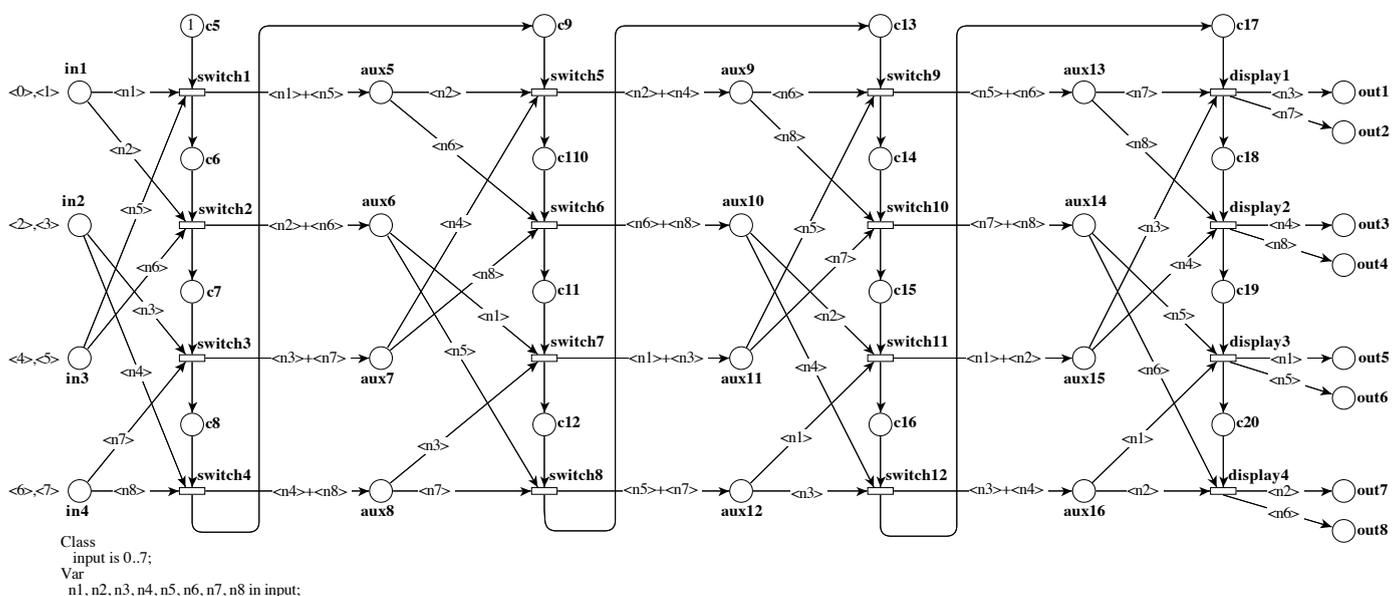


This form is a summary description of the model entitled "Permutation admissibility in multistage interconnection networks" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many 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 describes a 8×8 4 stages shuffle-exchange network. In order to ease readability, the net components are grouped in columns similar to the way the switches are arranged in stages. Thus, whole net is represented as a cascade of columns alternating in type of the components being either place or transition. Transitions occur column-wise from the leftmost to the rightmost and in columns from the topmost to the bottommost. It can be easily seen that no token can visit a place more than once. Direction of the arcs indicates the flow of tokens through the net.

Here, we consider the scaling parameter N as a multiplier for the initial marking in places $\text{in}(x)$ and c5 . The figure shows the model when $N = 1$.



Graphical representation for $N = 1$

References

R. Bashirov, F. Kordon, and H. Lort. Exploiting colored Petri nets to decide on permutation admissibility. *Acta Informatica*, 46(1):43-55, February 2009.

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	Multiplier for the marking of places $\text{in}(x)$ and c5	1, 2, 5, 10, 20, 50

Size of the model

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

number of places: 40
number of transitions: 16
number of arcs: 83

Structural properties

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

Behavioural properties

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

(a) the net is not ordinary in all its 6 instances (1, 2, 5, 10, 20, and 50).

(b) the net is not ordinary in all its 6 instances (1, 2, 5, 10, 20, and 50).

(c) the net is not ordinary in all its 6 instances (1, 2, 5, 10, 20, and 50).

(d) the net is not ordinary in all its 6 instances (1, 2, 5, 10, 20, and 50).

(e) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (1, 2, 5, 10, 20, and 50).

(f) from place “aux16_0” one cannot reach place “in4_6”.

(g) there exist 9 source places, e.g., place “in4_6”.

(h) there exist 64 sink places, e.g., place “out7_1”.

(i) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (1, 2, 5, 10, 20, and 50).

(j) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (1, 2, 5, 10, 20, and 50).

(k) stated by [CÆSAR.BDD](#) version 1.7 on all 6 instances (1, 2, 5, 10, 20, and 50).

(l) stated by [PNML2NUPN](#) 3.1.0 on all 6 instances (1, 2, 5, 10, 20, and 50).

(m) stated by [PNML2NUPN](#) 3.1.0 on all 6 instances (1, 2, 5, 10, 20, and 50).

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

(o) in the initial marking, some places have several tokens (the number of which depends on N).

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

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
$N = 1$	52 537 ^(q)	54 600 ^(r)	1 ^(s)	9 ^(t)
$N = 2$?	?	?	18 ^(u)
$N = 5$?	?	?	45 ^(v)
$N = 10$?	?	?	90 ^(w)
$N = 20$?	?	?	180 ^(x)
$N = 50$?	?	?	450 ^(y)

^(q) Computed by Alpina, and ITS-Tools at MCC'2013; confirmed at MCC'2014 by Helena on the colored net instance, and by GreatSPN, Marcie, PNMC, PNXDD, and Tapaal on the P/T net instance.

^(r) computed at MCC'2014 by Helena on the colored net instance, and by Marcie on the P/T net instance.

^(s) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal on the P/T net instance.

^(t) number of initial tokens, because the net is sub-conservative; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal on the P/T net instance.

^(u) number of initial tokens, because the net is sub-conservative.

^(v) number of initial tokens, because the net is sub-conservative.

^(w) number of initial tokens, because the net is sub-conservative.

^(x) number of initial tokens, because the net is sub-conservative.

^(y) number of initial tokens, because the net is sub-conservative.