

This form is a summary description of the model entitled "ViralEpidemic" 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.

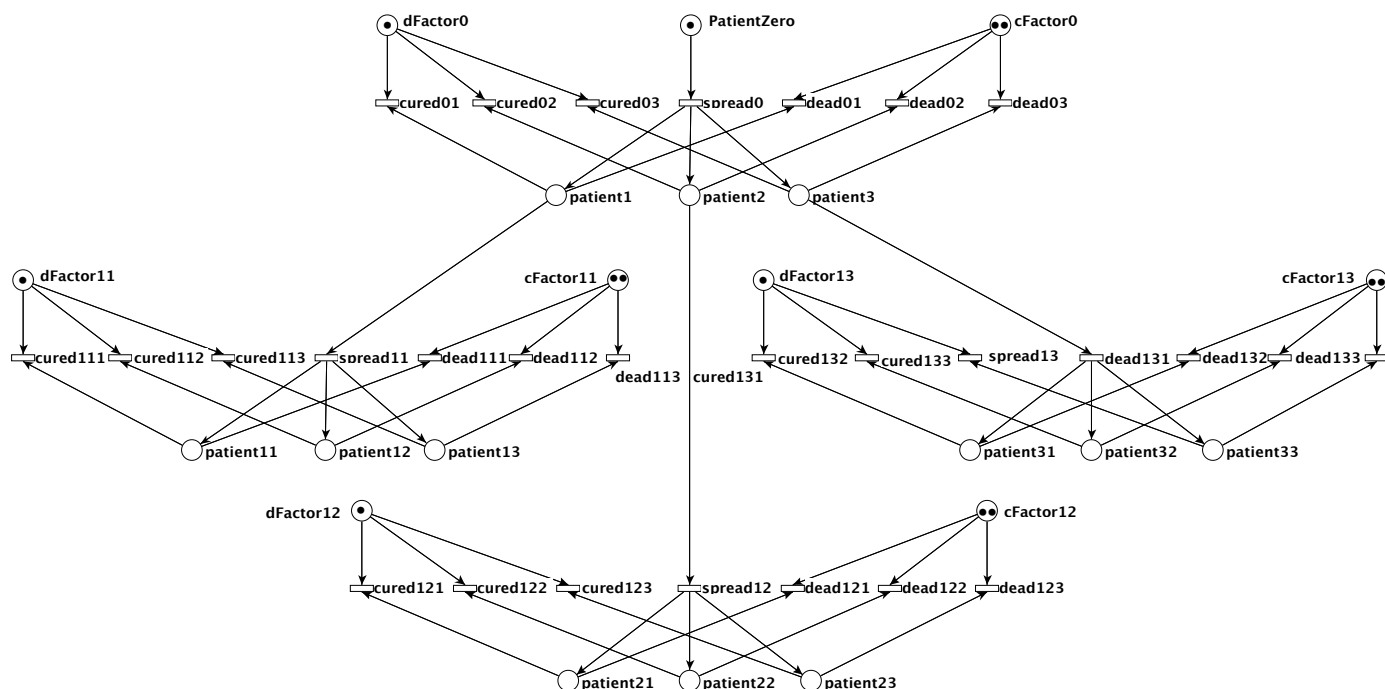
Description

This Petri net models the simplified propagation of a contagious disease (from the point of view of a distributed system). It is based on a standard module describing a step where a given patient may either:

- propagate the disease
- die (according to an upper bound)
- cure himself (according to an upper bound)

In the two later cases, the disease does not propagate again.

In April 2021, Pierre Bouvier provided a decomposition of ten instances of this model into networks of communicating automata. Each network is expressed as a Nested-Unit Petri Net (NUPN) that can be found, for each instance, in the "toolspecific" section of the corresponding PNML file.



Instantiation of this model for a spread factor of the virus (R_0) of 3 (i.e. a patient contaminates 3 others), a death factor of 1 (i.e. at one stage, $\frac{1}{3}$ of the patients may die) and a potential cure factor of 2 (i.e. at one stage, $\frac{2}{3}$ of the patients may cure themselves); the analysis depth is 1 (one level of propagation of the disease)

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
S, D, C, A	S , the spread factor (how many people are contaminated), D , the number of potential deaths at each step of the propagation, C , the number of potential cured patients at each step of the propagation, A , the depth of the analysis (how many steps of the contamination are explored)	$\langle 2, 1, 1, 10 \rangle$, $\langle 2, 1, 1, 12 \rangle$, $\langle 3, 1, 1, 2 \rangle$, $\langle 3, 1, 1, 4 \rangle$, $\langle 3, 1, 1, 6 \rangle$, $\langle 3, 1, 1, 8 \rangle$, $\langle 4, 1, 1, 2 \rangle$, $\langle 4, 1, 1, 3 \rangle$, $\langle 4, 1, 1, 4 \rangle$, $\langle 4, 1, 1, 6 \rangle$, $\langle 8, 1, 2, 2 \rangle$, $\langle 8, 1, 2, 4 \rangle$, $\langle 16, 2, 4, 1 \rangle$, $\langle 16, 2, 4, 2 \rangle$, $\langle 16, 2, 4, 3 \rangle$

