

## SSC04-II-8

### **Migration of DOD Satellite Operations from the Space Ground Link Subsystem Frequency Band to the Unified S-Band. Transponder Specifications for Small Satellites.**

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**ABSTRACT:** Since the beginning of satellite operations in the 60's, the Department of Defense (DOD) has enjoyed exclusive use of the Space Ground Link Subsystem (SGLS) band (1755-1850 MHz) for satellite operations. Growing pressure from 3<sup>rd</sup> generation mobile wireless devices for use of the SGLS band, as well as the need for the DOD to be interoperable with the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration is making it necessary for the DOD to re-evaluate the exclusive use of the SGLS band and a possible additional use of the Unified S-Band (2025-2110 MHz). Included will be an implementation plan for the migration of DOD satellite operations and the possible impacts on small DOD satellites. Included will be a discussion on the Air Force Satellite Control Network modification timetable and a discussion on development of a dual band transponder for operation in both bands.

#### **BACKGROUND**

For 50 years, the Department of Defense has had the advantage of exclusive use of the Space Ground Link Subsystem (SGLS) frequency band (1755-1850 Mhz). The Air Force Satellite Control Network, has invested considerably in satellite and ground system infrastructure which has exclusive use of that band. Recently, the advancement and development of third generation (3G) wireless technology has placed considerable pressure on the government to reallocate spectrum currently used for other purposes and re-auction it to 3G service providers. The Federal Communications Commission and the National Telecommunications and Information Administration (NTIA) have

focused on two spectrum bands, These are the 2500-2690 Mhz and 1755-1850 Mhz.

Prior to Sept 11, 2001, government agencies and members of congress had been seriously considering phasing out DOD use of the 1755-1850 Mhz band. In fact, an executive directive signed by President Clinton in October, 2000, directed a study to examine spectrum possibilities for future 3G use. SGLS was one of the possibilities identified. Since then, the events of Sept. 11, 2001 have caused that executive order to be rescinded. Although the events of Sept 11 have greatly strengthened the DOD position that national security would suffer greatly if it had to give

up or share this spectrum, pressure continues from the wireless community.<sup>1</sup>

To complicate matters further, There is a major effort being made for DOD to be compatible with other national satellite users, the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration who use Unified S-Band (USB). The unification of national satellite operations in a common band opens up the possibility of a single national satellite control network.



**Figure 1. Spectrum under study**

It remains to be seen, whether DOD will retain exclusive use or will vacate or share the SGLS band, however, expanding spectrum needs of commercial users, compatibility with NASA and NOAA, as well as technical merit inherent in the USB, has caused the DOD to pursue a dual band capability.

**RECOMMENDATION TO MIGRATE TO DUAL BAND**

Recommendation for new satellite acquisitions to have dual band transponders (both SGLS and USB) was received in a memo dated December 9, 2003 from Maj. Gen. C.R. Kehler, Director, National Security Space Office (NSSO). Rationale for the transition were the advantages of S-Band and the interoperability with the National

Aeronautics and Space Agency (NASA) and the National Oceanic and Atmospheric Agency (NOAA) ground stations.<sup>2</sup> Further guidance was given by the Program Executive Officer for Space, Lt. General Brian Arnold. General Arnold has taken steps to develop USB standardized data formats and modulation techniques, as well as a frequency plan. In addition, he has given Program Management Directive to develop a dual band SGLS/USB transponder.<sup>3</sup> Direction has been given to large satellite programs to include dual band capability in all new satellite launches where it is economically and technically feasible. In addition, the Navy Satellite Control Network is also pursuing a dual band capability. Studies are ongoing to assure that Government space operation will have minimum impact on the Television Broadcast Auxiliary Service, the Cable Television Relay Service, or the Local Television Transmission Service who also share the USB band.

**DUAL BAND IMPLEMENTATION SCHEDULE FOR AFSCN**

The Air Force implementation plan is being drafted by the Air Force Satellite Control Network (AFSCN) program. Early indications point to an “initial capability for dual band” in 2010. The definition of this interim state involves having at least three ground antennae and stations having S-band capability. The estimate for full AFSCN capability to S-band is presently placed in 2014.

**STATUS OF DUAL-BAND SPACE HARDWARE**

To date, a transponder with the dual band capability has not been available on the commercial market. The Space and Missile System Center is pursuing transponder technology, however, that development is intending to be all things to all users, and requirements are primarily being driven by large satellite programs with large power and weight budgets.

Therefore, It is expected that once dual band transponders are available, they would be more expensive, heavier, more complex and require a larger software investment from

the spacecraft developer to facilitate switchover from SGLS to S-Band. Presumably, there will be a reliability benefit associated with having the additional capability, but that would depend on the architecture of the dual band transponder.

### **APPLICABILITY TO SMALL SPACE VEHICLES**

The heritage space programs have multiple space vehicle (block) buys and single vehicle lifetimes of 10 years or more. They need to plan for programs lasting multiple decades.

On the other hand, most small space vehicles have single year lifetimes with much faster development and integration times, and are rarely part of a multiple block buy.

These differences between heritage programs and small space vehicle programs lead the authors to the conclusion that the “small space arena” should wait for the heritage programs to lead the way, gather their “lessons learned”, and implement dual band (or USB) when the schedule for full implementation is 3 to 5 years away from fulfillment.

### **RECOMMENDATIONS**

The small satellite community should, in the authors’ opinion, be fully supportive of the transition of the AFSCN from SGLS to dual band and eventually to S-band. There are eventual benefits that are inherent in the transition, and these are welcomed. Indeed, it is very likely that the testing of the new evolved transponders will occur in one or more of our small satellites.

The 10 year timeline associated with the transition from SGLS to dual band is much longer than the characteristically short development times associated with small satellite development (< than 5 years).

Currently the implementation plan for dual band use, being drafted by the NSSO contains language that exempts Experimental or R&D satellites from the DOD dual band requirement, however, the

small satellite community should be vigilant to resist any broad DOD directives requiring dual band transponders for new small satellite programs. Hopefully, this waiver will allow our generally under-funded community to benefit from the experience of the heritage programs. When ground implementation of the dual band capability is closer to completion, the program office embarking on a new acquisition for a small spacecraft will need to decide if USB or dual band is the optimum approach to be used.

Perhaps leapfrogging of the dual band transponder approach will become the obvious solution with small satellites transponders going directly from SGLS to USB. That decision however needs to be dependent on how elegant the implementation of the dual band transponder turns out to be.

Small satellite acquisitions encompassing multiple identical spacecraft buys provide a possible requirement for dual band transponders. The answer needs to consider the period of performance of the satellites. If the first satellite will be in space before 2014 it will require SGLS. If however the last satellite in the series will fly after the SGLS support is abandoned, then a transition to dual band or to USB will need to be conceived during the contracting stage.

### **REFERENCES**

1. Viability Assessment; NTIA, “An assessment of the viability of accommodating advanced mobile wireless (3G) systems in the 1710-1770 and 2110-2170 bands”, Jul 22, 2002
2. Letter; Director, NSSI, “Satellite Operations (SATOPS) Dual Band Command and Control (C2) Capability”, Dec 9, 2003
3. Letter; Commander, Space and Missile System Center, “Space Systems Command and Control Policy”, Sep 21, 2003