

*This form is a summary description of the model entitled “RERS2020” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.*

## Description

These 9 models were presented as parallel problems at the RERS (Rigorous Examination of Reactive Systems) challenge in 2020. We have used the models of the CTL and LTL parallel challenges (designed by M. Jasper) which exhibit complex behaviour and were solved by only one participant [2]. All these models have a non-trivial NUPN structure.

## References

- 1 F. Howar, M. Schordan, B. Steffen. Parallel Problems (overview) of the RERS challenge, 2020, <http://rers-challenge.org/2020/index.php?page=parallelProblemsHead#>.
- 2 See, e.g., <https://cadp.inria.fr/news13.html#section-3>

## Scaling parameter

Parameter name	Parameter description	Chosen parameter values
$N$	each model corresponds to a different problem proposed at RERS 2020	problems 101, 102, ..., 109

## Size of the model

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
problem 101	906	149 363	595 952	6	1-5-36
problem 102	1 276	125 387	499 222	8	1-7-47
problem 103	520	31 658	125 892	9	1-8-46
problem 104	1 353	143 642	572 292	10	1-9-61
problem 105	1 982	153 412	610 156	12	1-11-73
problem 106	2 041	125 740	498 326	13	1-12-76
problem 107	1 382	104 643	417 030	14	1-13-82
problem 108	2 339	132 214	523 950	16	1-15-94
problem 109	1 907	151 872	605 350	17	1-16-101

## Structural properties

**ordinary** — all arcs have multiplicity one ..... yes  
**simple free choice** — all transitions sharing a common input place have no other input place ..... no <sup>(a)</sup>  
**extended free choice** — all transitions sharing a common input place have the same input places ..... no <sup>(b)</sup>  
**state machine** — every transition has exactly one input place and exactly one output place ..... no <sup>(c)</sup>  
**marked graph** — every place has exactly one input transition and exactly one output transition ..... no <sup>(d)</sup>  
**connected** — there is an undirected path between every two nodes (places or transitions) ..... yes <sup>(e)</sup>

<sup>(a)</sup> stated by CÆSAR.BDD version 3.7 on all 9 instances (problems 101 to 109).

<sup>(b)</sup> stated by CÆSAR.BDD version 3.7 on all 9 instances (problems 101 to 109).

<sup>(c)</sup> stated by CÆSAR.BDD version 3.7 on all 9 instances (problems 101 to 109).

<sup>(d)</sup> stated by CÆSAR.BDD version 3.7 on all 9 instances (problems 101 to 109).

<sup>(e)</sup> stated by CÆSAR.BDD version 3.7 on all 9 instances (problems 101 to 109).

- strongly connected** — *there is a directed path between every two nodes (places or transitions)* ..... no <sup>(f)</sup>  
**source place(s)** — *one or more places have no input transitions* ..... yes <sup>(g)</sup>  
**sink place(s)** — *one or more places have no output transitions* ..... ? <sup>(h)</sup>  
**source transition(s)** — *one or more transitions have no input places* ..... no <sup>(i)</sup>  
**sink transitions(s)** — *one or more transitions have no output places* ..... no <sup>(j)</sup>  
**loop-free** — *no transition has an input place that is also an output place* ..... no <sup>(k)</sup>  
**conservative** — *for each transition, the number of input arcs equals the number of output arcs* ..... yes <sup>(l)</sup>  
**subconservative** — *for each transition, the number of input arcs equals or exceeds the number of output arcs* ..... yes <sup>(m)</sup>  
**nested units** — *places are structured into hierarchically nested sequential units* <sup>(n)</sup> ..... ?

## Behavioural properties

- safe** — *in every reachable marking, there is no more than one token on a place* ..... yes <sup>(o)</sup>  
**dead place(s)** — *one or more places have no token in any reachable marking* ..... ? <sup>(p)</sup>  
**dead transition(s)** — *one or more transitions cannot fire from any reachable marking* ..... ? <sup>(q)</sup>  
**deadlock** — *there exists a reachable marking from which no transition can be fired* ..... ? <sup>(r)</sup>  
**reversible** — *from every reachable marking, there is a transition path going back to the initial marking* ..... ? <sup>(s)</sup>  
**live** — *for every transition  $t$ , from every reachable marking, one can reach a marking in which  $t$  can fire* ..... ? <sup>(t)</sup>

