ASKAP Update, April 2020

In this issue, we discuss contingency plans associated with COVID-19, including the need to conclude pilot survey observations as soon as possible. We also provide an update on recent development activity and system improvements.

Observatory operations and COVID-19

The need for social distancing means that much of the world's astrophysical research is now being done away from offices. Many optical observatories have already ceased operations due to the pandemic.

CASS will continue operating ASKAP and its other radio observatories while this remains safe and practical. Being in a remote location with limited access to emergency medical assistance makes the MRO particularly sensitive to any health concern, so we are operating under the assumption that it may be necessary to evacuate observatory staff at short notice.

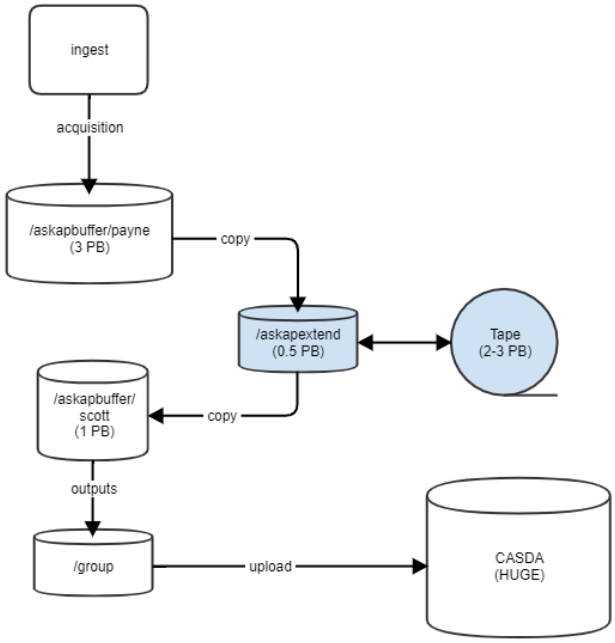
ASKAP has been designed to run fully remotely with no on-site presence, and this is our first fall-back position. Some equipment faults cannot be recovered without local intervention, so fully remote operation would continue for as long as possible but likely not indefinitely.

With this in mind, we have raised the priority of completing pilot survey observations at the expense of processing existing data, since Pawsey supercomputers may be available even if the observatory is not.

Pilot survey workflow and disk allocation

As part of our response to the global circumstances, ASKAP requested access to additional data storage space at Pawsey to cope with a new influx of pilot survey observations. Pawsey are providing the required amount of space (roughly 3 PB) in the form of a tape system with 0.5 PB of disk cache. This will be used as an intermediate storage area that sits between data ingest and processing, with the use of tape storage allowing lengthy caching of new data prior to processing, without impacting the space needed for intermediate processing products.

We have also switched data ingest to the larger of two partitions on ASKAP's 3.7 PB Lustre filesystem. Deletion of intermediate products and pilot data recently uploaded to CASDA has allowed spectral line pilot observations to continue, with both GASKAP zoom 32x and FLASH pilot observations now complete.



ASKAP data flow diagram highlighting the new tape stage
Diagram provided by E. Bastholm

Observing plans and timescales

Roughly one month is needed to complete the initial pilot survey program (assuming no scheduling block failures). Given previous experience, it is likely to take twice as long to successfully obtain all the required data. As much as possible, we will limit routine maintenance and development testing during this time, in exchange for an extended consolidation period later this year.

Development and consolidation

Completing pilot surveys with an intensive observing campaign will create a large data backlog. Upon concluding the first round of pilot surveys, we already planned to begin a consolidation period where engineering development and testing would take priority over science observations. This consolidation time will also be used to catch up with data processing.

Meanwhile, we will continue planning a second round of pilot surveys designed to maximise on-sky efficiency by

combining several survey modes into commensal strategies. We will consult with the survey team PIs during this process and use feedback from the first pilot surveys to inform the final strategy.

