

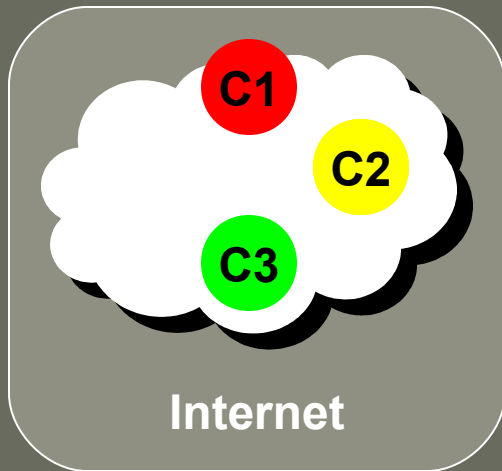
# Openflow-based Server Load Balancing Gone **WILD**

Richard Wang, Dana Butnariu, Jennifer Rexford

## Key Tradeoffs

1. Fast Enough
2. Scalable
3. Programmability
4. Cost

# Load Balancing

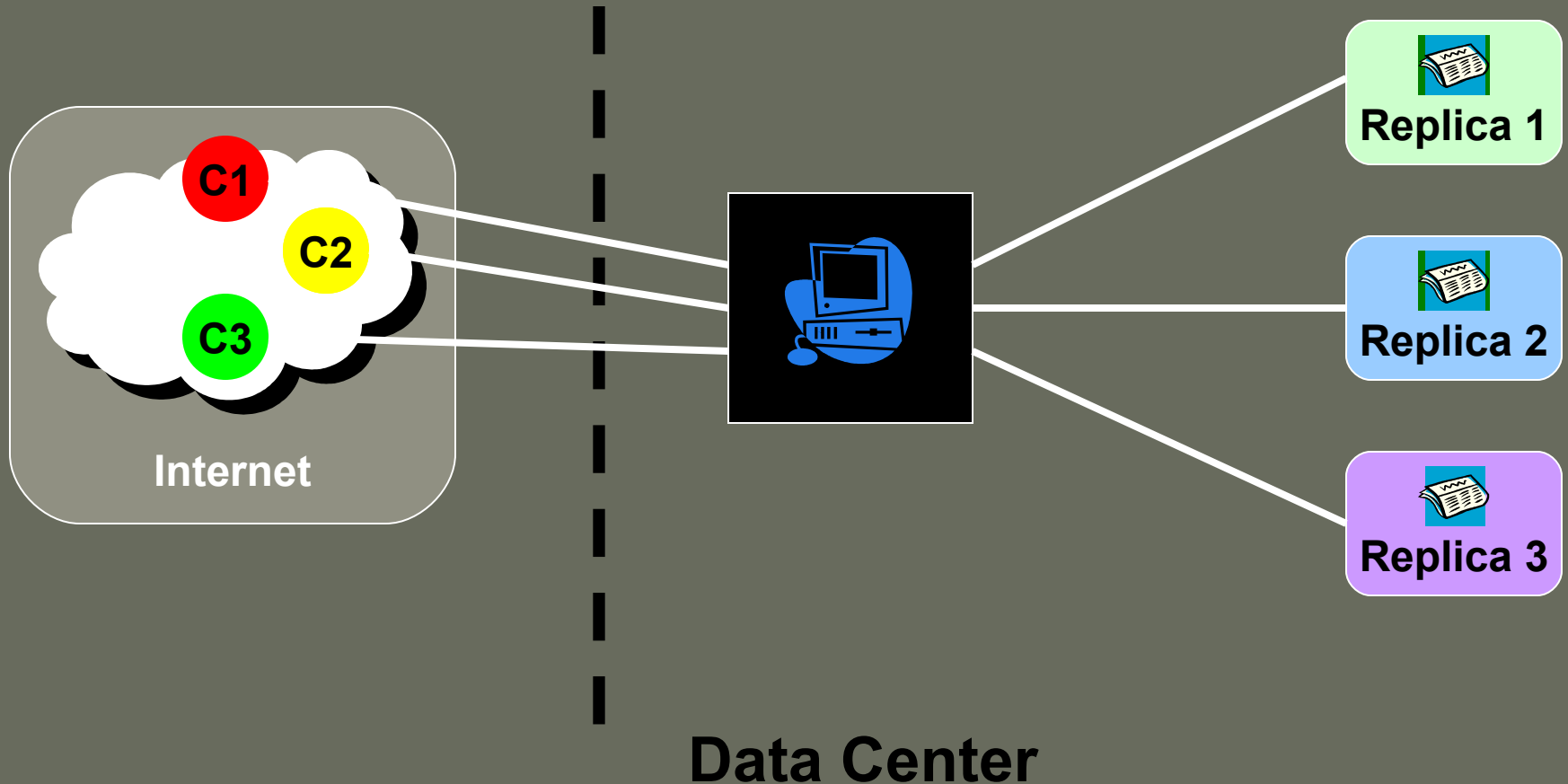


Data Center

## Key Tradeoffs

1. ~~Fast Enough~~
2. Scalable
