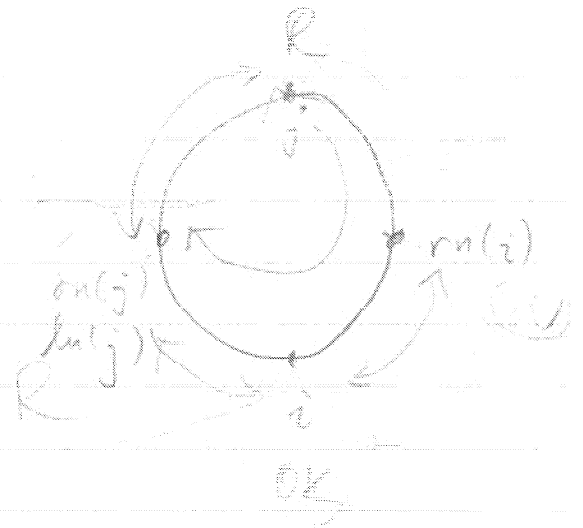
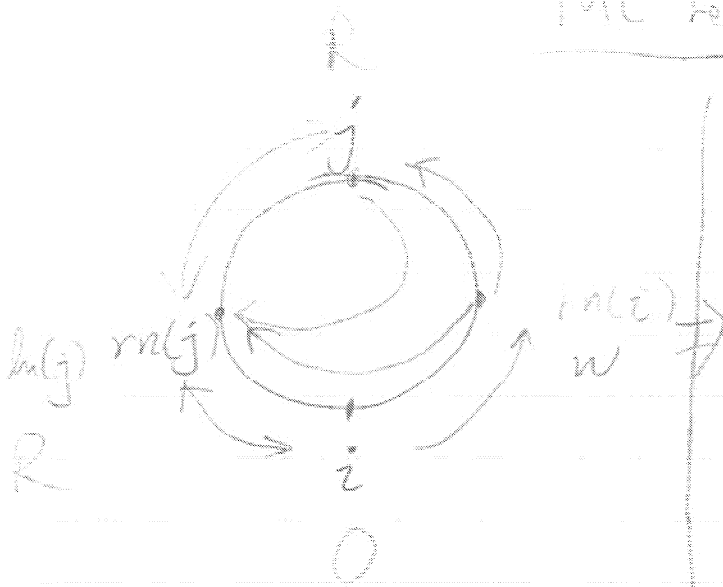
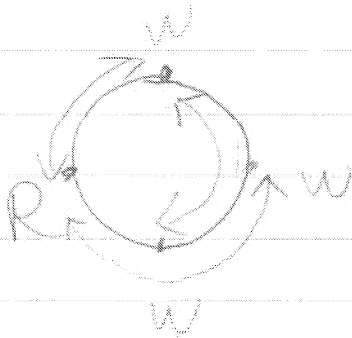


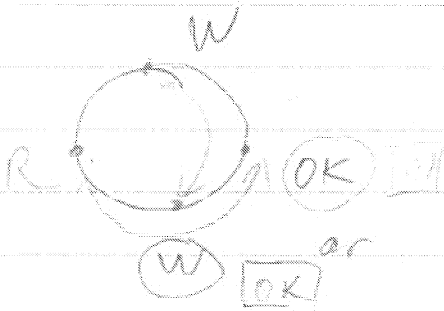
MC results



Counter Example of Ready Neighbor



Counter Example of Cross Neighbor



Depth 3 NO SE

Ready OK Ready $\triangleq \forall a, b \in \text{Ready}, e \in \text{OK/Ready}:$
 $a \neq b, b \neq c, a \neq c$

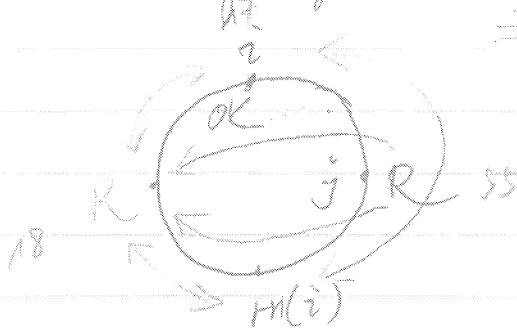
$$\Rightarrow \forall a \xrightarrow{rn(a)} e \leq a \xrightarrow{e}$$

$$\forall b \xrightarrow{ln(b)} b \leq e \xrightarrow{b}$$

In English: an OK node between two Ready Nodes but be outside of one of the "inside neighbor" and the Ready Nodes

Fault properties:

① OK Ready Neighbor $\stackrel{(Right)}{\triangleq} \forall i \in \text{Ready OK}, j \in \text{Ready}: i \neq j \wedge l_0(m(i)) = i$
 $\Rightarrow i \xrightarrow{rn(i)} m(i) \leq i \xrightarrow{rn(i)} j$



17 join \Rightarrow probe \Rightarrow 18, 95 \Rightarrow RL \Rightarrow 18, 18 \Rightarrow BLS \Rightarrow 95

