NLSRT Memo No. 25

Dec 6

Memo to: P. Vanden Bout, G. Seielstad
From: K. Kellermann
Subject: Antenna Costs

The following estimates of the costs of large steerable antennas have become available since my Nov 28 memo (number in parenthesis is wavelength limit):

1) <u>100 meter (2cm)</u> Lee King has scaled the VLBA design to estimate the cost and performance of a 100 meter antenna. Adding the cost of the subreflector, foundation, and contingency I come up with 59 M. This design is limited by gravitational deformations. Operation at 2 cm requires moving the subreflector to keep it a the optimum position. A further improvement in performance can be achieved by using the order of 60 motors to adjust the surface. This could be cheaper than introducing an homologous design.

2) <u>100 meter (1.3 cm)</u>: Scaling the cost of the above design by $f^{-0.7}$ (JPL empirical law) suggests a cost of 80 M for a 1.3 cm antenna.

3) <u>300-ft (6 cm):</u> RSI has estimated the cost of replacing the 300-ft as 6.74 M plus an additional 2.9 M to make it steerable in azimuth. Allowing for contingency would bring this to a total of 11.6 M. Note that this structure still has a 30 degree elevation limit. Considering this constraint, the RSI estimate is roughly consistent with the cost of an all-sky 6 cm 300-ft instrument estimated by the Fisher method of 15.8 M.

4) <u>450-ft (6 cm)</u>: Scaling the 300-ft dish by a 2.7 exponential law increases the cost to 35 M for the limited elevation instrument and 47 M for the full sky instrument.

5) <u>100 m (3 cm)</u>: JPL has a cost estimate from Ford Aerospace of 91 M. This is much higher than the numbers we have been considering, but can probably explained by the DSN requirements on slew speed, operating under high wind conditions and other gold plating that distinguishes JPL antennas from radio astronomy antennas.

6) <u>100 m (1.3 cm):</u> MAN in New York has given an estimate of 38 M for reproducing the Effelsberg telescope in the United States as a joint effort between MAN and an American company. Note that this is about 10 M less than the estimate received about a year ago via MPIfR. I had incorrectly assigned this earlier estimate to Krupp/MAN whereas in fact it cam from Krupp (Germany) only.

The reality of the MAN estimate may be reflected in the cost of the 32 meter dish that MAN is actually building at Cambridge for VLBI. MAN gives the cost of this antenna as 7.1 million dollars, which I find to be very inconsistent with their estimate of 38 million dollars for a 100 meter antenna with similar specifications. Using a 2.6 power exponential scaling law, the cost of the Cambridge antenna would suggest something like 140 million dollars for a 100 meter antenna.

Summary:

We can probably build a copy of the 100 meter Bonn dish for 40M to 50 M. or for the same price a fully steerable 140 meter telescope good to 6 cm. For 50 M to 60 M we can make it a little better than the Bonn dish, or a little bigger; but probably not both. For reference the following dish efficiencies (referred to 100 m aperture) have been measured at Bonn (Altenhoff and Wink 1988).

Wavelength	Efficiency
6 cm	47%
2 cm	36%
1.2 cm	21%
0.7 cm	16%
3.5 mm	5%