Modelling real-time applications based on resource reservation

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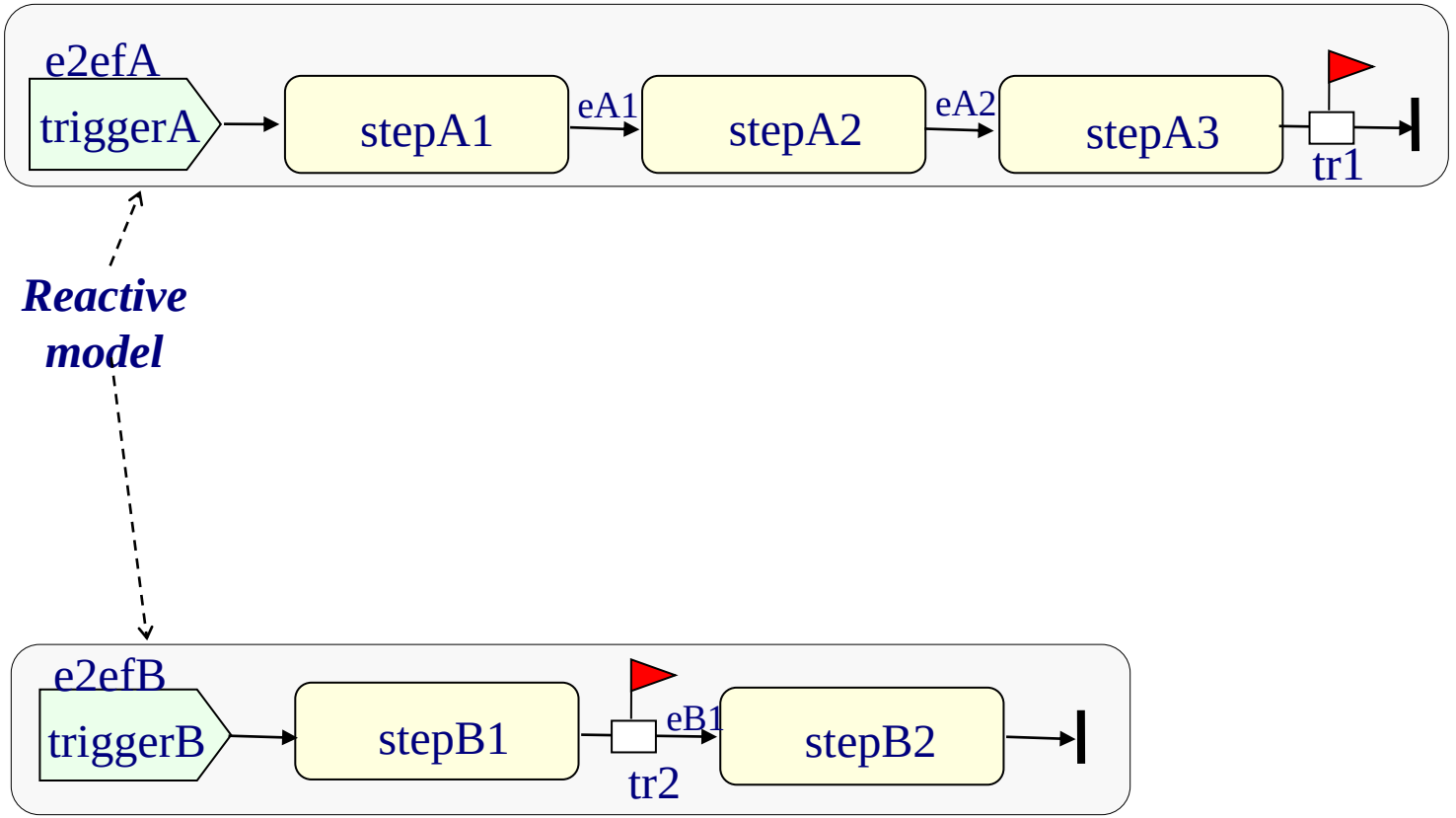
Introduction

