THE EGNOS DATA ACCESS SYSTEM (EDAS): THE VEHICLE TO THE FUTURE EGNOS COMMERCIAL DATA DISTRIBUTION SERVICE

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ABSTRACT

The EGNOS Data Access System (EDAS) is the main interface point for multimodal Service Providers, to deliver the EGNOS products in real-time, within guaranteed performance boundaries. Service providers will then exploit these EGNOS products, offering services to end users. EDAS will constitute the means for the EGNOS multimodal service growth and introduction of the EGNOS Commercial Data Distribution Service.

INTRODUCTION

The mission of EGNOS is specified to fulfil the needs for a wide number of applications, and as such it is usually broken down in the following services:

- **The Open Service**, freely available to the public over Europe,
- **The Safety of Life Service**, which provides the most stringent level of signal-in-space performance to all communities of Safety of Life users over Europe,
- **The Commercial Data Distribution Service (CDDS)** for customers who require enhanced performance for commercial and professional use.

EDAS is the technical implementation of the EGNOS Commercial Data Distribution Service. Since the successful EGNOS Operational Readiness Review held in mid 2005, the European Space Agency (ESA) is driving the follow-on for EGNOS development, one of whose goals is to progress on the multimodal spirit of EGNOS, bringing on the broad needs of all EGNOS users.

Since 2002 ESA has actively promoted the development of services based on using alternative means to disseminate the EGNOS information. Signal in Space through the Internet (SISNeT) – see [4] to [7] – has been the first and one of the most successful of those initiatives, leading to the development of a SISNeT-enabled receiver based on a Personal Digital Assistant (PDA) device – see [8] and [9] – demonstrations of the SISNeT concept in cars and buses, and even the application of SISNeT to help blind pedestrians find their way around – see [10] and [11]. Other studies have focussed on the dissemination of EGNOS messages through other non-GEO means such as Digital Audio Broadcast (DAB) or Radio Data Service (RDS).

In order to progress with the line of work originated by the previous activities, a new interface providing access to the EGNOS products becomes necessary. The overall objectives of this new interface are to:

- Provide access to the EGNOS products;
- Provide that information within guaranteed performance boundaries (delay, data integrity, security, etc.);

ESA has responded to the above needs by conceiving the EGNOS Data Access System (EDAS). EDAS has been funded by the European Commission 6th Framework Programme, and is managed by the GNSS Supervisory Authority (GSA). Since the start of the activity, GSA and ESA agreed to delegate the technical management of the EDAS project to ESA. The EDAS project has been framed in the context of the GSA GAlileo Reference MIssion Support (GARMIS) project, with FDC (France) being the GARMIS prime contractor. EDAS has been, hence, one of the GARMIS activities and has been executed by an Industrial consortium led by GMV-AD (Spain).

THE EDAS PRODUCTS

The two main types of data provided by EDAS are:

- The data collected by the network of Ranging and Integrity Monitoring Stations (RIMS) ,and Navigation Land Earth Stations (NLES);
- The EGNOS augmentation messages;

These data are intended to be provided to 3rd Party Service Providers for further processing according to the specific needs of their application. The EDAS products are provided to the Client (service provider) software in real-time, with stringent latency requirements for the transmission of the data (between 150 ms and 300 ms, depending on the type of product).

THE EDAS ARCHITECTURE OVERVIEW

EDAS architecture and interface boundaries are illustrated in Fig.1, where the system is placed in its intended operational context. The diagram in Fig.2 shows more details about the system interfaces.

In order to provide a common and standard interface for external Service Providers, the EDAS architecture is decomposed into two separate elements:

- **EGNOS Data Server**, implementing the interface with the EGNOS Master Control Centre (MCC) and performing the necessary data processing.

