

AI_19-05: Consideration of GMSK+PN Ranging for Simultaneous Uplink High Rate Commanding and Ranging

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I. Introduction

Action item AI_19-05 was issued at the Spring 2019 RFM meeting to check if GMSK+PN ranging on the uplink was needed by the Lunar Gateway mission, and if so, propose its addition to the RF & Modulation working group charter.

II. Lunar Gateway

Gateway is a joint international project involving NASA, ESA, and other international partners to deploy a manned space station in lunar orbit. The lunar space station will support scientific research as well as human and robotic exploration of the Moon and beyond. The first element of Gateway, the Power and Propulsion Element (PPE), is expected to be launched in 2022.

The preliminary X-band and Ka-band uplink bandwidth requirements for the PPE are 10 MHz and 200 MHz, respectively. The PPE communication system will require a ranging capability. There will also be an ESA-developed communication system to be placed on another Gateway element which will have a high rate Ka-band uplink. The uplink symbol rates for the eventual Gateway system are expected to far exceed those typically required for unmanned space research missions. The maximum uplink symbol rates being currently considered for Gateway at Ka-band range from 25 Mbps up to 200 Mbps.

A decision on the modulation format for the PPE X-band and Ka-band uplinks has not been made yet, but GMSK+PN is an option being considered, particularly if simultaneous ranging is needed with high rate uplinks at Ka-band. Other modulations being considered, which may not be compatible with simultaneous ranging, are filtered OQPSK, PCM/PM/biphase, PCM/PM, and BPSK. One issue is that there is no CCSDS modulation recommendation that covers uplink symbol rates above 2.048 Msps; similarly there is no CCSDS recommendation covering simultaneous high rate telecommand and ranging.

III. Summary

Gateway is considering uplink symbol rates at X-band (8450-8500 MHz) and Ka-band (22.55-23.15 GHz) that far exceed those covered by CCSDS telecommand modulation recommendations. These uplink symbol rates are needed to support human exploration of the moon, including applications with live streaming feeds and high definition video.

As such, the CCSDS RFM working group should begin work on developing an uplink modulation recommendation for telecommand symbol rates greater than 2.048 Msps, particularly for Ka-band applications. In addition, a recommendation for simultaneous high rate telecommand and ranging should be developed. Both items should be added to the RFM WG charter.