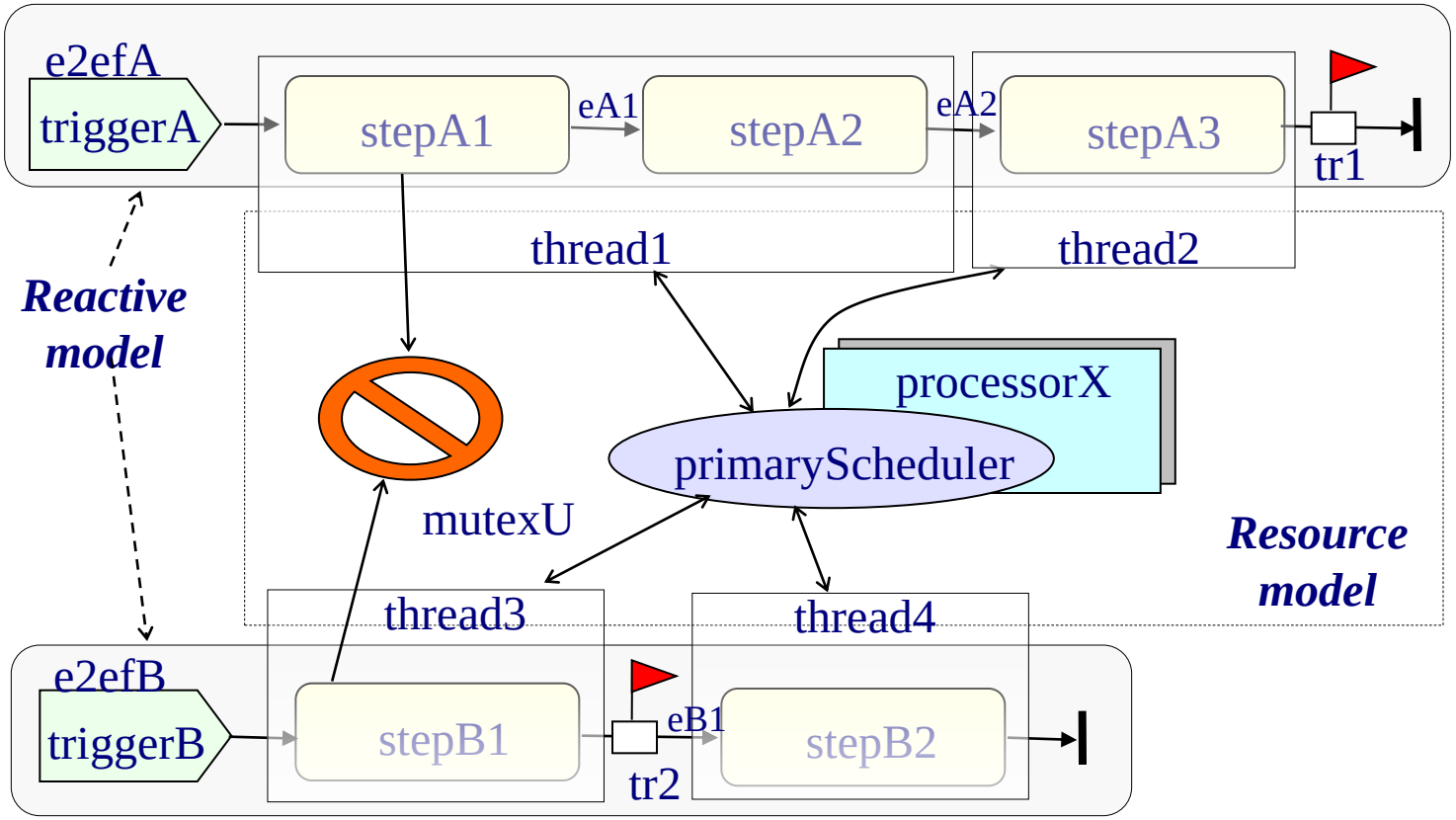
- Resource Reservation (RR)
  - Executing each system thread or communication session in a server
  - Server: it has assigned a fraction of the processor capacity or the communication network.
  - Advantages:
    - System robustness
    - Design simplicity
    - Reusability of software components

- MAST
  - Open source set of tools to design and analysis of RT applications
  - MAST *model* extended =>MAST 2
  - MAST 2 *tools* under development:
    - Possibility of usage of MAST 1 tools transforming models by MDA

