

SPACE SYSTEMS SYMPOSIUM (D1)
Lessons Learned in Space Systems (5)

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FROM VAX TO IPHONE: 20 YEARS OF CLUSTER MISSION GROUND SEGMENT EVOLUTION

Abstract

Cluster is a multi-spacecraft ESA mission launched in 2000 to study the Earth's magnetic environment. The ground segment was designed in the early 1990s for the original Cluster mission destroyed during launch in 1996.

In 2006, a large number of upgrades were performed in preparation for the second mission extension: communications were migrated from X.25 to TCP/IP, VAX servers were replaced and Internet became the primary way of distributing science data. All these allowed a 25% reduction of the annual operations costs.

In the last years a significant orbit change and the degradation of the spacecraft batteries and solar panels have dramatically increased operations complexity. A mission extension up to 2014 has prompted further updates of the ground segment to handle the new scenarios within the mission budget. The tools and technologies implemented in the areas of automation, data access and mission planning are the subject of this paper.

The MOIS automation system is now routinely used for critical eclipse operations without batteries. Every 54 hours, all platforms and payloads are safely recovered in less than two hours by only two spacecraft controllers under engineer supervision. This is a key achievement to survive nine months of eclipse operations in 2011 without increasing the team size.

Existing tools to access Cluster house keeping telemetry were slow and limited to the operational environment on site. MUST, a parameter archive tool developed at ESOC/ESA has been customized for Cluster and allows an easy and quick access to any spacecraft parameter from anywhere. More complex tools have been built on top, like iCluster, an iPhone application which allows on-call engineers to access Cluster operational procedures and telemetry in real time.

Finally, the original Cluster mission planning system has proved to be too rigid to accommodate seven ground stations, eclipse operations and dynamic data rates when operating the transponder in low power mode. A set of web tools internally developed by the Cluster team have greatly improved mission planning activities offering a visual overview of the short and long term plan and a simple and elegant interface to implement conflict-free changes.

This paper demonstrates how applying new technologies can be extremely positive to overcome the natural limitations of an obsolete ground segment and to deal with the new challenges that arose when missions go far beyond their design lifetime.