SAFE: Simulation Automation Framework for Experiments

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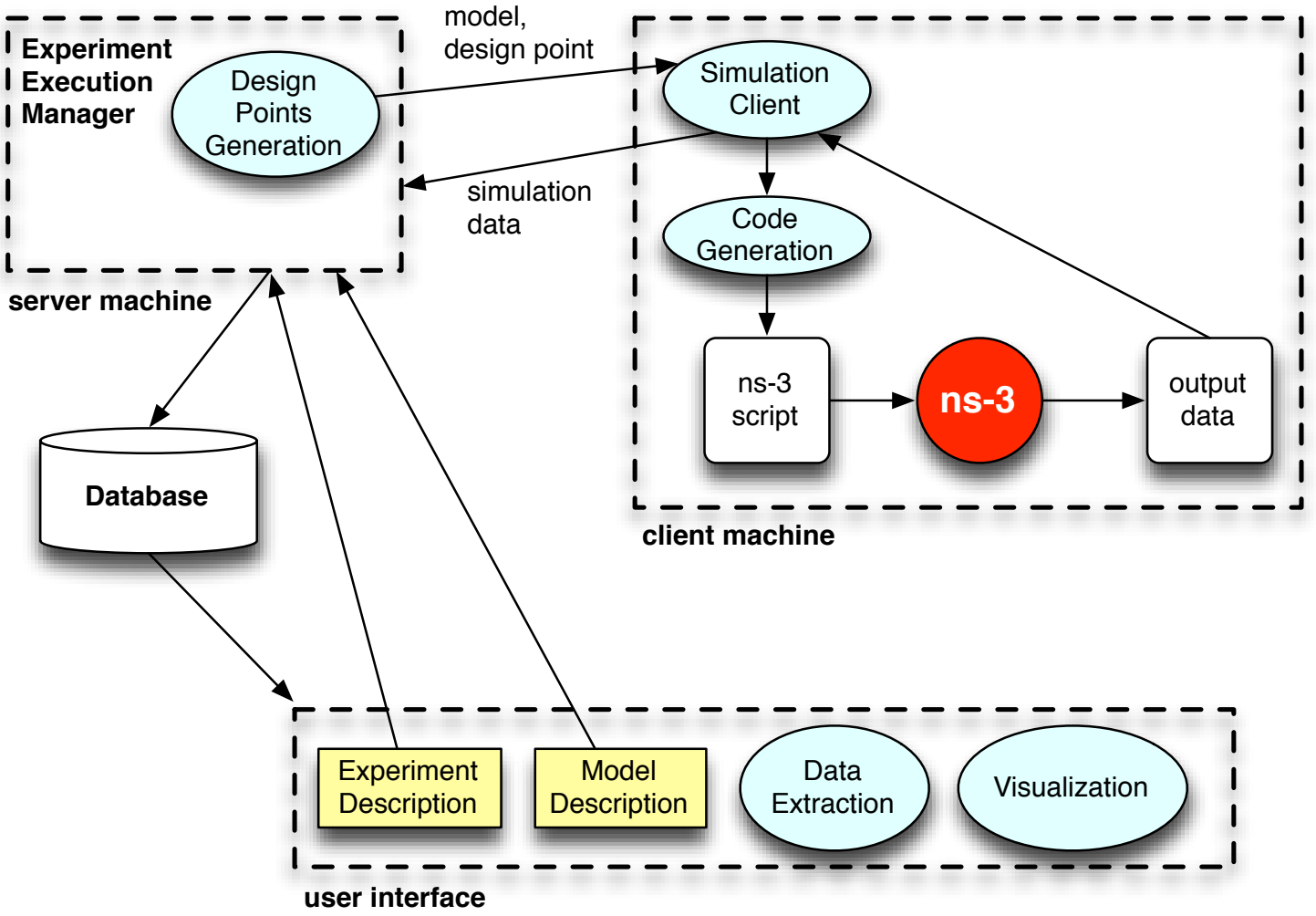
General architecture



Experienced user interface

- Status: in progress (Andrew Hallagan).
- Design language to describe experiments.
- Design language to describe model used in experiments.
- Validate documents written in languages above.
- Generate points in design of experiment space and translate them into executable ns-3 scripts.

Experiment control

- Status: in progress (Bryan Ward).
- Control the execution of simulations for each design point.
- Implement MRIP functionality on a collection of networked hosts.
- Design database to store experiment description and output data.
- Provide hooks to terminate individual simulation runs when they are determined 'complete'.
- Provide mechanism to record samples of metrics and ignore (or not) data generated before steady-state.

Novice user interface

Web browser interface to:

- Status: in preparation for 2011-2012.
- Define experiments getting input from forms.
- Launch execution of experiments.
- Control experiments running on distributed hosts.
- Issue database queries to pull experimental data.
- Visualize graphed output data.
- Process output data for interoperation with external tools.

Steady-state detection

- Status: started, but little advance on implementation.
- C++ statistics class ported from SWAN and augmented.
- Takes the shape of an external program to process metric samples already extracted from database.
- Simple strategies to determine end of transient didn't yield accurate results. Review of current literature indicates several possible algorithms.

