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Scheduling the SKA

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Telescope Manager

Overall Control system for SKA, from proposing to data delivery to CSP/SDP.

Institutes

- National Centre for Radio Astrophysics (NCRA), India
- Science and Technology Facilities Council (STFC/ UKATC), UK
- SKA South Africa, South Africa
- National Institute for Astrophysics (INAF), Italy
- Engage SKA Consortium, Portugal
- Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia
- National Research Council of Canada (NRC), Canada
- Tata Research, Development and Design Centre (TRDDC), India

Industry Partners

- Persistent Systems Limited (PSL), India
- SCISYS UK Ltd, UK
- Tata Consultancy Services (TCS) Ltd, India

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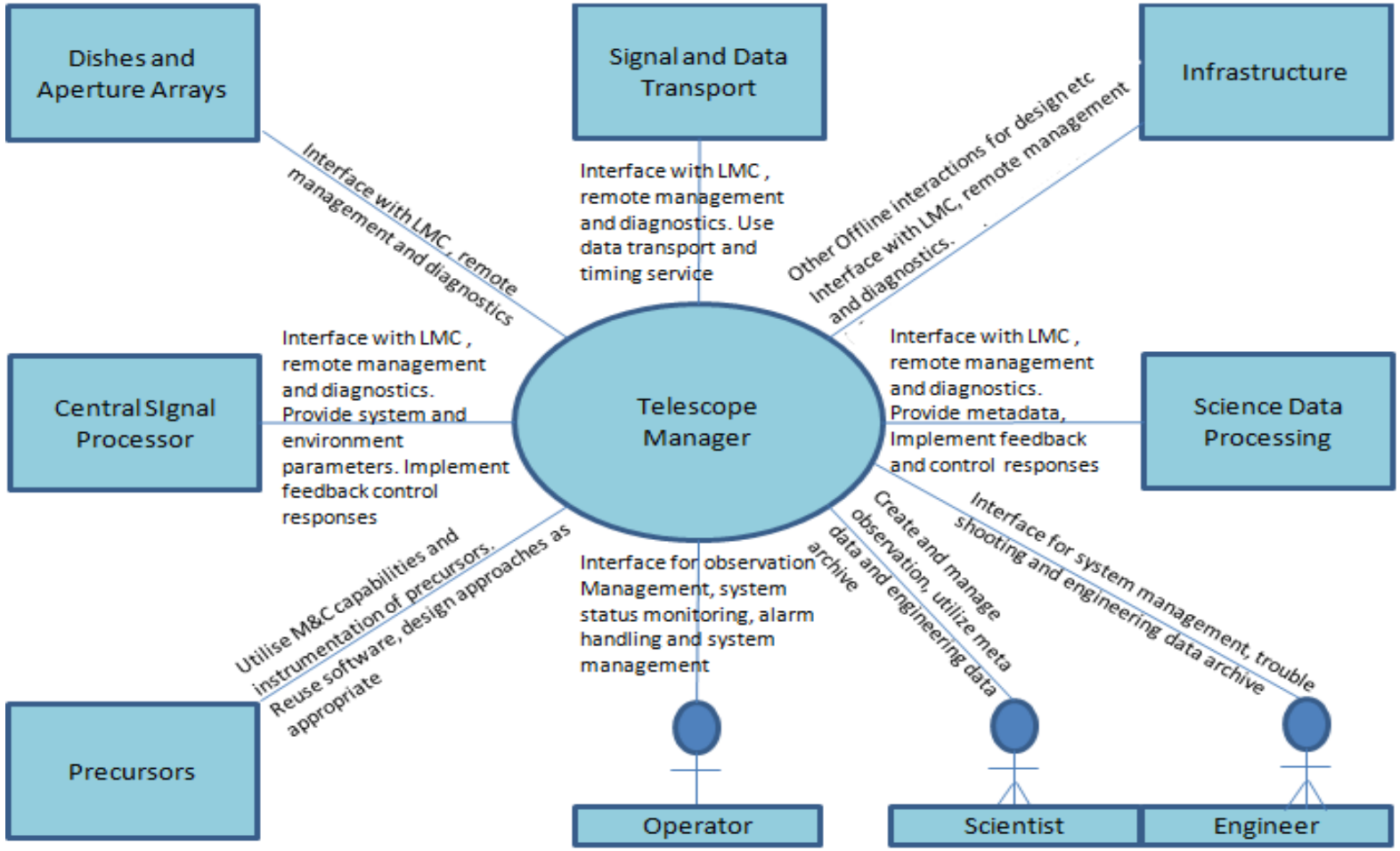