65, 95 join 18

17 \Rightarrow P \Rightarrow 65

18 reply 65, 95

65 \Rightarrow PR \Rightarrow 17

95, 65 probe 18

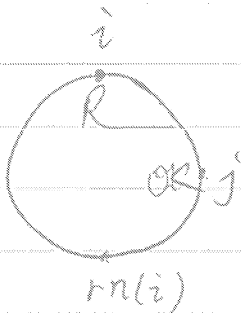
$\Rightarrow \{18 \Rightarrow PR \Rightarrow 65 \Rightarrow 95\}$

18 \Rightarrow PR \Rightarrow 95

\Rightarrow 65
 \Rightarrow 17

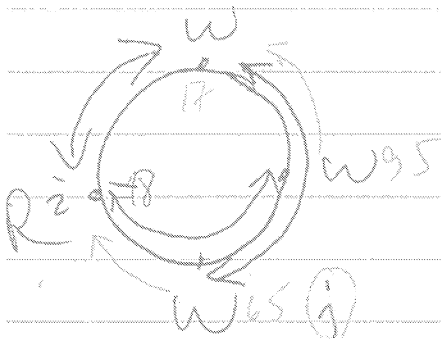
see VI/IN/EN/OKN, log

② Ready OK Neighbor $\stackrel{(Right)}{\triangleq} \forall i \in \text{Ready}, j \in \text{OK}: i \neq j \wedge l_0(rn(i)) = i$
 $\Rightarrow i \xrightarrow{rn(i)} rn(i) \leq i \xrightarrow{rn(i)} j$



$18 \xrightarrow{(i)} 95 \xrightarrow{(j)} 18$
 $(R) \quad OK \quad (R, l_0(95), rn(95))$

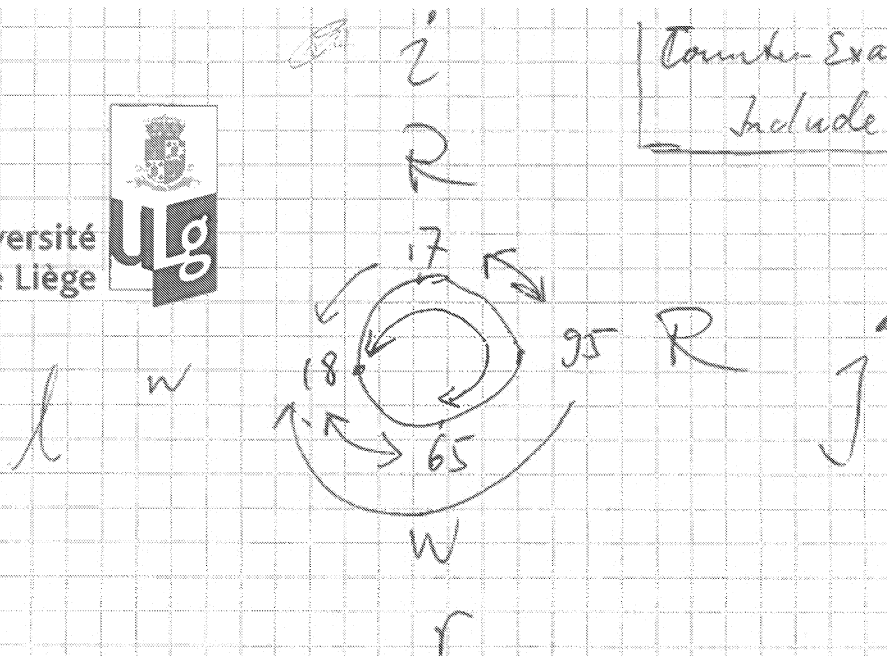
③ Cross Neighbor $\stackrel{(Right)}{\triangleq} \forall i \in \text{Ready}, j, k \in \text{Nondead}: i \neq j, k \neq j, k \neq i$
 $\wedge rn(l_0(i)) = i \wedge rn(l_0(j)) = j$



$\Rightarrow l_0(i) \leq j \xrightarrow{rn(i)} i$

see VI/CN-violation, log

Counter-Example of Include Neighbor



$$i < j < r \quad X$$

Trace: (see $\sim 1/\log$ Incl Neighbor ~~log~~ CE. log)

17 \rightarrow join 18
65 \rightarrow join 18
18 \rightarrow reply 65

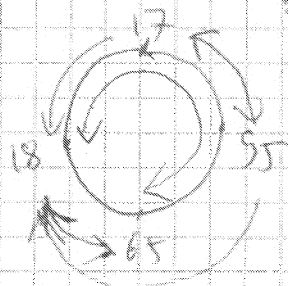
18 \rightarrow reply 17 $\xrightarrow{\text{prob}}$ 18 $\xrightarrow{\text{PRep}}$ 17 : OK

17 \rightarrow R 18 $\xrightarrow{\text{BLS}}$ 17 \rightarrow 17: Ready. by state 17 line 197

