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 NCLIENTS clients and NSERVERS 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..NCLIENTS;
Server is 1..NSERVERS;

Domain
Computation is <Client,Server>;

Var
  c in Client;
  s in Server;

```plaintext
Class
  Client is 1..NCLIENTS;
  Server is 1..NSERVERS;

Domain
  Computation is <Client,Server>;

Var
  c in Client;
  s in Server;
```
Scaling parameter

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter description</th>
<th>Chosen parameter values</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n)</td>
<td>To set only one parameter, we set a parameter (n) and compute model parameters with: (\text{NCLIENTS}=n^2), (\text{NSERVERS}=n), (\text{BUFFERSIZE}=n)</td>
<td>2, 3, 4, 5, 7, 10</td>
</tr>
</tbody>
</table>

Size of the model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of places</th>
<th>Number of transitions</th>
<th>Number of arcs</th>
</tr>
</thead>
<tbody>
<tr>
<td>((\text{NCLIENTS, NSERVERS, BUFFER-SIZE}))</td>
<td>(n^3 + 3n^2 + n + 1)</td>
<td>(2n^3 + 3n^2)</td>
<td>(8n^3 + 7n^2)</td>
</tr>
<tr>
<td>(n = 2)</td>
<td>23</td>
<td>28</td>
<td>92</td>
</tr>
<tr>
<td>(n = 3)</td>
<td>58</td>
<td>81</td>
<td>279</td>
</tr>
<tr>
<td>(n = 4)</td>
<td>117</td>
<td>176</td>
<td>624</td>
</tr>
<tr>
<td>(n = 5)</td>
<td>206</td>
<td>325</td>
<td>1175</td>
</tr>
<tr>
<td>(n = 7)</td>
<td>498</td>
<td>833</td>
<td>3087</td>
</tr>
<tr>
<td>(n = 10)</td>
<td>1311</td>
<td>2300</td>
<td>8700</td>
</tr>
</tbody>
</table>

Structural properties

- ordinary — all arcs have multiplicity one
- simple free choice — all transitions sharing a common input place have no other input place
- extended free choice — all transitions sharing a common input place have the same input places
- state machine — every transition has exactly one input place and exactly one output place
- marked graph — every place has exactly one input transition and exactly one output transition
- connected — there is an undirected path between every two nodes (places or transitions)
- strongly connected — there is a directed path between every two nodes (places or transitions)
- source place(s) — one or more places have no input transitions
- sink place(s) — one or more places have no output transitions
- source transition(s) — one or more transitions have no input places
- sink transition(s) — one or more transitions have no output places
- loop-free — no transition has an input place that is also an output place
- conservative — for each transition, the number of input arcs equals the number of output arcs
- subconservative — for each transition, the number of input arcs equals or exceeds the number of output arcs
- nested units — places are structured into hierarchically nested sequential units

\(^{[a]}\) 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).
\(^{[k]}\) 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).

The definition of Nested-Unit Petri Nets (NUPN) is available from [http://mcc.lip6.fr/nupn.php](http://mcc.lip6.fr/nupn.php)
Behavioural properties

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

Size of the marking graphs

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Number of reachable markings</th>
<th>Number of transition firings</th>
<th>Max. number of tokens per place</th>
<th>Max. number of tokens per marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>(n = 2)</td>
<td>7424 (^{(t)})</td>
<td>37 088 (^{(s)})</td>
<td>2 (^{(t)})</td>
<td>8 (^{(u)})</td>
</tr>
<tr>
<td>(n = 3)</td>
<td>1.3408E+8 (^{(v)})</td>
<td>1.2939E+9 (^{(w)})</td>
<td>3 (^{(x)})</td>
<td>15 (^{(y)})</td>
</tr>
<tr>
<td>(n = 4)</td>
<td>3.0948E+13 (^{o})</td>
<td>()</td>
<td>4 (^{(aa)})</td>
<td>24 (^{(ab)})</td>
</tr>
<tr>
<td>(n = 5)</td>
<td>()</td>
<td>()</td>
<td>()</td>
<td>35 (^{(ac)})</td>
</tr>
<tr>
<td>(n = 7)</td>
<td>()</td>
<td>()</td>
<td>()</td>
<td>63 (^{(ad)})</td>
</tr>
<tr>
<td>(n = 10)</td>
<td>()</td>
<td>()</td>
<td>()</td>
<td>120 (^{(ae)})</td>
</tr>
</tbody>
</table>

\(^{(o)}\) stated by CÆSAR.BDD version 2.0 on all 6 instances (2, 3, 4, 5, 7, and 10).
\(^{(p)}\) confirmed at MCC’2014 by Helena on all 6 colored instances, and by Lola and Tapaal on all 6 P/T instances.
\(^{(q)}\) 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).
\(^{(r)}\) 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.
\(^{(s)}\) computed at MCC’2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.
\(^{(t)}\) computed at MCC’2014 by GreatSPN, Marcie, PNMC, and Tapaal.
\(^{(u)}\) number of initial tokens, because the net is sub-conservative.
\(^{(v)}\) 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.
\(^{(w)}\) computed at MCC’2014 by Marcie.
\(^{(x)}\) computed at MCC’2014 by GreatSPN, Marcie, and PNMC.
\(^{(y)}\) number of initial tokens, because the net is sub-conservative.
\(^{(z)}\) computed at MCC’2014 by GreatSPN on the colored net instance, and by PNMC on the P/T net instance.
\(^{(aa)}\) computed at MCC’2014 by PNMC.
\(^{(ab)}\) number of initial tokens, because the net is sub-conservative.
\(^{(ac)}\) number of initial tokens, because the net is sub-conservative.
\(^{(ad)}\) number of initial tokens, because the net is sub-conservative.
\(^{(ae)}\) number of initial tokens, because the net is sub-conservative.