ROBOTIC CONTROL SYSTEM

ENVIRONMENTAL REACTIVE SYSTEM

HIGH LEVEL INTERACTIONS

EMS

TCM

ICM

ERS

(EnvChangeEvent)

BAD_WEATHER
SYS_STBY
ENC_OPEN
ENG_REQ
AXES_FAIL
NETW_ALERT

State
Model

(controlAction)

open
close
startup
shutdown
startOps
abortOps
initialize
finalize

Operations
Manager

init()
start()
dispose()
abort()

OpenTask
CloseTask
FinalizeTask
StartTask
ShutdownTask
InitializeTask

TMS

SOCA
BGCA
CAL
TOCA
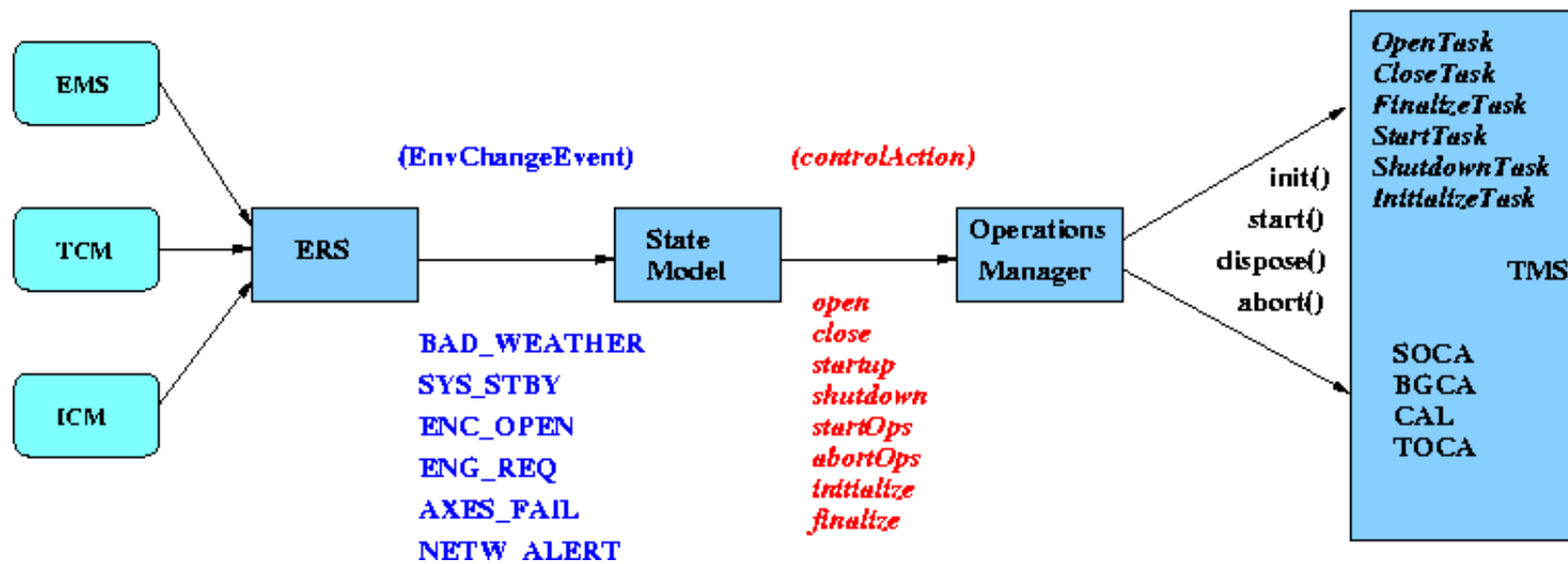
FLOW OF CONTROL

- Feeds from EMS, TCM, ICM into the ERS are processed and can trigger *EnvironmentChangeEvents* which are received by the StateModel.
- The StateModel maintains a set of condition or state variables to keep track of environment changes - (see OpsUI at the lower left corner) and include:-
  - System
  - Weather
  - Axes
  - Intent
  - TimeOfDay
  - Network
- When in the OPERATIONAL state, there is a secondary OperationalStateModel which handles the fine detail of initialization and finalization of observing and switching between modes.
- The current state and set of conditions in force determines whether to change state and which *ControlAction*(s) if any to perform via the OperationsManager.
  - E.g. In OPERATIONAL state and Weather is bad -> execute *AbortOps* action and *Close* action.