3. Programmability
4. Cost

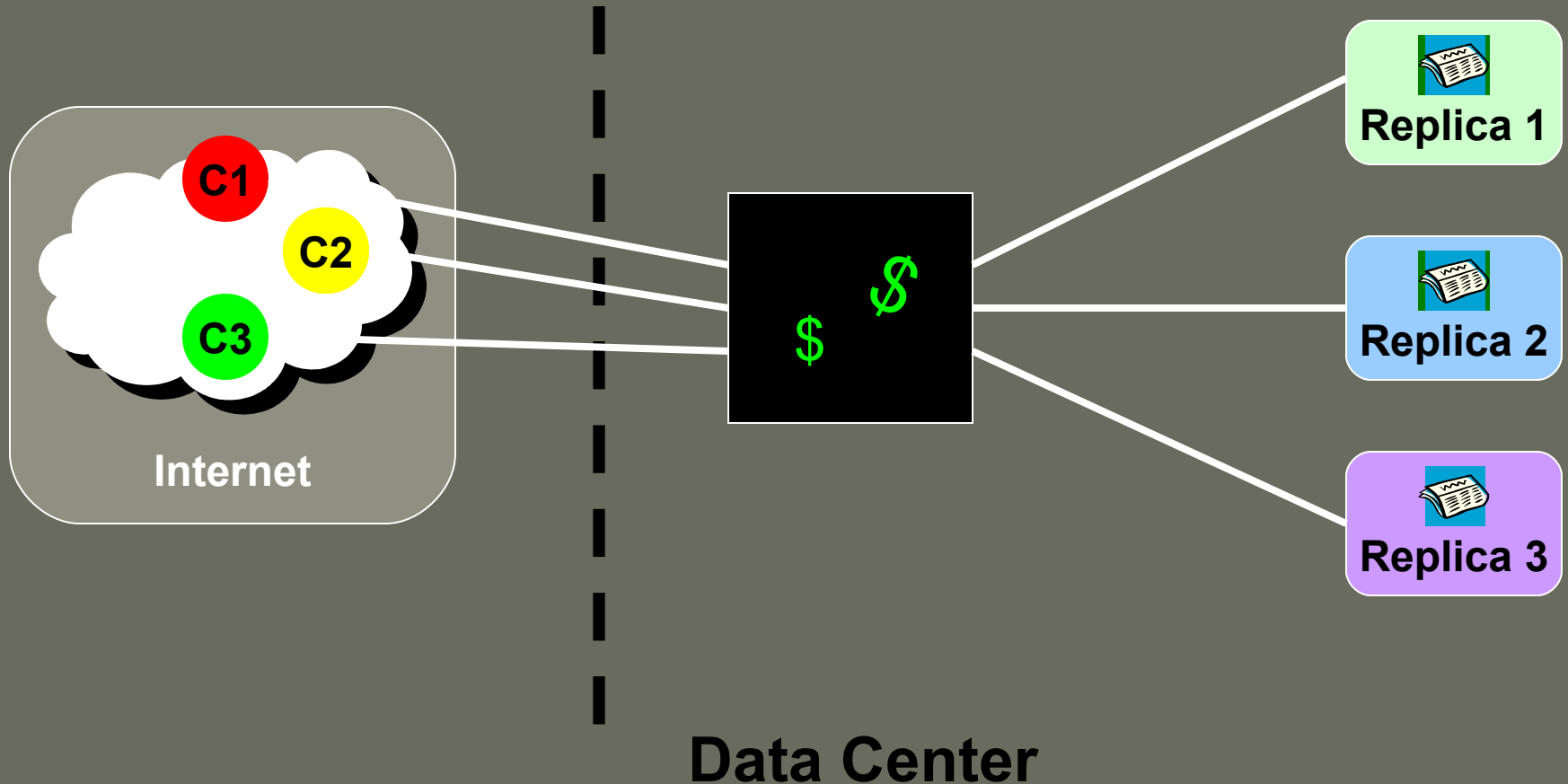
# Software LB



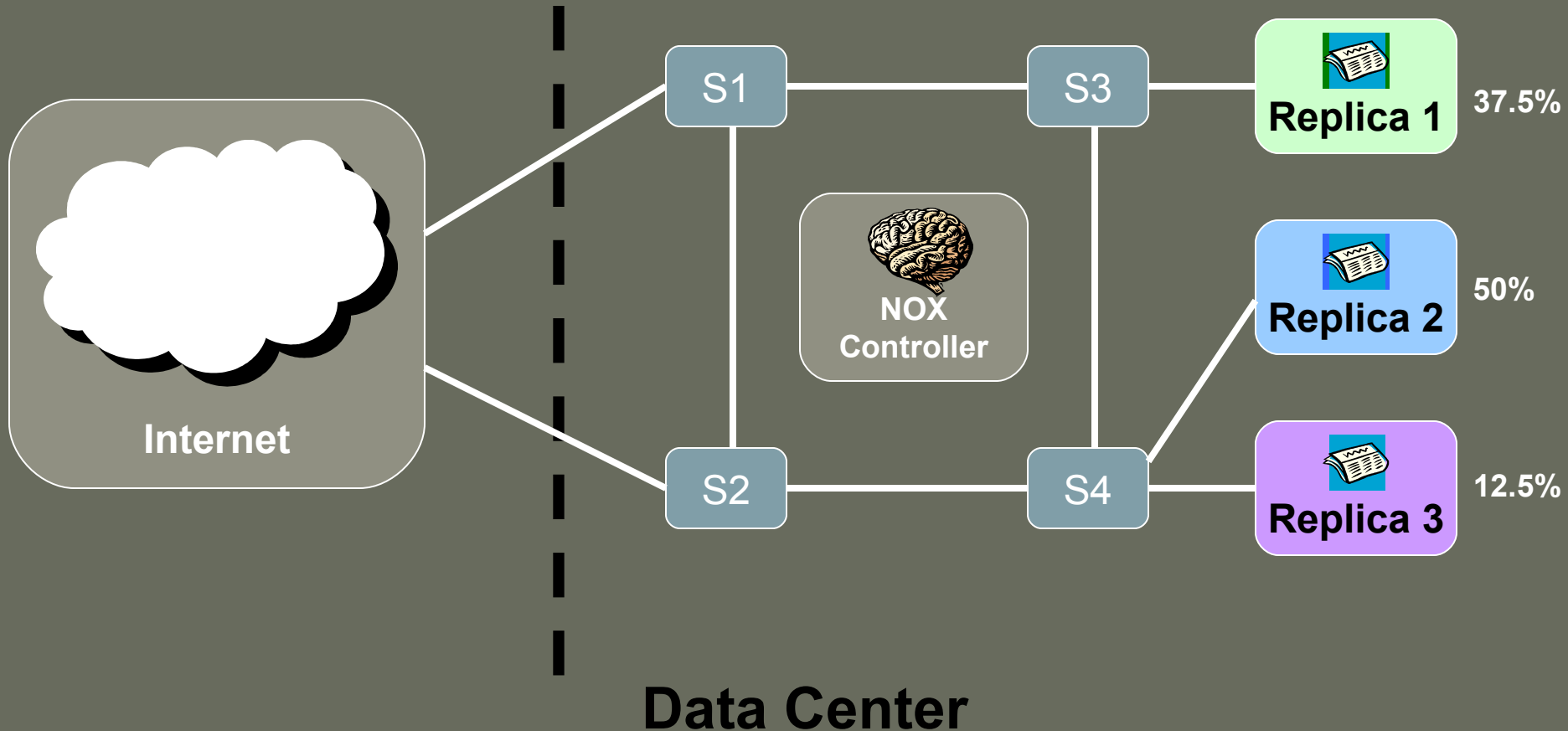
## Key Tradeoffs

1. Fast Enough
2. Scalable
