Möbius Tool

LAB 03

Contacts

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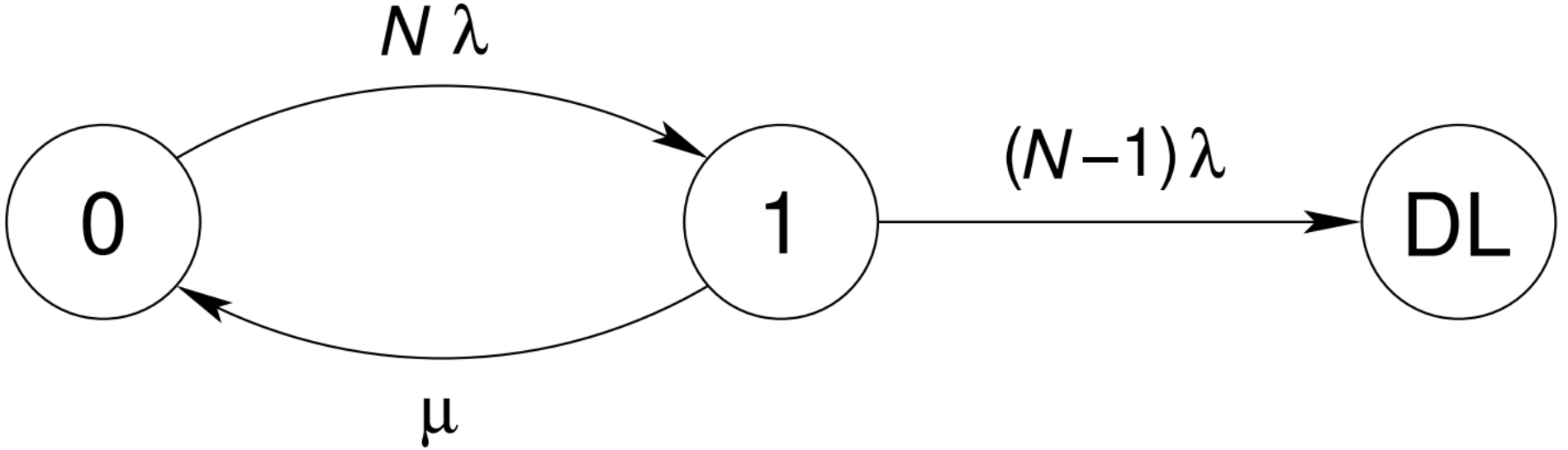
Overview