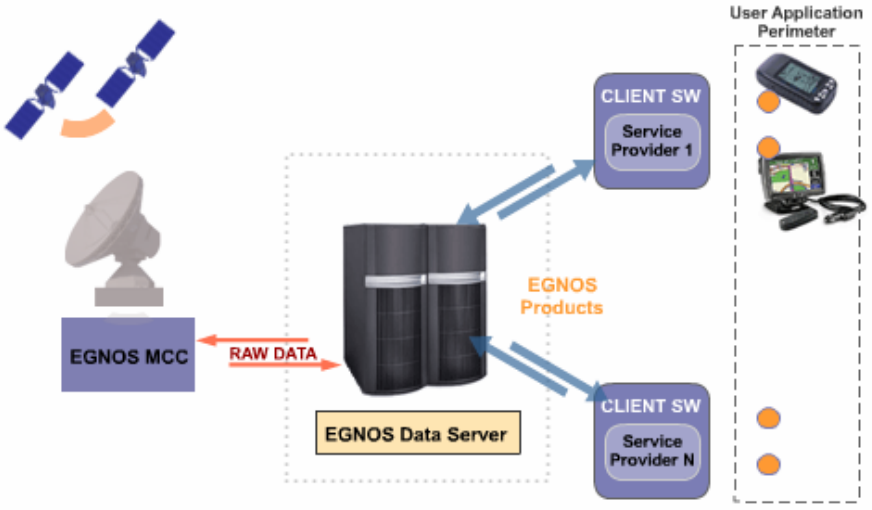

Fig.1: The EDAS in context: architecture and interface boundaries.

- **The EDAS Client Software Component**, resident at the service provider, implementing the external interface of EDAS and responsible for basic security functions and for the interface with the EDAS through the appropriate communication means.

These two elements (and indeed EDAS) are outside of the EGNOS system perimeter. They implement a number of communication protocols defined by the following interfaces:

- The so-called **INSPIRE interface**, between the EGNOS core and the EDAS Data Server: The INSPIRE interface belongs to the EGNOS system.
- The **Interface between the EGNOS Data Server and the Client Software**. This interface is internal to the EDAS perimeter, and it is not accessible to the Service Providers
- The **Interface between the Client Software and the Service Providers**. This is the interface available to Service Providers, in order to obtain and process the EGNOS data according to their specific needs.

All the above subsystems and interfaces are presented in more detail in the next Sections, covering both the components of the EDAS and also the interfaces with internal and external systems (i.e. INSPIRE and the Service Providers).

The INSPIRE Interface

The primary source from which the EGNOS products are obtained in real-time is the INSPIRE interface. Therefore, EDAS uses the INSPIRE interface as the source of data. INSPIRE – which belongs to the EGNOS system perimeter and is not directly accessible to Service Providers – provides access to the following data:

- Navigation Overlay Frame (NOF) for each of the EGNOS GEO satellites
- RIMS A, B and C raw measurements, and NLES receiver measurements