3. ~~Programmability~~
4. ~~Cost~~

# Dedicated HW



# Openflow Load Balancing

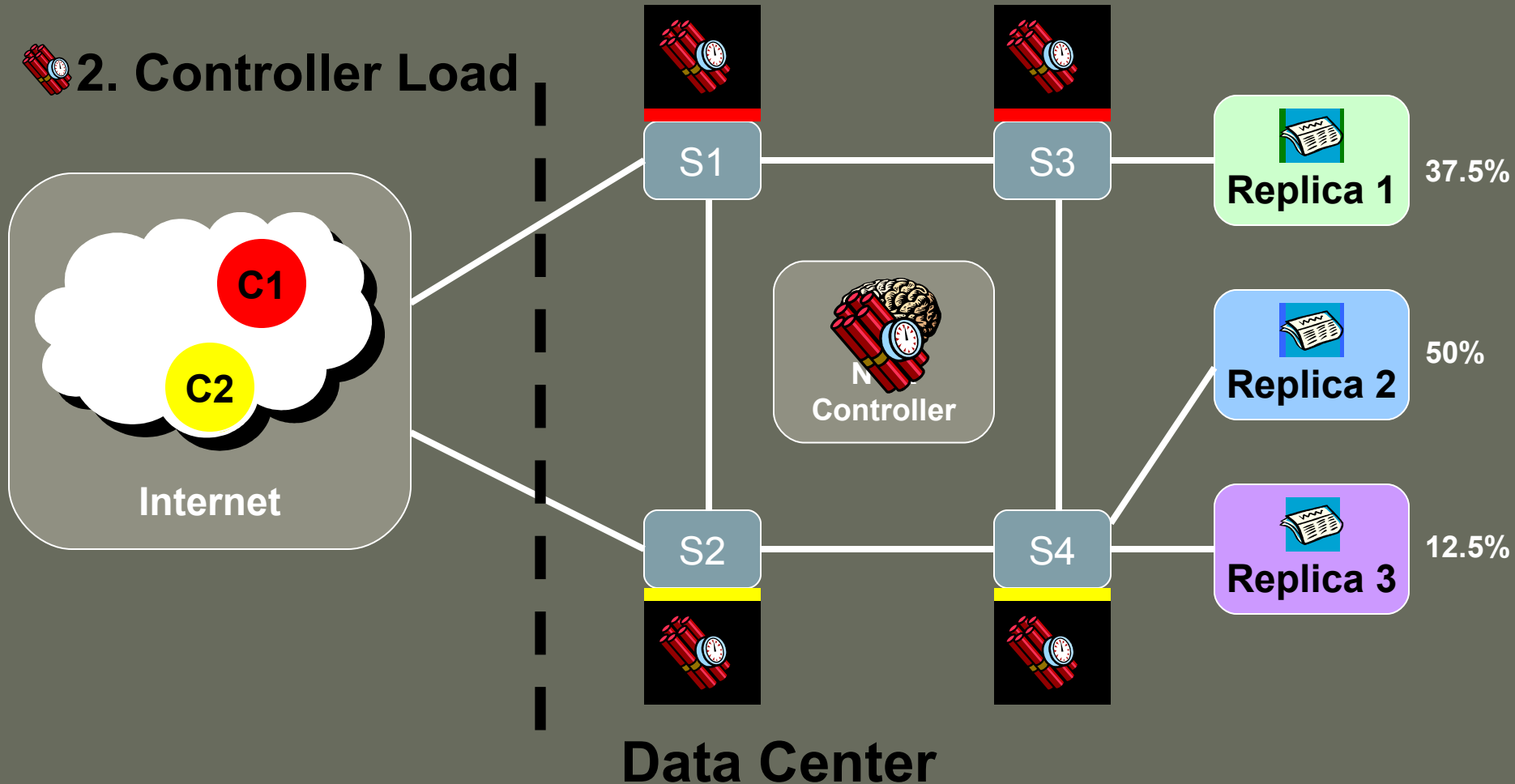


# Challenges

# Naiive Solution

 1. # Microflow Rules

