Transient Buffers

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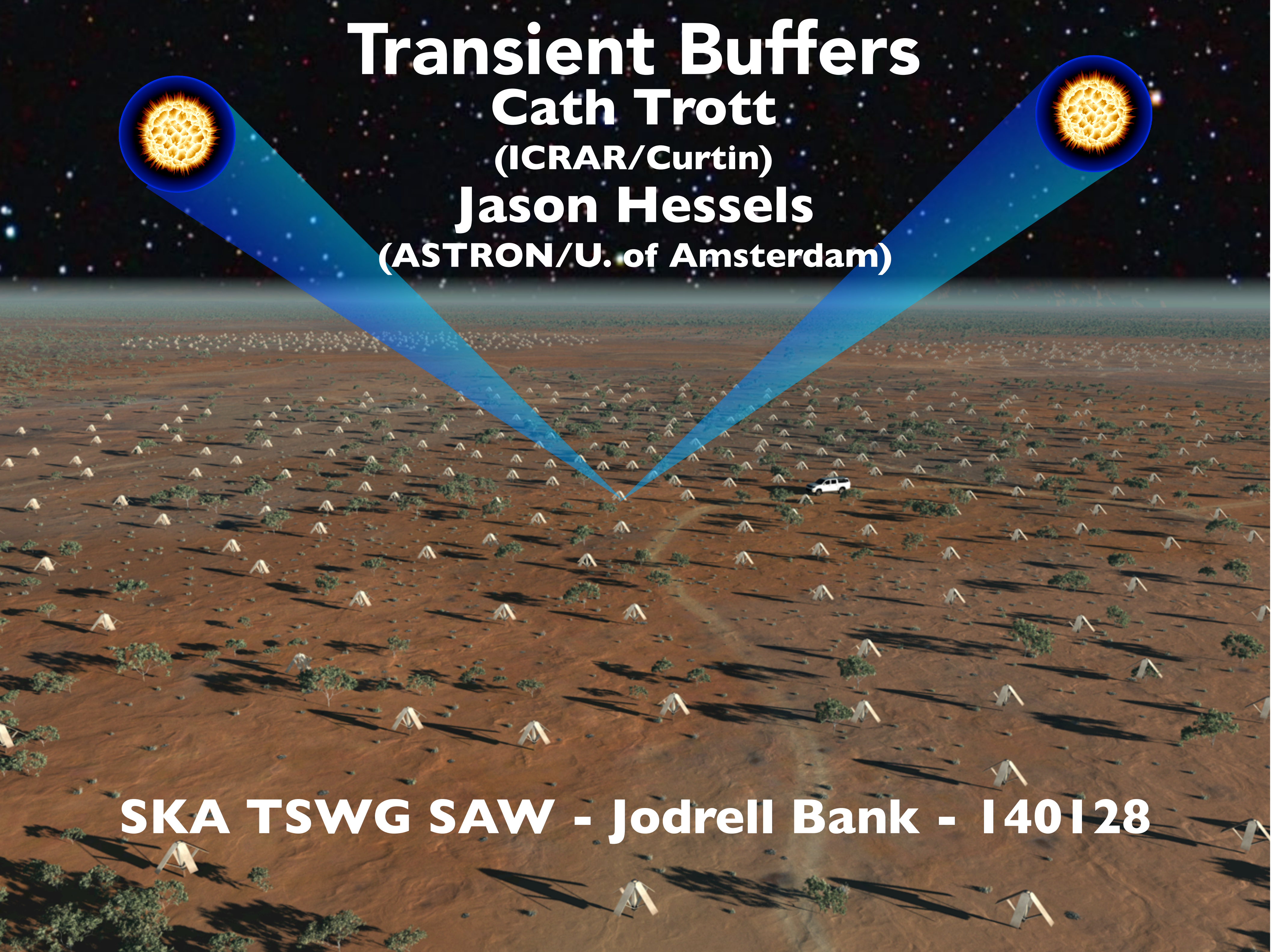

SKA TSWG SAW - Jodrell Bank - 140128

Buffering Transients

Basic use cases

- Buffer stores a rolling N seconds of "raw" data.
- Buffer can be frozen, dumped to storage, and processed offline.
- Scenario 1: triggered by a real-time SKA transients search pipeline (internal trigger).
- Scenario 2: triggered by an external alert.
- Scenario 3: triggered randomly for other science purposes (e.g. very high-time-res imaging offline).
- Scenario 4: triggered for testing, commissioning, regular system monitoring.

Buffering Transients

Why?

- Localization to 1-2 arcsec of short, impulsive, non-repeating transients.
- Full polarimetry.
- Full time resolution.
- Possibly coherent dedispersion.
- Low-level signal verification.

Buffering Transients

Where?

