SKA Computing

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SKA Computing

- Many aspects to SKA Computing

  - Wide variety of hardware, firmware and software products that need to be developed and integrated into a working observatory-level system spanning three continents

    - Systems at HQ, on site in RSA/Aus, in Perth/Cape Town

      - And let's not forget SKA Regional Centres

- This talk will concentrate on two critical pieces - one for each telescope - the SDP (Science Data Processor)
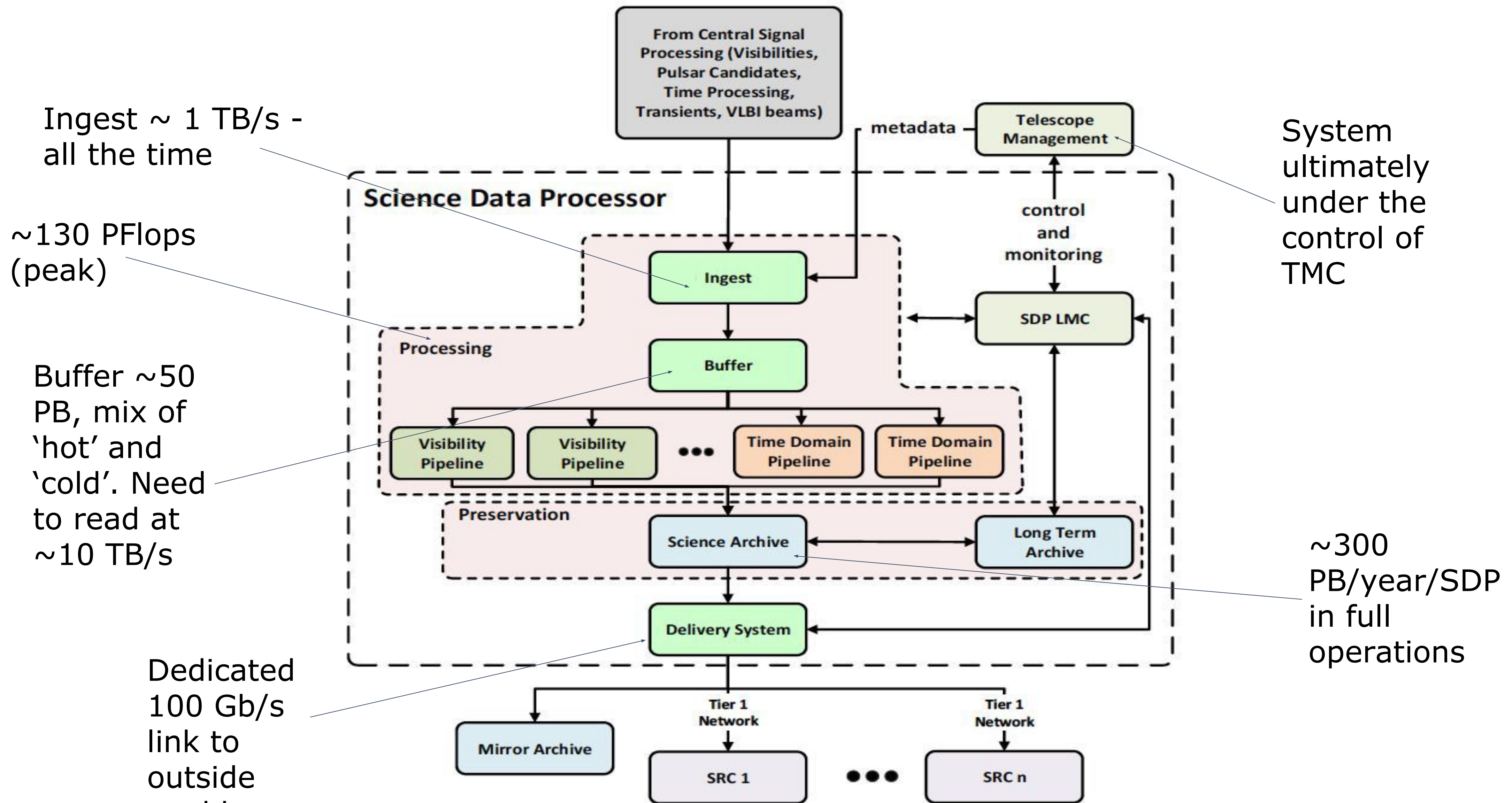
SDP - data flow, architecture, functions

Figure 1-16: SDP data-flow, architecture and functions.

Ingest ~ 1 TB/s - all the time

~130 PFlops (peak)

Buffer ~50 PB, mix of 'hot' and 'cold'. Need to read at ~10 TB/s

Dedicated 100 Gb/s link to outside world

System ultimately under the control of TMC

~300 PB/year/SDP in full operations

Challenges

- SDP is a HPC system but with some unique characteristics
  - Integral part of the telescope, needs to provide real-time computation as well as batch processing. Stringent uptime and QA needs. Need to keep power consumption down
  - Computations are I/O and memory bound. A machine focused on a top HPL score (80+% efficiency) is not what we need. (HPCG is a more interesting benchmark - ~5% efficiency)
  - Modelling and benchmarking to date suggests there is a significant gap between our requirements and what is available today. How might things look in late 2020s?

How will these challenges be met?

- Moving into the post-Moore's 'Law' era of computing
  - not the end of innovation though
- Talk of a "Cambrian Explosion" in processing technology - mid 2020s
    - But a lot of the investment aimed at AI - not really what we are doing but maybe we can do some computations with lower precision and repurpose these things
- SoCs e.g. RISC-V + specialist processors for FFTs for example could become an option
- Data-centric computing (Bytes not FLOP oriented) is coming to the fore
  - Helpful development - HBM, 3-d stacking etc + optical interconnects
  - Traditional HPC centres will need to deal with the data deluge coming from a range of experimental facilities and not just do first principles simulations and the like

How best to navigate this increasingly complex landscape and make informed choices for final SDP hardware procurements?

Co-design

- *"Co-design refers to a computer system design process where scientific problem requirements influence architecture design and technology and constraints inform formulation and design of algorithms and software." - US DOE report*
- We need a process that will look at the key trade-offs between hardware and architecture, software stacks, numerical methods and algorithms and application development techniques

Co-design cont.

- We will take forward a number of candidates - "set based design" - for components and systems
- And whittle down options over time during the SKA construction period prior to making decisions at the "last responsible moment"
  - SKAO has adopted Lean and Agile development principles and SAFe

Co-design cont.

- SKAO is in the process of putting together a co-design programme that will see HPC hardware, system software and optimisation expertise working closely with our application developers and radio astronomy experts
  - Former group funded as part of the SDP hardware contracts
  - Ongoing discussions involving EPFL and SKA France
- Also work with vendors, understand roadmaps and see how we can influence developments, e.g. provide benchmarks that capture SKA workflow characteristics and have vendors use these as part of design work

Thank you

We recognise and acknowledge the Indigenous peoples and cultures that have traditionally lived on the lands on which our facilities are located.

SKAO