Report of SKA Science Working Group 9
Spacecraft Tracking
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Technical Requirements on the SKA for Spacecraft Tracking

Dayton Jones

Working group members at Bologna: Manfred Warhaut (ESOC)
Boberto Madde (ESOC)
Dayton Jones (JPL)
Wim Brouw (CSIRO)

Additional members: Bill Hurd (JPL)
Bob Preston (JPL)

Level 1:

Coverage of 8-9 and 31-33 GHz frequency bands

Maximum baseline length of at least 1000 km for angular tracking

No gaps in data transmission from antennas to signal combining site

Level 2:

Coverage of 37-39 GHz frequency band

Simultaneous coverage of 8 and 32 GHz bands

Multi-beaming capability (TBD full-sensitivity array beams within primary beam of individual antennas)

Sub-arraying capability (sub-divide antennas within each SKA station to observe in widely-separated directions)

Discussion:

The level 1 requirements are those necessary for reception of telemetry from deep space missions and for angular navigation of spacecraft. These are the two areas where the benefits of a very large

array are most dramatic. Note that in the era of the SKA, nearly all deep space missions are likely to be using Ka band (32 GHz) as their primary telemetry band. The "no data gaps" requirement reflects the fact that for telemetry, unlike most radio astronomical signals, continuity is critical.

The level 2 requirements would enhance the value of the array for spacecraft tracking. The 37-39 GHz band is allocated for future human exploration away from Earth orbit, and may also be used for very high data rate downlinks from future space VLBI missions. Simultaneous reception at 8 and 32 GHz will be important for radio science experiments. Multi-beaming and sub-arraying would greatly increase the efficiency of array operations, allowing multiple spacecraft to be tracked simultaneously or both spacecraft tracking and astronomical observations to be made simultaneously.