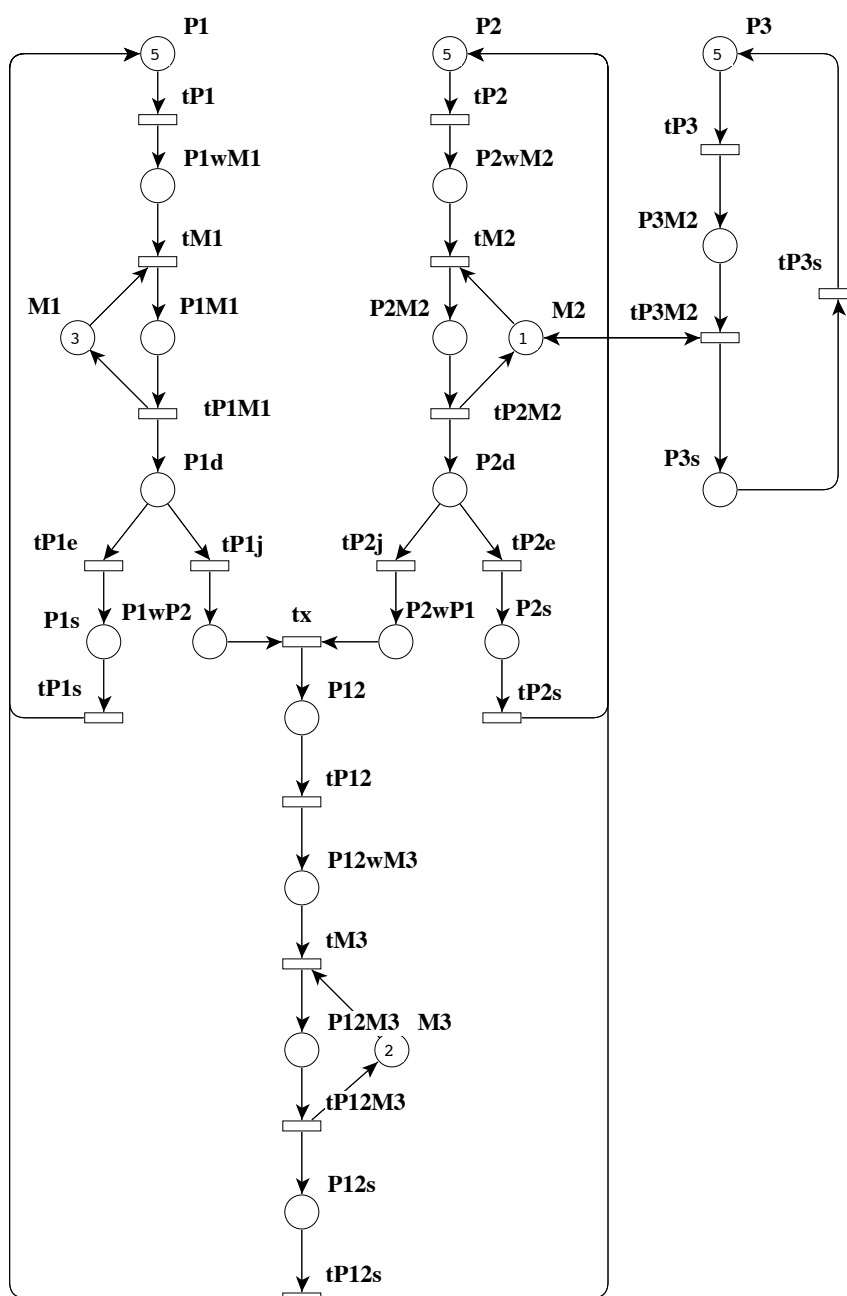


This form is a summary description of the model entitled "Flexible Manufacturing System (FMS)" proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. 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 is extracted a benchmark used for SMART. It models a flexible manufacturing system.

The six largest instances have been added in 2019.



References

<http://www.cs.ucr.edu/~ciardo/SMART/>

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	The scale factor is a value N that changes the initial marking of places P_1 , P_2 and P_3 (i.e., $M(P_1) = M(P_2) = M(P_3) = N$)	2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, 50000

Size of the model

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

number of places: 22
 number of transitions: 20
 number of arcs: 50

Structural properties

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

(a) 2 arcs are not simple free choice, e.g., the arc from place “M2” (which has 2 outgoing transitions) to transition “tM2” (which has 2 input places).

(b) transitions “tM2” and “tP3M2” share a common input place “M2”, but only the former transition has input place “P2wM2”.

(c) 9 transitions are not of a state machine, e.g., transition “tM1”.

(d) 5 places are not of a marked graph, e.g., place “P1d”.

(e) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(f) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(g) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(h) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(i) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(j) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).

(k) transition “tP3M2” is not loop free.