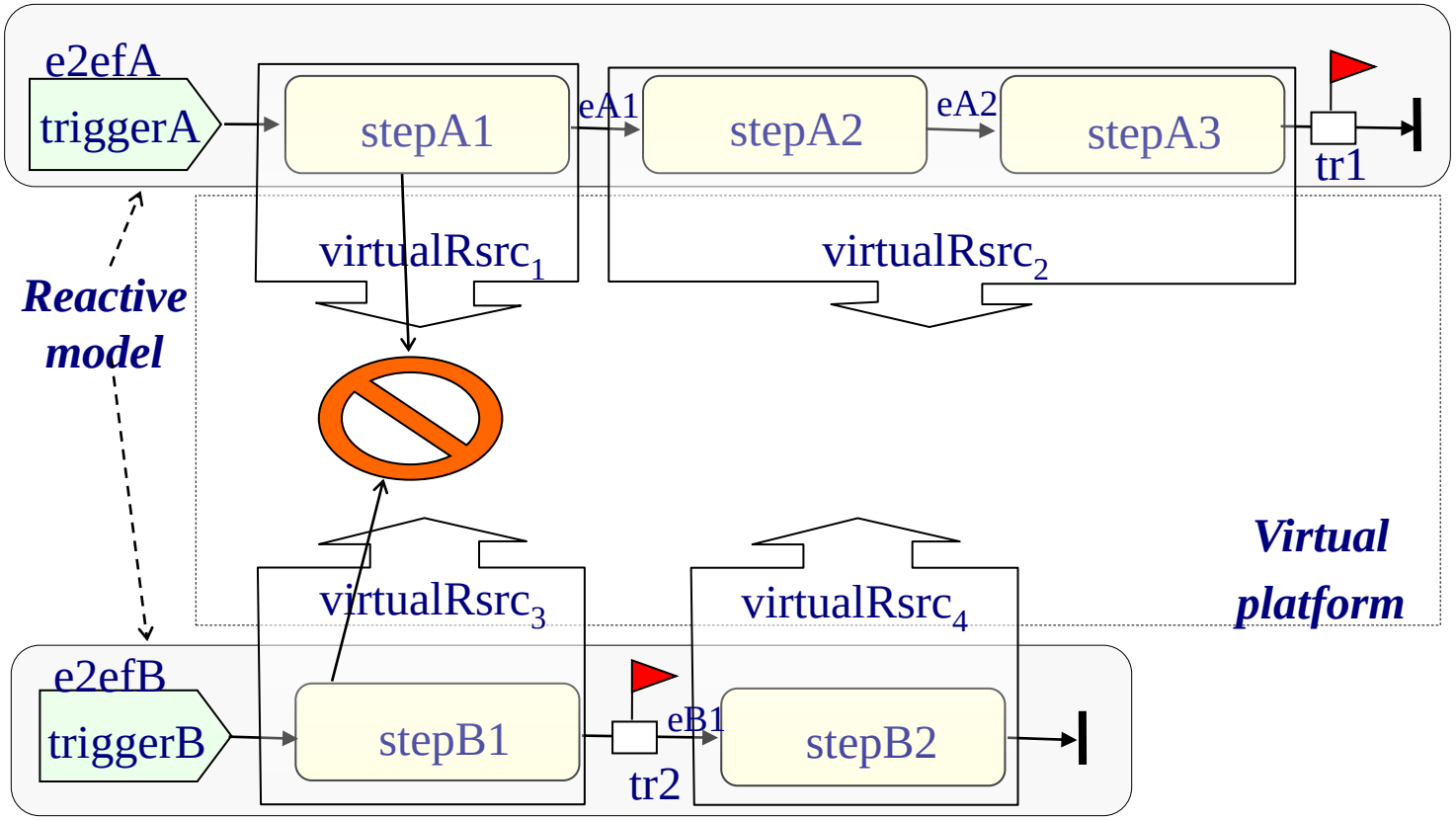
Modelling elements for the resource reservation paradigm I



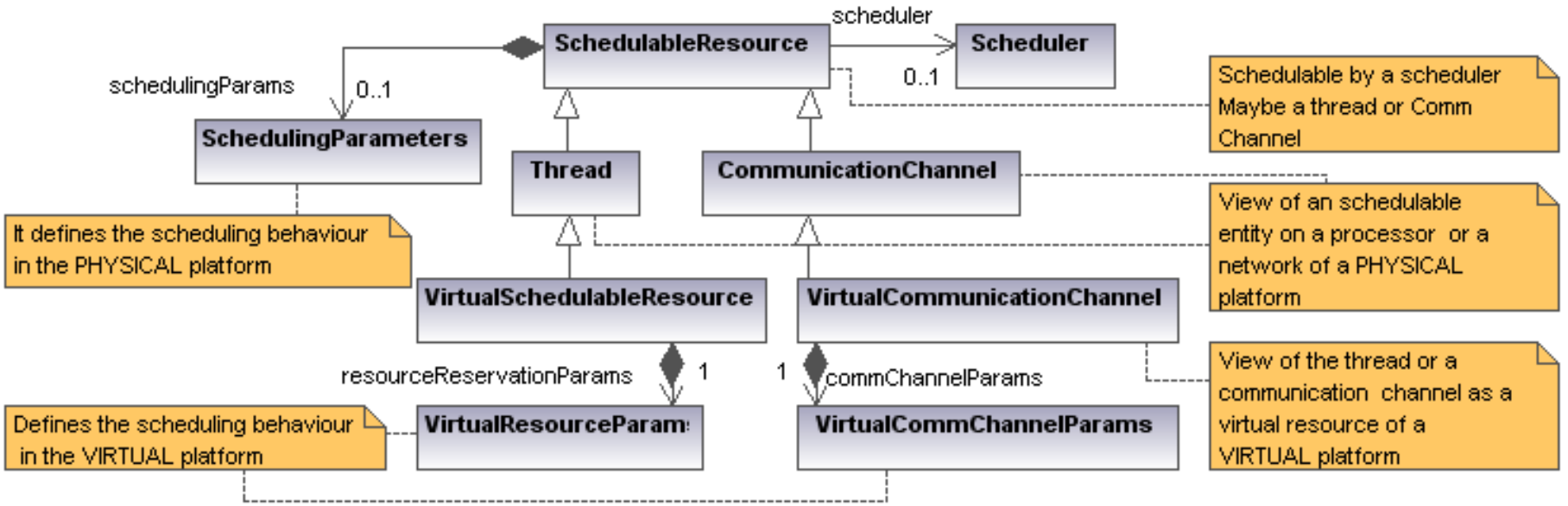
Modelling elements for the resource reservation paradigm I



