LSST Operations Simulator v3

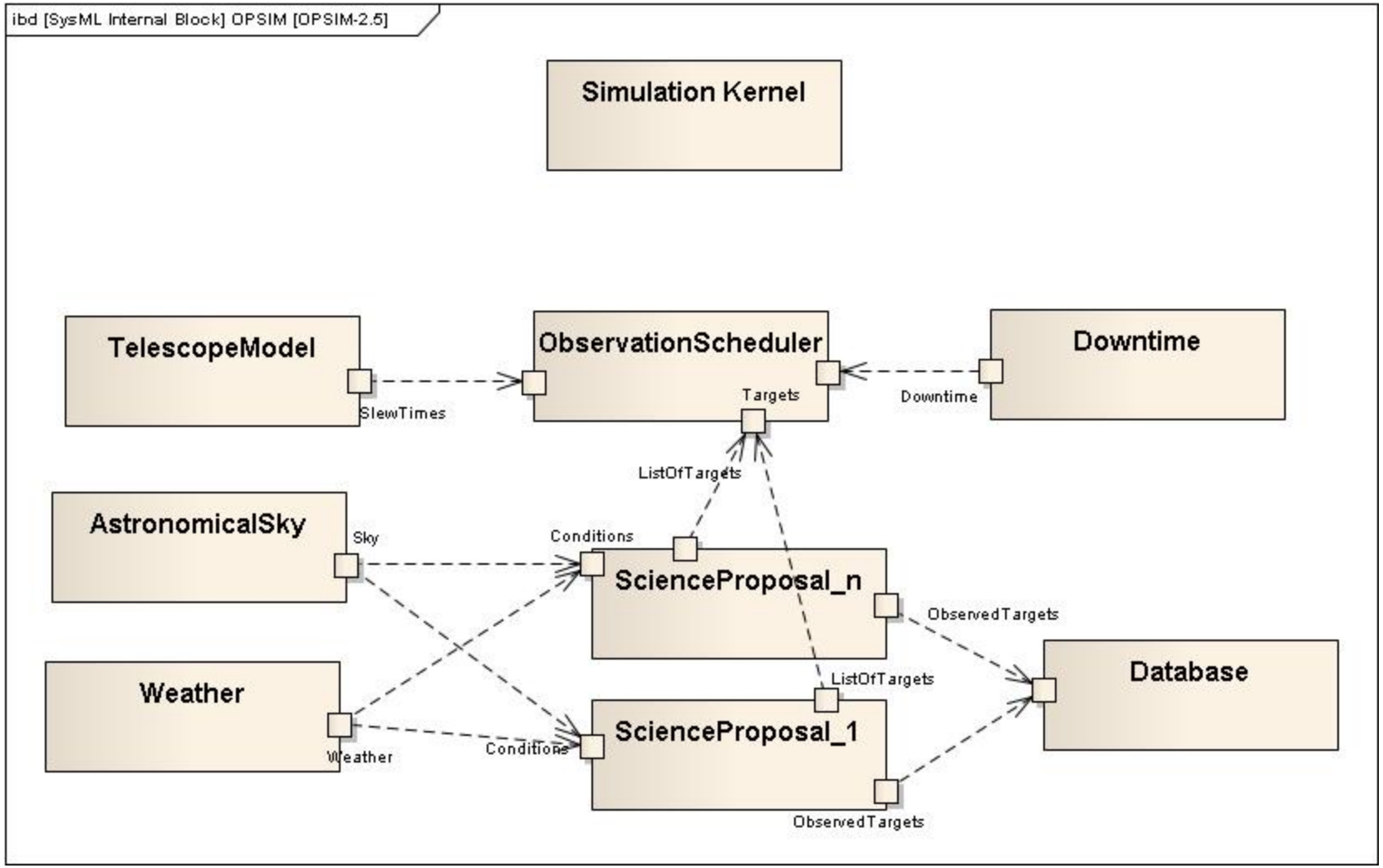
Main Specific Goals for OpSim 3.0

- Keep capacity of running OpSim 2.5 baseline survey
- Implement look-ahead capabilities
- Increase flexibility for algorithm experimentation
- Expand capacity for scripted cadences

Secondary Specific Goals for OpSim 3.0

- Improve Observations Database structure and performance
- Improve architecture and performance of the code
- Achieve deterministic behavior

LSST Operations Simulator v2.5 structure



OpSim v3 development plan

Scheduling in V2.x

Dynamic and adaptive process for each Visit:

- Each science proposal analyzes its assigned sky region, and selects the candidate targets that comply with its requirements for airmass, sky-brightness and seeing.
- Each proposal computes the scientific merit for each target according to its own distribution and cadence requirements.
- The observation scheduler combines all the targets and invokes the telescope model to compute slew cost for each one.
- The scheduler computes the overall rank and select the best.

$$\textbf{Rank} = \textbf{CoaddedMerit} + \mathrm{SlewBonus} * \frac{a}{(\boldsymbol{SlewTime}+b)}$$

Area Distribution Proposals

- Designed to obtain uniform distribution
- Basic parameter: goal visits per filter

$$ProposalNeedFactor = 1 - \frac{ProposalVisits}{ProposalGoal}$$

$$FieldNeedFactor = 1 - \frac{FieldVisits}{FieldGoal}$$

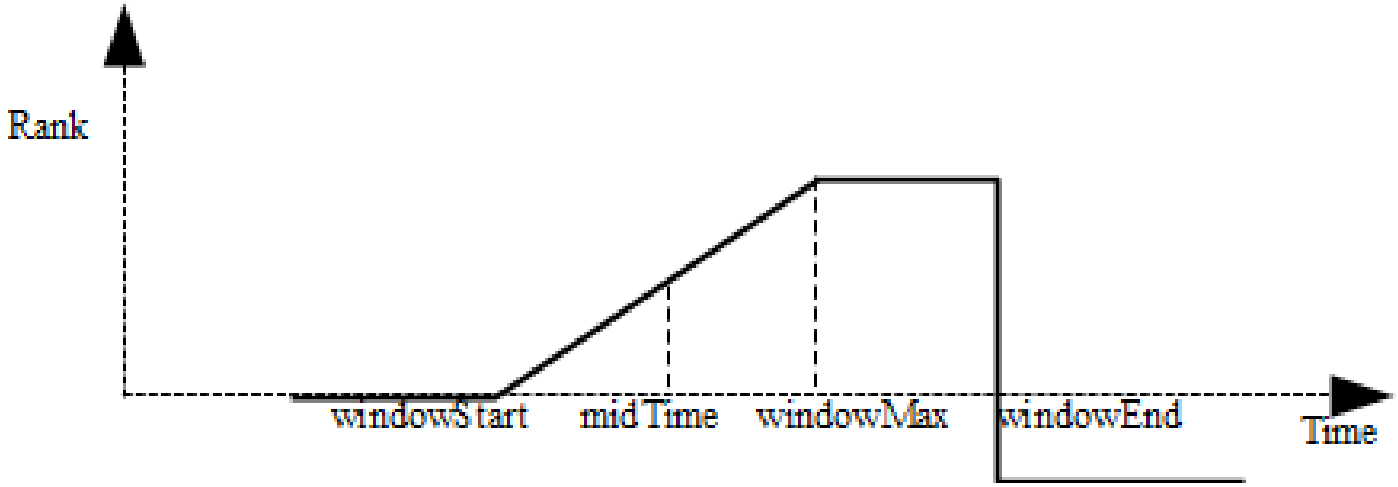
$$FieldFilterNeedFactor = 1 - \frac{FieldFilterVisits}{FieldFilterGoal}$$

$$\boldsymbol{FieldFilterMerit} = IdleRank * \frac{FieldNeedFactor + FieldFilterNeedFactor}{2 * ProposalNeedFactor}$$

- Field-filters receiving visits reduce their rank, while not observed Field-filters increase their rank.

