

*This form is a summary description of the model entitled "Client/Server with Repetitions" 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

This Petri net models a client/server application with  $N_{CLIENTS}$  clients and  $N_{SERVERS}$  servers. Communication from clients to servers is not reliable, with requests stored in a buffer of size  $BUFFERSIZE$ . Communication from servers to clients are reliable. A client send its message until it receives an answer.

The interesting point is that place RequestBuffer is not 1-bounded. This model can thus be used to assess how model checkers behave for colored non-safe nets.

Class

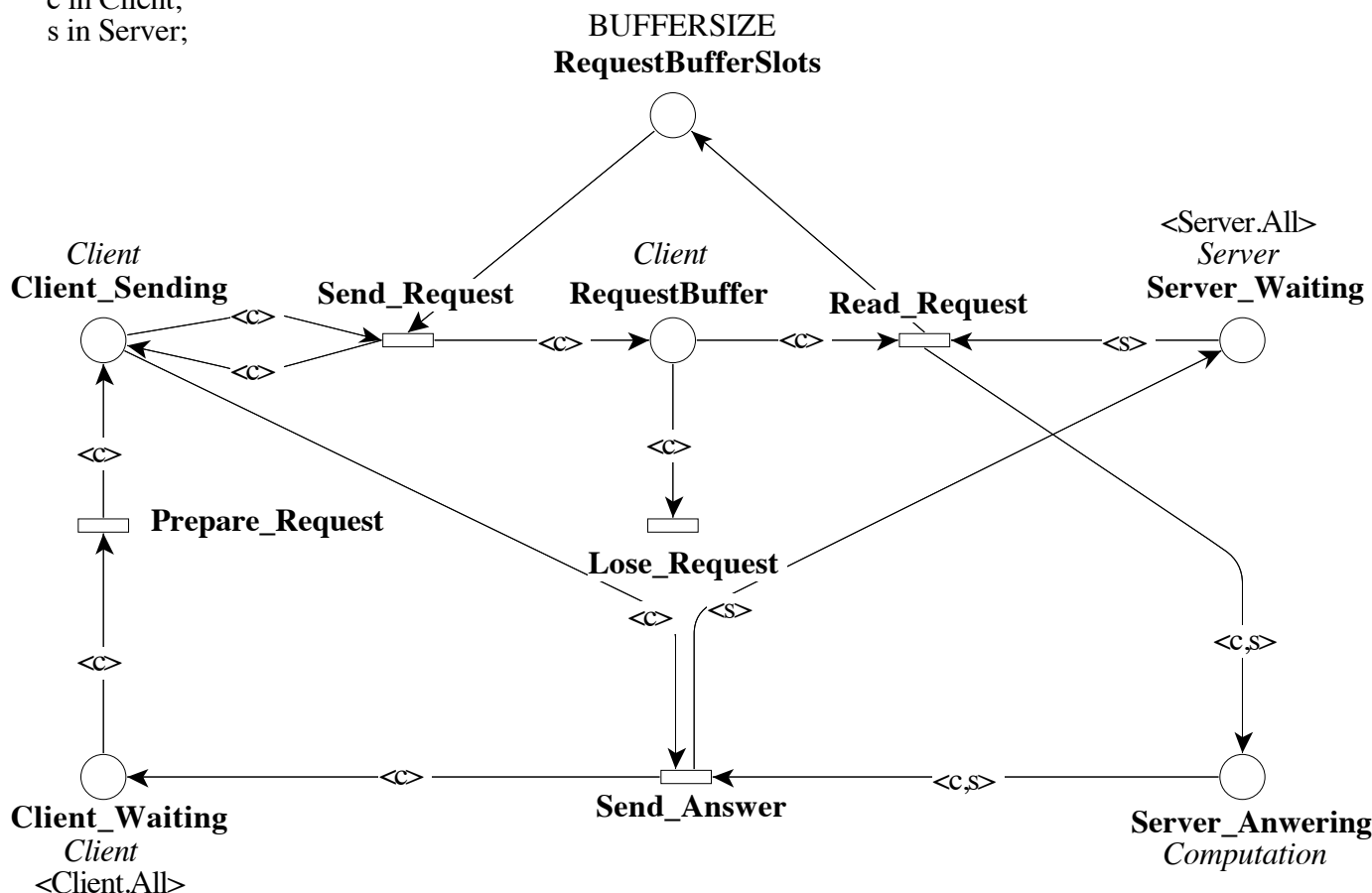
Client is  $1..N_{CLIENTS}$ ;  
 Server is  $1..N_{SERVERS}$ ;

Domain

Computation is  $\langle Client, Server \rangle$ ;

Var

$c$  in Client;  
 $s$  in Server;



## Scaling parameter

Parameter name	Parameter description	Chosen parameter values
$n$	To set only one parameter, we set a parameter $n$ and compute model parameters with: $NCLIENTS=n^2$ , $NSERVERS=n$ , $BUFFERSIZE=n$	2, 3, 4, 5, 7, 10

## Size of the model

Parameter	Number of places	Number of transitions	Number of arcs
(NCLIENTS, NSERVERS, BUFFER-SIZE)	$1 + 3*NCLIENTS + NSERVERS + NCLIENTS*NSERVERS$	$3*NCLIENTS + 2*NCLIENTS*NSERVERS$	$7*NCLIENTS + 8*NCLIENTS+NSERVERS$
$n$	$n^3 + 3n^2 + n + 1$	$2n^3 + 3n^2$	$8n^3 + 7n^2$
$n = 2$	23	28	92
$n = 3$	58	81	279
$n = 4$	117	176	624
$n = 5$	206	325	1175
$n = 7$	498	833	3087
$n = 10$	1311	2300	8700

