

Scheduling Large Facilities

H2020 ASTERICS – CLEOPATRA

Connecting Locations of ESFRI Observatories and Partners for Timing
and Real-time Alerts

Aim is to develop scheduling schemes that maximise scientific gain

this talk

- the scheduling environment
- what we do now – is it good enough?
- how can improvements be achieved?
- summary

scheduling environment

- multiple facilities
 - X-ray, optical, radio
 - ground-based, satellite
 - national, multinational
- requirements
 - must be able to take `classic' observations or be `event-driven'
 - multi-facility coordination in `classic' and `event-driven' modes
 - `prompt' and `non-prompt' events
- constraints
 - weather
 - instrument availability (schedule/breakdown)
 - observing budget

what we do now

- Phase 1 – apply for time - science justification + observation definition
 - sometimes limited multi-facility application: VLT/XMM, OPTICON up to 3 telescopes from 17.
 - forms often ask for related applications / time on other telescopes
 - visitor or service : soft-ToO / hard-ToO / rapid response / Director's Time
 - observation definition
- Time allocated
- Phase 2 – detailed observations
 - tinker with details: e.g. pointings
 - 'robotic observatories' – can submit observing requests throughout semester

what we do now - 2

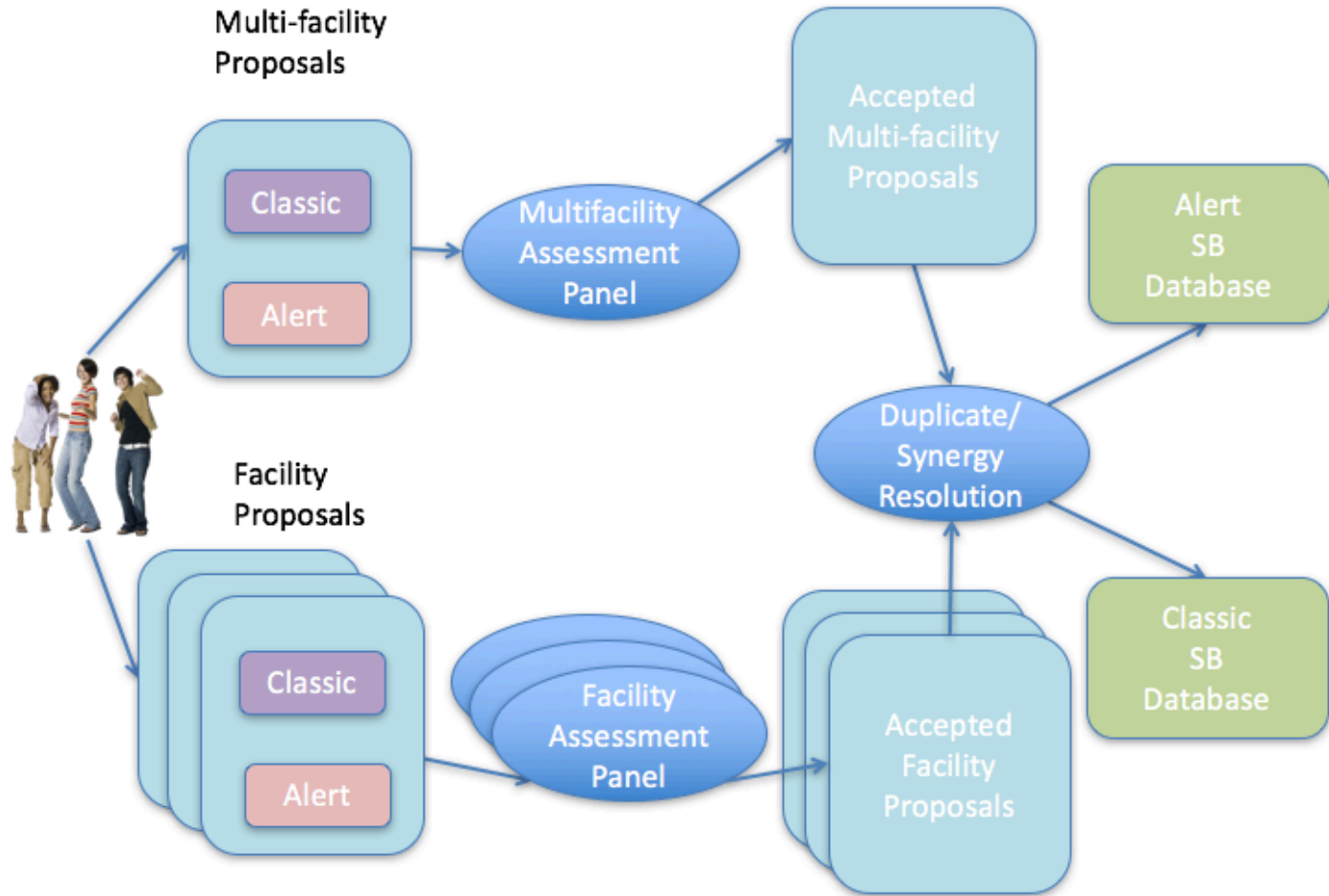
- Schedules constructed in various ways:
 - Gemini - group of humans decide general schedule weekly / options for weather
 - ALMA – long-term schedule satisfying constraints – short-term groups of SBs to suit array, dynamic on weather
 - robotic – dynamic scheduling algorithm, re-calculated on obs request list, weather or hardware change
 - hard timing, multi-facility constraints handled by setting aside blocks of time e.g. VLBI ‘coordinated observing’
- Pipeline reduction:
 - quick-look, science ready
- Feedback
 - JCMT consulted observers
 - ALMA observes until reaches desired S/N
 - LCOGT will re-observe an obs-request that fails - feedback via GUI in minutes