Size of the model

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$\langle 2, 1, 1, 10 \rangle$	8 189	10 235	22 517	6 143	1-6 142-7 438
$\langle 2, 1, 1, 12 \rangle$	32 765	40 955	90 101	24 575	1-24 574-29 758
$\langle 3, 1, 1, 2 \rangle$	66	91	208	54	1-53-63
$\langle 3, 1, 1, 4 \rangle$	606	847	1 936	486	1-485-575
$\langle 3, 1, 1, 6 \rangle$	5 466	7 651	17 488	4 374	1-4 373-5 184
$\langle 3, 1, 1, 8 \rangle$	49 206	68 887	157 456	39 366	1-39 365-46 664
$\langle 4, 1, 1, 2 \rangle$	127	189	441	107	1-106-123
$\langle 4, 1, 1, 3 \rangle$	511	765	1 785	427	1-426-494
$\langle 4, 1, 1, 4 \rangle$	2 047	3 069	7 161	1 707	1-1 706-1 978
$\langle 4, 1, 1, 6 \rangle$	32 767	49 149	114 681	27 307	1-27 306-31 659
$\langle 8, 1, 2, 2 \rangle$	731	1 241	2 993	-	-- 731
$\langle 8, 1, 2, 4 \rangle$	46 811	79 577	191 921	-	-- 46 811
$\langle 16, 2, 4, 1 \rangle$	307	561	1 377	-	-- 307
$\langle 16, 2, 4, 2 \rangle$	4 915	9 009	22 113	-	-- 4 915
$\langle 16, 2, 4, 3 \rangle$	78 643	144 177	353 889	-	-- 78 643

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)

- (a) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (b) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (c) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (d) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (e) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (f) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (g) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (h) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
 (i) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).

- 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⁾ ? (o)

Behavioural properties

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

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
$\langle 2, 1, 1, 10 \rangle$?	?	1 ^(v)	6142
$\langle 2, 1, 1, 12 \rangle$?	?	1 ^(w)	24574
$\langle 3, 1, 1, 2 \rangle$	9.16868e+09 ^(x)	?	1	53
$\langle 3, 1, 1, 4 \rangle$	4.5789e+89 ^(y)	?	1 ^(z)	485
$\langle 3, 1, 1, 6 \rangle$?	?	1 ^(aa)	4373
$\langle 3, 1, 1, 8 \rangle$?	?	1 ^(ab)	39365
$\langle 4, 1, 1, 2 \rangle$	9.93735e+19 ^(ac)	?	1	106
$\langle 4, 1, 1, 3 \rangle$?	?	1 ^(ad)	426
$\langle 4, 1, 1, 4 \rangle$?	?	1 ^(ae)	1706
$\langle 4, 1, 1, 6 \rangle$?	?	1 ^(af)	27306
$\langle 8, 1, 2, 2 \rangle$?	?	?	≥ 220 ^(ag)
$\langle 8, 1, 2, 4 \rangle$?	?	?	≥ 14044 ^(ah)
$\langle 16, 2, 4, 1 \rangle$	1.21378e+35 ^(ai)	?	?	≥ 103 ^(aj)
$\langle 16, 2, 4, 2 \rangle$?	?	?	≥ 1639 ^(ak)
$\langle 16, 2, 4, 3 \rangle$?	?	?	≥ 26215 ^(al)

- (j) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
- (k) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
- (l) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
- (m) stated by [CÆSAR.BDD](#) version 3.3 on all 15 instances (see all aforementioned parameter values).
- (n) the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>
- (o) stated by [CÆSAR.BDD](#) version 3.5 to be true on 10 instance(s) out of 15, and false on the remaining 5 instance(s).
- (p) stated by [CÆSAR.BDD](#) version 3.5 to be true on 10 instance(s) out of 15, and false on the remaining 5 instance(s).
- (q) stated by [CÆSAR.BDD](#) version 3.3 to be false on 3 instance(s) out of 15, and unknown on the remaining 12 instance(s).
- (r) stated by [CÆSAR.BDD](#) version 3.3 to be false on 3 instance(s) out of 15, and unknown on the remaining 12 instance(s).
- (s) stated by [CÆSAR.BDD](#) version 3.3 to be true on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
- (t) stated by [CÆSAR.BDD](#) version 3.3 to be false on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
- (u) stated by [CÆSAR.BDD](#) version 3.3 to be false on 2 instance(s) out of 15, and unknown on the remaining 13 instance(s).
- (v) this net is safe.
- (w) this net is safe.
- (x) stated by [CÆSAR.BDD](#) version 3.5.
- (y) stated by libITS version 1.1.
- (z) this net is safe.
- (aa) this net is safe.
- (ab) this net is safe.
- (ac) stated by [CÆSAR.BDD](#) version 3.3.
- (ad) this net is safe.
- (ae) this net is safe.

^(af) this net is safe.

^(ag) lower bound given by the number of initial tokens.

^(ah) lower bound given by the number of initial tokens.

^(ai) stated by libITS version 1.1.

^(aj) lower bound given by the number of initial tokens.

^(ak) lower bound given by the number of initial tokens.

^(al) lower bound given by the number of initial tokens.