

## SWG Chairs Telecon 21-July-2020

Notes: Philippa Hartley

Participants: SWGs: Natasha Hurley-Walker, Abhirup Datta, Adriano Ingallinera, Andrei Mesinger, Paolo Serra, George Heald, Jason Hessels, Laurent Lamy, Phil Edwards, Eduard Kontar, Mark Sargent, Sarah Blyth, Valentina Vacca, Sebastien Muller

Apologies: Anna Nelles, Françoise Combes, Stefano Camera, Cormac Reynolds, An Tao

SKAO: Robert Braun, Jeff Wagg, Tyler Bourke, Philippa Hartley, Evan Keane

### RFI from Mega-Constellations (Robert):

The modelling is progressing; a paper is still to come  
Materials adapted from Federico di Vruno

slide 3. Radio spectrum plot shows SKA1-Mid band coverage overlaid with RAS protected bands.

slide 4. Radio quiet zones around the telescopes are large and will have uplink restrictions.

slide 5. Plot of geostationary satellite tracks across sky. LEO numbers will increase to 1000s and possibly 10000s.

slide 6. Sky becomes filled as seen from Mid site. Federico, Tim Stevenson and Robert B have looked at the impacts in terms of: engineering damage (saturation and receiver damage), science impact, and mitigations.

slide 7. Models show no receiver damage, but a chance of saturation. Zone at 10-20 deg where orbits pile up.

Slide 8. If we don't saturate, we could still have performance loss. Cradle of life WG plot shows complex organic molecule transitions. Overlaid cross hatch indicates frequency range impacted by constellations

slide 9. Galactic methanol masers and several red-shifted molecular lines impacted

slide 10. Continuum: lose some operational efficiency due to loss at mid-freq range

slide 12. Mitigations: most promising is to reach an agreement on transmission power levels at the respective SKA locations. We are in discussion with constellation operators and hoping to make progress. Operators do have legal right to transmit in these frequencies. Most useful strategy appears to be active engagement with the operators.

Slide 13. Numbers of satellites could grow more dramatically yet, >90000. Vital to reach agreements on mitigation measures.

Questions:

Jason: How many arcsec/min are the satellites moving?

RB: about 200 arcsec/s

Jason: False positives for transient searches?

RB: The likelihood of satellite being near the main beam is small. The biggest problem is in far side lobes, where the satellites add incoherently to raise the noise floor at all times. The likelihood of appearing as a coherent emission source within the beam is zero, since if it is in the beam the receiver will be saturated. In total power the situation is worse.

Mark: Can we (with SKA) offer the companies anything? E.g. radio emission used to locate space debris.

RB: Possibility of constellation operators getting good publicity by working with us, releasing joint publications that could highlight their technical capabilities and responsible behaviour. In parallel, we will try to achieve a longer-term shift in the regulatory framework by working closely with our SKA member governments.

Andrei: what is the status for SKA LOW freq?

RB: Far less commercial interest in this part of the spectrum; greater commercial interest in the higher frequencies.

Andrei: Microsatellites could spill into lower frequencies

RB: These have already been observed to be a nuisance due to reflections, but thankfully are not being commercially exploited.

Sarah: Are the filings mainly in US? Is SKA working with NRAO, to put pressure on government there?

RB: Working closely with NRAO to come up with a joint strategy. There is a small piece of spectrum, 10.6-10.7 GHz, that has international protection and NRAO is normally consulted by the US regulatory body (the FCC) regarding compatibility with neighbouring services.

### **SKA1-LOW station design work (Jeff)**

slide 14. Test results and simulation meeting for AAVS2

Testing has continued despite pandemic

Real time beam-formation simulations, demonstrations of pointing tracking

Please let Jeff know if you would like a copy of presentations.

Robert Laing's group have been looking at effects of various errors on images.

slide 15. Station beamforming errors are reassuringly small compared to other sources of error that impact the image quality.

Using simulated embedded element patterns over several frequencies. These are available for scientific purposes for anyone interested.

Delay-based calibration solutions using Sun are stable over 24 hours or more.

Slide 16. Results from AAVS2: x and y pols for each antenna in AAVS2 station. Shows delay offsets are fairly stable in time, down to about one nanosecond. Station calibration based on a model of the Galactic emission and embedded element patterns worked well in simulation but needs improved all sky model for real data.

Slide 17. Verifying sensitivity of AAVS2 station, using the Sun again. Technique is to make difference images between integrations. These are scaled to get effective sensitivity of full array. Blue is Xpol, red is Ypol. Expected sensitivity exceeds requirement when observing a cold patch of sky; sensitivity is reduced when looking at Galactic plane, as expected.

Slide 18. The simulation work with the SKALA4.1 embedded element patterns have been used to update the expected zenith sensitivity of the station beam, which is shown here - They assume a simplified sky model which is independent of direction, and no coupling effects. Expected station sensitivities: L1 requirements at zenith shown in red; work shows expected sensitivity exceeds requirements at all frequencies.

Qs;

Natasha: What about the off-zenith polarisation performance, which was still a point of some concern?

JW: That work is still on-going.

### **Observatory Development Programme, ODP (Tyler):**

Slide 20. Led by Robert Laing.

We are preparing the Construction Proposal and Observatory Enabling Plan which includes ODP funding wedge over the coming 10 years.

ODP will co-fund larger projects and smaller studies.

Science road-map development is most relevant to the SWGs. ODP not scoped to support pure blue-sky R&D, but items much closer to actual deployment.

slide 21. Road maps and development plan.

External Advisory Group for Science Roadmap to be chaired by Director of Science

Will be dynamic as new priorities come forward

Technology road map will aim to enhance TRL of most relevant technologies

Development plan: evolving package of studies and projects guided by the road maps.

Plans will go through SEAC and wider SKA community

slide 22. 2 or 3 year funding cycles for project proposals. Small (studies) and large (projects) scope

Light touch management by SKAO.

Slide 23. Current baseline is 40M Euro over 10 years, including ramp-up to steady-state 20M per year. Want to maintain current community momentum in increasing TRL. Major projects will not happen until after construction is complete

Slide 24. Timeline: from year 1 to 11, larger funding comes in towards the end of the timeline.

Qs:

RB: External Advisory Group could be an evolution of our SWG structure. Funnel up ideas from community and look at for priority assessment. Want to think ahead with long lead times.

Tyler: Ideas e.g. adding another band but also other ideas.

**Any other Qs or groups:**

RB: Please do send in suggestions for future topics