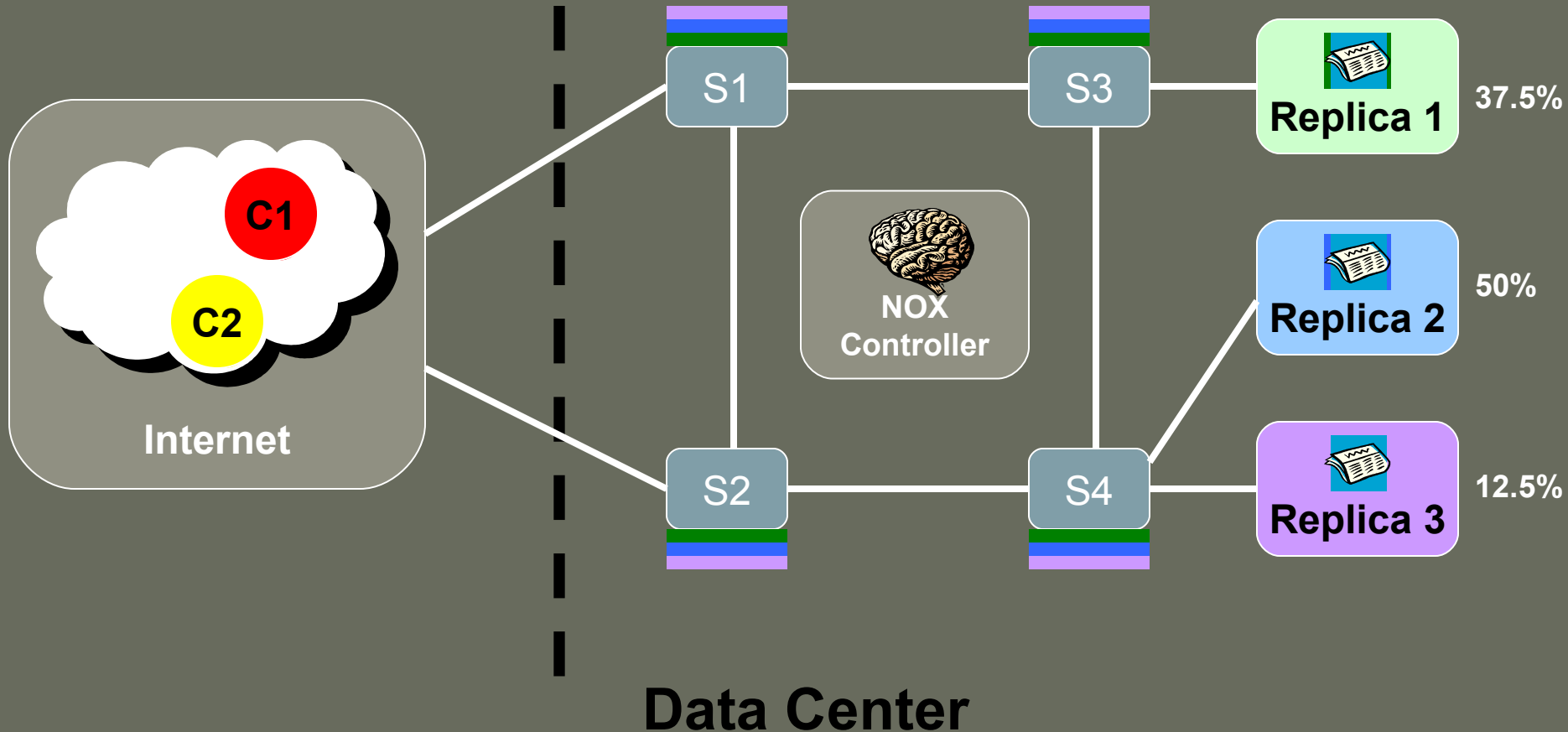
 2. Controller Load



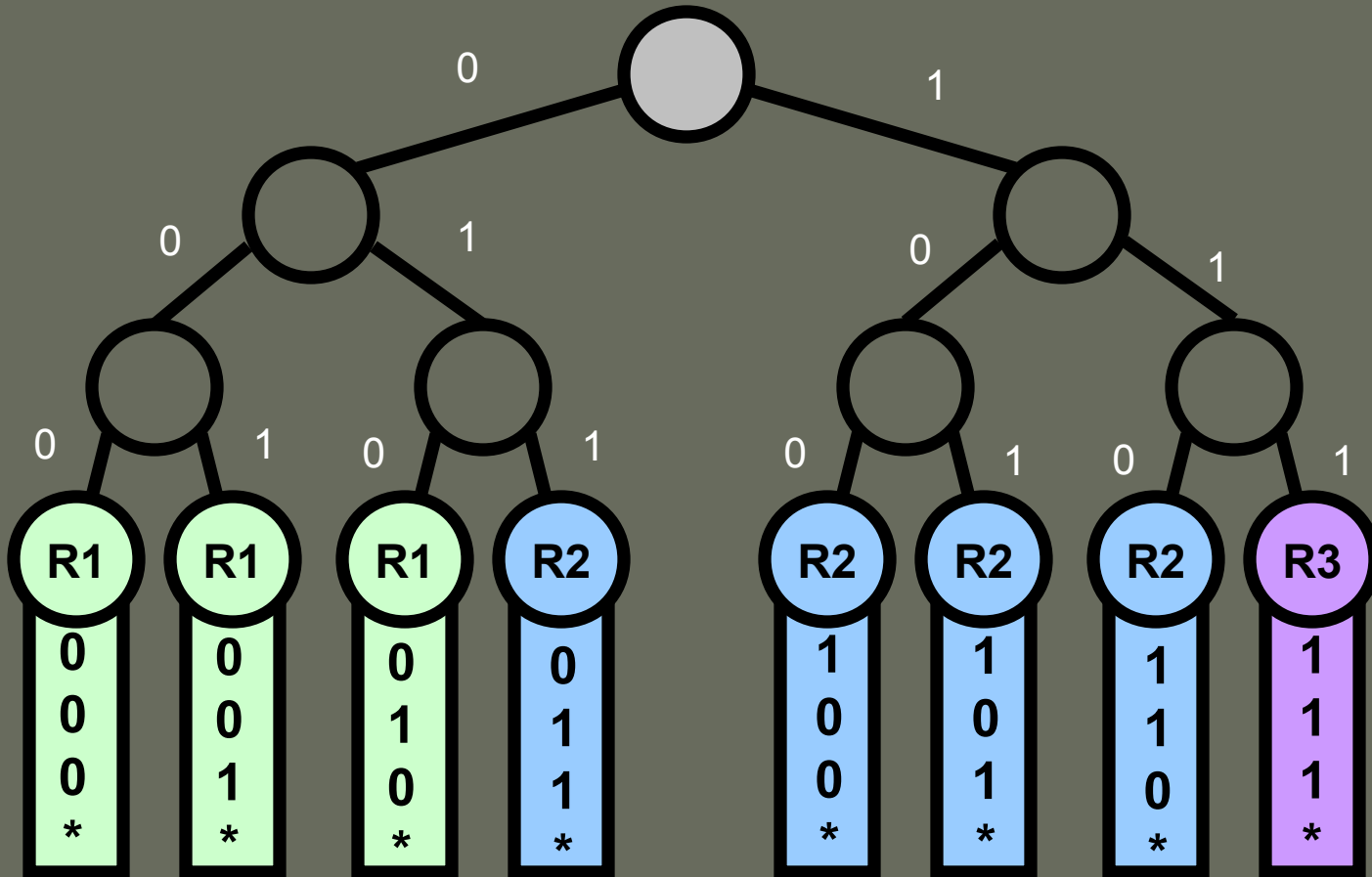
# Proactively Install Rules

## Issues

1. Wildcards Rules
2. Connection Affinity



# Wildcard Rules on Client IPs



- 111\* → R3
  - 110\* → R2
  - 101\* → R2
  - 100\* → R2
  - 011\* → R2
  - 010\* → R1
  - 001\* → R1
  - 000\* → R1
- Switch