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Observation Management

- Responsible for the Observatory Science Operations Software:
  - Proposal Submission and Management
  - Observation preparation
  - Planning of observations
  - Dynamic, reactive scheduling execution
  - Instrument Configuration and Observation Execution
  - Archive support for above
  - Project tracking support

- Team:
  - UK ATC, SCISYS UK, INAF, Persistent Systems Ltd. (India)

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Key Operational Requirements

- PI proposals (including ToO)
- Large programmes (Key Science ~70%)
- Accessible to non-specialists
- Largely automatic operation
- Observation Planning (including use of SDP)
- Commensal observing
- Response to transients
- Partner time tracking
- Support for science operations staff
  - Reviewing, plan creation, project tracking
- Easy (at least semi-automatic) creation of scheduling blocks
  - Simulated execution

Most Science Operations activities take place at the Global HQ

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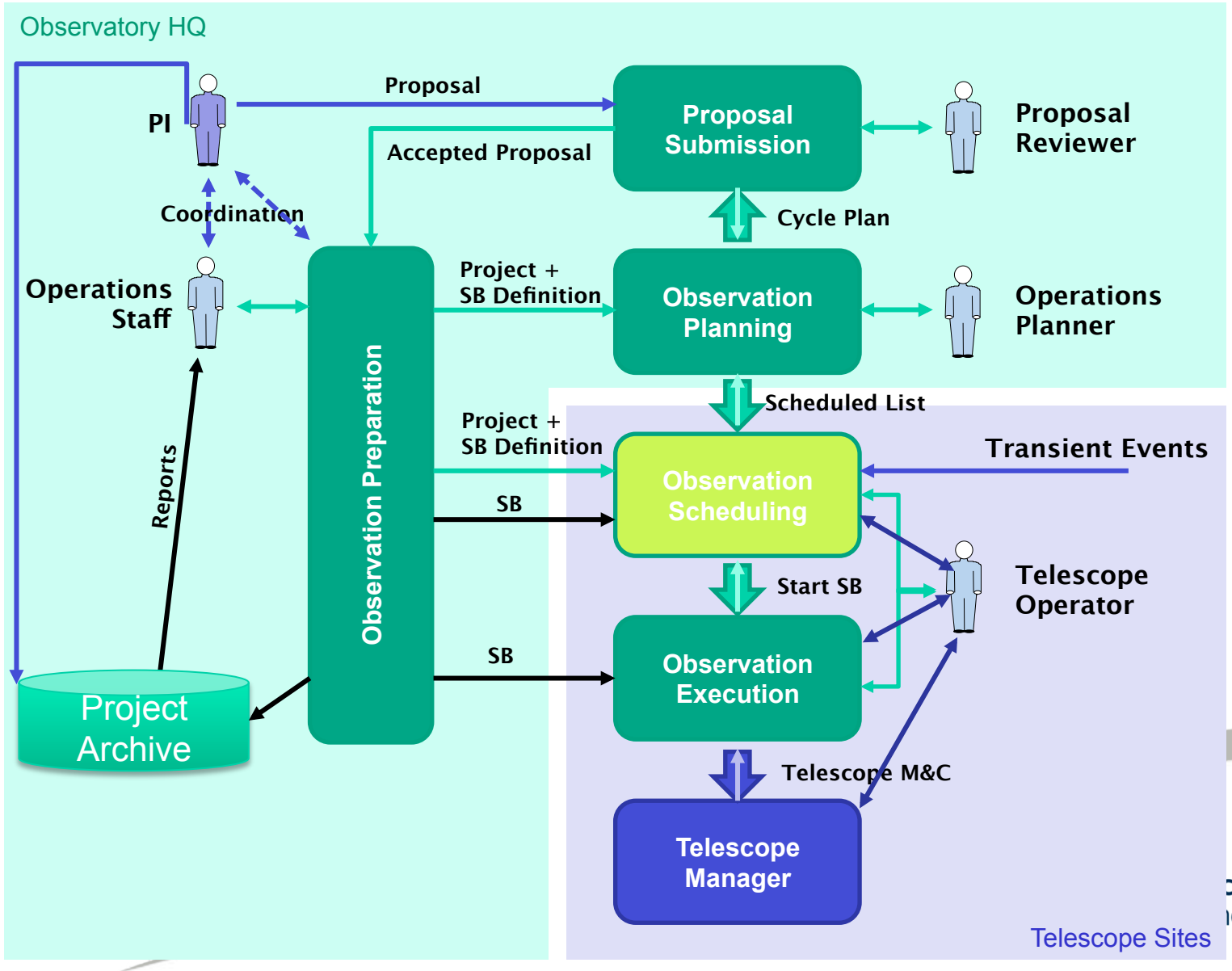
Operational Concepts

