

Conceptual Design of a European Space Surveillance System

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Space Surveillance denotes the task of systematically surveying and tracking all objects above a certain size and maintaining a catalogue with updated orbital and physical characteristics for these objects. Space Surveillance is gaining increased importance as the operational safety of spacecraft is depending on it. Presently, Europe has no operational capability for Space Surveillance, and is strongly dependant on external information from the USA and Russia.

Two design studies for a European Space Surveillance System (ESSS) were conducted for ESA since 2002. These studies have proposed a system covering the LEO, MEO and GEO orbit regions. This system associates dedicated sensors with the required survey strategies allowing for the autonomous maintenance of an orbital parameters catalogue (including cold start capability).

Concerning the LEO surveillance system, the main findings are the following:

- For the surveillance of objects larger than 10 cm, a survey strategy using a UHF bistatic radar with a large field of view (20° in elevation and 180° in azimuth) and a long range (1500 km for a 10 cm sphere) is proposed. This proposition is based on the French experience with the GRAVES system development. An interesting European location for this radar would be Spain.
- The optimal frequency for the detection of such objects is around 600 MHz (UHF). This option is very risky from the point of view of frequency allocation, since it is reserved for TV broadcasting. The 435 MHz frequency (UHF also) appears to be a good alternative in terms of implementation risk, detection performance and cost.
- Since this radar is based on a continuous wave transmission, the proposed European surveillance radar is bistatic (one site for transmission and one site for reception). With respect to GRAVES, its design has considerably evolved, decreasing both complexity and cost.
- The LEO surveillance system will be capable of cataloguing 98 % of the LEO objects contained in the US catalogue.

Concerning the GEO surveillance system for objects larger than 1 m, a combined survey and tasking strategy is proposed. Four sites equipped with survey and tasking telescopes are proposed. It is estimated that such a system would be capable of maintaining 95 % of the GEO objects contained in the US catalogue.

Concerning the MEO region that will soon gain more importance for Europe due to the GALILEO system deployment and the surveillance of objects larger than 1 m, the main findings are the following:

- MEO space surveillance shall follow a strategy similar to GEO's, a combined survey and tasking strategy. Two sites (chosen from the four GEO's sites) are necessary for MEO survey, each one equipped with a dedicated MEO survey telescope. MEO tasking observations will be carried out in combination with GEO tasking observations by the previously proposed GEO telescopes.
- Depending on the efficiency of the MEO survey sensors, 89% of the US catalogue can be covered after 2 months using standard detector technology, while 95% can be covered after 1 month using innovative, demanding detector technology.

A development plan for the ESSS is proposed with 3 phases (demonstration for the UHF radar, pre-operational for the LEO and GEO systems and operational). A cost evaluation for the complete system is given.