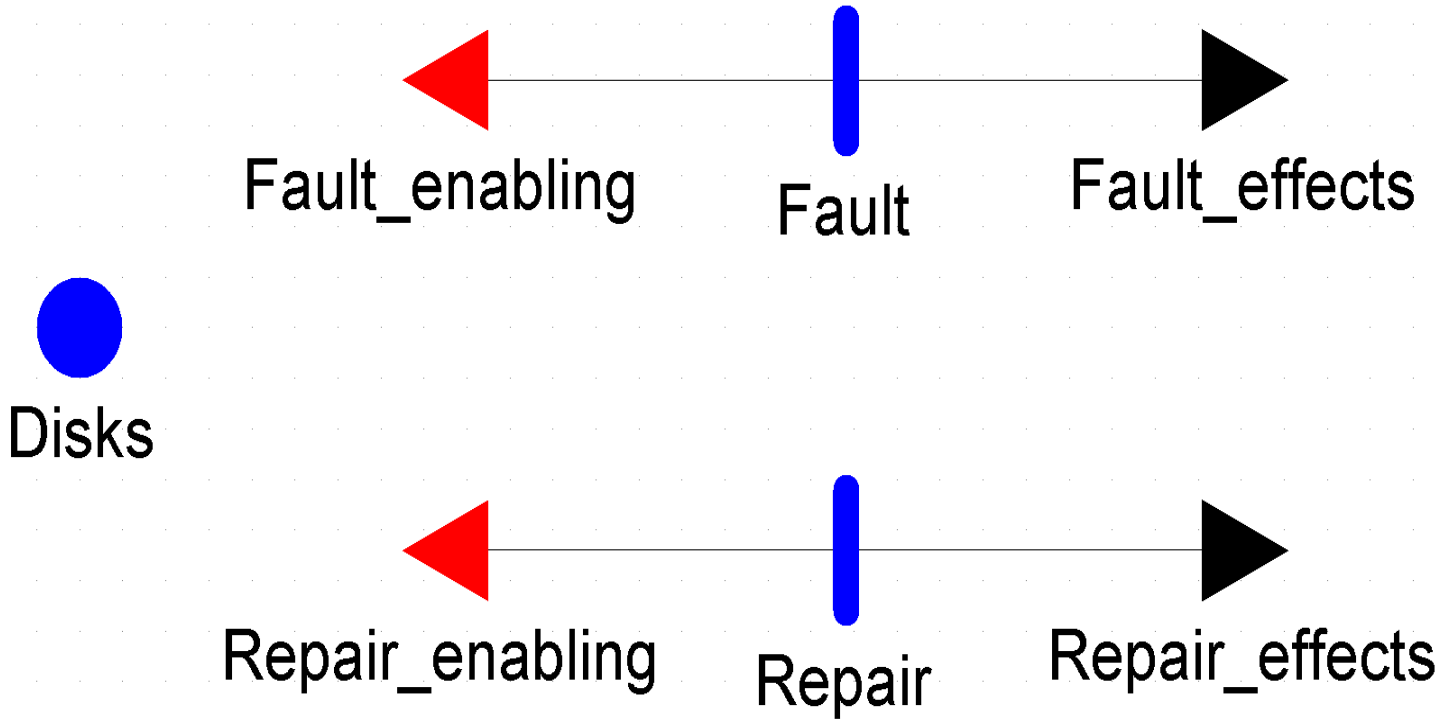
- Tutorial on RAID5 and RAID51
  - Systems formalization
  - Markov chains
  - Mobius SAN models

System formalization of RAID5

- RAID5 scheme arranges *N* disks an array, with one redundant disk, and can tolerate(repair) up to 1 disk failure.
- Assume λ is the failure rate of a disk and μ is the repair rate, then the Markov Chain of a RAID5 array is the following, where each state represents the number of failed disks.

