

SYMPOSIUM ON INTEGRATED APPLICATIONS (B5)  
Tools and Technology in support of Integrated Applications (2)

Author: Mr. Riccardo De Benedictis  
Italian National Research Council (CNR), Italy, riccardo.debenedictis@istc.cnr.it

Dr. Luigi Carotenuto  
Telespazio S.p.A., Italy, luigi.carotenuto@telespazio.com

Dr. Antonio Ceriello  
Telespazio S.p.A., Italy, antonio.ceriello@telespazio.com

Dr. Amedeo Cesta  
Italian National Research Council (CNR), Italy, amedeo.cesta@istc.cnr.it

Mr. Andrea Orlandini  
Italian National Research Council (CNR), Italy, andrea.orlandini@istc.cnr.it

Dr. Riccardo Rasconi  
Italian National Research Council (CNR), Italy, riccardo.rasconi@istc.cnr.it

## PLANNING AND SCHEDULING SERVICES TO SUPPORT FACILITY MANAGEMENT IN THE ISS

**Abstract**

The “USOCs Knowledge Integration and dissemination for Space Science Experimentation” (ULISSE) is a project (funded by EU and indicated by REA as example of successful FP7 project in the Space field) whose objective is data valorization around the ISS experiments. In fact, each USOC (User Support and Operation Centres) is responsible for a particular on-board facility that is to be operated to perform scientific experiments and to generate the related scientific data. In this regard, USOCs have to interact with the Columbus European Planning Team (EPT) - during a phase referred to as Increment Planning Process - in which the EPT collects the activity plan for each facility and produces an overall ISS schedule. One of the main problems that the USOC engineers have to tackle in their daily activities is the synthesis and management of the experiment plans which originate from the requests of the ESA Principal Investigators (PI) and that will have to be communicated to the EPT and eventually executed on board the scientific facility controlled by the USOC.

Within the ULISSE project, a Planning and Validation Tool (PVT) has been implemented to support USOCs efforts during the Increment Planning Process. Such tool aims at supporting the automatic definition of activity schedules for scientific payloads, validated with respect to a set of identified requirements and constraints. In particular, a Planning and Scheduling Service (PSS) has been developed and integrated in the ULISSE platform in order to support data production capabilities around the ISS activities. The PSS has been designed on top of the Timeline Representation Framework (TRF) [Fratini&Cesta2008] software infrastructure, following an approach to problem solving named timeline-based [Mussettola1994] that models the world in terms of a set of functions of time that describe their evolution over temporal intervals. The ISS Fluid Science Laboratory (FSL) facility, managed by the Telespazio USOC, has been identified as a representative case study due to its complexity. A planning and scheduling methodology has been exploited to produce a PSS prototype as presented in [Cesta&al2011].

In this work, we present a new PSS version following a re-engineering phase within the J-TRE environment [De Benedictis&Cesta2012] which, based on a combination of integrated P&S algorithms relying on Satisfiability Modulo Theories (SMT) techniques, leads to performance improvements and allows the management of more complex constraints like both reusable and consumable resources profile shaping. Moreover, the FSL problem will be discussed in more details.