

New Operational Concepts, innovative Manufacturing and Air Launched Platforms

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Abstract

The present contribution aims at summarizing the discussion and the conclusions of the the workshop “HIGH TECH SMALL SAT MISSIONS New Operational Concepts, Innovative Manufacturing and Air Launched Platforms”, held in Rome on May 5 and 6, 2011, and organized by CESMA and the University of Rome La Sapienza. The present paper is proposed in the frame of a special issue of “Aerotecnica Missili e Spazio” collecting a selection of some of the scientific papers originally presented at the workshop.

1. Executive summary

The Workshop was organized by the “Giulio Douhet” Center for Aeronautical Military Studies^Å and by the University of Rome “La Sapienza” with the Italian Air Force and Italian Space Agency contribution, with the following goals: to perform a realistic assessment of the advantages that small satellites can offer to the Nation, especially in Security and Defense fields, by means of an analysis of the operative needs, of the technological readiness, of the opportunity of an autonomous access to space, of the economic potential and of an all-around development of the sector at international level; to lay the foundations for a road map definition, made by deeply involved and motivated actors and based on clear aims, and on real funding estimations.

The Workshop was attended by highly qualified representatives of the Ministry of Defense, of the Ministry of University and Scientific Research, of the Italian Air Force, of the European and Italian Space Agencies (ESA and ASI), of Aerospace and Defense Industrial Associations and of the Aerospace companies, among which Small and medium enterprises (SMEs) had a significant role. The Workshop results can be summarized in the following points:

Operational Need According to the Italian Air Force, “an autonomous access to space infrastructures is a critical strategic asset, necessary to assure a leading role in the aerospace sector”. The Defense General Staff assigns to Italian Air Force the following responsibilities (Guideline SMD -L - 002, “Piano Spaziale della Difesa 2”):

- Cooperation with the Italian Space Agency in the manned space flights and San Marco project sectors;
- meteorology and oceanography;
- aerospace medicine;
- micro/nano-satellites and airborne launchers;
- hypersonic and suborbital flights.

In other words, Space can be seen as a natural extension of the traditional aeronautical domain. The Italian Air Force’s strategic lines of action for the extension of the space domain are expressed in the following four guidelines:

- doctrine improvement;
- fight units support;
- astronautic activities;
- new capabilities.

In particular the Operationally Responsive Space (ORS) falls into the “new capabilities” and includes the use of micro/nano satellites and “On demand” Space access by means of airborne launchers. The possibility of a Memorandum of Understanding concerning ORS is in discussion with Department of Defense and with USAF, and the Italian Air Force is candidate to be the main actor on the Italian side.

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2. Development of required technologies

In order to make the use of small satellites convenient, it's necessary to go forward in the miniaturization, standardization and development of subsystems and components (power supply, payloads, navigation and control systems, propulsion, thermal control, etc.) with the aim to obtain relevant performances with small weights and dimensions. Moreover, the development of Earth stations and networks able to manage in an efficient and affordable way a big amount of space assets, even heterogeneous, is of the utmost importance. The Workshop revealed a vast amount of initiatives to develop the required technologies, with ASI or ESA support, or by means of the companies R & D funds. This situation shows a big fervor from one hand, but a fragmented condition on the other, which makes difficult to understand if the initiatives will be able to cover all the necessities and which amount of funds is necessary in order to develop the enabling technologies to develop operative mini, micro and nano-satellites.

3. New launch strategies

During the Workshop different launch options, for micro and nano-satellites, were proposed by means of traditional and airborne launchers. The latter kind of launchers is of great interest in order to guarantee a responsive access to Space.

An airborne launcher involves the following operative advantages:

- independent access to Space;
- reduction of response time;
- confidentiality on launch activities;
- flexibility in the choice of orbit;
- flexibility in launches planning;
- coverage optimization;
- economic sustainability.

This characteristics give airborne launches a big strategic value, including the opportunity of dual use in the national area. Different solutions were proposed by the companies on the matter of the flight platforms to be used for the launch vehicle release. Both options with the launcher carried in a ventral external position by a fighter aircraft, like Eurofighter or Tornado, and options with the launcher carried inside a transport aircraft, like C130 J or C27 J were considered. Each option has pro's and con's and more studies are required. The Italian Air Force expressed its interest in providing support with its aeronautical systems testing and certification competences to any development projects which may be proposed.

4. Industrial and economic features

From a market point of view it was highlighted that 274 small satellites were launched in the period 1999-2010, which means, 23 launches per year on average. These data do not take into account the three commercial communication LEO satellites constellations (Orbcom, Gonets and Globalstar), which include nearly 100 satellites. At the moment 78 satellites are in development with launches scheduled in the period 2011-2013, and this corresponds to a 13 % increment in relation to the past average. This data show fairly good market prospects also considering the university Cube-sat market capability. In current opinion this market could grow in an exponential way when the required technologies will be developed and costs reduction of one or two order of magnitude will be reached. From a conceptual point of view the mini, micro and nano-satellites present significant advantages such as a very low end-to-end response time from the customer request to the launch; high performances due to the opportunity to launch constellations with a great number of small satellites in order to increase spatial, temporal and spectral resolutions; great service robustness because of the redundancy and the very easy substitution of damaged satellites; possibility of spiral development, due to the easy opportunity to launch new satellites with technological improvements and more performances.