 **Replica 1**

$$\frac{3}{8} = 37.5\%$$

 **Replica 2**

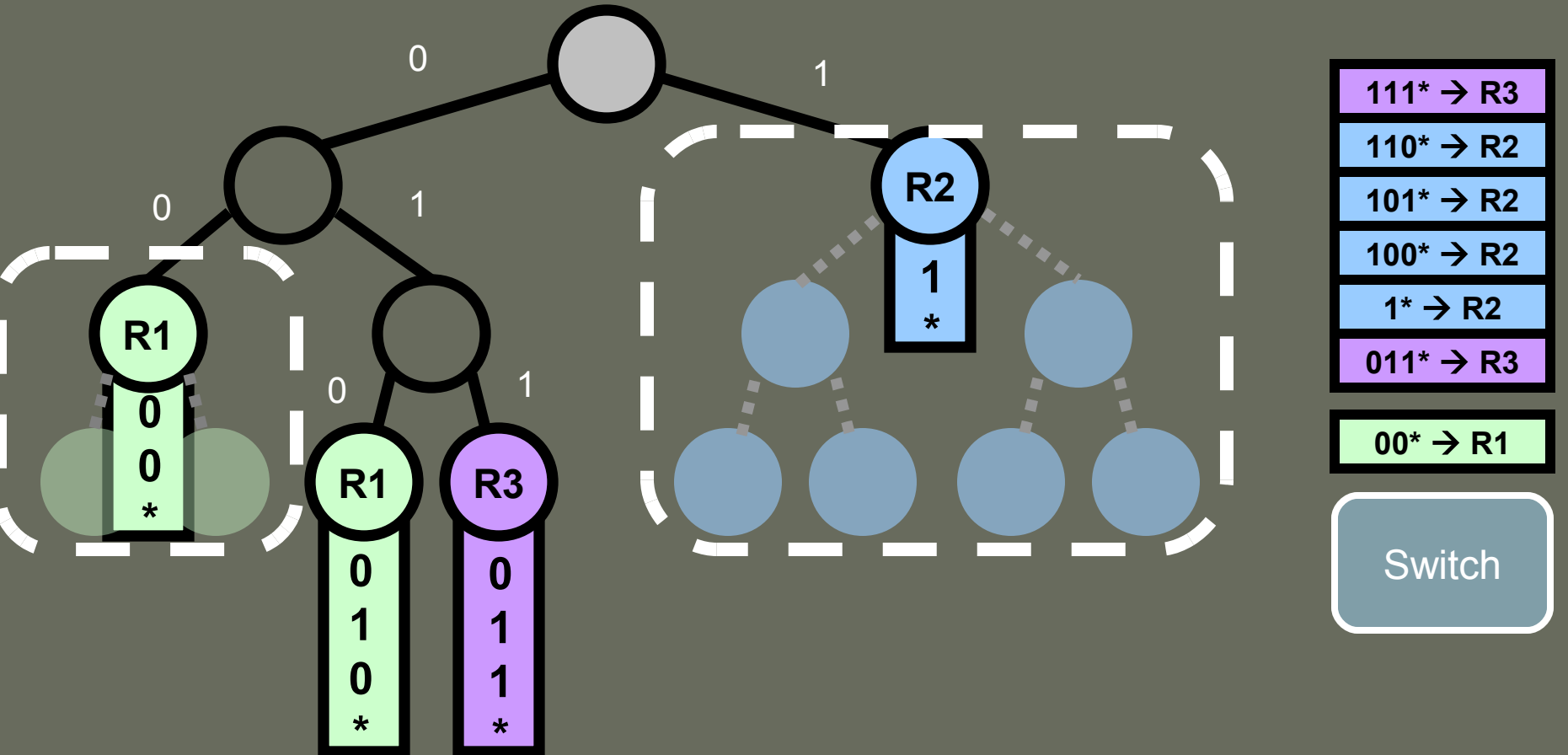
$$\frac{4}{8} = 50\%$$