is it good enough?

- most facilities acknowledge the outside world
 - ask for details of applications to other telescopes
 - awake to transient events:
 - VLT RRM – ASCII file arrives in ftp, breaks into schedule
 - ToO observations generally triggered by a request from the observer
 - VOEvents filtered by people – slow but flexible
- birth of multi-facility observation but no common framework

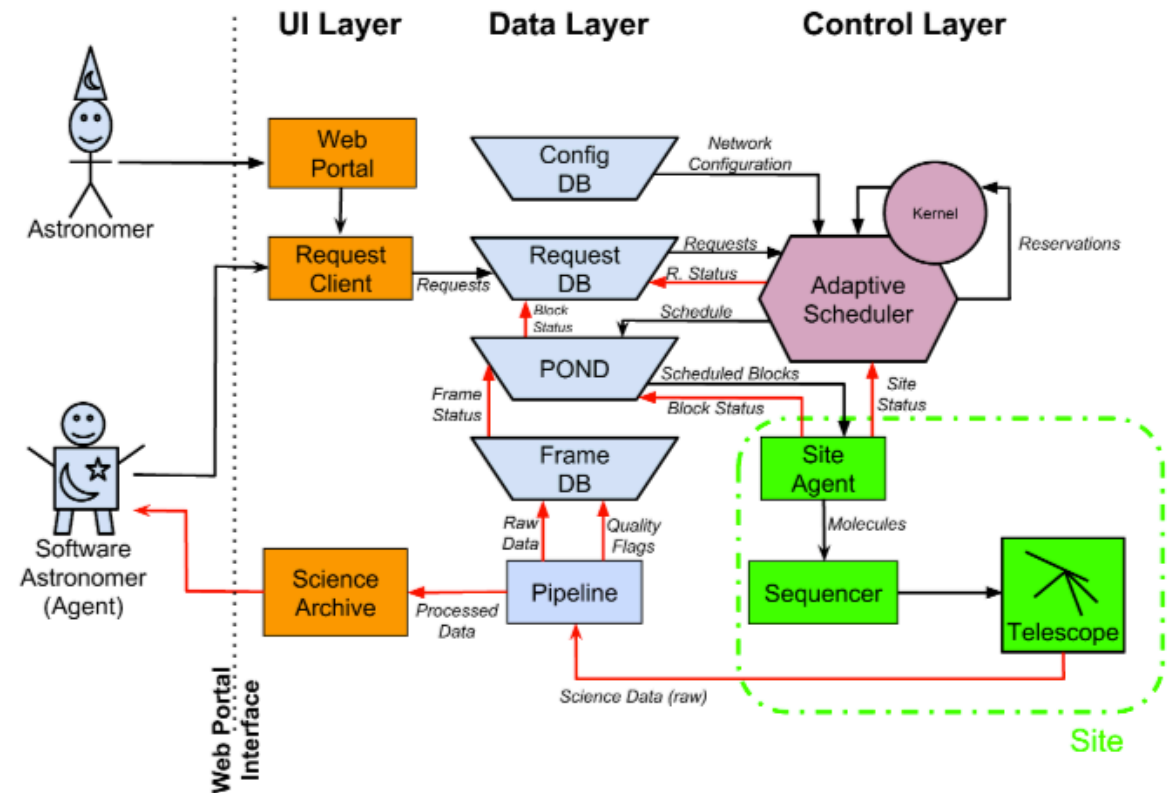
time allocation

- `classic' proposals specify method and target
- `alert' proposals specify method and trigger



