Paper ID: 23473
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SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Near-Earth and Interplanetary Communications (3)

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AN OPTICAL COMMUNICATIONS NODE

Abstract

In the first half of the year 2013 it became known in the aerospace press that the U.S. National Reconnaissance Office donated two partially completed telescope of the Hubble size (2.4 m mirror diameter) to NASA. It is not the objective of this paper to go further into this issue of potential use for science missions but to explore what could be achieved with such a telescope in an Earth-orbit for communication links. In a previous IAC paper (IAC-05-B3.06.01) it was concluded that for a duplex link between Mars and Earth the use of an optical relay satellite in Earth-orbit is not advantageous for the link due to the assumed telescope diameter based on state-of-the-art optics used so far; telescope diameters are assumed to be not larger than 30 cm. However, with a 2.4 m telescope in an Earth-orbit this conclusion changes. A duplex link between Earth-orbit and Mars will be re-discussed in this paper and the achievable data rates will be evaluated. There are two extreme cases for a Mars link: short distances up to 0.5 AU and long distance up to 2.7 AU. The assumed telescope diameter on the Mars surface can be 30 cm and very optimistic up to 2.4 m. The achievable data rates are being evaluated which vary between some Mbit/s up to some Gbit/s. Another application would be to place a 2.4 m telescope in a GEO-orbit and use it for a duplex space-to ground link as a feeder link for the GEO ring. For a 1 m ground telescope and a 2.4 m GEO telescope without atmospheric losses the achievable data rate is in the Pbit/s (1015 bit/s) range. Assuming atmospheric losses due to absorption, scintillation, beam wander, ... reduces the achievable data rate to several Tbit/s. Besides the link budget considerations a discussion of advanced technologies to realize e.g. a 2-3 m telescope at e.g. the Mars surface or in GEO-orbit will be discussed as well.