5 Mutual exclusion

In Folder 5, the mutex locks are added to the local supervisors, as is discussed in Section V. The communication between supervisors is modeled, such that the system controlled by the distributed supervisor (i.e. the set of local supervisors with mutex locks) can be validated through simulation.

5.1 Folder *definitions*

The models for the mutex algorithm as discussed in Section V, are given in the files *Home.cif* and *Away.cif* for the home and the away process of the mutex algorithm respectively.

The communication between the home process and the away process of a mutex lock, consists of two events and a boolean value. When the away process requests the token from the home process, boolean *R* in the away process is set to true. When this is observed in the home process, boolean R2, in the home process, is set to true. When event *c_to2* happens in the home process, this is observed as event *c_request* in the away process. This represents sending the token from the home process to the away process. Similarly, event *c_return* in the away process, which is observed as event *u_receive* in the home process, represents returning the token from the away process to the home process.

The files *Communication Bool.cif*, *Communication Event.cif*, and *Timer.cif* are used for simulation of the communication between the local supervisors. The *Communication Event* automaton observes an input event *eventIn* and after a 1 second delay output event *eventOut* is triggered. Similarly, the *Communication Bool* automaton observes an input boolean *bool in* and outputs an output boolean *out*, which is set to the value of *bool in* with a 1 second delay on each update.

5.2 Folders *Loc1* and *Loc2*

The folders *Loc1* and *Loc2* contain the local supervisors, with the addition of the mutex locks. In this example 4 mutex locks are required, as is discussed in Section V. The mutex locks are instantiated at the bottom of the files *loc1.cif* and *loc2.cif*. A home process is instantiated in the following format:

```
1 alg bool Mutex1HomeReturnCondition =
2          not event1Enabled and not event2Enabled and not event2Enabled;
3 Mutex1Home: Home(Mutex1HomeReturnCondition);
```

The boolean variable represents the return condition for returning the token. The variables *eventiEnabled* are booleans, which are true when *event i* is enabled. An away process is instantiated in a similar fashion.

5.3 Folder *SimulationSupervisor*

Simulating the distributed supervisor is done similarly to simulating the non-distributed supervisor, which was discussed in Section 1. Therefore, the files that are not changed with respect to the files in Section 1, are not discussed. However, in this simulation mutexes and communication between local supervisors is added. The communication between the two local supervisors is defined in the file *Hybrid.cif*. The file

Merge.tooldef2 is used to merge the files *loc1.cif*, *loc2.cif*, and *Hybrid.cif*. The result of this merge is given in the file *Supervisor.cif*. The file *Simulatie.tooldef2* can be used to run the simulation of the distributed supervisor with mutexes.