at the same time, EMS aims at storing EGNOS messages. Hence, SISNeT can act as the data source for EMS. This approach has a main advantage: only an Internet connection is needed to get the EGNOS messages. Furthermore, the EMS is located inside the SISNeT platform private network (which is firewall – protected), providing a reliable, fast and safe link with the SISNeT components.

Figure 1 depicts the EMS computer within the context of the SISNeT platform. The standard SISNeT components are the following:

- **Base Station (BS)**. Contains an EGNOS receiver connected to a computer. The software running on that computer is able to extract the EGNOS messages from the receiver, and send them in real time to another computer, called Data Server. The protocol employed for this data exchange is called SIS2DS.

- **Data Server (DS)**. A high performance computer, able to simultaneously dispatch the requests of a high number of clients. The DS forwards the EGNOS messages to the users in real-time through the Internet. The DS is also able to provide additional services, like the broadcast of GPS ephemeris information or the quick initialisation of SBAS receivers. The data exchange is done through a dedicated protocol called DS2DC [RD 01].

- **User Application Software (UAS)**. This is the most flexible component of the SISNeT platform. In fact, each developer builds his / her own UAS with specific requirements and capabilities. It is in the UAS where Satellite Navigation and the Internet really establish a

synergistic link. As said above, the UAS is a very flexible component; however, the recommendations and practices stated in the SISNeT User Interface Document [RD 01] must be respected, in order to obtain a SISNeT-compliant UAS.

The EMS is basically an additional computer, running a server software application called EMS² (EMS Software = EMSS = EMS²) and an FTP server application. The EMS² application manages the operation of the EMS computer and exchanges data with the SISNeT BS and DS components. The FTP server provides remote access to the EGNOS messages through the Internet, stored in the form of computer files. Those archives can be accessed through the standard FTP protocol (see [RD 04]).

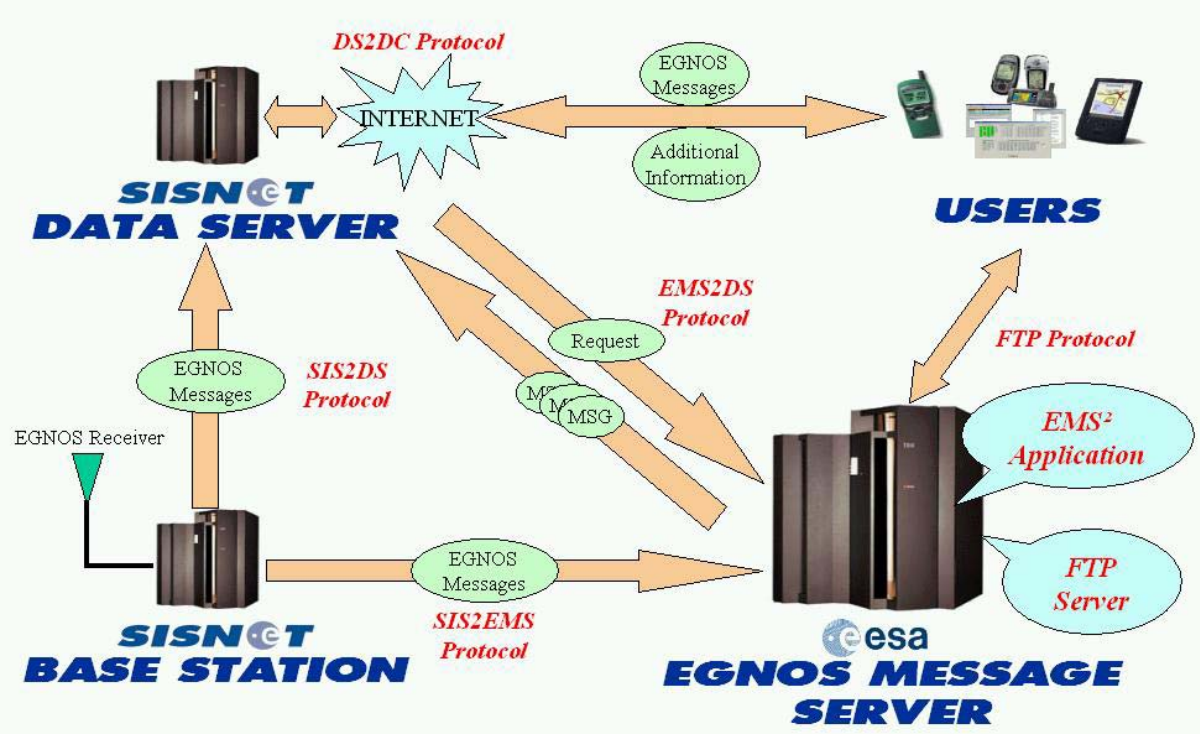

Figure 1. Overview of the EGNOS Message Server (EMS) and its links with the ESA SISNeT platform components