- Station/antenna raw voltages.
- and/or non-accumulated visibilities
- and/or tied-array voltage beam

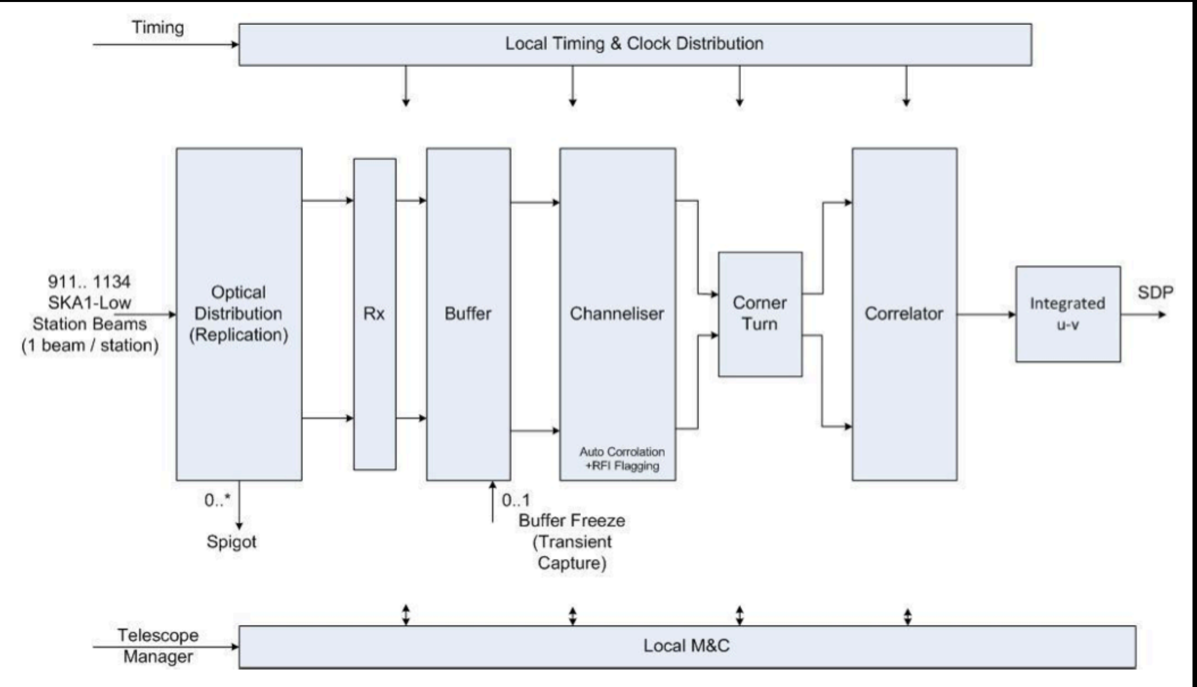

Figure 8 SKA1-Low Correlator Functional Architecture

Buffering Transients

What?

- Storing 10s of data will take ~256GB of memory per buffer element (could trade for bandwidth).
- Buffer size dictated by event duration, system latency *and* dispersive sweep across the band.
- SKA-Low: 350-250MHz is a 33s delay for a DM = 1000pc/cc.
- Readout and offline processing should be shorter than time between triggers.
- Expect order 10s of triggers per day.

Operations per second required to process real-time incoherent beam

$$N_{ops} = N_{DM} \times N_{pol} \times N_{beams} \times BW \times N_{ant}$$

$N_{pol} = 2$
$BW = 300/N_{beams}$ MHz
$N_{ant} = 1024$ (full array), 768 (core), 512 (inner core)
$N_{DM} = DM_{max,TBB}/\Delta DM$

$DM_{max,TBB} = T_s\, \nu_{GHz}^3 / 8.3\times10^{-6} / \Delta\nu_{MHz}$
where T_s is the size of buffer (seconds)

$$\Delta DM \approx 506 \frac{W_{ms}\nu_{GHz}^3}{\Delta\nu_{MHz}}$$ Cordes+ (2003)

$A_{eff}/T_{sys} = 1070\ m^2/K$
$\nu = 200$MHz

Example: Operations per second required to process real-time incoherent beam

$$N_{ops} = N_{DM} \times N_{pol} \times N_{beams} \times BW \times N_{ant}$$

N_{ant}	BW/beam	N_{beams}	T_s	$DM_{max,TBB}$	ΔDM	N_{DM}	N_{ops}
1024	300MHz	1	300s	960	0,01	72.300	4,40E+16
768	300MHz	1	300s	960	0,01	72.300	3,30E+16
512	300MHz	1	300s	960	0,01	72.300	2,20E+16
1024	100MHz	3	300s	2900	0,04	72.300	4,40E+16
768	100MHz	3	300s	2900	0,04	72.300	3,30E+16
512	100MHz	3	300s	2900	0,04	72.300	2,20E+16