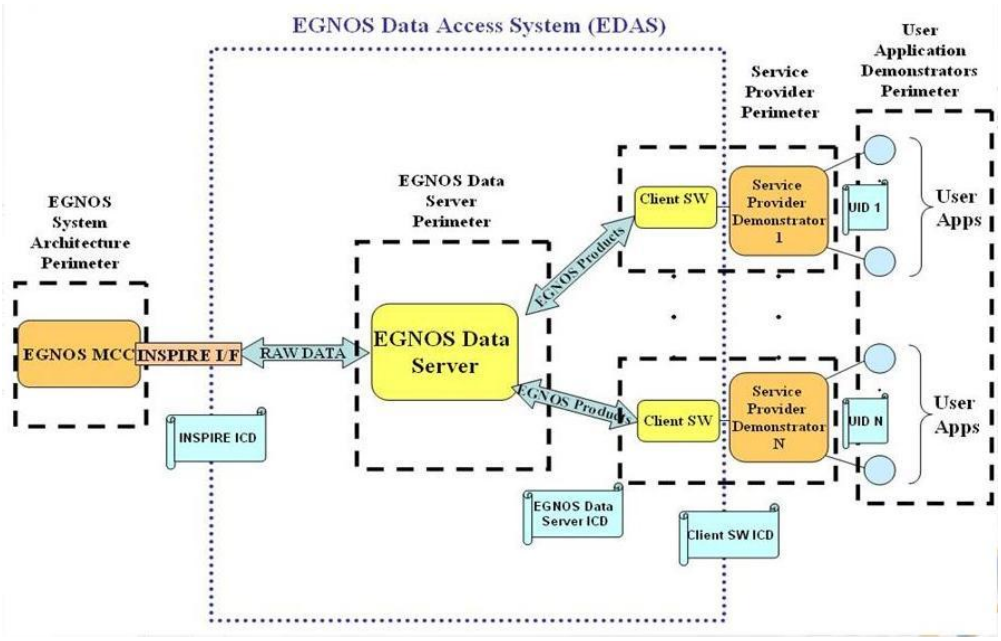

Fig.2: The EDAS in context: Detailed architecture and interface boundaries with ICDs.

Connection of Service Providers directly to INSPIRE could compromise EGNOS in terms of Security. As well, some Industry proprietary data formats need to be protected, and different levels of service provision (i.e. different data pre-processing levels) are convenient to meet the needs of some potential future Service Providers. For those reasons, a new component, the EGNOS Data Server, is connected to INSPIRE. This is described in the next Section.

The EGNOS Data Server

The EGNOS Data Server is fed by INSPIRE data. It provides, among others, the following functions:

- Allows accepting connection from a high number of Service Providers.
- Introduces a further security layer between INSPIRE and the Service Providers.
- Protects EGNOS proprietary protocols and data formats.
- Makes possible defining several levels of data provision (from raw data to more complex products)

Fig.3 presents the EGNOS Data Server interfaces. Regarding the interface with the EGNOS System, the EGNOS Data Server is currently connected to one INSPIRE implementation (although it is prepared to be connected to two), via dedicated lines. On the other side, the interface with the Service Providers is done via dedicated or Frame Relay lines.

When the EGNOS Data Server is connected to two INSPIRE implementations, this component is normally working through one of the two INSPIRE systems, defined as active. In case of detecting a configurable number of sequences of CRC errors or data gaps, the EGNOS Data Server will immediately switch to the other INSPIRE implementation.

The EDAS specifications are very stringent in terms of performance, ensuring that the latency between the output of raw data at the INSPIRE interface and the availability of data at the service provider (i.e. ready for processing) is 150 milliseconds maximum for Service Level 0 (raw data) products and 300 ms for Service Level 1 (pre-processed) products.

The Client Software Component

The Client Software Component is a platform-independent interface element allowing connecting Service Providers to the EDAS.

The Service Providers will make use of this software component to obtain the EGNOS products in real-time from the EDAS, then performing the necessary processing and finally providing services to end users via non-GEO means. The Client Software user manual – containing the interface specification – will be supplied to Service Providers. However, the interface between the Client Software and the EGNOS Data Server belongs to the EDAS internal perimeter, so the corresponding Interface Control Document (ICD) will not be visible to the Service Providers.

The Client Software Interface is based on Java code and messaging standards. Information is provided by the “publisher” (i.e. an EGNOS MCC through INSPIRE). This information is classified in “topics”, building a data queue per topic. Finally, the Client Software acts as a “subscriber”, subscribing to the desired “topics” (different information levels, from raw data to more elaborated products).