The system can be explained in terms of the available links between the components presented in Figure 1:

(a) A **public link** between the EMS and Internet users, based on computer archives and the use of the FTP protocol. This is the **standard EMS user interface**.

(b) A **real-time private link** between the SISNeT BS and the EMS. This link provides the EMS with a real - time source of EGNOS messages to be stored. A specific protocol – called SIS2EMS – is employed for that purpose. Note that the DS is an appropriate data source, as well. The low workload of the BS with respect to the DS is the main motivation for choosing

the BS as the data source. It is also possible to set-up a computer – equipped with an EGNOS receiver – as the EMS base station (i.e. source of EGNOS messages). In this scenario, the EMS base station is fully independent from the SISNeT architecture.

(c) A **private link** between the EMS and the SISNeT DS, through a protocol called EMS2DS. This connection allows the DS to extract previously broadcast EGNOS messages from the EMS on demand, and forward them to the SISNeT users over the open Internet, using special extensions of the DS2DC protocol [RD 01] (the main pillar of the SISNeT technology). This combination of links allows the access to EMS from the open Internet, via the ESA SISNeT technology. **This link is no implemented in the current version of EMS. However, ESA is assessing its introduction in future versions.**

(d) The **standard public link** between SISNeT users and the DS, allowing accessing the SISNeT services over the Internet. A SISNeT account is necessary to have access to this service (the account data can be obtained free of charge by following the instructions presented in [RD 26]). This link gives no access to EMS, but could have interest for applications requiring an Internet-based real-time source of EGNOS messages.

IMPORTANT NOTE

Link (c) is no implemented in the current version of EMS. However, ESA is assessing its introduction in future versions of the EMS service.

Note that the EMS machine is highly protected from any undesired external access, through a highly secure firewall system.

Note also that, in addition to the management of the EMS operation, the EMS² application implements the server part of the SIS2EMS protocol.

The next Chapters show more details on the EMS user interface. Firstly, the interface based on the DS2DC protocol – link (c) – is proposed as a potential future upgrade. Then, the FTP-based user interface is described in detail.

3. ACCESS TO EMS THROUGH THE SISNET SERVICE

As introduced in the previous Chapter, a potential future way to access the EGNOS messages stored in the EMS consists on using the DS2DC protocol [RD 01]. That protocol is specially designed for giving access to the SISNeT [RD 05 – RD 17] services.

In order to facilitate the access to the EMS, two new elements of the DS2DC protocol are proposed. Their syntax can be found in Figures 2 and 3. These commands follow the SISNeT DS2DC protocol philosophy and, hence, form a complementary request / answer couple.

Users send the EMS_GET R-command[1] to the SISNeT Data Server, requesting a set of EGNOS messages. The arguments included in the command are the following:

- **Ini_week**: initial GPS week.
- **Ini_time**: initial GPS time.
- **End_week**: final GPS week.
- **End_time**: final GPS time.
- **Time_step (optional argument)**: a natural number indicating increment of time between samples, expressed in seconds. If this argument is omitted, the default value of 1 second will be applied. If the argument is not correctly formatted, a SISNeT error message will be returned.

After processing the request enclosed in the EMS_GET command, the DS interacts with the EMS (in particular with the EMS2DS server side, implemented by EMS²), requesting the range of EGNOS messages demanded by the user. Then, the EMS returns the requested information to the DS. This interaction is based on the usage of the EMS2DS protocol.

EMS_GET	,	ini_week	,	ini_time	,	end_week	,	end_time	,	time_step

Figure 2. Format of the EMS_GET command. This command shall be terminated with a line-feed character (optionally preceded by a carriage return).