The Operational Responsive Space concept and the corresponding MoU proposal were well explained during the Workshop: The ORS assures the availability of all those space capabilities that are required by the US and Coalition military forces, with such a response time that can satisfy the operational need, both in rebuilding and improving the already existing capabilities; The ORS program requires the development of responsive and resilient capabilities for all the components of the space systems: launchers, payloads, launch procedures, satellite command and control, Tasking, Collection, Processing, Exploitation and Dissemination (TCPED) and operations concept definition. A key requirement to achieve the goals listed above is the development of payloads and buses that are small and cheap, with low design, manufacturing, integration, launch and operations time; USAF proposed the establishment of an MoU umbrella to several European and Commonwealth Countries (Italy, France, UK, Germany, The Netherland, Norway, Sweden, Spain, Australia, New Zealand and Canada). The general MoU purpose is: "...to define and establish the general terms and conditions that will be applied to start, conduct and manage cooperative projects of research, development, test and evaluation, to be detailed in specific Project Arrangements (containing the financial commitment) related to specific operationally responsive capabilities...".

More in detail the MoU intends: "...to ease and to support science and technology, the RT& D cooperation and to facilitate the information and the support exchange in ORS..." "...to cooperate in the requirements harmonization, in the architecture definition, in the use of the best technologies and expertise, to reduce the efforts duplication and to emphasize the synergies by means of the cooperative effort..." The participation to the ORS initiative can be an opportunity for the Italian Defense. It is therefore necessary to define interests and priority. During the Workshop an interest of the European aerospace industries, of which the "Italian Industries Federation for Aerospace, Defence and Security" (AIAD) acted as spokesperson, was also highlighted for a program, funded by the EU Commission, to develop capabilities in this sector.

5. Education and training

The importance that education and training of young people has in all the space activities was well emphasized. In particular the Master Classes, both in satellites and launch systems, and the CUBESAT Program (in which several worldwide Universities, are involved), are examples of the attention for this topic.

6. Conclusions

In conclusion of the Workshop possible guidelines to summarize the two days discussion were outlined: A more complete definition of the operative needs is required. This need could be satisfied by means of a permanent Working Group (WG), made up of the Italian Air Force, of the General Secretariat of Defense, of the Italian Space Agency, of the University and of the Industry. The WG could be established by CESMA. Within the WG, a technological roadmap should be developed in order to identify the main themes to be dealt with and the corresponding priorities; There are several proposals for an airborne launcher technological demonstrator. This development could be supported by the Italian Air Force and Italian General Secretariat of Defense, that could deal with the issues concerning the testing and the certification procedures. From the funding standpoint, an initiative to obtain European funds from the European Aerospace and Defense Associations of the LoI Countries exists. Such initiative will be monitored very closely. It would be important to obtain national funds to enforce Italian initiatives and capabilities in the small satellite field, in order to acquire a leadership role within the European and international programs and organizations. A particular attention has been given to ORS and to the MoU proposed by the US to various European and Commonwealth Countries. If Italy wants to acquire a leadership role in the small satellite field, it is necessary to sustain concrete activities. Moreover,

the USAF interest in ORS shows clearly that many advantages exist and that such a investment would be absolutely remunerative.

HIGH TECH SMALL SAT MISSIONS New Operational Concepts, innovative Manufacturing and Air Launched Platforms

A workshop organized by CESMA Università' di Roma La Sapienza
CASD 5-6 May 2011, Rome , Italy
General Chair: Gen. N. Cardinali, Prof. P. Gaudenzi
Welcome addresses

- Adm. Marcantonio Trevisani, CASD President
- Lt. Gen. AF (ret) Gianbortolo Parisi, AAA National President

Introduction
Prof. P. Gaudenzi, Università' di Roma La Sapienza,
The Need and the Opportunity: a Vision on Small Sat Missions
Mr. Remo Pertica, President of IT Industry Federation for Aerospace, Defence and Security
Mr. Enrico Saggese, President of Italian Space Agency
Lt. Gen AF Giuseppe Marani, ITAF Logistic Commander

New Missions and Operational Concepts

Chair: Hon. Mr. M. Airaghi, Counselor of Minister of Defence for Aerospace Activities, Lt. Gen. T. Tosi, AF Operational Commander

- ITAF Operational Concept - Gen. G. Fantuzzi, Airstaff,
- The Vision of Thales Alenia Space - M. Di Lazzaro, Thales Alenia Space
- Rapid Satellite Deployment - F. Depasquale, ELV
- The Italian Innovative Approach for Small Platforms, C. Contini, Carlo Gavazzi Space
- The Market of Small Satellites - R. Villain, Euroconsult
- The Integration of Radar Data - M. Maranesi, Telespazio

Technological Challenges

Chair. L. Pasquali, Thales Alenia Space Italia; Adm. O. Flagiello, SGD/NAD

- Plug and Play Technologies, F. Bruhn, AAC Microtec
- New Technologies, L. Mazzini, Thales Alenia Space
- Miniaturization in Optical Payloads, D. Labate, Selex Galileo
- Distributed Satellite Constellations for Situational Awareness, O. Hawkings, SSTL
- Innovative Space Launch Systems, Prof. M. Onofri, Università di Roma La Sapienza

Forum on Missions and Technology

Chair: Gen. N. Cardinali, Prof. P. Gaudenzi
Round Table with ASAS, AIPAS, AIAD, ASI, AIDAA, SGD
New Launching Strategies

Chair: Lt. Gen. AF D. Esposito, Director General Directorate of Air Armaments - B. Ancarola, Scientific Counselor of Minister of Education, Universities and Research

- Air Platform and Missile Integration Challenge, M. Rosati, MBDA / Ing. A Gatti, Alenia Aeronautica
- The Potentialities of a Cargo Carrier, M. Balducci, AVIO
- Air-Launch of Minisatellites and Cubesat, Prof. P. Teofilatto, Università di Roma La Sapienza
- International Co-operation of Italian MOD, Gen. L. Bianchi, Directorate of Air Armament