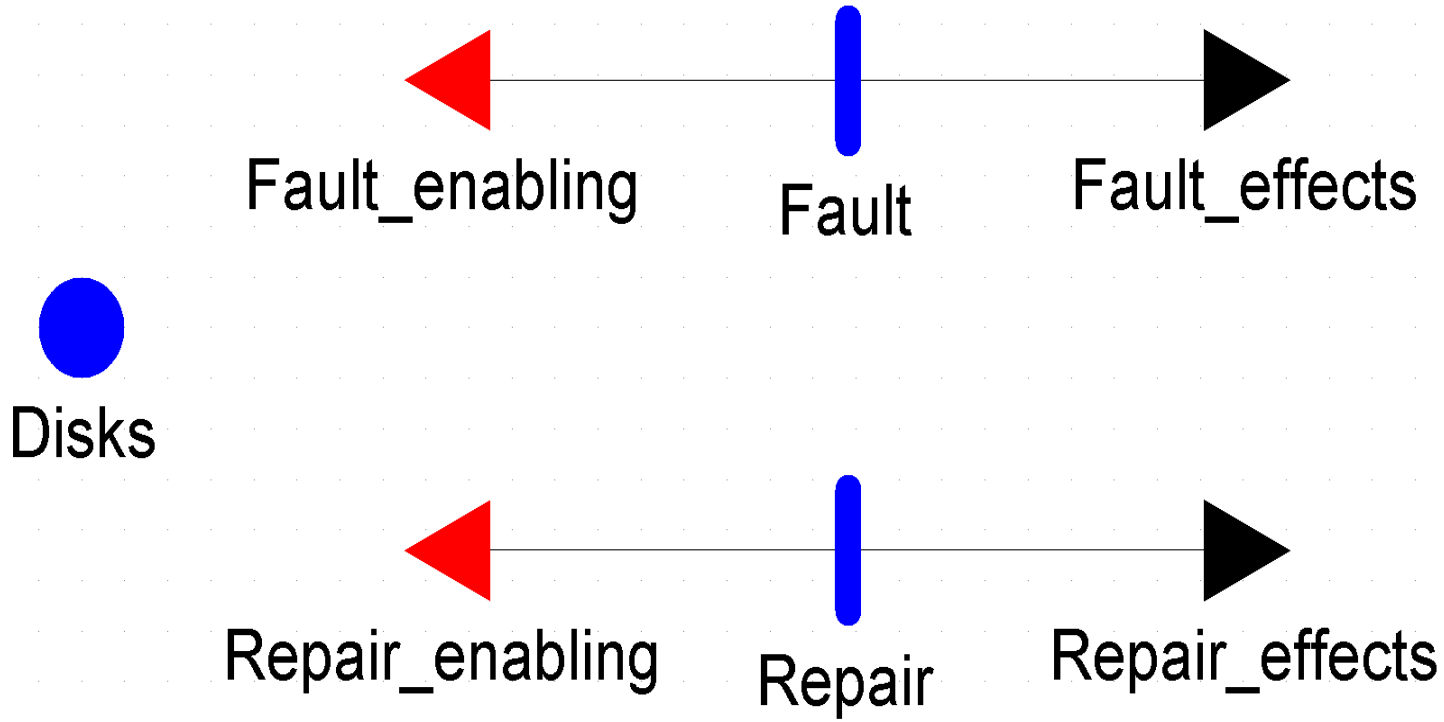


RAID5 in Mobius



Initial tokens of Disks?
Fault enabling?
Fault effect?
Fault rate?
Repair enabling?
Repair effect?
Repair rate?
Data loss condition?

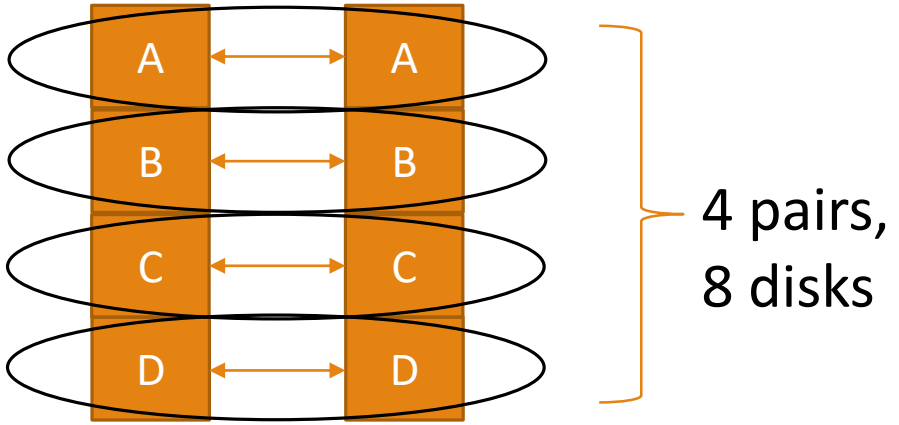
RAID5 in Mobius



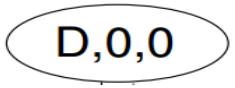
Initial tokens of Disks? N
Fault enabling? Disks->Mark() > 0
Fault effect? Disks->Mark()--;
Fault rate? Disks->Mark()*λ
Repair enabling? Disks->Mark() == N-1
Repair effect? Disks->Mark()++;
Repair rate? μ
Data loss condition?
Disks->Mark() < N-1

System Formalization of RAID51

- RAID51 is a RAID5 array with mirroring.
- The contents of a failed disk is recovered first by its mirror,
  - and if it is not possible, it is recovered through the corresponding RAID5 array.
- The configuration comprises *D* pairs of disks, where each pair contains 2 disks with identical content