Finally, the DS sends the requested information to the user through one or more *EMS_GET messages (A-commands[2]). The format of the *EMS_GET message is illustrated in Figure 3. It simply includes one field called "ASCII data", which contains one or more data records. Each data record refers to an EGNOS message, and is composed of five fields (see Figure 4), separated using blank characters. A "#" character – acting as a separator when packing multiple EGNOS messages inside the same ASCII data field – terminates each data record. The EGNOS message field (see Figure 4) consists on 63 hexadecimal digits[3], which is equivalent to 252 bits. Thus, the last two bits of the message should be ignored, considering that the EGNOS messages include 250 bits [RD 25].

[1] According to the DS2DC protocol nomenclature, commands sent from the user to the SISNeT Data Server are called R-commands.
[2] According to the DS2DC nomenclature, messages sent from the DS to the users as an answer to an R-Command are called A-commands.
[3] Depending on the receiver used in the SISNeT Base Station, the EGNOS messages could have 64 hexadecimal digits. If that is the case, the last digit is always set to 0 and should be ignored.

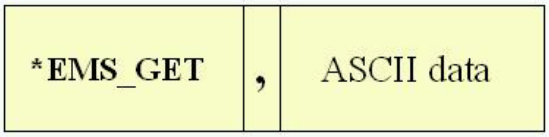

*Figure 3. Format of the *EMS_GET message. For each EMS_GET command sent to the Data Server, the user receives a set of *EMS_GET answers, containing the requested information.*[4]

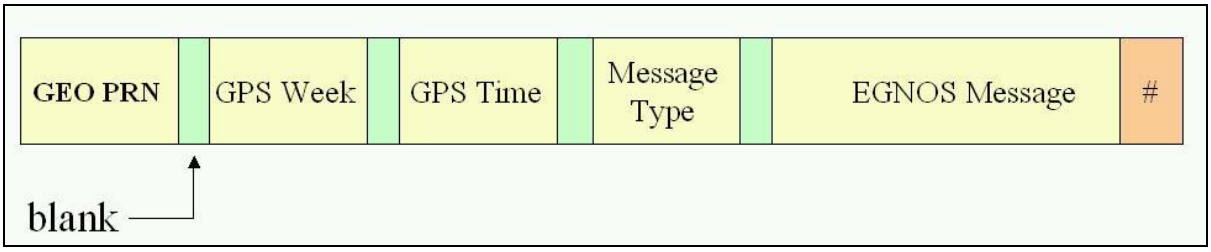

*Figure 4. Structure of data records, contained in the ASCII data field of the *EMS_GET message. Note fields inside the data record are separated by blanks, and each data record is terminated by a "#" character.*

The number of EGNOS messages packed into one *EMS_GET message is not a constant quantity. In fact, this parameter can be modified by the system at any time without previous notification. Moreover, this parameter can take different values for the different users connected in a given moment. The DS will send to each user as much *EMS_GET messages as necessary to provide all the requested EGNOS messages. **In order to avoid network overload situations, ESA reserves the right to set up a bound for the number of EGNOS messages to be received in response to a single EMS_GET command.**

The time interval between consecutive *EMS_GET answers depends on the network overload and several other parameters. **The SISNeT system does not warranty a bound for that time interval.**

After providing all the requested messages, the DS sends an extra *EMS_GET message, which ASCII data field contains the string "END". This message indicates the full provision of the requested information (see Figure 5).

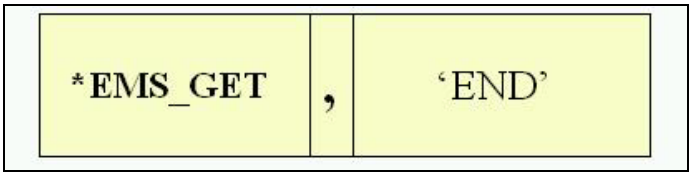

*Figure 5. The sequence of *EMS_GET answers ends with another *EMS_GET message, this time containing the string "END" in the "ASCII Data" field. Note that single quotes are not present in the message.*[5]

[4] The Data Server terminates this message with a line feed character (which could be preceded by a carriage return).
[5] The Data Server terminates this message with a line feed character (which could be preceded by a carriage return).

In order to regulate the bandwidth usage, the EMS_GET command will only work if no other EMS_GET transference is active. Otherwise, the user will receive a DS2DC error message from the DS.

The EGNOS messages are provided using the same format employed by the "*MSG" DS2DC message. Note that a specific compression algorithm (called SINCA) is applied[6].

