The Next Step for High Data Rate Communications for Sounding Rockets and Balloons

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Abstract

The technological advancement of instrumentation for space and earth science investigations drive the requirement for high data rate communications and on-board data recording to support new discoveries of our universe. In sounding rockets and balloons, the current telemetry systems that support science payloads limit the extent of the science conducted. This presentation investigates the past and current technologies and proposes possible solutions to achieving high data rate telemetry for sounding rockets and balloons.

High Rate Sounding Rocket Downlink

High data rate telemetry has been a constant need of the scientific community for both sounding rockets and balloons. Only recently within the last three years, the NASA Sounding Rocket Operations Contract (NSROC) supplemented the 10 Mbps PCM encoders with a 20 Mbps encoder for the science experiment downlinks, forcing scientists to develop their own high data rate on-board recorders. NSROC is currently working towards a 40-50 Mbps encoder with Ulyssix Technologies. Higher data rate flights utilizing X-band have been flown; however, there is no current X-band infrastructure dedicated for sounding rocket use.

The current infrastructure in place are the S-band telemetry bands of 2200-2290 MHz (lower S-band) and 2360-2395 MHz (upper S-band). The next logical step is to utilize the current S-band with modern communication schemes. The largest contiguous bandwidth that can be used is the lower S-band of 90 MHz, and this presentation demonstrates an efficient communications solution that may allow up to 400 Mbps downlink in this bandwidth. This solution provides the first step into higher data rates utilizing the current ground station RF infrastructure, eventually progressing into multi-gigabit downlinks.

High Rate Balloon Downlink

For high altitude balloons, direct line of sight communications typically last for only 24 hours due to loss of signal (LOS). After LOS from the launch site the payload relies on relay satellite networks such as TDRSS or Iridium with data rates at hundreds of kbps (S-band). Most balloon payloads will not be able to use the high data rate K-band TDRSS services, which are capable of data rates in the hundreds of Mbps.

A similar solution to the one presented for sounding rockets can also be used for balloons with minor changes; however, there is still the problem of LOS from direct line of sight. Similar to the concept used with cellular phone towers, several cells can be made on the ground in order to provide the necessary framework for high rate communications or receive data in the “store-and-forward” mode.

Conclusions

As the communications industry has advanced in recent years offering multi-gigabit communication links, the technologies used in these sub-orbital space research platforms have not advanced accordingly. This presentation offers a few possible methods for taking the first steps into achieving higher data rates.

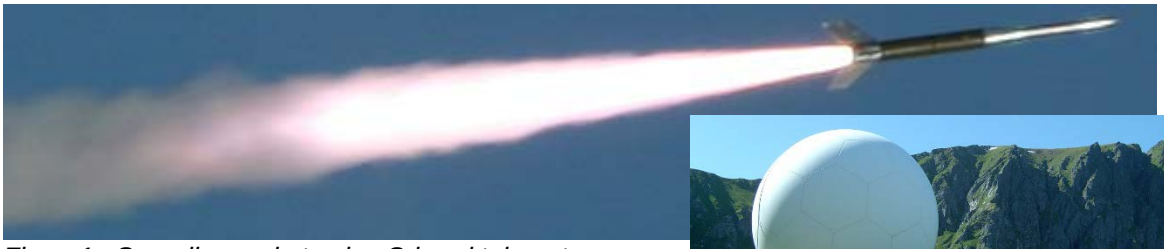

Figure1. Sounding rocket using S-band telemetry.

Figure 2. S-band antenna with radome.