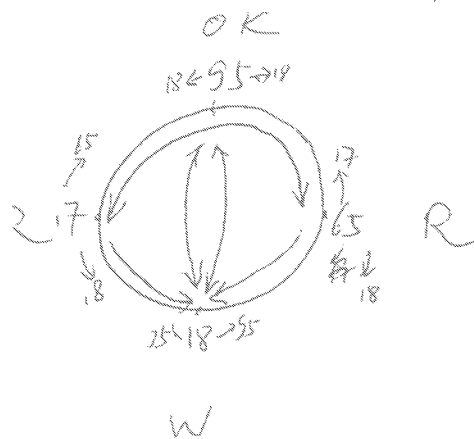
65 \rightarrow Prob \rightarrow 18

95 \rightarrow Join 18 \rightarrow JRep \rightarrow 95 \rightarrow Probe 17 \rightarrow PRep
95 \rightarrow Probe 18 \rightarrow PRep \rightarrow 95: OK ~~Reg BLS~~ ~~18~~ ~~95~~

18 Left by State 25 to join by 17. sending a JoinReq
18 \rightarrow PRep to 65 becoming wait



Counter Example of Ready OK Ready.



$$ROR \triangleq \forall a, b \in R, e \in OK: a \neq b, \wedge a \neq e \leq a \leq b$$

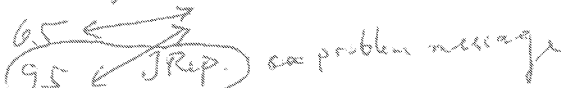
$$\Rightarrow \forall a \rightarrow m(a) \leq a \leq e$$

$$\forall \ln(b) \rightarrow b \leq e \leq b$$

English: an OK node must be known by ^{one of} its Ready neighbor, left or right.

Trace: 17 → join → 18

VI / ROR faulty log

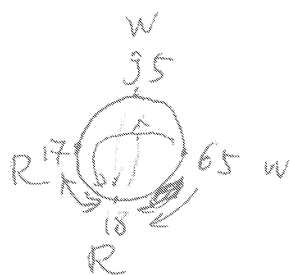


18 → 17 → 18 → 17 → 17: OK

by State 10 (line 1583)

17 → 18 → 17: Ready

by State 13 (line 1624)

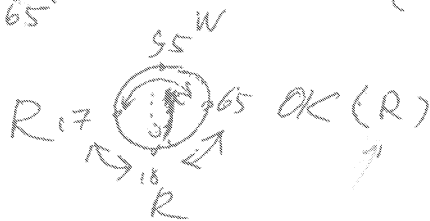


65 → receive JRep from 18 → Probe 18 → PRep to 17 now: $\overline{Is(18)} = \{17, 65, 18\}$

65 → 17 → 65 → 65: OK
(17, 18, 65)

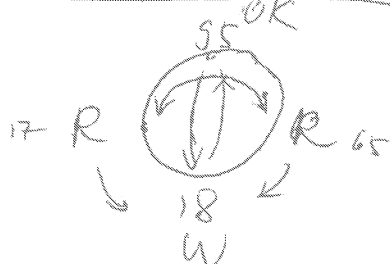
by State 18 (line 1701)

65 → 17 → 65 → 65: Ready



18 Left by state 24 and rejoins by 17 by send JRep to 17.

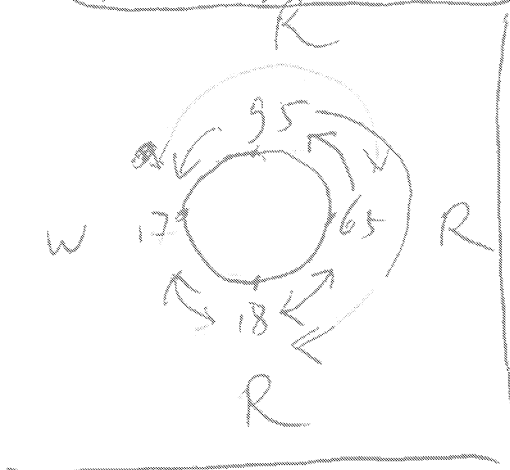
55 received JRep from 18 probe 18 → 95 → 95: OK



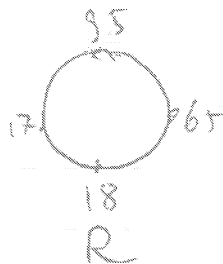
$\emptyset := JRep \text{ from } 18 \rightarrow 17.$

Neighbor Closest

Counter Example of Neighbor Closest.



Init



17 join 18 → JRply → 17 → Probe → 18
 65 join 18 → JRply → 65 → Probe → 18
 95 join 18 → JRply → 95 → Probe → 18
 18 PRply 95 ⇒ 95: OK → request Lease
 18 grand 95 → send BLS (18, 95)
 18 PRply 17 (95, 17)
 65 (65, 17)
 65 receive PRply from 18 probe 17, received {18, 65}
 17 PRply 65 (18, 65)
 17 receive PRply from 18 probe 95 (65, 18, 17)
 65 receive PRply from 17 become OK
 95 receive grand: Ready.
 95 received Probe from 17
 95 PRply → 17 (17, 18, 95)
 95 Probe → 65 (17, 18) → PRply → 95 (95, 65, 18)

17	18	65	95
{18}			
	{18}		
			{18}
		{95}	
			{95, 17}
		{65, 17}	
			{17, 18}
			{17, 18}
			{95, 18}