This form is a summary description of the model entitled “IOTPpurchase” 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

The model specifies the Purchase Transaction of Internet Open Trading Protocol as described in [Z13]. It represents Offer, Payment, and Delivery Trading Exchanges, and reflects IOTP Message structure with distinct Trading Components according to RFC 2801.

Graphical representation for CO = 5, MO = 4, PH = 3, DH = 2

References

Scaling parameter

<table>
<thead>
<tr>
<th>Parameter name</th>
<th>Parameter description</th>
<th>Chosen parameter values</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO, MO, PH, DH</td>
<td>CO is the number of ConsumerOffers; MO is the number of MerchantOffers; PH is the number of PaymentHandlers; DH is the number of DeliveryHandlers.</td>
<td>(1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)</td>
</tr>
</tbody>
</table>

Size of the model

Although the model is parameterized, its size does not depend on parameter values.

- number of places: 111
- number of transitions: 45
- number of arcs: 224

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

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(a) 2 arcs are not simple free choice, e.g., the arc from place “p-13F4-CD52-98” (which has 2 outgoing transitions) to transition “t-13F4-C885-8” (which has 5 input places).
(b) transitions “t-13F4-CCDD-83” and “t-13F4-C885-8” share a common input place “p-13F4-CD52-98”, but only the former transition has input place “p-13F4-CD52-119”.
(c) 36 transitions are not of a state machine, e.g., transition “t-13F4-C875-5”.
(d) place “p-13F4-CD52-98” is not of a marked graph.
(e) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(f) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(g) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(h) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(i) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(j) stated by CÆSAR.BDD version 2.2 on all 4 instances ((1,1,1,1), (3,3,3,3), (5,4,3,2), (12,10,15,17)).
(k) transition “t-13F4-C885-8” is not loop free.
(l) 25 transitions are not conservative, e.g., transition “t-13F4-C875-5”.
(m) 13 transitions are not subconservative, e.g., transition “t-13F4-C875-5”.
(n) the definition of Nested-Unit Petri Nets (NUPN) is available from http://mcc.lip6.fr/nupn.php
(o) CÆSAR.BDD version 2.2 to be true on 1 instance(s) out of 4, and false on the remaining 3 instance(s).
(p) Checked by the Tina http://www.las.fr/tina tool version 3.3.0 as well as other behavioural properties.
quasi-live — for every transition \( t \), there exists a reachable marking in which \( t \) can fire. …………………………………. ✔

live — for every transition \( t \), from every reachable marking, one can reach a marking in which \( t \) can fire. …………………… ✔

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>((1, 1, 1, 1))</td>
<td>204</td>
<td>436</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>((3, 3, 3, 3))</td>
<td>354,176</td>
<td>1,684,054</td>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>((5, 4, 3, 2))</td>
<td>17,406,024</td>
<td>108,419,358</td>
<td>5</td>
<td>51</td>
</tr>
<tr>
<td>((12,10,15,17))</td>
<td>?</td>
<td>?</td>
<td>17</td>
<td>?</td>
</tr>
</tbody>
</table>

\[(q)\] stated by CÆSAR.BDD version 2.2 on all 4 instances \(((1, 1, 1, 1), (3, 3, 3, 3), (5, 4, 3, 2), (12, 10, 15, 17))\).