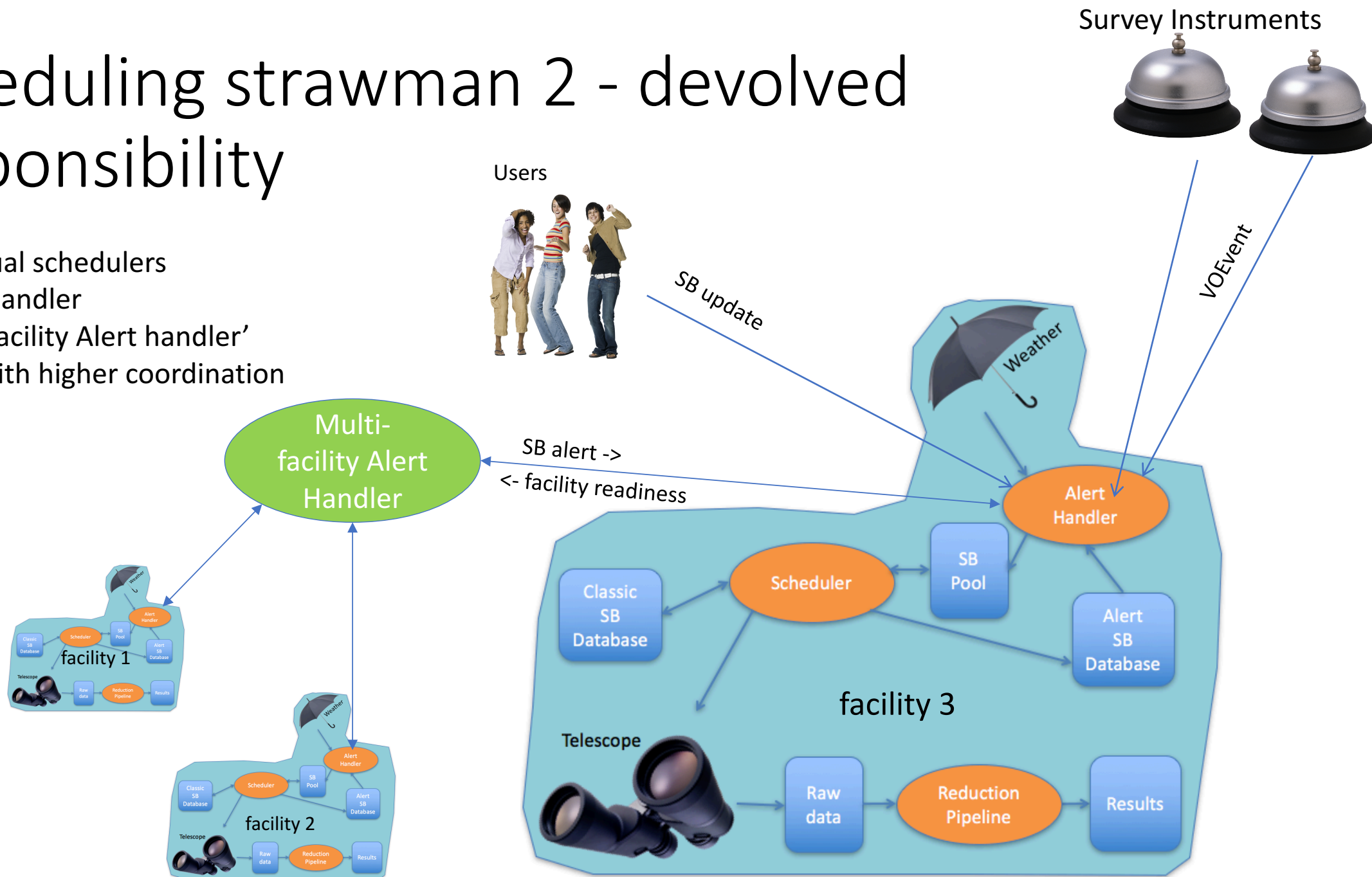
scheduling strawman 1 – ‘SkyNet’

- All knowing - All Powerful
- LCOGT – Las Cumbres Observatory Global Telescope – operational since 2014
 - Fully robotic
 - (fairly) uniform facilities
 - Schedule recalculated for:
 - receipt of obs requests
 - weather
 - fault
 - Schedule can be interrupted for rapid observation of ToO transients



