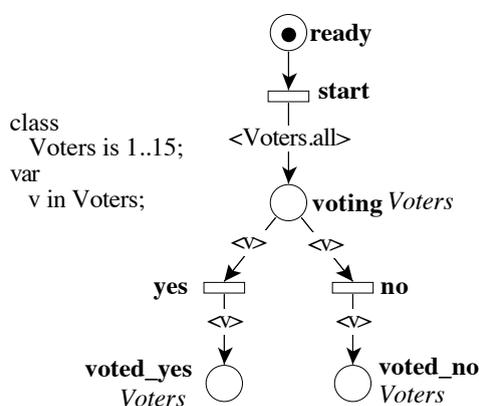


*This form is a summary description of the model entitled “Referendum” proposed for the Model Checking Contest @ Petri Nets. Models can be given in several instances parameterized by scaling parameters. Colored nets can be accompanied by one or many equivalent, unfolded P/T nets. Models are given together with property files (possibly, one per model instance) giving a set of properties to be checked on the model.*

## Description

This simple Petri net models a referendum system where a population is asked to accept a given proposal by votin “yes” or “no”. It was introduced in [1] as an example of combinatorial explosion that could be contained by using Symmetric Nets with Bags (SNB).

*In March 2020, Pierre Bowier and Hubert Garavel provided a decomposition of all 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.*



*Graphical representation of the Referendum model for V=15.*

## References

- 1 S. Haddad, F. Kordon, L. Petrucci, J-F. Pradat-Peyre, and N. Trèves. Efficient State-Based Analysis by Introducing Bags in Petri Net Color Domains. 28th American Control Conference (ACC), pages 5018-5025, Omnipress IEEE Catalog, June 2009

## Scaling parameter

Parameter name	Parameter description	Chosen parameter values
V	the maximum number of voters (in the color domain)	10, 15, 20, 50, 100, 200, 500, 1000

## Size of the colored net model

number of places: 4  
 number of transitions: 3  
 number of arcs: 6

## Size of the derived P/T model instances

Parameter	Number of places	Number of transitions	Number of arcs	Number of units	HWB code
$V = 10$	31	21	51	11	1-10-20
$V = 15$	46	31	76	16	1-15-30
$V = 20$	61	41	101	21	1-20-40
$V = 50$	151	101	251	51	1-50-100
$V = 100$	301	201	501	101	1-100-200
$V = 200$	601	401	1001	201	1-200-400
$V = 500$	1501	1001	2501	501	1-500-1000
$V = 1000$	3001	2001	5001	1001	1-1000-2000

## Structural properties

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

## Behavioural properties

**safe** — *in every reachable marking, there is no more than one token on a place* ..... yes <sup>(o)</sup>  
**dead place(s)** — *one or more places have no token in any reachable marking* ..... ? <sup>(p)</sup>  
**dead transition(s)** — *one or more transitions cannot fire from any reachable marking* ..... no <sup>(q)</sup>  
**deadlock** — *there exists a reachable marking from which no transition can be fired* ..... yes <sup>(r)</sup>

(a) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (b) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (c) transition “start\_0” is not of a state machine.  
 (d) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (e) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (f) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (g) place “ready” is a source place.  
 (h) stated by CÆSAR.BDD version 3.3 on all 8 instances (see all aforementioned parameter values).  
 (i) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (j) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (k) stated by CÆSAR.BDD version 2.7 on all 8 instances (see all aforementioned parameter values).  
 (l) transition “start\_0” is not conservative.  
 (m) transition “start\_0” is not subconservative.  
 (n) the definition of Nested-Unit Petri Nets (NUPN) is available from <http://mcc.lip6.fr/nupn.php>  
 (o) there is only one token of a given color at most in each colored place; stated by CÆSAR.BDD version 3.3 to be true on all 8 instances.  
 (p) stated by CÆSAR.BDD version 3.3 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).  
 (q) each transition is reachable from the initial state; stated by CÆSAR.BDD version 3.3 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).  
 (r) tokens accumulate in “vote\_yes” or in “voted\_no”; stated by CÆSAR.BDD version 2.7 to be true on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).

**reversible** — *from every reachable marking, there is a transition path going back to the initial marking* ..... no <sup>(s)</sup>  
**live** — *for every transition  $t$ , from every reachable marking, one can reach a marking in which  $t$  can fire* ..... no <sup>(t)</sup>

### 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
$V = 10$	59 050 <sup>(u)</sup>	393 661 <sup>(v)</sup>	1	10
$V = 15$	14 348 908 <sup>(w)</sup>	143 489 071 <sup>(x)</sup>	1	15
$V = 20$	3.48678e+09 <sup>(y)</sup>	?	1	20
$V = 50$	7.17898e+23 <sup>(z)</sup>	?	1	50
$V = 100$	5.15378e+47 <sup>(aa)</sup>	?	1	100
$V = 200$	2.65614e+95 <sup>(ab)</sup>	?	1	200
$V = 500$	3.63603e+238 <sup>(ac)</sup>	?	1	500
$V = 1000$	?	?	1	1000

<sup>(s)</sup> the marking graph has deadlocks and contains more than one reachable marking; stated by [CÆSAR.BDD](#) version 2.7 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).

<sup>(t)</sup> the net has at least one transition and its marking graph has deadlocks; stated by [CÆSAR.BDD](#) version 2.7 to be false on 7 instance(s) out of 8, and unknown on the remaining 1 instance(s).

<sup>(u)</sup> computed by Prod in March 2017; confirmed by [CÆSAR.BDD](#) version 2.7.

<sup>(v)</sup> computed by Prod in March 2017.

<sup>(w)</sup> computed by Prod in March 2017; confirmed by [CÆSAR.BDD](#) version 2.7.

<sup>(x)</sup> computed by Prod in March 2017.

<sup>(y)</sup> stated by [CÆSAR.BDD](#) version 2.7.

<sup>(z)</sup> stated by [CÆSAR.BDD](#) version 2.7.

<sup>(aa)</sup> stated by [CÆSAR.BDD](#) version 2.7.

<sup>(ab)</sup> stated by [CÆSAR.BDD](#) version 3.3.

<sup>(ac)</sup> stated by [CÆSAR.BDD](#) version 3.3.