- ControlActions are performed by the OperationsManager. They may involve starting transient or mode controller tasks or may involve aborting an operational task.
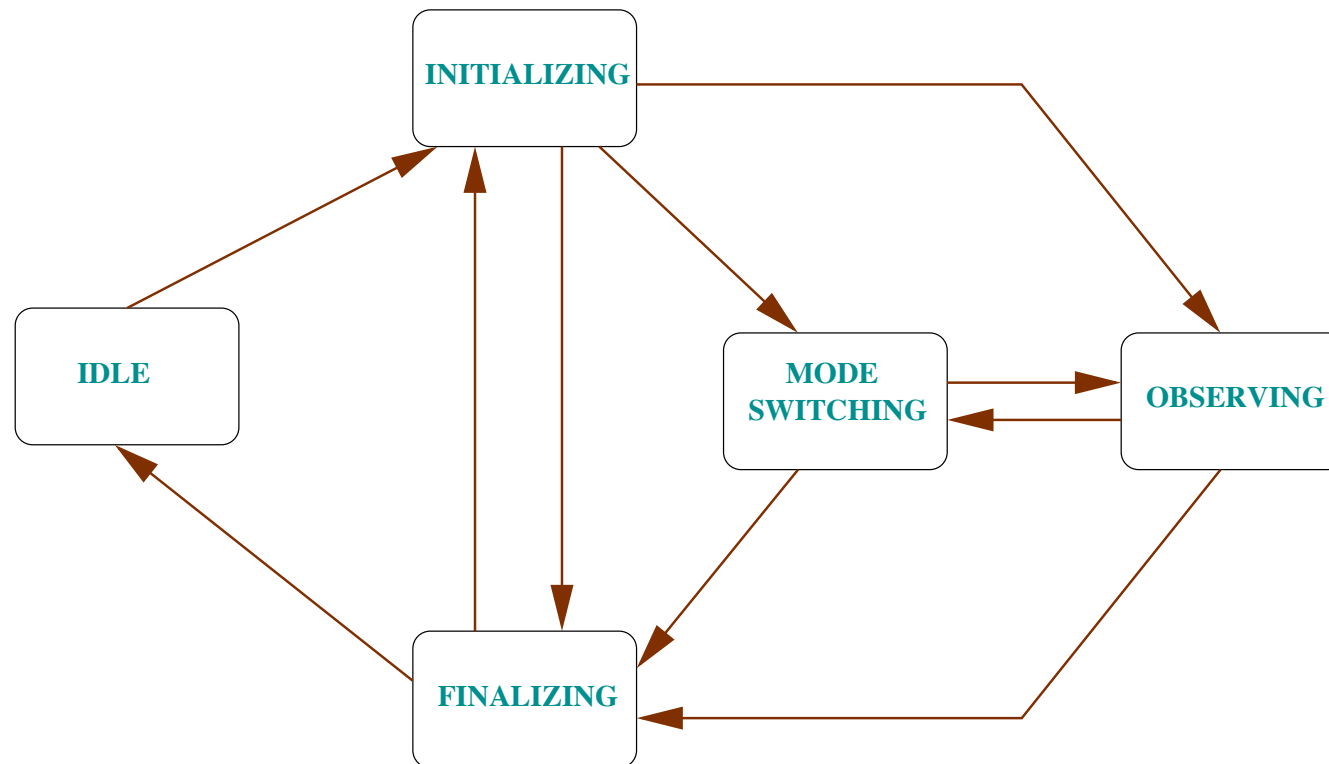
STATE MODEL
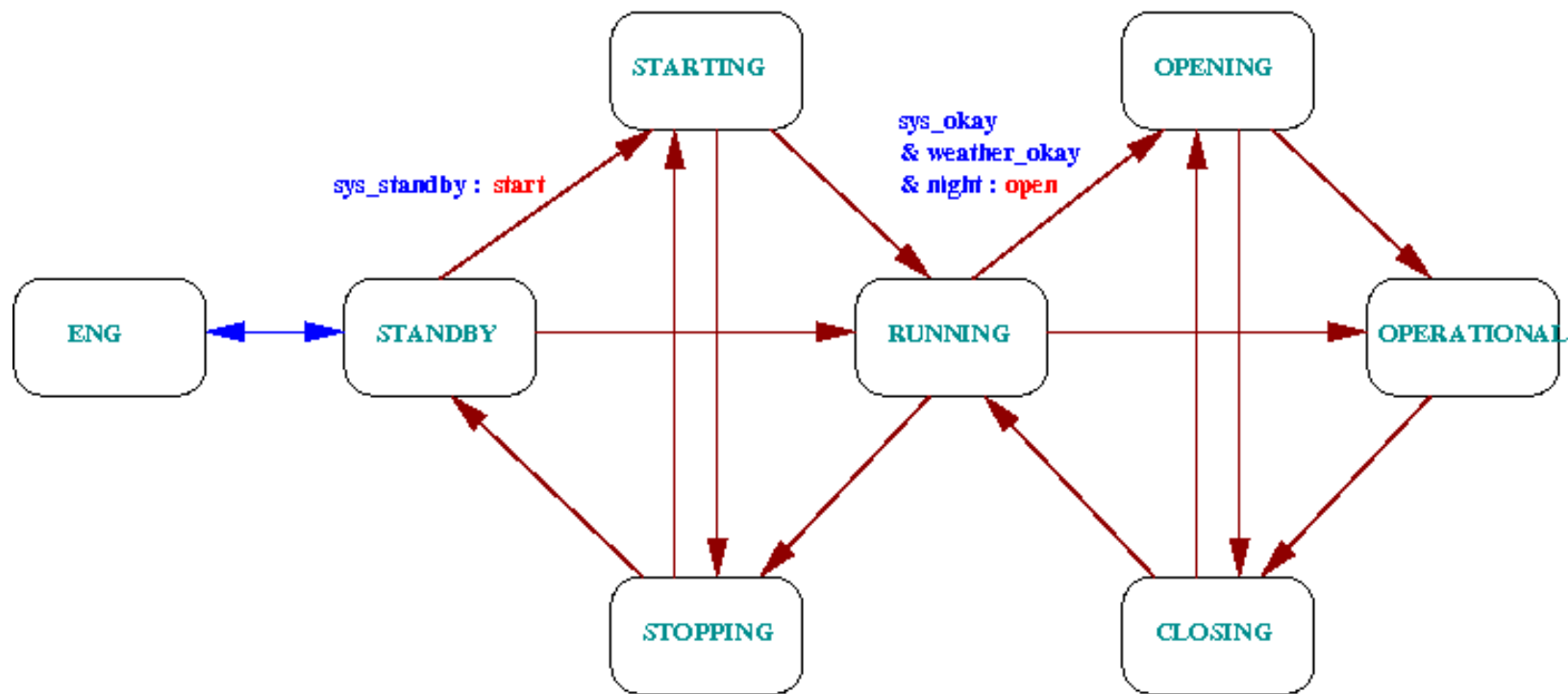
OPERATIONS STATE MODEL