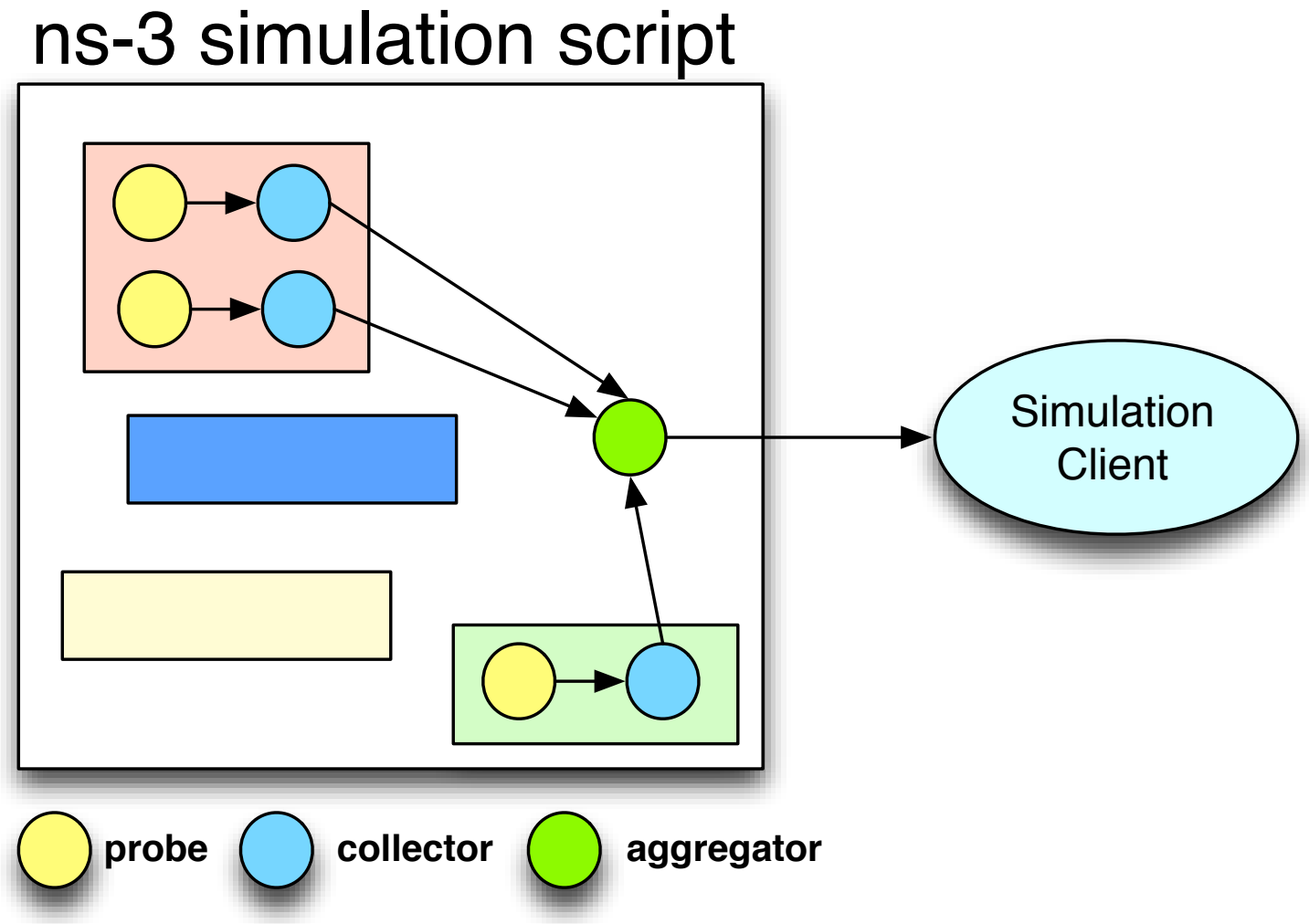
Data collection

- Status: in progress (Felipe Perrone).
- Record 'samples' of variables (attributes and non-attributes) every time there's a change in their value. Tag data with timestamp and an identifier of the source.
- Compute basic statistics on samples.

Concepts

- *Probe*: Mechanism for detecting changes to a variable.
- *Collector*: Contains and processes samples generated by a probe.
- *Aggregator*: Dispatches samples to appropriate output – stdout if simulation is not run from SAFE or the 'Simulation Client' otherwise. Encapsulates the protocol used to talk to the latter.

Probe/Collector/Aggregator



Data collection requirements - control

Global disable: No samples; negligible run time cost.

Global enable: All probes report samples during a window of simulation time specified by a start and an end value. Outside this window, no samples are reported.

Local enabled: Only individually selected probes report samples during a window of simulation time.

Data collection requirements - sample types

Integer: A standard integer data type (64 bit?)

Double: A standard double data type.

Scalar: The probe generates scalar data types.

Non-scalar: The probe generates a data type that can be seen as a collection of scalar values (e.g. a vector of values).

Data collection requirements - reporting

On change: A new sample of an enabled probed is generated when its value changes.

Format: Samples correspond to messages like $<timestamp, metric\ id, value>$

Points to notice

- ns-3 defines the `TracedValue` template class - when a variable changes, a pre-determined function is called.
- Some ns-3 classes use `TracedValue` to define *trace sources*, which can be connected to *trace sinks* via `Config::Connect` (one identifies the source using a path to the right object and the callback to serve as sink).
- What we are calling *probe* is not exactly a trace source. The value monitored by a probe is not an attribute; it can be "just a variable" in the scope of some method (main use case).

Implementation (1)

- Probe abstract class:
  - `static Ptr<Probe> CreateProbe(Ptr<Object> owner, TypeId tid));`
  - `virtual bool GetProbeStatus (void) const = 0;`
  - `virtual void SetProbeStatus (bool enabled) = 0;`
  - boolean *status* is an attributed of `Probe`
- Derive classes: `ProbeInt`, `ProbeDouble`, `ProbeIntVector`, `ProbeDoubleVector`

Implementation (2)

- `Collector` class:
  - Passes samples along without any processing.
  - Passes along statistics on windows of samples.
  - Computes reductions on non-scalar samples.

Implementation (3)

- `Aggregator` class:
  - Singleton configured with the right destination for output of data.
  - Implements the protocol to communicate data downstream.