

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

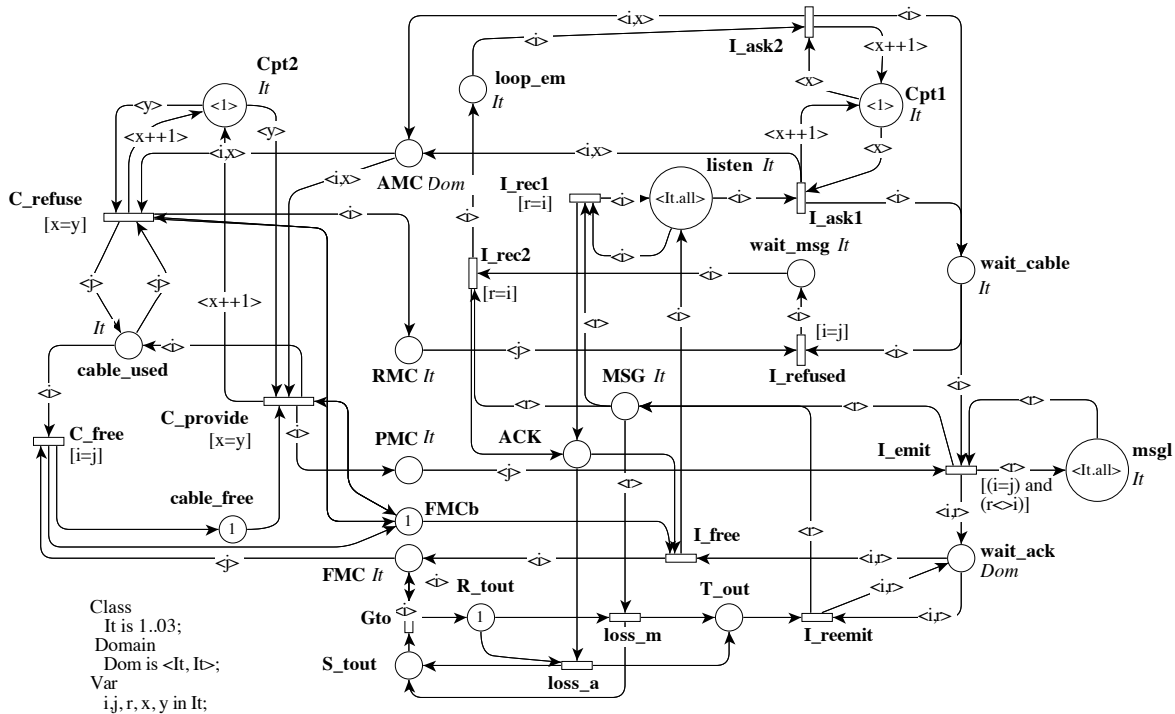
This model represents a safe bus that relates N interlocutors.

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 cable.

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.

In March 2020, Pierre Bouvier and Hubert Garavel provided a decomposition of two 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. In April 2021, Pierre Bouvier decomposed all the remaining instances of this model.



Graphical representation for $N = 3$

Scaling parameter

Parameter name	Parameter description	Chosen parameter values
N	N , the number of interlocutors connected to the bus ^(a) .	3, 6, 10, 15, 20, 50, 80

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

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$N = 3$	57	91	541	17	1-16-27
$N = 6$	144	451	2968	26	1-25-51
$N = 10$	316	1631	11384	38	1-37-75
$N = 15$	621	4771	34549	53	1-52-117
$N = 20$	1026	10461	77364	68	1-67-151

Structural properties

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

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

(b) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(c) transitions “loss.a” and “L.free.2.1” share a common input place “ACK”, but only the former transition has input place “R.tout”.

(d) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(e) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(f) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(g) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(h) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(i) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(j) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(k) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(l) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(m) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(n) stated by [CÆSAR.BDD](#) version 2.3 on all 5 instances (see all aforementioned scaling parameter values).

(o) 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* ✓ ^(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* ?
live — *for every transition t , from every reachable marking, one can reach a marking in which t can fire* ? ^(t)

Size of the marking graphs

Parameter	Number of reach-able markings	Number of tran-sition firings	Max. number of tokens per place	Max. number of tokens per marking
$N = 3$	4 650 ^(u)	12 888 ^(v)	1	$\in [14, 57]$ ^(w)
$N = 6$	6 816 756 ^(x)	29 904 912 ^(y)	1 ^(z)	$\in [23, 25]$ ^(aa)
$N = 10$	$\geq 4.09599\text{e}+09$ ^(ab)	?	1 ^(ac)	$\in [35, 37]$ ^(ad)
$N = 15$?	?	1 ^(ae)	$\in [50, 52]$ ^(af)
$N = 20$?	?	1 ^(ag)	$\in [65, 67]$ ^(ah)

^(p) stated by [CÆSAR.BDD](#) version 3.5 on all 5 instances (see all aforementioned scaling parameter values).
^(q) stated by [CÆSAR.BDD](#) version 3.5 to be false on 3 instance(s) out of 5, and unknown on the remaining 2 instance(s).
^(r) stated by [CÆSAR.BDD](#) version 2.3 to be true on 1 instance(s) out of 5, and unknown on the remaining 4 instance(s).
^(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) 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).
^(u) computed by PROD in December 2014; confirmed by [CÆSAR.BDD](#) version 2.3.
^(v) computed with PROD on December 2014.
^(w) upper bound given by the number of initial tokens and the number of places.
^(x) computed by PROD in December 2014.
^(y) computed with PROD on December 2014.
^(z) stated by [CÆSAR.BDD](#) version 3.3.
^(aa) upper bound given by the number of leaf units.
^(ab) stated by [CÆSAR.BDD](#) version 3.5.
^(ac) the P/T instance is safe.
^(ad) upper bound given by the number of leaf units.
^(ae) the P/T instance is safe.
^(af) upper bound given by the number of leaf units.
^(ag) the P/T instance is safe.
^(ah) upper bound given by the number of leaf units.