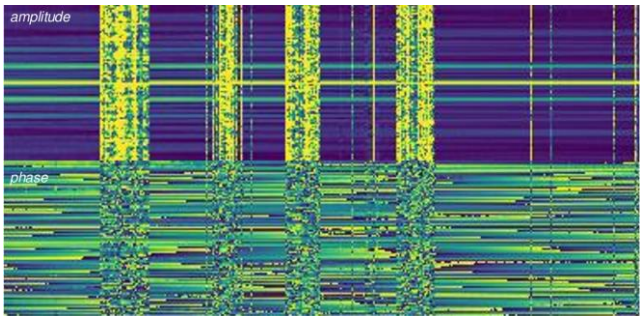
ASKAP system development

We continue to improve ASKAP's reliability and efficiency in many ways. Current priorities include investigating the occurrence of and automating recovery from loss of spectral channels in the correlator output. Preparation continues for automated management of beam weight calculation, storage, and retrieval alongside improving the reliability of beam weight calculation and updates.

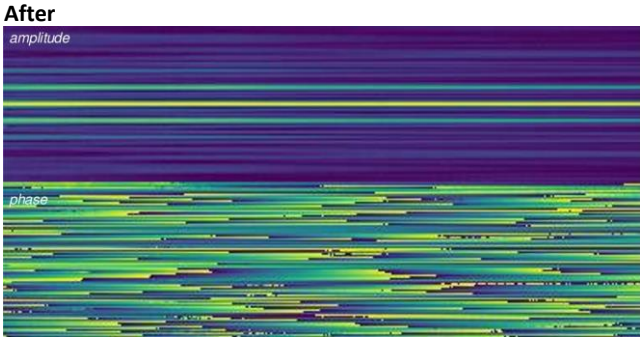
Beam formation and frequency interpolation

At the March science forum, Aaron Chippendale presented an update on improvements to the beam formation and update code. Recent work includes development and operational deployment of a frequency interpolation scheme to replace beam weights corrupted by RFI during the measurement process.

Before



After



Images provided by A. Chippendale

The plots above show the difference between raw weight solutions in the presence of satellite RFI (visible as vertical stripes), and the weights after interpolation. The horizontal axis shows frequency channel and the vertical axis is PAF port ID. The colour scale in each block shows the amplitude (upper half) and phase (lower half) of the complex weight assigned to each PAF port for this beam.

Interpolation should improve both the success rate of the weight computation process, and data quality in bands impacted by time-variable interference. It does not remove the RFI from science observations but prevents it from being frozen into the beam weights themselves.

Correlator reliability improvements

Channel dropouts are particularly damaging to spectral line surveys because they cause loss of specific redshift ranges. Continuum data are also impacted due to loss of bandwidth and sensitivity. Different firmware builds can have different dropout likelihoods, making this a difficult problem to track down. The symptom may in fact have several causes, including one of the most complicated aspects of the firmware – the memory buffer controller. While investigation into the cause continues, we are experimenting with ways to recover from dropouts.

The main problem for extended observations is that the dropouts accumulate over time. Issuing an automatic reset at an opportune time (e.g. the beginning of each scheduling block) could prevent this accumulation from continuing for too long. Attempts at recovery have in the past shown that some classes of dropout are cleared by the existing reset procedure while others are not. If we can ensure that all dropouts respond to the reset procedure, then automation may be enough to greatly minimise the impact of the problem.

Per-beam flagging and calibration research

The highly requested option to flag individual beams in ASKAPsoft has now been implemented and released. This should allow more precise targeting of bad data without removing entire antennas at a time, improving overall image quality. We have also been investigating how to improve continuum subtraction and provide the spectral uniformity required for absorption science. Some improvements could be made using existing alternative algorithms (e.g. continuum subtraction based on CLEAN model components rather than source-finding) but other changes would need additional development (e.g. performing calibration on spectral windows instead of the entire band).

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