This form is a summary description of the model entitled “SafeBus” 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 model represents a safe bus that relates \(N\) interlocutors.

Each interlocutor is connected to the controller using a dedicated control cable and have a unique identification number. Each one is also connected to the main cable. When an interlocutor sends a message, it provides the identification of its correspondent. Acknowledge does not requires identification while only the sender is listening to it in the main cable.

Each interlocutor tries to get the cable and if it refused, it must wait for an incoming message and send back an acknowledge before trying again to get the vable.

In this model, we consider that both messages or acknowledgements can be lost (but a limited number of time only). The protocol tolerant to such failures but is not fair to the interlocutors.

**Graphical representation for \(N = 3\)**

**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>(N), the number of interlocutors connected to the bus (a).</td>
<td>3, 6, 10, 15, 20, 50, 80</td>
</tr>
</tbody>
</table>

(a) These parameters affect the initial marking and thus do not impact the size of the model.
Size of the colored net model

- number of places: 20
- number of transitions: 14
- number of arcs: 68

Size of the derived P/T model instances

<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>(N = 3)</td>
<td>57</td>
<td>91</td>
<td>541</td>
</tr>
<tr>
<td>(N = 6)</td>
<td>144</td>
<td>451</td>
<td>2968</td>
</tr>
<tr>
<td>(N = 10)</td>
<td>316</td>
<td>1631</td>
<td>11384</td>
</tr>
<tr>
<td>(N = 15)</td>
<td>621</td>
<td>4771</td>
<td>34549</td>
</tr>
<tr>
<td>(N = 20)</td>
<td>1026</td>
<td>10461</td>
<td>77364</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

Behavioural properties

safe — in every reachable marking, there is no more than one token on a place

deadlock — there exists a reachable marking from which no transition can be fired

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

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\(\text{(b)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(c)}\) stated by C\text{\textsc{esar}}.BDD version 2.6 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(d)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(e)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(f)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(g)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(h)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(i)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(j)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(k)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(l)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(m)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(n)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(o)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

\(\text{(p)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 to be false on 1 instance(s) of 5, and unknown on the remaining 4 instance(s).

\(\text{(q)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 to be false on 1 instance(s) of 5, and unknown on the remaining 4 instance(s).

\(\text{(r)}\) stated by C\text{\textsc{esar}}.BDD version 2.3 to be false on 1 instance(s) of 5, and unknown on the remaining 4 instance(s).

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live — for every transition t, from every reachable marking, one can reach a marking in which t can fire ..............\(^{(s)}\)

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 = 3)</td>
<td>4 650 (^{(t)})</td>
<td>12 888 (^{(t)})</td>
<td>1</td>
<td>(\in [11, 57]) (^{(t)})</td>
</tr>
<tr>
<td>(N = 6)</td>
<td>6 816 756 (^{(w)})</td>
<td>29 904 912 (^{(w)})</td>
<td>?</td>
<td>(\geq 17) (^{(t)})</td>
</tr>
<tr>
<td>(N = 10)</td>
<td>(\geq 9.8641e+06) (^{(x)})</td>
<td>?</td>
<td>?</td>
<td>(\geq 25) (^{(aa)})</td>
</tr>
<tr>
<td>(N = 15)</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>(\geq 35) (^{(ab)})</td>
</tr>
<tr>
<td>(N = 20)</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>(\geq 45) (^{(ac)})</td>
</tr>
</tbody>
</table>

\(^{(s)}\) stated by CÆSAR.BDD version 2.3 to be false on 1 instance(s) out of 5, and unknown on the remaining 4 instance(s).

\(^{(t)}\) computed by PROD in December 2014; confirmed by CÆSAR.BDD version 2.3.

\(^{(w)}\) computed with PROD on December 2014.

\(^{(x)}\) lower and upper bounds given by the number of initial tokens and the number of places.

\(^{(v)}\) lower bound given by the number of initial tokens.

\(^{(aa)}\) lower bound given by the number of initial tokens.

\(^{(ab)}\) lower bound given by the number of initial tokens.

\(^{(ac)}\) lower bound given by the number of initial tokens.