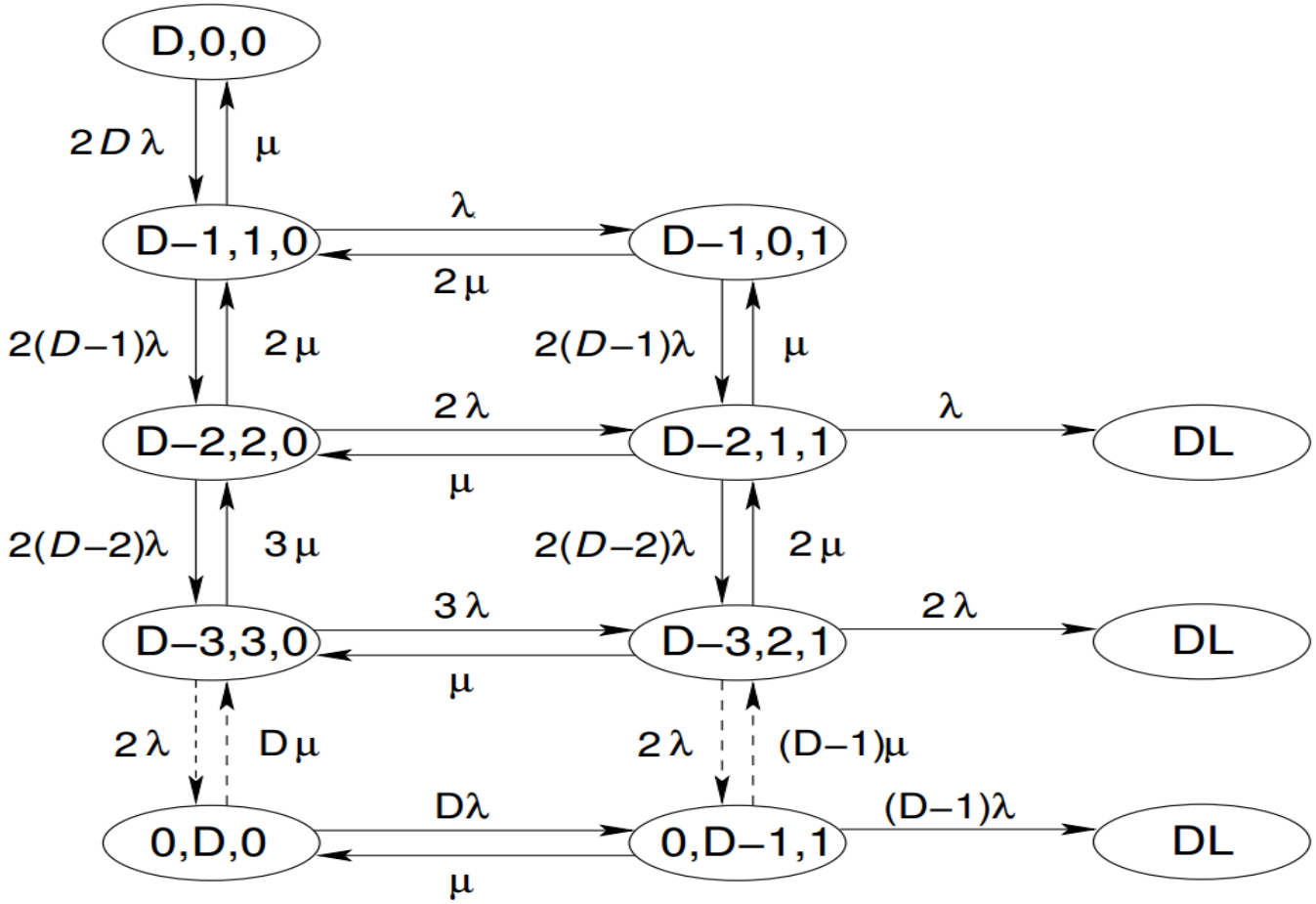


Markov Chain of RAID51



D is the size of an array.
λ and μ failure and repair rates of a disk.
Each state is represented by a triplete(*x, y, z)* where:
x represents the number of pairs with both disks working.
y represents the number of pairs with one disk working.
z represents the number of pairs with both disks failed.