ENVIRONMENTAL REACTIVE SYSTEM

- The ERS is made up from various components:-
  - Filters receive input from telemetry feeds from each of the low level systems:-
    - EMS (meteo, seeing, cloud, dust)
    - TCM (axes, enclosure, mirror-cover, mcp)
    - ICM (instruments)
  - Criteria are attached to filters – a criterion can only be attached to a single filter but a given filter may feed many criteria.
    - Criteria provide simple boolean conditions on the state of the feed:-
      - Equals
      - Greater
      - Less
      - One-of
  - Rules are attached to criteria
    - Indicate a period of time for which the criterion must be satisfied.
    - Rules can be combined via AND and OR operations. Potentially others could be added like FUZZY.

ERS CONFIGURATION

- The ERS is configured from a file: *rules.xml*
- Structured with sections for:-
  - Filters (name, type, feed-ID)
  - Criteria (name, filter-ID, condition)
  - Rules (name, class, class-config)
  - Rules can be nested to any depth as
    - Conjuncts (AND)
    - Disjuncts (OR)

FILTER CONFIG

- Filter example:-
  - \<filter name = "M_HUM_SLOW" class = "AVERAGE"\>
    - \<source\> METEO \</source\>
    - \<category\> WMS \</category\>
    - \<item\> humidity \</item\>
    - \<period unit = "mins"\> 5 \</period\>
  - \</filter\>

  - Name: M_HUM_SLOW
  - Type: Averaging, period 5 mins
  - Feed: METEO / WMS / humidity

CRITERION CONFIG

- Criterion example:-
  - <criterion name = "C_WS_HI" class = "GREATER">
    - <minimum> 15.0 </minimum>
    - <filter> M_WS_FAST </filter>
  - </criterion>

  - Name: C_WS_HI
  - Filter: M_WS_FAST
  - Condition: value > 15.0

RULE CONFIG

- Rule example:-
  - <rule name = "CLOUD_HI" class = "timed">
    - <period unit = "mins"> 10 </period>
    - <criterion>…….</criterion>
  - </rule>

  - Name: CLOUD_HI
  - Class: timed (condition must be true for specified amount of time)
  - Class-config: period = 10 minutes

COMBINATION RULE CONFIG

- Combination (CONJUNCT) example:- (internal detail hidden)
  - <rule name = "ENC_OPEN" class = "CONJUNCT">
    - <rule name = "EN1_OPEN" class = "timed"> … </rule>
    - <rule name = "EN2_OPEN" class = "timed"> … </rule>
    - <rule name = "EN1_IN_POSN" class = "timed"> … </rule>
    - <rule name = "EN2_IN_POSN" class = "timed"> …</rule>
  - </rule>

  - Rule ENC_OPEN is triggered only if ALL the enclosed rules are also triggered, i.e. their enclosed criteria must all satisfied for the required amount(s) of time.

FLOW THROUGH ERS LAYERS