Modelling elements for the resource reservation paradigm II

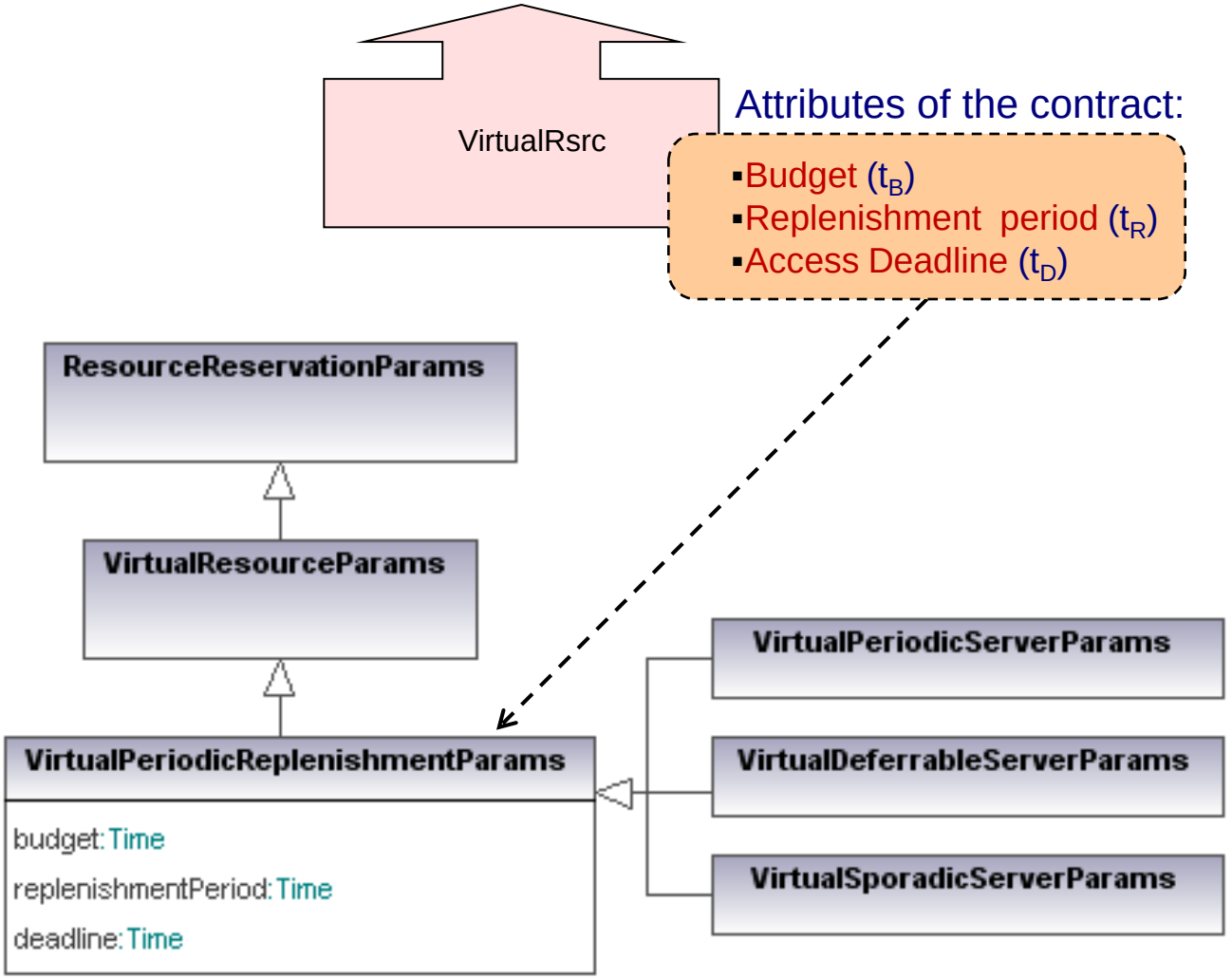


New classes in resource reservation MAST models I

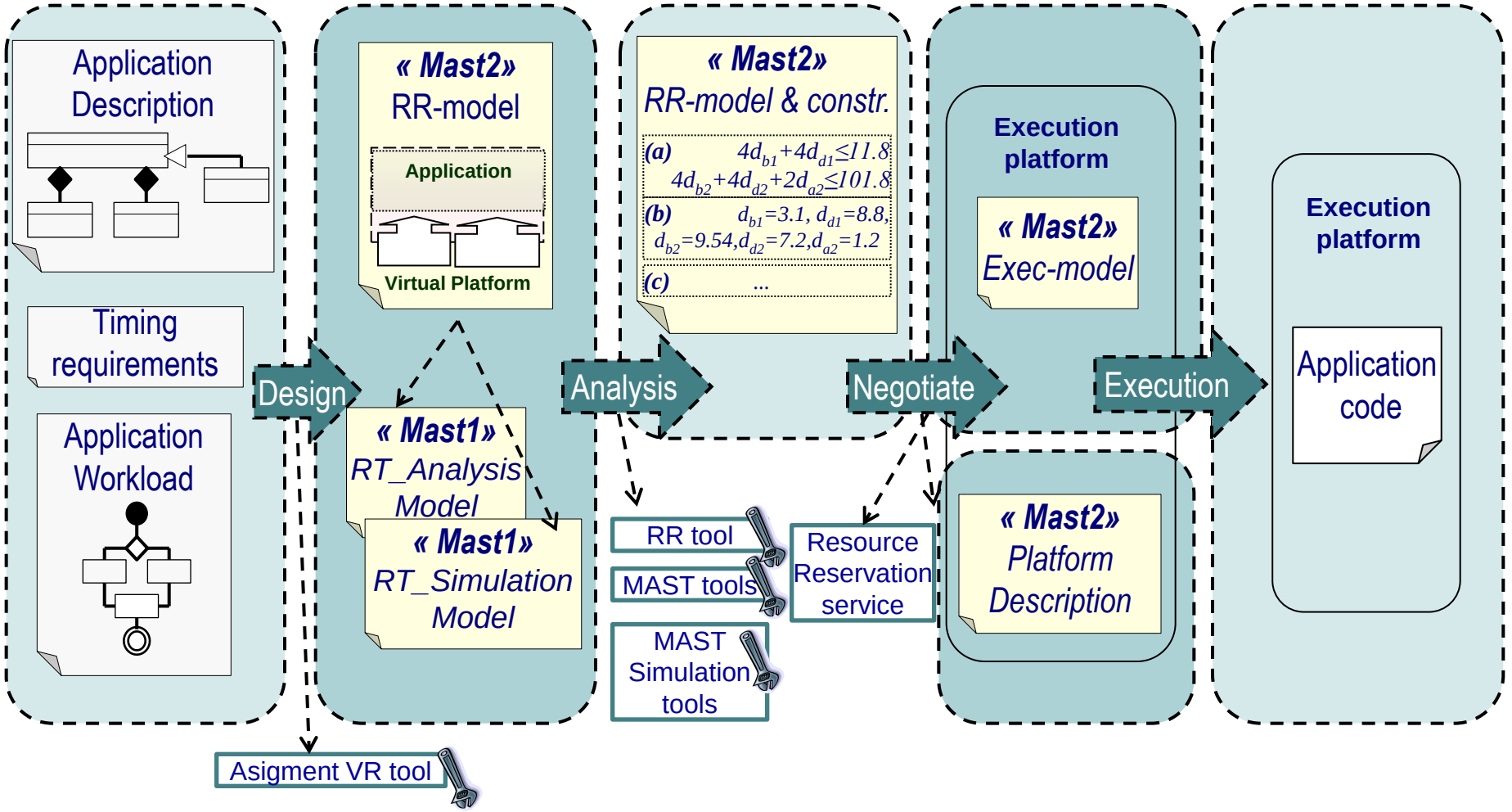