In the case of introducing the SISNeT-based user interface in a future EMS version, the couple of DS2DC elements introduced here would be added to a new version of the SISNeT User Interface Document [RD 01].

Regarding the availability of the EGNOS messages, the applied policy is in line with the file storage rules employed for FTP access (see Chapter 4): **from the beginning (t=0) of each GPS week, each hour of EGNOS messages will be available after concluding that hour (plus a small delay due to file storage and pre-processing)**. For instance, data in the 0 to 3599 seconds interval will be available from t = 3600 GPS seconds.

4. ACCESS TO EMS VIA FTP

As introduced in Chapter 2, the standard way to reach EMS data consists on using the File Transfer Protocol (FTP, see [RD 04]). Users directly communicate with the FTP server software running in the EMS. Communications are not based on the exchange of text messages. Instead, information is obtained in the form of computer files.

Users start an FTP link with EMS, using the particular host name or IP address of the EMS machine. After the login phase – anonymous or not – access to a directory called "pub" is conceded. The "pub" directory contains all the EGNOS message files already recorded. This directory has no access restriction, i.e. is available even if the user performs anonymous login.

HOW TO REACH THE EMS SERVER

The EMS service is accessible via anonymous FTP, connecting to ems.estec.esa.int. Using a Web browser (e.g. Internet Explorer), EMS can be easily accessed by typing ftp://ems.estec.esa.int in the address bar.

Other directories could exist in the EMS, always containing information related to EMS or generated by that service (e.g. maintenance reports, EMS access statistics, etc.). However, those directories will only be accessible by users authorised by ESA – principally ESA Engineers in

[6] See [RD 01] for details on the *MSG message format and the SINCA compression and decompression algorithms.

charge of the EMS maintenance – requiring login / password information. Summarising, all the interactions with EMS always take place inside the 'pub' directory.

Users will only be allowed to download files from the FTP server to their computers, so file upload is forbidden.

The "pub" directory is organised taking the following rules into account (see Figure 6):

- No EMS files are directly stored into the "pub" directory. Instead, only sub-directories will be present, each one referring to a different data-collection site.

- Inside each site's directory, one or more sub-directories will be present. Each sub-directory corresponds to a year, and is named using the year number, preceded by the "y" character (e.g. "y2003").

- Each yearly sub-directory includes several daily sub-directories, named using the day-of-year number, preceded by the "d" character (e.g. "d121"). Day-of-year is expressed using three digits.

- Finally, each daily directory contains 24 files (called EMS files hereafter), each one containing an hour of EGNOS messages (i.e. 3600 messages). These files are created on the server each hour.

- EMS files are named as "h00.ems", "h01.ems", … , "h23.ems". File "h00.ems" contains EGNOS messages broadcast from 00:00:00 to 00:59:59 (UTC time). File "h01.ems" covers data from 01:00:00 to 01:59:59 (UTC time). At the end of the day, file "h23.ems" is written, containing messages broadcast from 23:00:00 to 23:59:59 (UTC time).

- Each EMS file is written just after collecting data for the corresponding one-hour interval (a delay of less than 1 minute could appear due to data processing). For instance, file "h13.ems", containing data from 13:00:00 to 13:59:59 UTC will be written at 14:00:00 UTC approx.