SKA Observing based on the idea of “Scheduling Blocks” or SBs (cf. ALMA, Gemini, VLT, UKIRT, JCMT):

- Self-contained, calibratable, unit of observing
- The “building blocks” of an observing plan (schedule)
- Proposals will outline “Science Goals”, detailed observation design creates SBs
- Planning creates plans of any desired length for both telescopes
- Dynamic scheduling executed at each telescope
  - Rescheduling as required in case of ToO/VOEvents/transients
- Data linked back to SBs and projects for tracking

Connected by set of tools: proposal handling, observation design, planning, dynamic scheduling, execution & lifecycle tracking, persisted in (distributed/replicated) project data archive

Science Operations Process



Planning and Scheduling

Construct observing plans (for any timescale) that:

- Maximise use of resources and science output
  - Including the sky, commensality, receptors, CSP, environment…
  - *And* ensuring the SDP is well exploited, but not over-committed
- Ensure completion of highest priority (and key science) projects
- Ensure partner shares are kept in balance

Results in prioritised list of SBs for near term observing (~1 day)

- And a pool of ToO SBs ready for activation

Dynamic scheduling selects highest priority SB for current conditions from this list, depending on resource availability and responds to transient events as required.

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Commensal Observing in the SKA

Three types of commensality:

1. data commensality – multiple projects, same data product(s), different science goals;
2. observing commensality – multiple projects, same setup/field of sky, different data products;
3. multiplexed commensality (use of subarrays)

Software must:

- Identify potentially commensal SBs and plan them
- Ensure correct linking of products to proposals

For types (1) & (2) use *host* SBs that take data and *guest* SBs that share that data.

Commensal observing expected to be one source of transients

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Planning the SDP

The SDP is not a simple resource:

- use depends on context (observing mode, number baselines, number channels, etc.);
- processing is in two stages: ingest & “just in time” fast imaging/ real-time calibration;
- then final processing hours/days/weeks later

Without the SDP the SKA telescopes cannot function (data not processed is lost & live calibration feedback is required).

Planning needs to ensure SDP is not over-committed over the planning period

- uses parametric model of SDP processing

Online scheduling needs to ensure upcoming SB executions will not over-commit the SDP