The EDAS Service Providers

The Service Providers are linked to the EDAS via the Client Software Component, using either a high-speed, high reliability, dedicated line to reach EDAS (e.g. Frame Relay) or regular internet. The dedicated line allows the Service Providers to obtain the EGNOS products in real time, and perform the desired processing of data. The internet connectivity to EDAS allows the same functionality but with reduced reliability and increased real-time latencies. Finally, they provide services to end users via non-GEO means

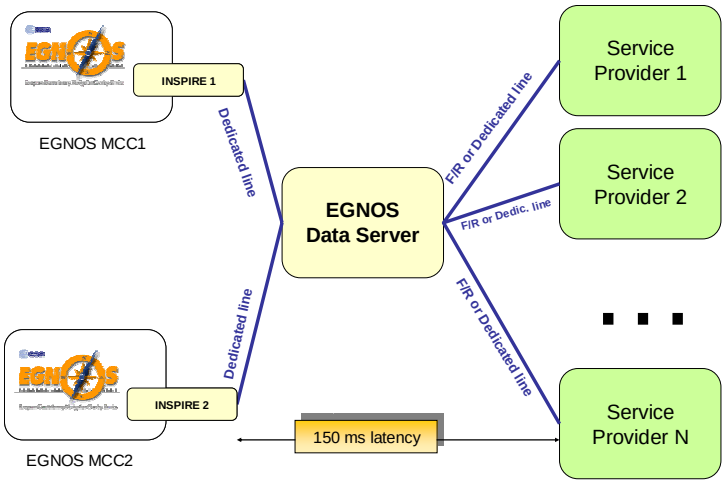

Fig.3: EGNOS Data Server Interfaces

The mosaic of applications that may be derived from EDAS is extremely wide. Some examples of potential future Service Providers are the following:

- SISNeT Data Server
- EGNOS Broadcast in RTCM SC104 Format
- EGNOS Dissemination via RDS
- EGNOS Message Server (EMS, see http://www.egnos-pro.esa.int/ems)
- EGNOS Pseudolites [12]
- WARTK Ionospheric Corrections [13]

At R&D level, ESA – in coordination with the GSA –is already working in the connection of the ESA SISNeT Data Server to EDAS, not intended for commercial use. In addition, a test of the first EGNOS Pseudolite (developed under ESA contract) connected to EDAS will be performed, also with no commercial intention.

It is expected that service providers and end users will find new innovative ways to use EDAS. The GSA and ESA expect that service providers and end users will be actively consulted and involved in the future evolutions of EDAS, in order to respond to their evolving needs as best as possible.

EDAS DATA PROVISION SERVICE LEVELS

There are two options of service levels that will be provided by the EDAS to Service Providers. Using first option (Service Level 0) the EDAS will provide only raw products, i.e., raw data coming from INSPIRE (with minimum post-processing) will be relayed to Service Providers. The other option considers higher service levels; in this case, the EDAS process the information coming from INSPIRE adapting the data format before relaying it to Service Providers.

EDAS HARDWARE AND SOFTWARE ARCHITECTURE

The functional software architecture of the EGNOS Data Server (EDS), composed of several well-identified modules, is depicted in Fig.4. First of all is the INSPIRE processing module of EDAS, which is responsible of acquiring and performing some basic pre-processing on the information coming from INSPIRE. A core function sub-system performs the internal tasks regarding implementation of the different service levels explained above. In order to deal with distribution of processed data to Service Providers (SP), a SP Interface module has been designed. The Man Machine Interface (MMI) allows configuration by EDAS operators of the system parameters and obtain useful reports, managing a user-friendly web-based interface, which is complemented with an additional command-line interface. The MMI allows an effective control and monitoring of the platform.

The above mentioned four core functions are complemented by a Monitoring and Control function, and finally the whole software system is protected by Software Security functions.

Independence of all of these modules has been ensured, so that a problem related to one module cannot affect the other modules. These modules are supported by a hardware architecture designed with high availability in mind; redundancy of critical elements is implemented.

As EDAS constitutes a relevant entry point from the outside world to the EGNOS architecture, strong security requirements are compulsory. Access control measures are specially focused in assuring Authentication, Authorization and Accounting (AAA) for Service Providers.