## Structural properties

<b>ordinary</b> — all arcs have multiplicity one .....	✓
<b>simple free choice</b> — all transitions sharing a common input place have no other input place .....	✗ (a)
<b>extended free choice</b> — all transitions sharing a common input place have the same input places .....	✗ (b)
<b>state machine</b> — every transition has exactly one input place and exactly one output place .....	✗ (c)
<b>marked graph</b> — every place has exactly one input transition and exactly one output transition .....	✗ (d)
<b>connected</b> — there is an undirected path between every two nodes (places or transitions) .....	✓ (e)
<b>strongly connected</b> — there is a directed path between every two nodes (places or transitions) .....	✗ (f)
<b>source place(s)</b> — one or more places have no input transitions .....	✗ (g)
<b>sink place(s)</b> — one or more places have no output transitions .....	✗ (h)
<b>source transition(s)</b> — one or more transitions have no input places .....	✗ (i)
<b>sink transitions(s)</b> — one or more transitions have no output places .....	✓ (j)
<b>loop-free</b> — no transition has an input place that is also an output place .....	✗ (k)
<b>conservative</b> — for each transition, the number of input arcs equals the number of output arcs .....	✗ (l)
<b>subconservative</b> — for each transition, the number of input arcs equals or exceeds the number of output arcs .....	✓ (m)
<b>nested units</b> — places are structured into hierarchically nested sequential units <sup>(n)</sup> .....	✗

(a) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(b) stated by [CÆSAR.BDD](#) version 2.6 on all 6 instances (2, 3, 4, 5, 7, and 10).

(c) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(d) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(e) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(f) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(g) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(h) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(i) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(j) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10); transition “Lose\_Request” is a sink transition.

(k) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(l) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(m) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (2, 3, 4, 5, 7, and 10).

(n) the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>

## Behavioural properties

- safe** — *in every reachable marking, there is no more than one token on a place* ..... ✗<sup>(o)</sup>  
**deadlock** — *there exists a reachable marking from which no transition can be fired* ..... ✓<sup>(p)</sup>  
**reversible** — *from every reachable marking, there is a transition path going back to the initial marking* ..... ?  
**quasi-live** — *for every transition  $t$ , there exists a reachable marking in which  $t$  can fire* ..... ?<sup>(q)</sup>  
**live** — *for every transition  $t$ , from every reachable marking, one can reach a marking in which  $t$  can fire* ..... ?

## Size of the marking graphs

Parameter	Number of reach-able markings	Number of tran-sition firings	Max. number of tokens per place	Max. number of tokens per marking
$n = 2$	7424 <sup>(r)</sup>	37 088 <sup>(s)</sup>	2 <sup>(t)</sup>	8 <sup>(u)</sup>
$n = 3$	1.3408E+8 <sup>(v)</sup>	1.2939E+9 <sup>(w)</sup>	3 <sup>(x)</sup>	15 <sup>(y)</sup>
$n = 4$	3.0948E+13 <sup>(z)</sup>	?	4 <sup>(aa)</sup>	24 <sup>(ab)</sup>
$n = 5$	?	?	?	35 <sup>(ac)</sup>
$n = 7$	?	?	?	63 <sup>(ad)</sup>
$n = 10$	?	?	?	120 <sup>(ae)</sup>

<sup>(o)</sup> stated by [CÆSAR.BDD](#) version 2.0 on all 6 instances (2, 3, 4, 5, 7, and 10).

<sup>(p)</sup> confirmed at MCC'2014 by Helena on all 6 colored instances, and by Lola and Tapaal on all 6 P/T instances.

<sup>(q)</sup> stated by [CÆSAR.BDD](#) version 2.0 to be true on 2 instance(s) out of 6, and unknown on the remaining 4 instance(s).

<sup>(r)</sup> computed at MCC'2013 by Alpina and ITS-Tools; confirmed at MCC'2014 by GreatSPN and Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, Stratagem, and Tapaal on the P/T net instance.

<sup>(s)</sup> computed at MCC'2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

<sup>(t)</sup> computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.

<sup>(u)</sup> number of initial tokens, because the net is sub-conservative.

<sup>(v)</sup> computed at MCC'2013 by Alpina and ITS-Tools; confirmed at MCC'2014 by GreatSPN on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, and Stratagem.

<sup>(w)</sup> computed at MCC'2014 by Marcie.

<sup>(x)</sup> computed at MCC'2014 by GreatSPN, Marcie, and PNMC.

<sup>(y)</sup> number of initial tokens, because the net is sub-conservative.

<sup>(z)</sup> computed at MCC'2014 by GreatSPN on the colored net instance, and by PNMC on the P/T net instance.

<sup>(aa)</sup> computed at MCC'2014 by PNMC.

<sup>(ab)</sup> number of initial tokens, because the net is sub-conservative.

<sup>(ac)</sup> number of initial tokens, because the net is sub-conservative.

<sup>(ad)</sup> number of initial tokens, because the net is sub-conservative.

<sup>(ae)</sup> number of initial tokens, because the net is sub-conservative.