(l) 8 transitions are not conservative, e.g., transition “tM1”.

(m) 4 transitions are not subconservative, e.g., transition “tP12M3”.

(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* **X** ^(o)
dead place(s) — *one or more places have no token in any reachable marking* **X** ^(p)
dead transition(s) — *one or more transitions cannot fire from any reachable marking* **X** ^(q)
deadlock — *there exists a reachable marking from which no transition can be fired* **X** ^(r)
reversible — *from every reachable marking, there is a transition path going back to the initial marking* ?
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 reachable markings	Number of transition firings	Max. number of tokens per place	Max. number of tokens per marking
$N = 2$	3444 ^(s)	16 311 ^(t)	3 ^(u)	12 ^(v)
$N = 5$	2.8950E+6 ^(w)	2.3527E+7 ^(x)	5 ^(y)	21 ^(z)
$N = 10$	2.501E+9 ^(aa)	2.7568E+10 ^(ab)	10 ^(ac)	36 ^(ad)
$N = 20$	6.0292E+12 ^(ae)	8.1442E+13 ^(af)	20 ^(ag)	66 ^(ah)
$N = 50$	4.2403E+17 ^(ai)	6.6135E+18 ^(aj)	50 ^(ak)	156 ^(al)
$N = 100$	2.7031E+21 ^(am)	?	100 ^(an)	306 ^(ao)
$N = 200$	1.9536E+25 ^(ap)	?	200 ^(aq)	606 ^(ar)
$N = 500$	2.7006E+30 ^(as)	?	500 ^(at)	≥ 1506 ^(au)
$N = 1000$?	?	?	≥ 3006 ^(av)
$N = 2000$?	?	?	≥ 6006 ^(aw)
$N = 5000$?	?	?	≥ 15006 ^(ax)
$N = 10000$?	?	?	≥ 30006 ^(ay)
$N = 20000$?	?	?	≥ 60006 ^(az)
$N = 50000$?	?	?	≥ 150006 ^(ba)

- ^(o) in the initial marking, some places have several tokens (the number of which depends on N).
^(p) stated by [CÆSAR.BDD](#) version 3.3 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
^(q) stated by [CÆSAR.BDD](#) version 2.8 on all 14 instances (2, 5, 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000, 20000, and 50000).
^(r) stated at MCC'2014 by GreatSPN and Lola on 8 instances, and by Tapaal on 5 instances.
^(s) computed at MCC'2013 by Alpina, GreatSPN, ITS-Tools, Marcie, Neco, and PNxDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNxDD, Stratagem, and Tapaal.
^(t) computed at MCC'2014 by Marcie.
^(u) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
^(v) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
^(w) computed at MCC'2013 by Alpina, GreatSPN, ITS-Tools, Marcie, Neco, and PNxDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNxDD, Stratagem, and Tapaal.
^(x) computed at MCC'2014 by Marcie.
^(y) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
^(z) computed at MCC'2014 by GreatSPN, Marcie, PNMC, and Tapaal.
^(aa) computed at MCC'2013 by GreatSPN, ITS-Tools, Marcie, and PNxDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNxDD, and Stratagem.
^(ab) computed at MCC'2014 by Marcie.
^(ac) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ad) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ae) computed at MCC'2013 by GreatSPN, ITS-Tools, Marcie, and PNxDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, PNxDD, and Stratagem.
^(af) computed at MCC'2014 by Marcie.
^(ag) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ah) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(ai) computed at MCC'2013 by GreatSPN, ITS-Tools, Marcie, and PNxDD; confirmed at MCC'2014 by GreatSPN, Marcie, PNMC, and PNxDD.
^(aj) computed at MCC'2014 by Marcie.
^(ak) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(al) computed at MCC'2014 by GreatSPN, Marcie, and PNMC.
^(am) computed at MCC'2013 by GreatSPN, ITS-Tools, and Marcie; confirmed at MCC'2014 by GreatSPN and PNMC.
^(an) computed at MCC'2014 by GreatSPN and PNMC.
^(ao) computed at MCC'2014 by GreatSPN and PNMC.
^(ap) computed at MCC'2013 by ITS-Tools; confirmed at MCC'2014 by GreatSPN and PNMC.

^(aq) computed at MCC'2014 by GreatSPN.
^(ar) computed at MCC'2014 by GreatSPN and PNMC.
^(as) computed at MCC'2014 by PNMC.
^(at) computed at MCC'2014 by GreatSPN and PNMC.
^(au) lower bound given by the number of initial tokens.
^(av) lower bound given by the number of initial tokens.
^(aw) lower bound given by the number of initial tokens.
^(ax) lower bound given by the number of initial tokens.
^(ay) lower bound given by the number of initial tokens.
^(az) lower bound given by the number of initial tokens.
^(ba) lower bound given by the number of initial tokens.