New classes in resource reservation MAST models II

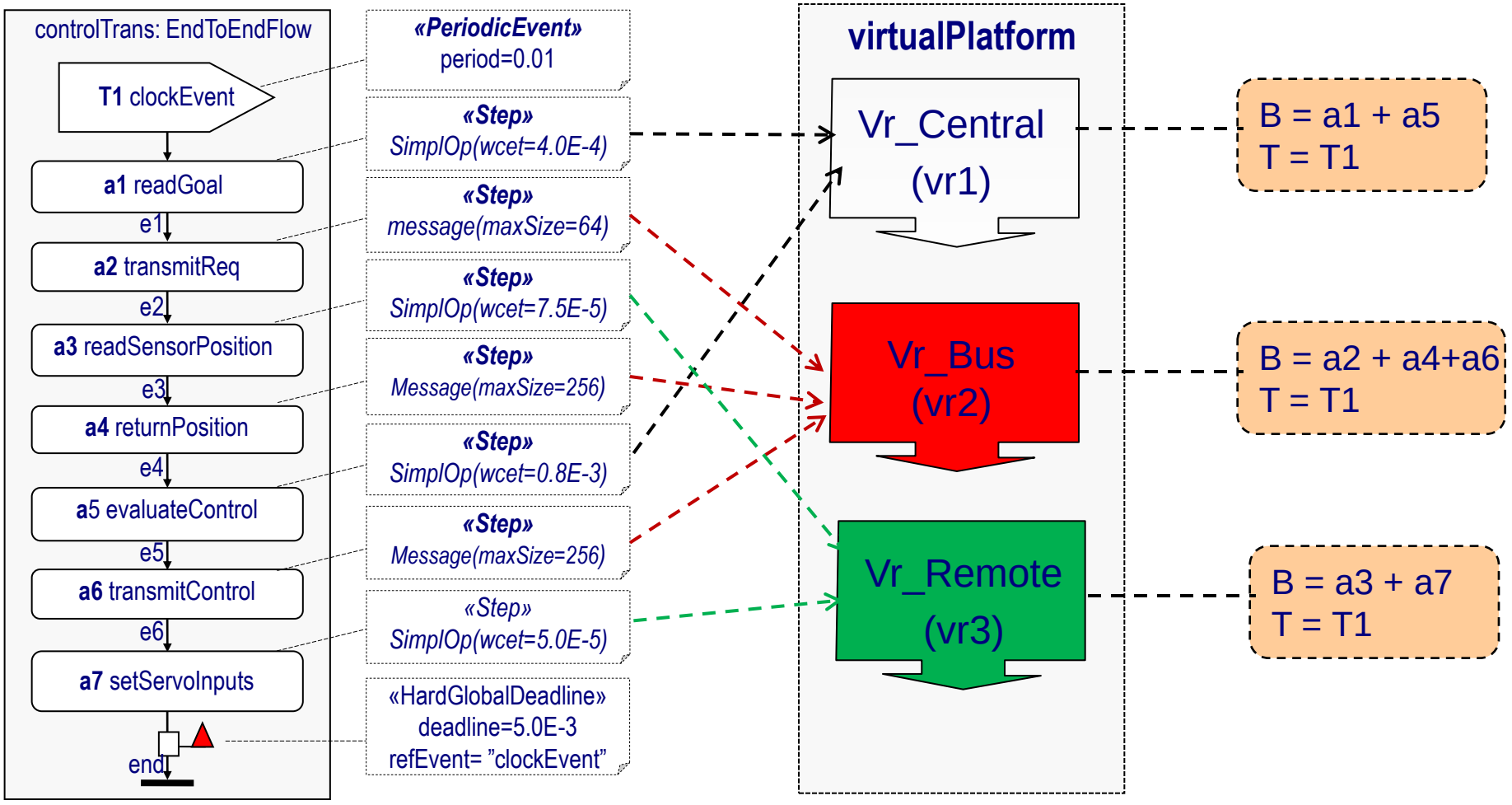
- **Contract:** it represents the capacity required by the application to be executed.



