Abstract

NASA’s Deep Space Network is now being re-designed to provide the next generation of ground based equipment for communicating with spacecrafts throughout our solar system. In the receiving direction, it seems clear that large arrays of relatively small antennas provide the correct combination of conventional high gain antennas and their associated pointing systems. However, the cost-benefit analysis must take into account the operating environment, pointing requirements, and required EIRP, and it is expected to be highly cost-effective for large arrays to be implemented on a cost-benefit basis. The keywords here are the array of antennas that provide communicating capability to all possible positions in the solar system. To achieve this goal, a continuous effort is made to develop new technologies for antennas and associated pointing systems. The design presented has not been selected for implementation, and other possibilities are also under consideration.

1. Introduction

To achieve our objectives, antennas and pointing systems must be able to communicate with a large number of positions in the solar system. This means that the antenna should be accurately controlled to compensate for the effects of atmospheric turbulence, the point positions. The design presented has not been selected for implementation, and other possibilities are also under consideration. The design presented has not been selected for implementation, and other possibilities are also under consideration.

Table 1: System Transmissions at 7.2 GHz

<table>
<thead>
<tr>
<th>Antenna Diameter</th>
<th>Power</th>
<th>No. in array</th>
<th>EIRP</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 m</td>
<td>20 kW</td>
<td>1</td>
<td>380 G</td>
<td>existing</td>
</tr>
<tr>
<td>34 m</td>
<td>20 kW</td>
<td>1</td>
<td>85 G</td>
<td>existing</td>
</tr>
<tr>
<td>12 m</td>
<td>2 kW</td>
<td>1</td>
<td>1 TW</td>
<td>possible future</td>
</tr>
<tr>
<td>8 m</td>
<td>430 W</td>
<td>1</td>
<td>1 TW</td>
<td>possible future</td>
</tr>
</tbody>
</table>

1.1 Transmission Performance at 7.2 GHz

The main facilities of the present Deep Space Network (DSN) are 70 m and 34 m diameter antennas with 20 kW power amplifiers at three locations around the world. The design presented has not been selected for implementation, and other possibilities are also under consideration.

2.2 Error Budget

Errors in the phase and time delay information to be received at one of these antennas as “reference” of the array antenna positions and the calibration antenna positions are accurately known. Initially, all the positions can be established within a few degrees of arc, with GPS and optical surveying, but will not be accurate as the final calibration (see Table 2 below). If three calibration receivers are placed at different azimuths, the knowledge of each antenna is known, but it is also possible to position the three receivers at different locations, and the results must be appropriately weighted. We propose to have four receivers. However, accurate determination of the vertical coordinates of most antennas is difficult because of the shallow angles imposed by the geometry. The reason for this is that the spacecraft antenna of 1.0 m2 effective area, although larger antennas are possible. With modern spacecraft electronics, 1.0 TW earth station, error correction code for routine case only. (c): Existing space electronics, 85 GW routine, 360 GW emergency, no coding.

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REFERENCES

1. L. R. D’Addario, "Jet Propulsion Laboratory, California Institute of Technology. This research was carried out by JPL/Caltech under contact with the National Aeronautics and Space Administration.


