MODULE *streamlet_v2*

EXTENDS *Sequences*, *Integers*, *Naturals*, *TLC*, *FiniteSets*

CONSTANTS *MAXEPOCHS*, *N*
Nodes $\triangleq$ $1 \,..\, N$

--algorithm *streamlet*{
variable *votes* $= \{\}$, *proposal* $= \{\}$,
notarized $= [ep \in 0 \,..\, MAXEPOCHS \mapsto \text{FALSE}]$;

define {
$NoOfVotes(ep,\ vo) \triangleq \{response \in votes : response.epoch = ep \wedge response.vote = vo\}$
}

macro *Propose*(*ep*, *n*) {
proposal := $proposal \cup \{[epoch \mapsto ep,\ node \mapsto n]\}$
}

macro *Vote*(*ep*, *n*, *v*) {
votes := $votes \cup \{[epoch \mapsto ep,\ node \mapsto n,\ vote \mapsto v]\}$
}

fair process ($p \in Nodes$)
variable $epoch = 0$;
{
BEGIN: **while** ($epoch < MAXEPOCHS$) {

if ($epoch\%N = self$) {
$Propose(epoch,\ self)$;
} **else** {
either {
$Vote(epoch,\ self,\ 0)$;
}
or {
$Vote(epoch,\ self,\ 1)$;
}

} ;
if ($Cardinality(NoOfVotes(epoch,\ 1)) \geq N \div 2$) {
$notarized[epoch]$:= TRUE ;

} ;
$epoch := epoch + 1$;
}

```
}
}
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VARIABLES $votes$, $proposal$, $notarized$, pc

$NoOfVotes(ep,\ vo) \triangleq \{response \in votes : response.epoch = ep \land response.vote = vo\}$

VARIABLE $epoch$

$vars \triangleq \langle votes,\ proposal,\ notarized,\ pc,\ epoch\rangle$

$ProcSet \triangleq (Nodes)$

$Init \triangleq$ Global variables
$\land\ votes = \{\}$
$\land\ proposal = \{\}$
$\land\ notarized = [ep \in 0\ ..\ MAXEPOCHS \mapsto \text{FALSE}]$

$\land\ epoch = [self \in Nodes \mapsto 0]$
$\land\ pc = [self \in ProcSet \mapsto \text{“BEGIN”}]$

$BEGIN(self) \triangleq\ \land\ pc[self] = \text{“BEGIN”}$
$\land$ IF $epoch[self] < MAXEPOCHS$
THEN $\land$ IF $epoch[self]\%N = self$
THEN $\land\ proposal' = (proposal \cup \{[epoch \mapsto epoch[self],\ node \mapsto self]\})$
$\land\ votes' = votes$
ELSE $\land\ \lor\ \land\ votes' = (votes \cup \{[epoch \mapsto epoch[self],\ node \mapsto self,\ vote \mapsto 0]\})$
$\lor\ \land\ votes' = (votes \cup \{[epoch \mapsto epoch[self],\ node \mapsto self,\ vote \mapsto 1]\})$
$\land$ UNCHANGED $proposal$
$\land$ IF $Cardinality(NoOfVotes(epoch[self],\ 1)) \geq N \div 2$
THEN $\land\ notarized' = [notarized$ EXCEPT $![epoch[self]] = \text{TRUE}]$
ELSE $\land$ TRUE
$\land$ UNCHANGED $notarized$
$\land\ epoch' = [epoch$ EXCEPT $![self] = epoch[self] + 1]$
$\land\ pc' = [pc$ EXCEPT $![self] = \text{“BEGIN”}]$
ELSE $\land\ pc' = [pc$ EXCEPT $![self] = \text{“Done”}]$
$\land$ UNCHANGED $\langle votes,\ proposal,\ notarized,\ epoch\rangle$

$p(self) \triangleq BEGIN(self)$

$Terminating \triangleq\ \land \forall\ self \in ProcSet : pc[self] = \text{“Done”}$

$\land$ UNCHANGED $vars$

$Next \triangleq (\exists\, self \in Nodes : p(self))$
$\lor\ Terminating$

$Spec \triangleq \land Init \land \Box[Next]_{vars}$
$\land \forall\, self \in Nodes : \mathrm{WF}_{vars}(p(self))$

$Termination \triangleq \Diamond(\forall\, self \in ProcSet : pc[self] = \text{“Done”})$