Real-time application development



Reactive model of ServoControl example



Virtual Platform assignment tool

Virtual Platform

	Period	Budget	Deadline
Vr_Central(vr1)	T1	a1+ a5	?
Vr_Bus(vr2)	T1	a2+a4+a6	?
Vr_Remote(vr3)	T1	a3+a7	?

$2\ \mathbf{vr1}.t_{D+}\ 3\ \mathbf{vr2}.t_{D+}\ 2\ \mathbf{vr3}.t_{D} \leq 9.182$ ms

It is possible to calculate the *wrt* (t_X) of an activity (t_a) in a VirtualRsrc.

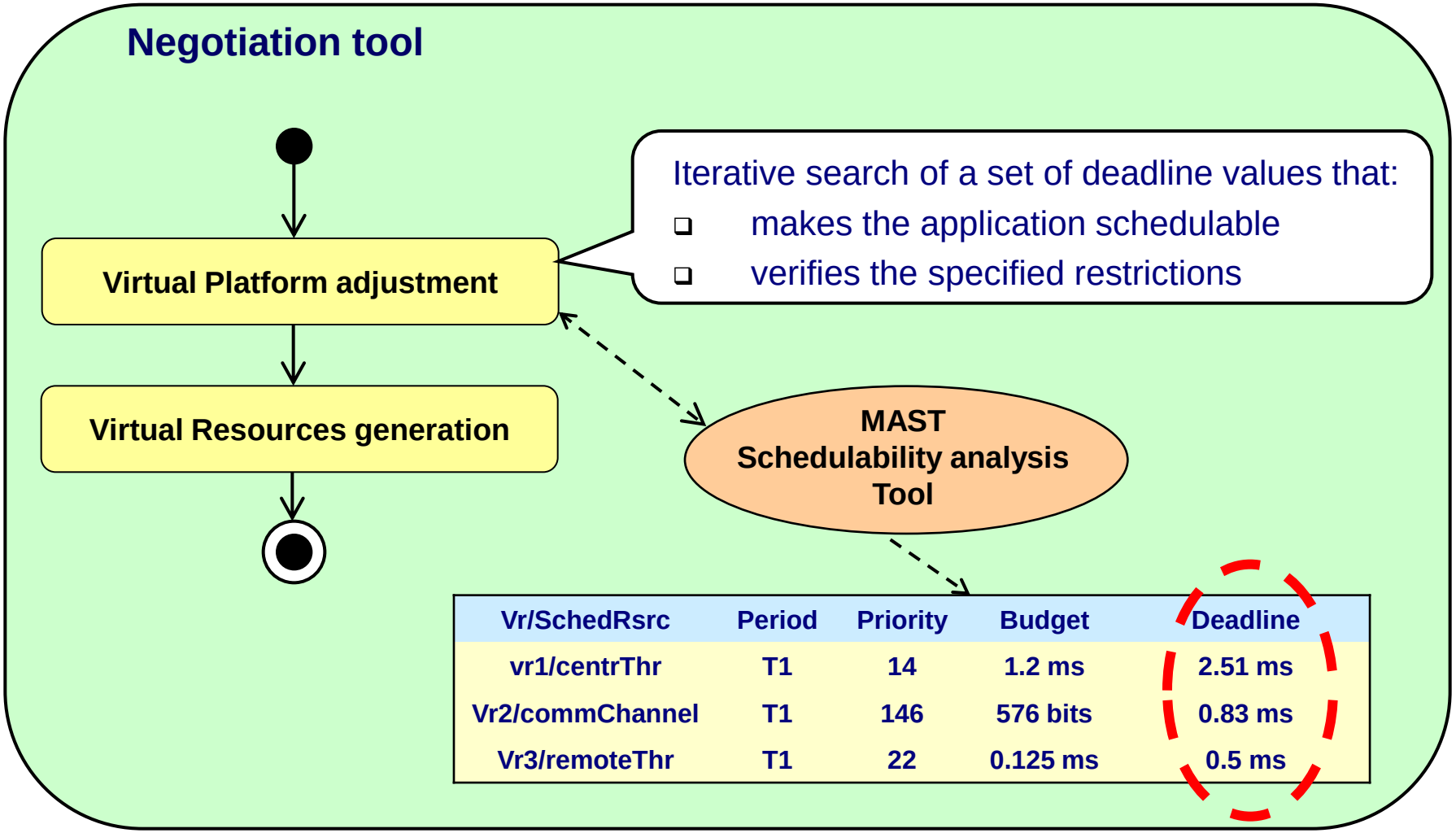
$wrt\ (a_x) < \mathbf{vr}.t_D - (\mathbf{vr}.t_B - a_x)$