EDAS PROJECT STATUS AND EXPLOITATION PLANS

The design, implementation and qualification of EDAS started in May 2006, and were completed in October 2007, after successful Acceptance Review (AR) and Security Audit Review (SAR) events. The EDAS system is currently available and operated at the EGNOS Mission Control Centre (MCC) in Torrejon (Spain).

The operations and maintenance of the EDAS server are secured in the long term, as these activities are part of the overall EGNOS Service Provision. In parallel to the operations and maintenance of EDAS, the GSA is planning the commercial exploitation of EDAS to be accomplished in two phases:

- **Phase 1 (until beginning of 2010):** prototyping (or "beta testing") phase. During this phase, access to the EDAS data is provided free-of-charge to users. The term "free-of-charge" means that users will not pay a fee to access the EDAS data, but costs of installation of the connection to EDAS (e.g. telecom line) will be incurred by the user. In phase 1, access to EDAS data is intended to be as open as possible, with no restrictions on usage (except the time duration), but also no guarantee or liability from GSA. The purpose of this phase is consolidating both the technical and commercial potential of EDAS and the CDDS.

- **Phase 2 (from 2010 onwards):** Commercial exploitation phase. In this phase, the commercial model defined in the previous phase will be rolled-out, possibly including a fee-per-use scheme between users of the EGNOS CDDS Service Provider

Phase 1 will allow gaining an in-depth knowledge of EDAS performance, to identify possible system deficiencies and to correct them in time for Phase 2. Phase 1 is due to start by the end of 2008.

Apart from the fundamental EDAS Operations & Maintenance, the commercial exploitation will also need provision of last-mile connectivity to users. These activities will be run by the EGNOS CS provider (to be chosen after the Phase 1)

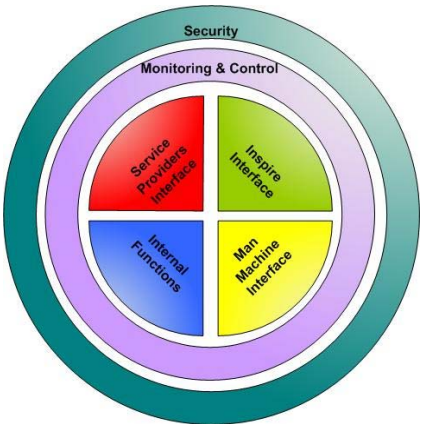

Fig.4: EGNOS Data Server Functional Design Architecture

SUMMARY

This paper has presented the EGNOS Data Access System (EDAS) project, a system that will constitute the single interface point where multimodal Service Providers can obtain the EGNOS products in real-time and within guaranteed performance boundaries, for Service Provision through non-GEO means. The EDAS is the technical core of the EGNOS Commercial Data Distribution Service, which is one of the 3 services that EGNOS is required to provide to the user community (the other two being the Open Service and the Safety-Of-Life Service).

The motivation, objectives, and architecture have been presented in detail. A number of potential applications based in EDAS have been also anticipated in this paper. It is expected that the number of applications based on EDAS will grow with the realisation by end users and service providers of the potential that the access to the EGNOS products through this technology offers.

The EDAS project has been kicked-off in May 2006, and completed in October 2007. EDAS is available at the EGNOS MCC in Torrejon (Spain). The GSA is planning to implement the commercial exploitation of the EGNOS system in two phases. The first phase (until beginning of 2010) will constitute a beta-testing stage, and will encompass free-of-charge access to the system (however, without guarantees). In a second phase, from 2010 onwards, the EGNOS CDDS exploitation phase will start, and will be managed by the EGNOS CDDS Service Provider responsible for providing products within guaranteed performance boundaries (with terms and conditions to be defined before Phase 2 starts).

EDAS will constitute the vehicle for the EGNOS multi-modal services growth and EGNOS commercial exploitation.

For further information about EDAS, the reader is addressed to the EDAS Official website (http://www.egnos-edas.com) and also [1] to [3].

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