Markov Chain of RAID51



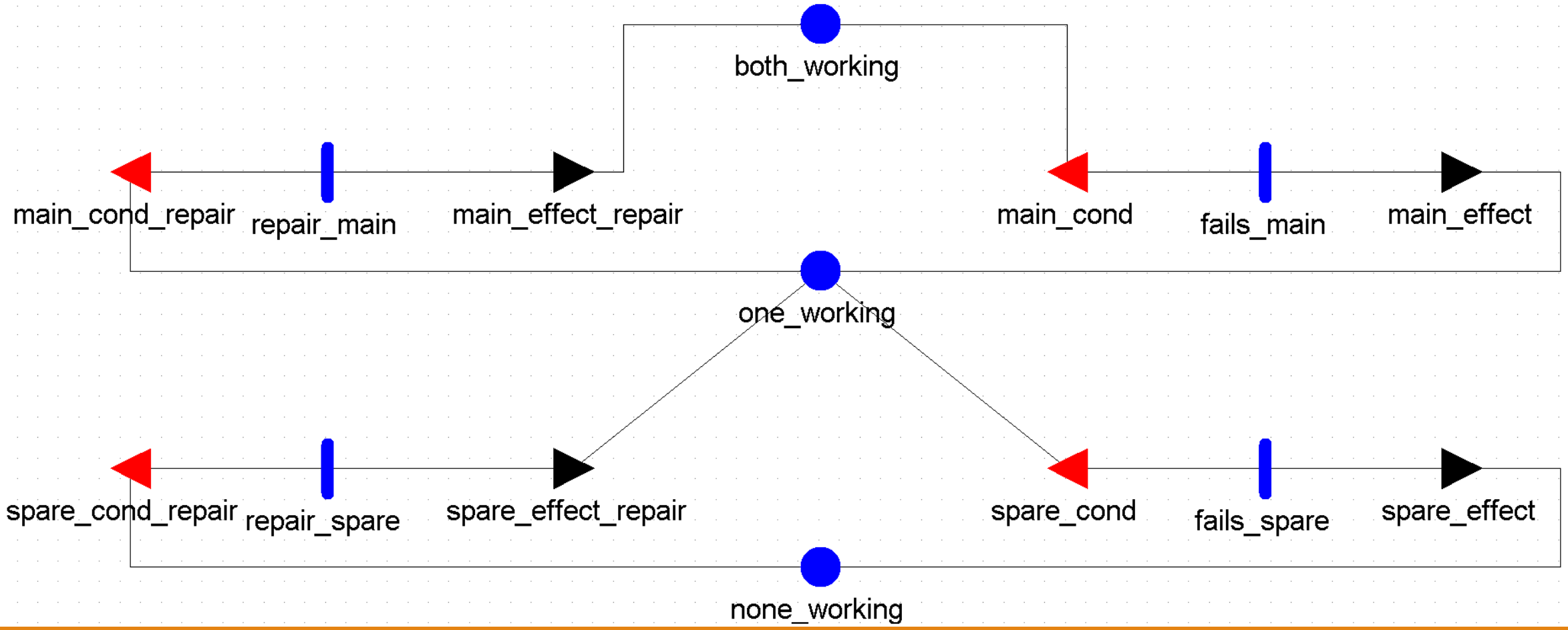
D is the size of an array.
Each state is represented by a triplete(*x, y, z)* where:

x represents the number of pairs with both disks working.

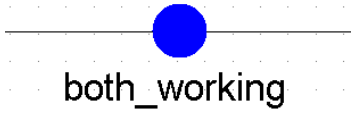
y represents the number of pairs with one disk working.

z represents the number of pairs with both disks failed.

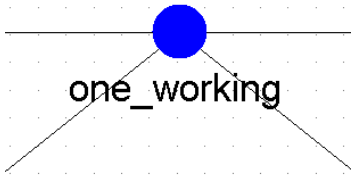
RAID51 in Mobius



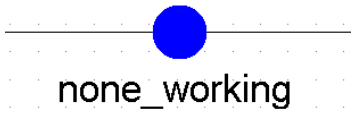
Places of RAID51 model



Place that represents the number of pairs with both disks working (*x*).
Initial number of tokens?