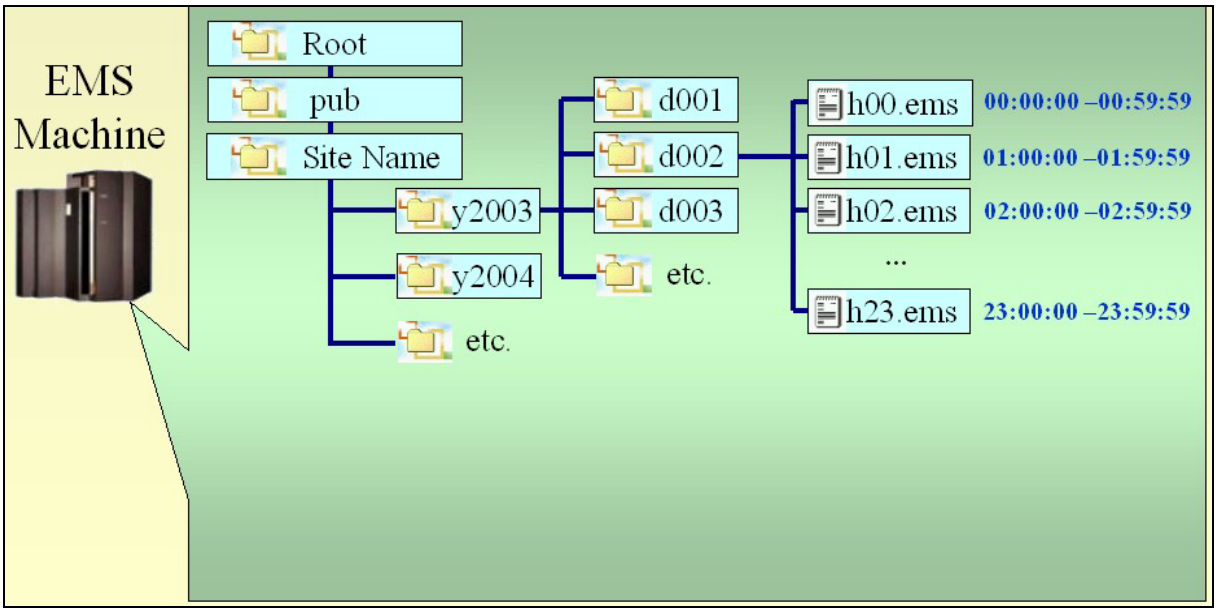

Figure 6. Organisation of EMS files

The EMS files are basically text archives, enclosing one data record per text line. Each data record contains an EGNOS message. Therefore, considering the rules exposed in the previous paragraphs, each EMS file will contain 3600 lines of text. The structure of a data record is shown in Figure 7. Blank characters are employed to separate data fields. Each data record ends with a line feed character (LF).

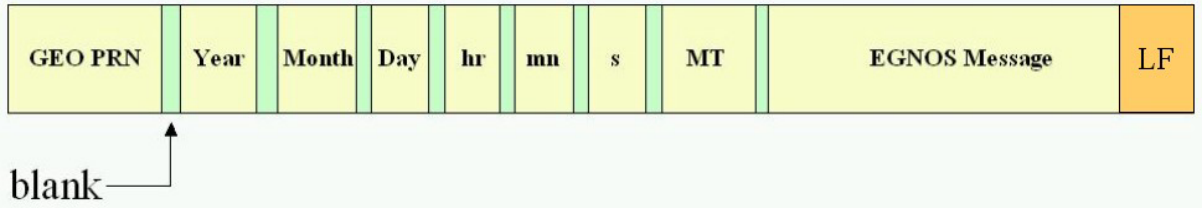

Figure 7. Structure of data records in EMS files.

The contents of each data record are the following:

- PRN number of the GEO satellite providing the EGNOS messages;
- UTC time stamp, indicating year, month, day, hours, minutes and seconds (being all expressed using two digits);
- Message Type, derived from bits 9 to 14 of the EGNOS message;
- The EGNOS message in hexadecimal format (see Chapter 3 for more details).

As an example, Figure 8 shows a fragment of an EMS file.