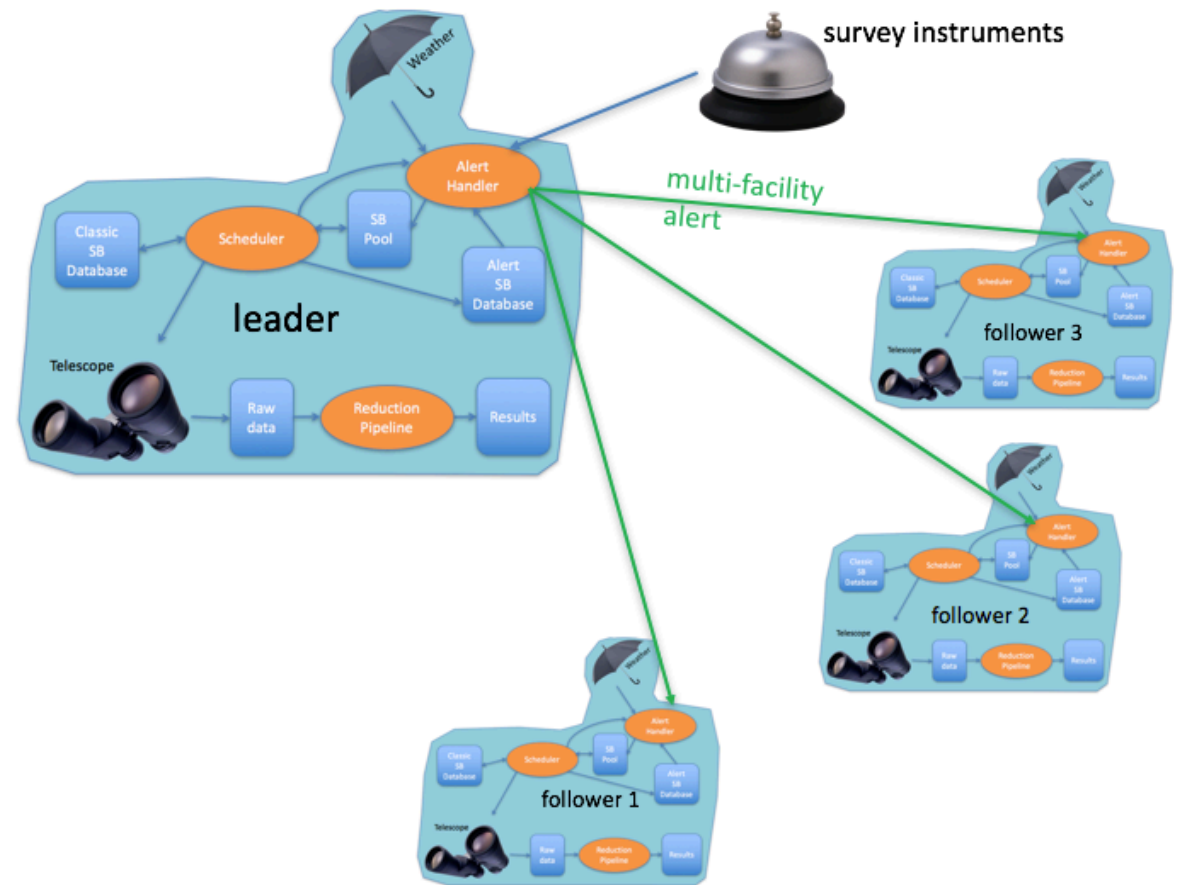
scheduling strawman 2 - devolved responsibility

- Individual schedulers
- 'Alert' handler
- 'Multi-facility Alert handler' deals with higher coordination



scheduling 3 – leader / followers

- Select one observation as the 'leader' - the most problematic e.g.:
 - difficult - weather
 - inflexible - satellite
- On startup it alerts 'follower' observations at other facilities via a 'multifacility alert'
- Least work to implement but:
 - there can only be one leader
 - limited check that followers are ready



how to proceed?

- do we need to?
- politics – what is achievable?
- incremental development:
 - use-cases: CTA-SKA, XMM-VLT, ?
 - design `multi-facility SB' - component for each facility - part of application for time?
 - build tool to find duplication and synergy within a collection of SBs
 - a `schedule description' to contain the constraints and observing schedule of a generic facility
 - tools for display and editing
- further study of scheduling algorithms for different regimes
- choose a strawman design for multi-facility scheduling (leader-follower?) and simulate it
- event filtering
- alert handler design and prototype
- continuity
 - `Paving the way to simultaneous multi-wavelength astronomy', Middleton et al. arxiv:1709.03520
 - <http://www.isdc.unige.ch/SmartNet/>

summary

- many institutions moving towards collaboration – but no framework
- facilitate application for multi-facility time
- interfaces and tools
- continue development of scheduling algorithms
- develop event filtering
- develop leader-follower scheme:
 - use-cases
 - alert handler – prototype?
 - model performance