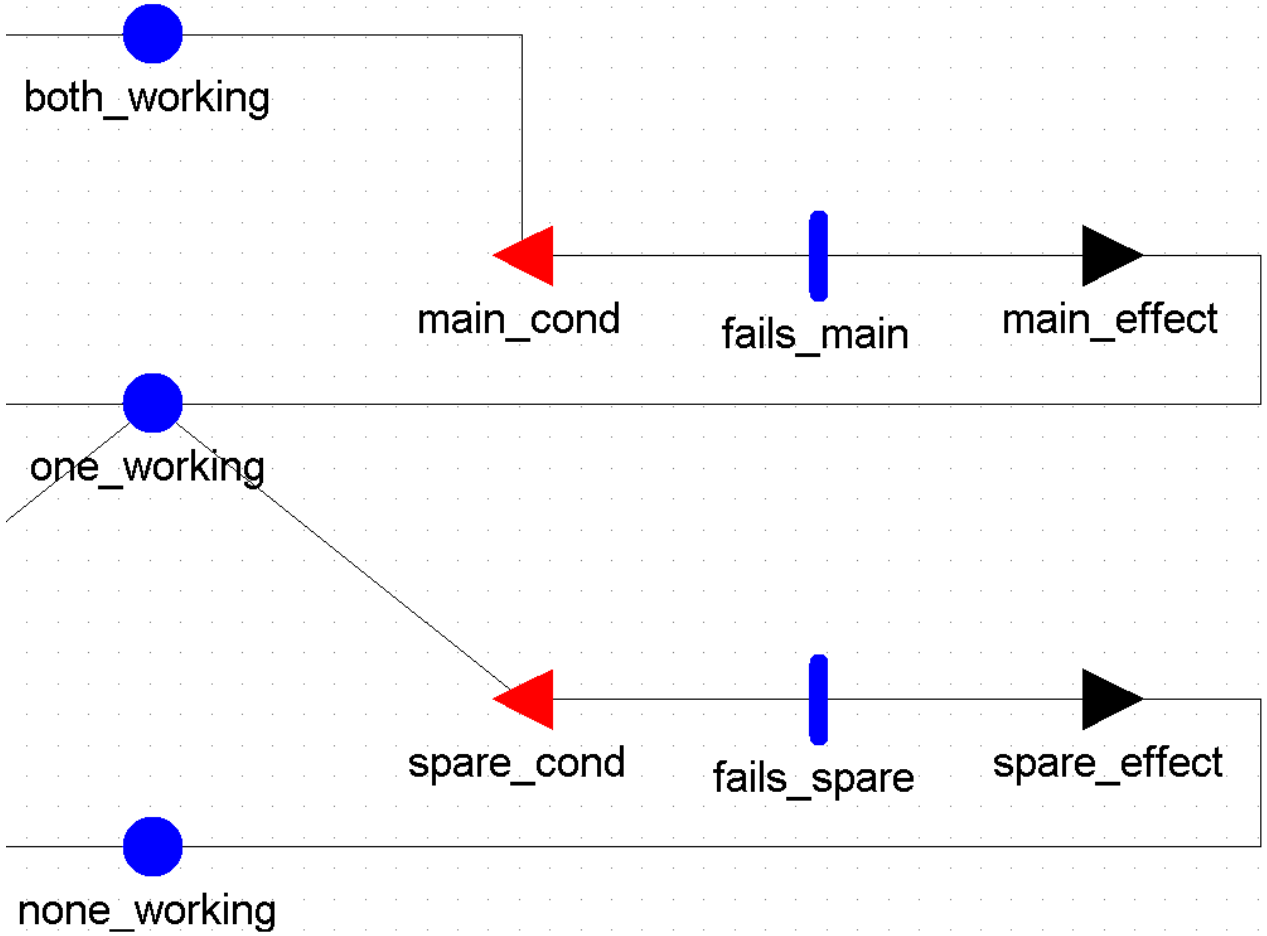


Place that represents the number of pairs with one disk working (*y*).
Initial number of tokens?



Place that represents the number of pairs with no disk working (*z*).
Initial number of tokens?

Transitions 1/2



Fails_main represents the failure of a disk which is within a pair of **both working** disks

Enabling condition?

Effect?

Rate?

