

USAF Scientific Advisory Board Study

Microsatellite Mission Applications

Study Abstract

The USAF Scientific Advisory Board's (SAB) Microsatellite Mission Applications (MMA) Study was chartered to review the potential mission utility of satellites with weight less than 300 kilograms (i.e., microsats). Satellite design approaches considered the ability of microsats to achieve mission utility by delivering: (1) complete mission capability, (2) disaggregated mission requirements, (3) augmentation of current capabilities, (4) fractionation of satellite functions, or (5) reconstitution of capability. The Study was motivated by the rapidly changing strategic setting of space as a result of evolving threats, diminishing budgets, increasing space activity, increasing technology miniaturization, and emerging launch options.

The SAB Panel gathered extensive data from a wide cross-section of academia, commercial, and defense satellite designers/manufacturers, military and commercial satellite operators and users, and small satellite launch service providers to assess the near-term and possible far-term state of the art in microsatellite design/manufacture, mission capabilities/utility, and launch. The Study Panel also performed proof-of-concept engineering designs to assess mission capability for proposed microsats.

The Study found that microsatellites have significant near-term (2-5 years) mission capability. Specific findings include: (1) microsats can address all Category A weather requirements, (2) microsats can address some critical space situational awareness (SSA) requirements, (3) other potential near- and mid-term microsat missions exist in space-to-surface intelligence, surveillance, and reconnaissance (ISR) and position, navigation, and timing (PNT), (4) potential far-term microsat missions exist in missile warning, PNT, and communications. In addition, the Study found that: (1) microsats are not currently well supported by Air Force launch architecture, (2) microsat ground system costs could prevent effective mission application, and (3) more suitable ground command and control (C2) architectures and processes exist. In general, the current Air Force space enterprise does not effectively utilize microsatellites for operational missions. However, implementation of the recommended actions below will provide a high-payoff opportunity to enable efficient acquisition, timely launch, and effective use of microsatellites in support of Air Force missions.

The SAB Panel recommended that the Air Force should:

1. Undertake a near-term Pathfinder Microsat Program.

Mission areas with greatest potential are the: (1) Weather mission (address Category A requirements gaps) with a Microwave Imager Sounder microsat program and/or a Space Weather microsat/nanosat program and (2) SSA mission (address critical SSA Initial Capability Document requirements) with a low-earth-orbit to geo-synchronous-orbit (GEO) tracker microsat program and/or a GEO neighborhood watch microsat program.

The Pathfinder microsat program should be implemented with a tailored acquisition process that employs best practices derived from prior small/microsat demonstration programs. This program will also validate the benefits of microsats and provide an opportunity for the development of supporting ground and launch infrastructure.

2. Adapt and Mature Current Launch Architecture to Accommodate Microsats.

The Air Force should establish a Microsat Launch Office that will assist nanosat and microsat programs in obtaining rides on DoD/commercial launches and dedicated small launch vehicles. The Air Force should improve the Enhanced Expendable Launch Vehicle (EELV) Microsat Rideshare Program (e.g., decrease EELV Secondary Payload Adapter (ESPA) integration timeline to 12-24 months and expand secondary payload options). It should foster a robust small launch vehicle industrial base, and develop an approach for shared primary launches that addresses operational priorities, and develop an approach for tailored mission assurance.

3. Implement a Microsat Common Ground Architecture (CGA) Pathfinder.

The Air Force should employ an architecture based on the CGA in use by the DoD at the Naval Research Laboratory and Kirtland Air Force Base to ensure scalability for additional missions and satellites, streamline operations through well-designed automation, and utilize modular open standards software.

4. Initiate Science and Technology (S&T) Investments to Enable Far-Term Employment of Microsats

S&T investments by the Air Force should address both hardware (i.e., infrared focal plane arrays, cryocoolers, radio frequency amplifiers, on-board digital processing, etc.) and processes (open/modular architectures, constellations, rapid design/prototype manufacture, automation and autonomy, etc.). Advances in these areas will reduce the size, weight, and power requirements of microsat payloads and help optimize design, performance, cost, and constellation size to best meet Air Force Requirements.