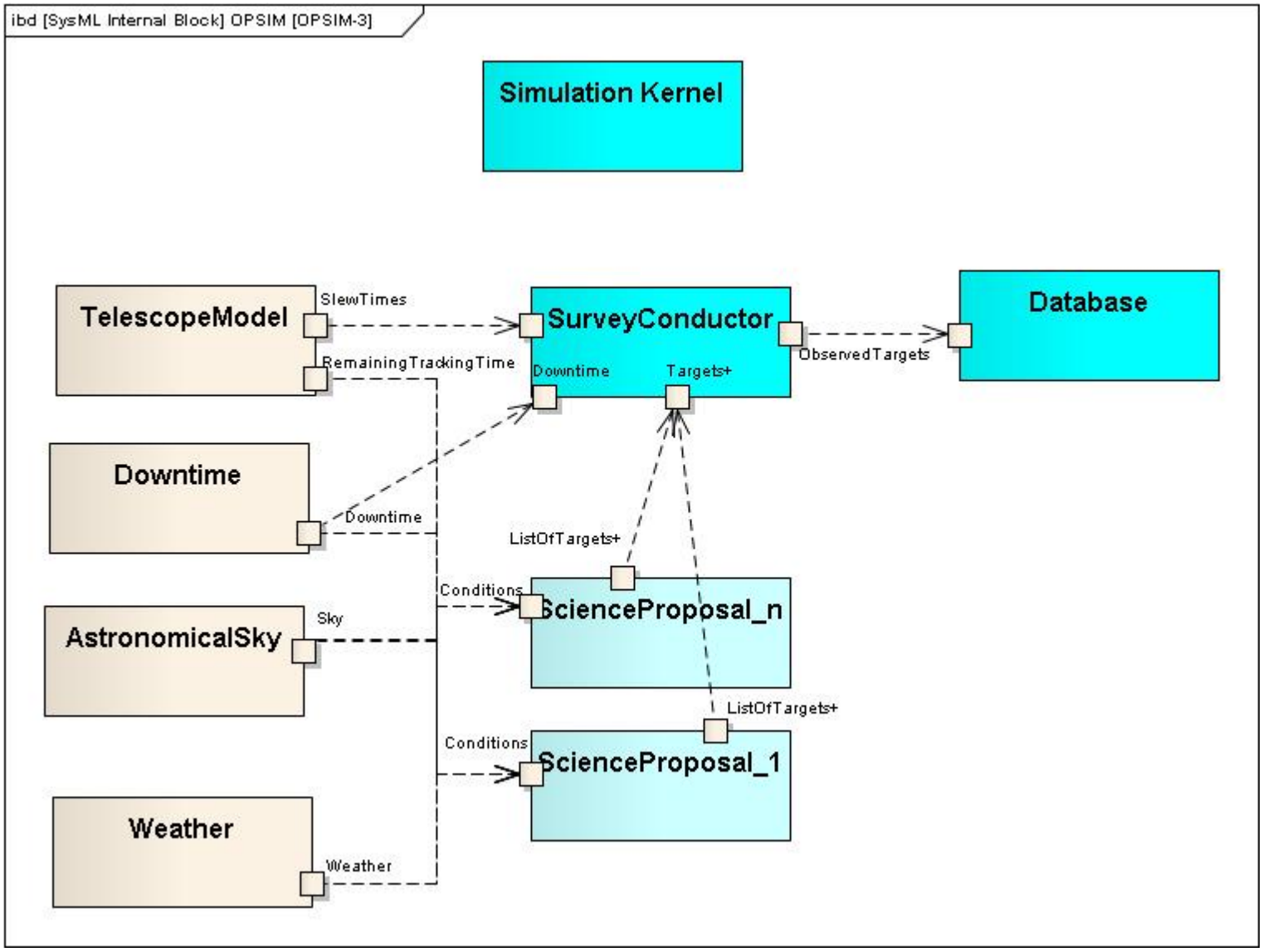
Time Distribution Proposals

- Designed to obtain specified intervals
- Basic parameter: time window for visits interval



- Each field has a sequence of visits with time intervals.
- The rank is calculated applying the time window to the time elapsed since the last visit to that field.

LSST Operations Simulator v3 structure



SchedulingData

- A software component that stores look-ahead information for the aggregated list of relevant fields for a given cycle.

- SchedulingData.airmass[field][t]
- SchedulingData.skybrightness[field][t]
- SchedulingData.downtime[t]
- SchedulingData.visible[program][field][filter][t]

- The list of fields is obtained aggregating the science programs target fields for the cycle.
- Airmas and SkyBrightness is populated from a precomputed database.
- Visible is populated by each science program.

Area Distribution Proposals

$$targetNeed = \frac{goalVisits - numVisits}{availableTime}$$

$$targetMerit1 = \frac{targetNeed}{\sum targetNeed}$$

$$targetMerit2 = \frac{targetNeed}{\max(targetNeed)}$$

- availableTime is the addition of the future time windows when the target (field-filter) is visible for the science program.
- targetMerit1 gives a normalized addition of all targets
- targetMerit2 gives a normalized maximum

Sequences look ahead filtering

- A science program with sequences evaluates the look ahead visibility of the field-filter series of visits given a start time.
- A list of possible start times is populated for each sequence.

Science Programs balance

$$programProgress = \frac{\sum numVisits}{\sum goalVisits}$$

$$programTime = \frac{elapsedTime}{totalTime}$$

$$programProgressIndex = \frac{programProgress}{\mathrm{programTime}}$$

$$programNeedIndex = \frac{1 - programProgress}{1 - \mathrm{programTime}}$$

$$programBoost = \frac{programNeedIndex}{programProgressIndex}$$