- Direct communication with “live” SDP

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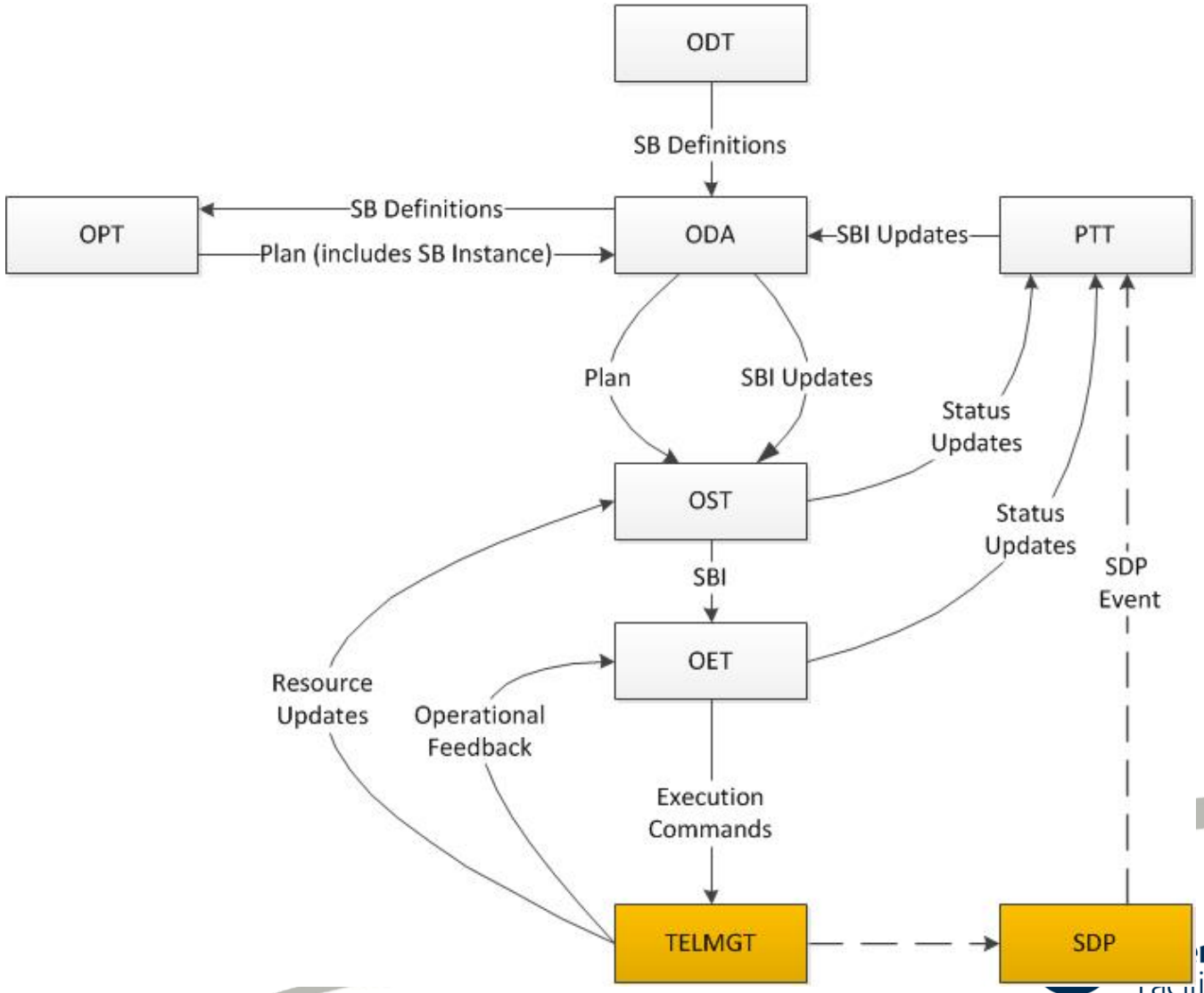
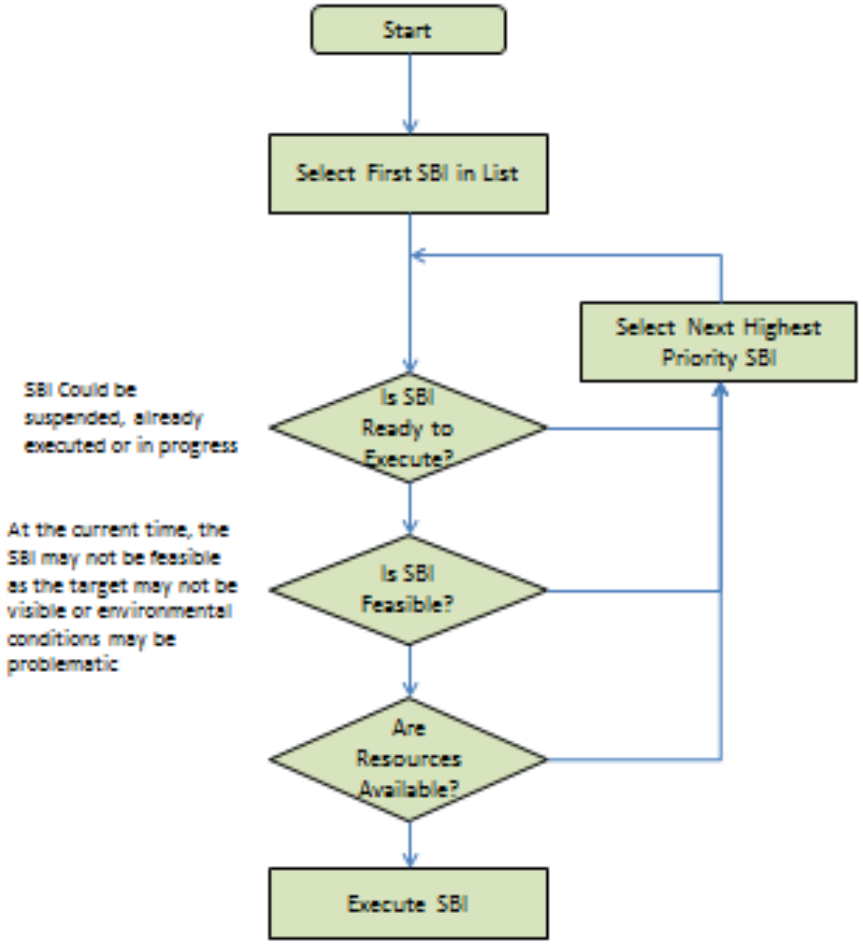
Context of Planning and Scheduling



Dynamic Scheduling



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Transients

SKA will be a significant producer & consumer of transients.