## Size of the marking graphs

Parameter	Number of reachable markings	Number of transition firings	Max. number of tokens per place	Max. number of tokens per marking
problem 101	345421 <sup>(u)</sup>	?	1	5 <sup>(v)</sup>
problem 102	$\geq 1.14736e+07$ <sup>(w)</sup>	?	1 <sup>(x)</sup>	7 <sup>(y)</sup>
problem 103	$6.46576e+07$ <sup>(z)</sup>	?	1	8 <sup>(aa)</sup>
problem 104	$\geq 3.92045e+06$ <sup>(ab)</sup>	?	1 <sup>(ac)</sup>	9 <sup>(ad)</sup>
problem 105	$\geq 2.96522e+06$ <sup>(ae)</sup>	?	1 <sup>(af)</sup>	11 <sup>(ag)</sup>
problem 106	$\geq 3.75815e+08$ <sup>(ah)</sup>	?	1 <sup>(ai)</sup>	12 <sup>(aj)</sup>
problem 107	$\geq 6.59343e+07$ <sup>(ak)</sup>	?	1 <sup>(al)</sup>	13 <sup>(am)</sup>
problem 108	$\geq 2.61085e+08$ <sup>(an)</sup>	?	1 <sup>(ao)</sup>	15 <sup>(ap)</sup>
problem 109	$\geq 4.82768e+06$ <sup>(aq)</sup>	?	1 <sup>(ar)</sup>	16 <sup>(as)</sup>

- <sup>(f)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(g)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(h)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be true on 3 instance(s) out of 9, and false on the remaining 6 instance(s).  
<sup>(i)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(j)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(k)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(l)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(m)</sup> stated by [CÆSAR.BDD](#) version 3.7 on all 9 instances (problems 101 to 109).  
<sup>(n)</sup> the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>  
<sup>(o)</sup> safe by construction – stated by [PNML2NUPN](#) 3.2.0.  
<sup>(p)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be true on 2 instance(s) out of 9, and unknown on the remaining 7 instance(s).  
<sup>(q)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be true on 2 instance(s) out of 9, and unknown on the remaining 7 instance(s).  
<sup>(r)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be true on 1 instance(s) out of 9, false on the remaining 1 instance(s), and unknown on the remaining 7 instance(s).  
<sup>(s)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be false on 1 instance(s) out of 9, and unknown on the remaining 8 instance(s).  
<sup>(t)</sup> stated by [CÆSAR.BDD](#) version 3.7 to be false on 2 instance(s) out of 9, and unknown on the remaining 7 instance(s).  
<sup>(u)</sup> stated by [CÆSAR.BDD](#) version 3.7.  
<sup>(v)</sup> number of initial tokens, because the net is conservative.  
<sup>(w)</sup> stated by [CÆSAR.BDD](#) version 3.7.  
<sup>(x)</sup> stated by [PNML2NUPN](#) 3.2.0.  
<sup>(y)</sup> number of initial tokens, because the net is conservative.  
<sup>(z)</sup> stated by [CÆSAR.BDD](#) version 3.7.  
<sup>(aa)</sup> number of initial tokens, because the net is conservative.  
<sup>(ab)</sup> stated by [CÆSAR.BDD](#) version 3.7.  
<sup>(ac)</sup> stated by [PNML2NUPN](#) 3.2.0.

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- (ad) number of initial tokens, because the net is conservative.
  - (ae) stated by [CÆSAR.BDD](#) version 3.7.
  - (af) stated by [PNML2NUPN](#) 3.2.0.
  - (ag) number of initial tokens, because the net is conservative.
  - (ah) stated by [CÆSAR.BDD](#) version 3.7.
  - (ai) stated by [PNML2NUPN](#) 3.2.0.
  - (aj) number of initial tokens, because the net is conservative.
  - (ak) stated by [CÆSAR.BDD](#) version 3.7.
  - (al) stated by [PNML2NUPN](#) 3.2.0.
  - (am) number of initial tokens, because the net is conservative.
  - (an) stated by [CÆSAR.BDD](#) version 3.7.
  - (ao) stated by [PNML2NUPN](#) 3.2.0.
  - (ap) number of initial tokens, because the net is conservative.
  - (aq) stated by [CÆSAR.BDD](#) version 3.7.
  - (ar) stated by [PNML2NUPN](#) 3.2.0.
  - (as) number of initial tokens, because the net is conservative.