$\mathbf{vr1}.t_D\text{-}(\mathbf{vr1}.t_B\text{-}a1) + \mathbf{vr1}.t_D\text{-}(\mathbf{vr1}.t_B\text{-}a5) +$

$+ \mathbf{vr2}.t_D\text{-}(\mathbf{vr2}.t_B\text{-}a2) + \mathbf{vr2}.t_D\text{-}(\mathbf{vr2}.t_B\text{-}a4) + \mathbf{vr2}.t_D\text{-}(\mathbf{vr2}.t_B\text{-}a6) +$

$+ \mathbf{vr3}.t_D\text{-}(\mathbf{vr3}.t_B\text{-}a3) + \mathbf{vr3}.t_D\text{-}(\mathbf{vr3}.t_B\text{-}a7) < t_{GD}$

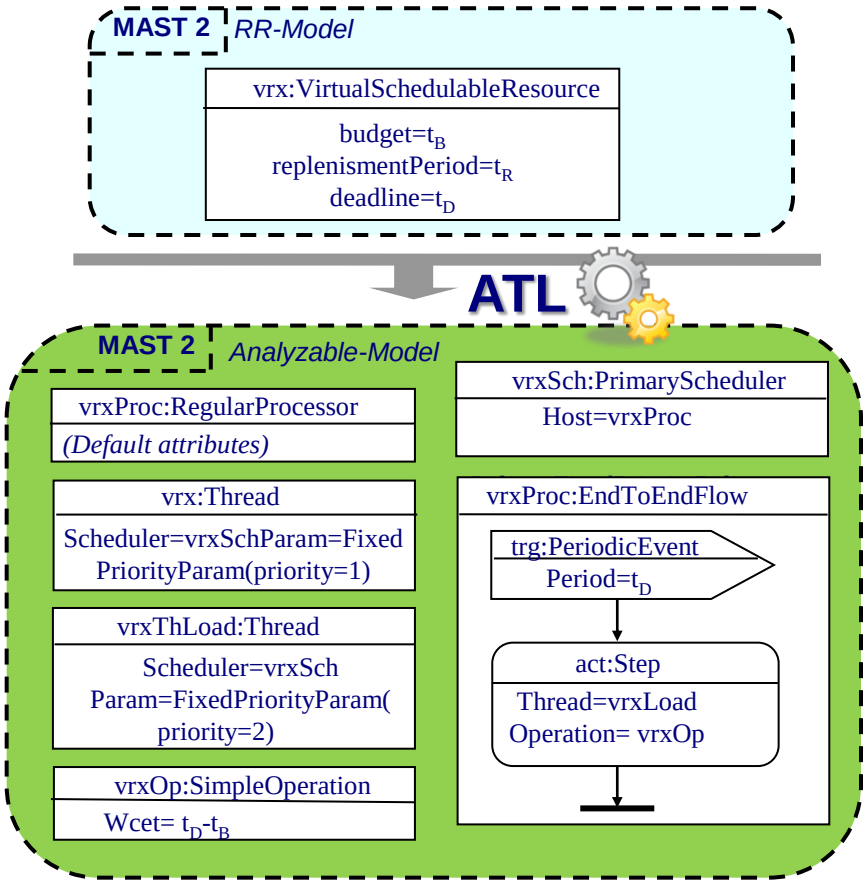
Negotiation tool



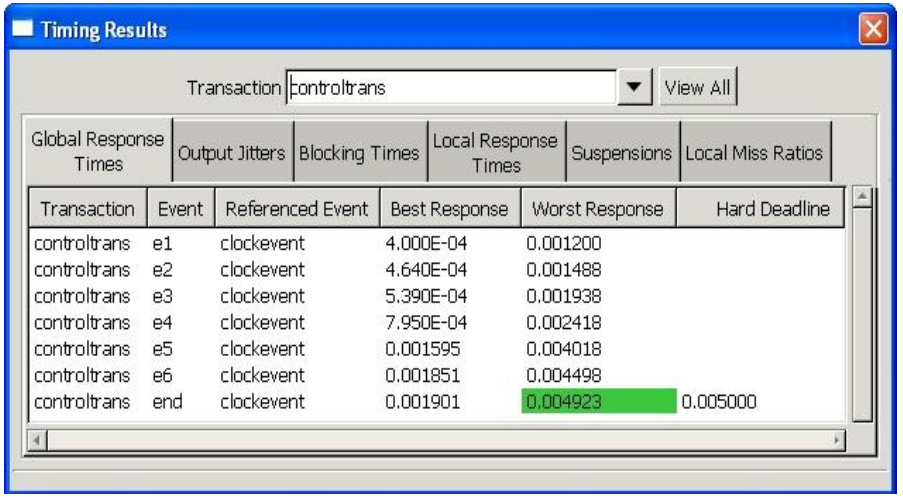
Vr/SchedRsrc	Period	Priority	Budget	Deadline
vr1/centrThr	T1	14	1.2 ms	2.51 ms
Vr2/commChannel	T1	146	576 bits	0.83 ms
Vr3/remoteThr	T1	22	0.125 ms	0.5 ms