Key requirements on the planning and scheduling software:

- Respond to external VOEvents by planning a new observation
- Or by triggering immediate override – with a 1 second response
  - Impact on SDP must be considered!
  - And sub-arrays – do they need to be reconfigured?
- All observations must be associated with a proposal (TOO)
  - Proposer may specify streams to subscribe to, conditions of triggering, etc.
- Both telescopes must be able to respond to internal transient discoveries
- Discoveries may initiate new observations in the same, or the other telescopes
- And triggering a buffer “dump”
- May also result in publishing external VOEvents

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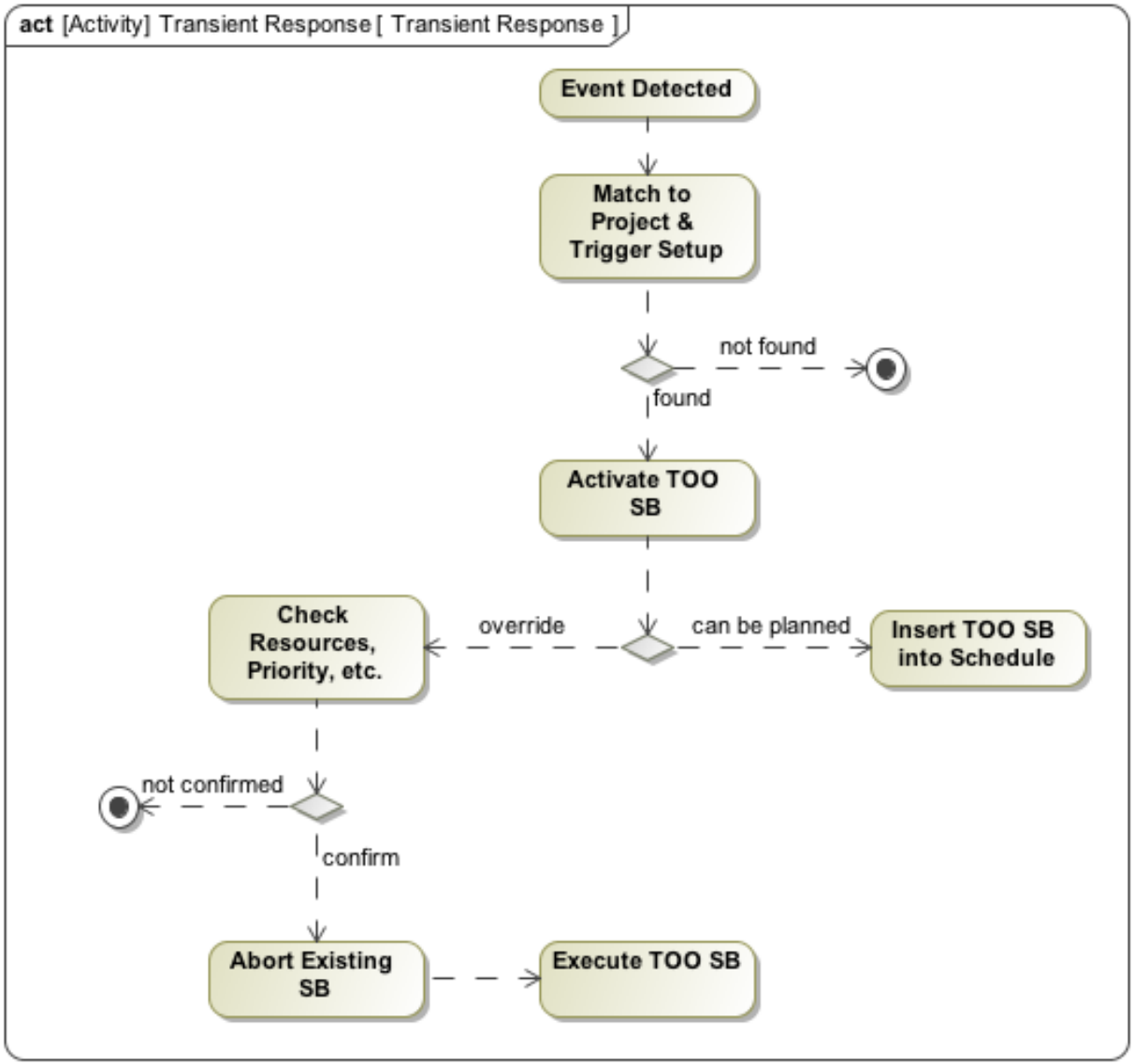
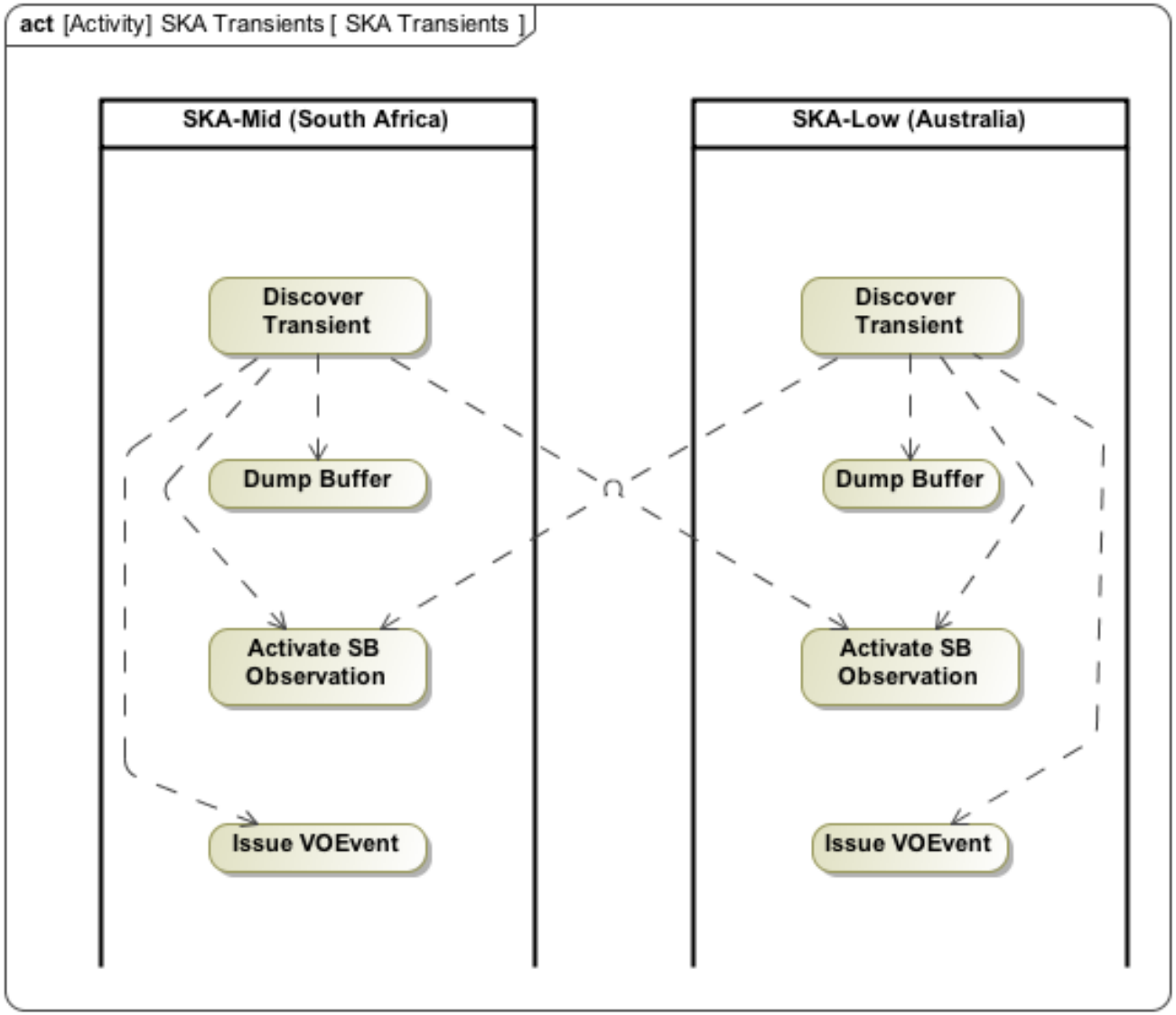
Observing an Override



SKA Transient Discovery



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Summary

SKA will be a powerful tool for producing and consuming transients

We are at a very early stage of working out how!

We have same issues of filtering, triggering conditions, etc., so keen to build on experience from current projects.

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