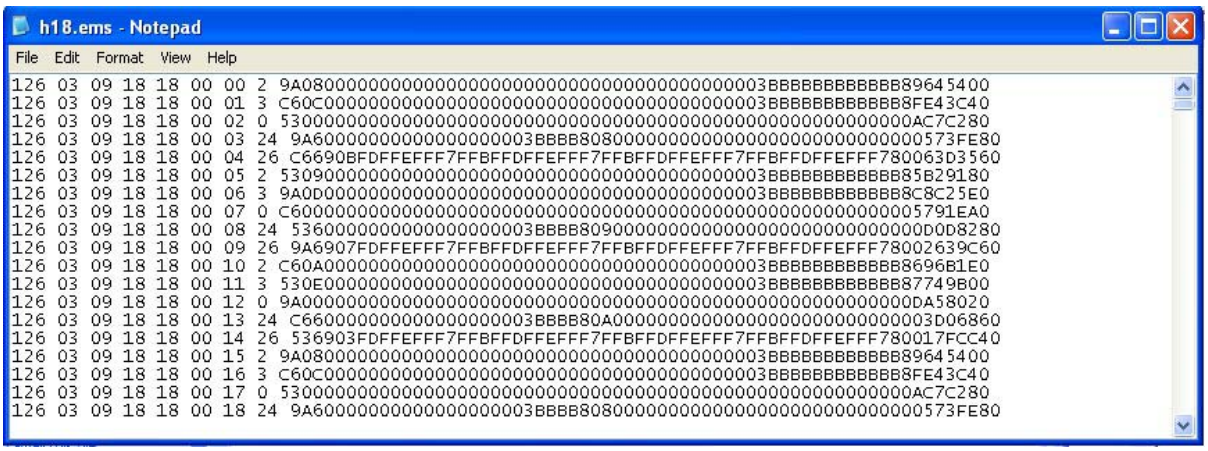

Figure 8. Example of an EMS file

Considering that:

- Usually, a data record has 90 characters;
- Each EMS file contains 3600 data records.

Then, the typical size of an EMS file will be 90 x 3600 = 324,000 bytes, i.e. approximately 317 KB. A more detailed study has been performed, taking into account the case of having the longest possible data records, resulting on a file size of 334 KB. In such worst-case scenario, the total volume of information written per year is 2.8 GB. Since the EMS computer will have a minimum of 30 GB of free hard disk, more than ten years of data can be stored in the EMS without deleting information.

In view of this figures, no data deletion is necessary during the life of the EMS. In other words, all the EGNOS messages since the beginning of the service will always be accessible during the whole operational life of the EMS.

5. LEAP SECONDS MANAGEMENT

In order to compensate Earth rotation anomalies (due to rotation slowing trend), leap seconds are sometimes applied to UTC time. When applicable, leap seconds take effect on the 30th of June or the 31st of December. This information is officially announced, with enough anticipation, in http://hpiers.obspm.fr/eoppc/bul/bulc/bulletinc.dat

Since EMS employs UTC time, leap seconds must be taken into account. Figure 9 shows the effect of applying a leap second on the message time sequence. This can be observed in the EMS file recorded when the leap second is applied, which is always 'h23.ems'. If the leap second is positive, an extra second is added, so that the EMS file has 3601 data records, instead of 3600. In the case of applying a negative leap second, one data record is skipped, so that the EMS file contains 3599 data records.

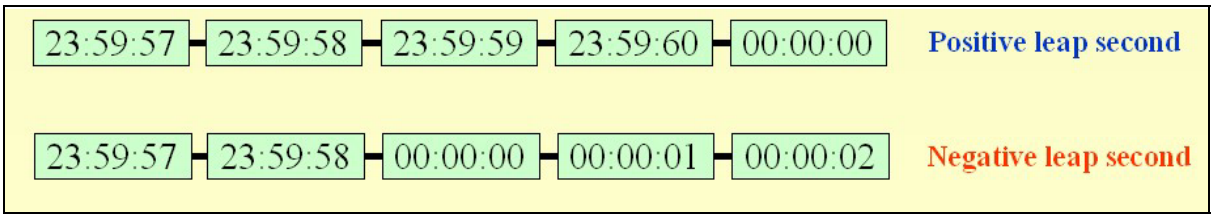

Figure 9. Application of leap seconds

6. SUMMARY

This Document has presented the architecture and user interface of the ESA EMS service, which continuously stores the SBAS messages broadcast by the EGNOS system, allowing users retrieving the EGNOS messages broadcast during a given period of time over the Internet. This functionality is of high interest as a complement to the ESA IMAGE [RD 02, RD 03] initiative. EMS opens the possibility to enhance existing service volume simulation tools (e.g. ESPADA, see [RD 18] and [RD 19]), making them able to get EGNOS messages broadcast during a certain period, and evaluate performances using those real data.

Two basic interfaces with the EMS service have been presented. The first one relays on the ESA SISNeT technology [RD 05 – RD 17]. This option (explained in Chapter 3) is not implemented in the current version of EMS. However, ESA is assessing the potential introduction of this feature in future versions of EMS.

The standard way to reach EMS consists on using the well-known FTP protocol [RD 04]. All the details about file organisation, access policy, naming conventions, file deletion policy and file formats have been discussed in Chapter 4. Some explanations on leap second management have been provided through Chapter 5.

The Document ends with a remarkable conclusion: due to the reduced size of files, the EMS service will be able to work without the need of deleting files during all its operational life. In other words, all the SBAS messages broadcast by EGNOS since the official launch of the EMS (planned in early October 2003) will be available to users at any time.