Complex application: No restrictions. Virtual schedulability analysis

Model transformation



Results of analysis using MAST tools



Transaction	Event	Referenced Event	Best Response	Worst Response	Hard Deadline
controltrans	e1	clockevent	4.000E-04	0.001200	
controltrans	e2	clockevent	4.640E-04	0.001488	
controltrans	e3	clockevent	5.390E-04	0.001938	
controltrans	e4	clockevent	7.950E-04	0.002418	
controltrans	e5	clockevent	0.001595	0.004018	
controltrans	e6	clockevent	0.001851	0.004498	
controltrans	end	clockevent	0.001901	0.004923	0.005000

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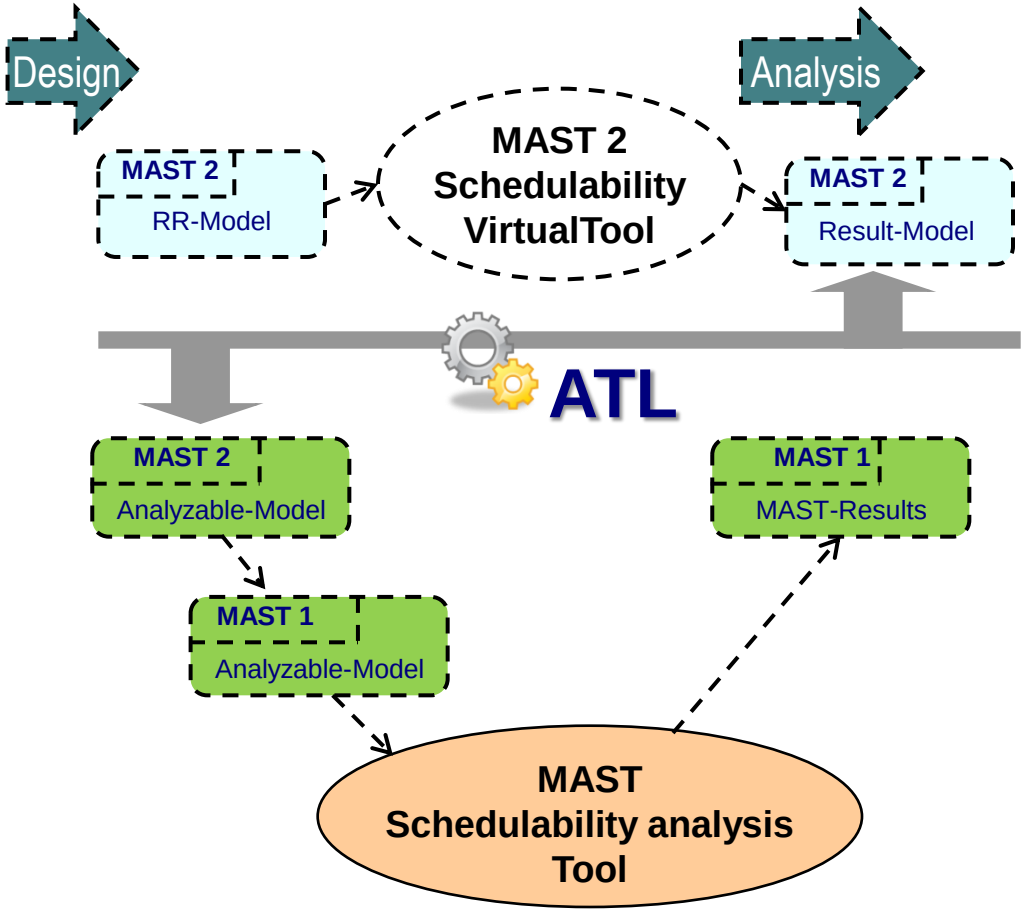
Model Transformation for the MAST 1 compatibility



Conclusions

- Modelling elements based on RR paradigm with MAST:
  - Scenario:
    - The application can be analysed independently of the current workload
    - The programmers do not require any knowledge about the underlying platform
  - Solution:
    - MAST tools cover the different phases in the development and execution of applications based on resource reservation
    - Relying in the availability of a resource reservation middleware installed in the platform
  - Currently working on:
    - Updating the MAST tools in order to support the new advanced paradigms for real time systems covered by MAST2
    - Other :
      - Implementation of the virtual platform assignment tool
      - Implementation of the resource reservation service based on Rt-linux