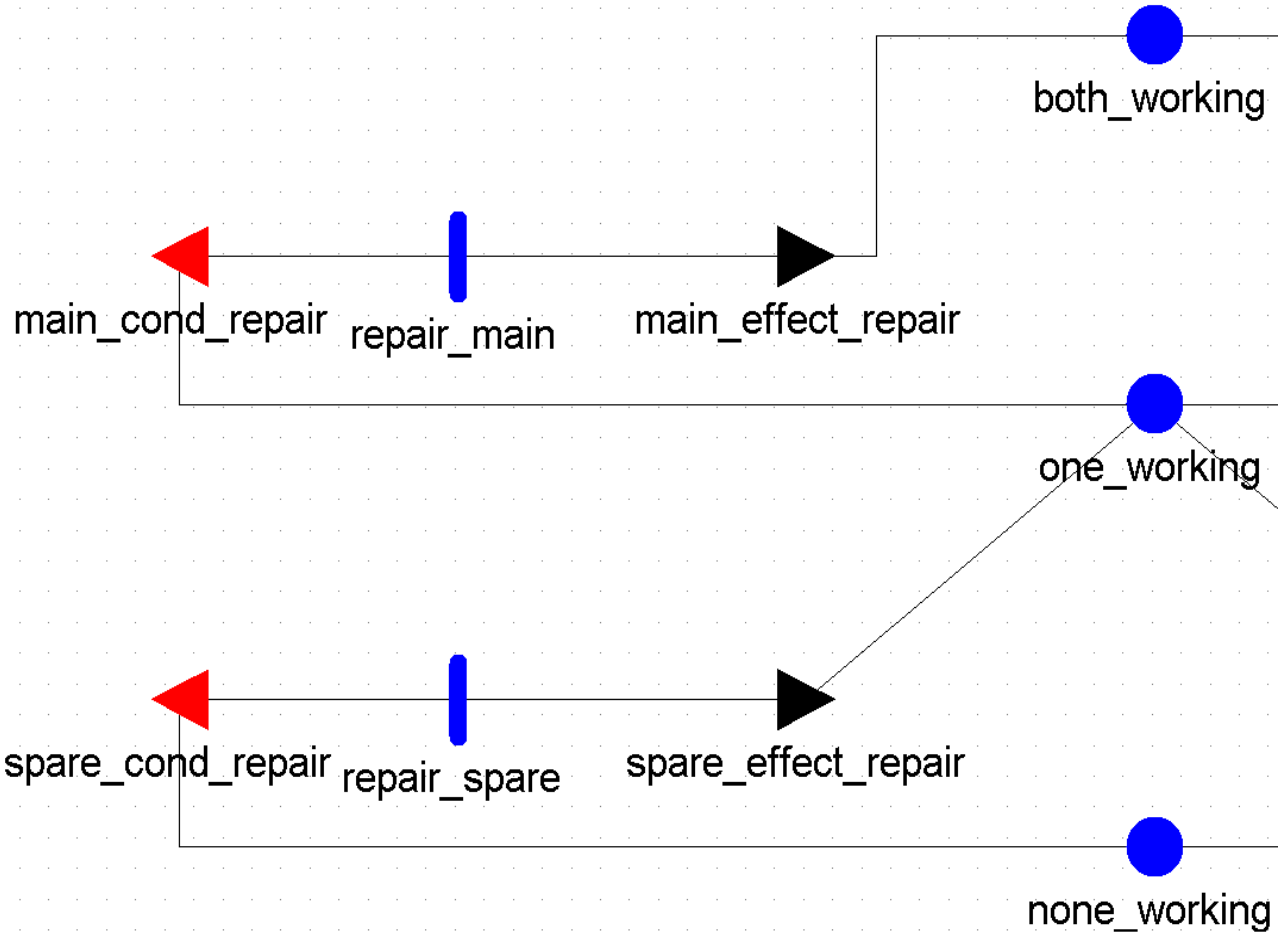
Fails_spare represents the failure of a disk which is within a pair of **one working** disks

Enabling condition?

Effect?

Rate?

Transition 2/2



repair_main represents the repair of a disk which is within a pair of **one working** disks

Enabling condition?

Effect?

Rate?

repair_spare represents the repair of a disk which is within a pair of **none working** disks

Enabling condition?

Effect?

Rate?

References

https://pdfs.semanticscholar.org/f2f1/b23e010de35e2537abab741fb8f9417a0827.pdf

https://www.mobius.illinois.edu/wiki/index.php/Möbius_Documentation

Thanks to prof. Andrea Domenici for previous version of the slides.