 **Replica 3**


$$\frac{1}{8} = 12.5\%$$




# Minimizing Wildcard Rules



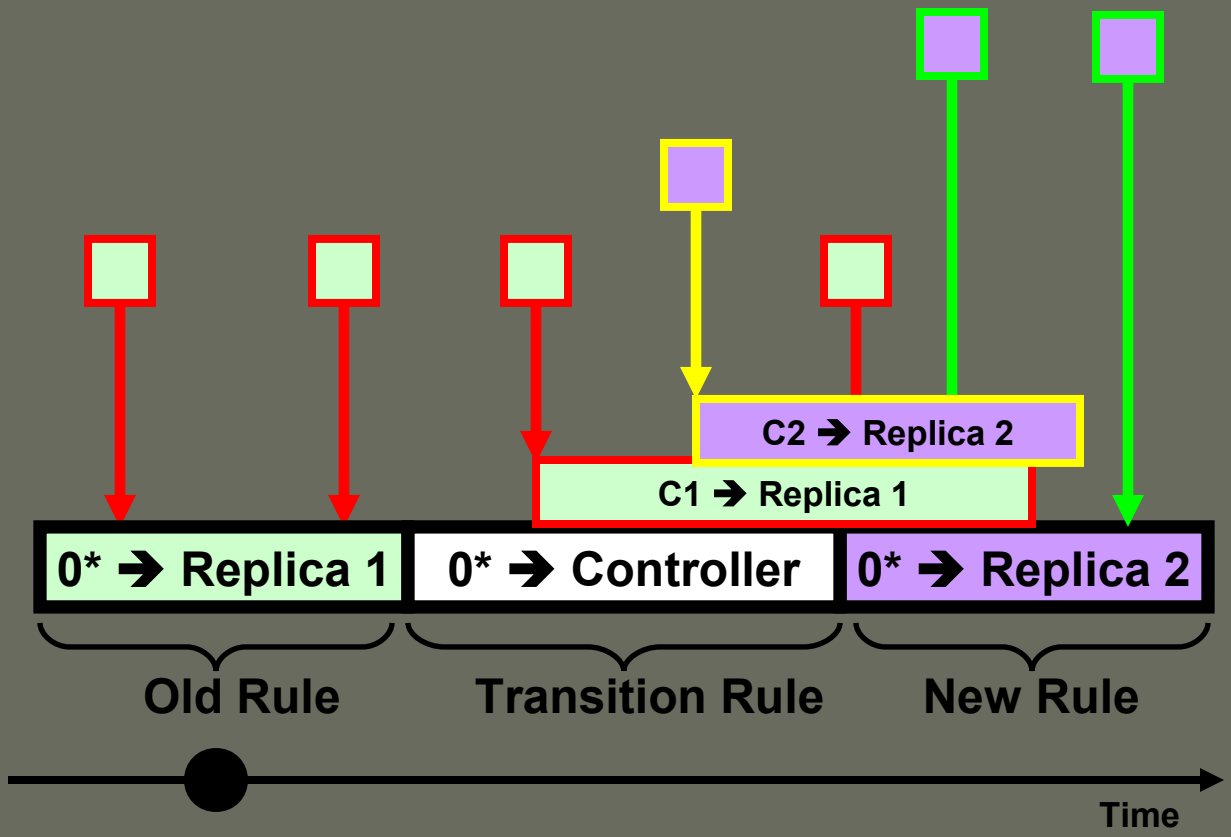

  
**Replica 1**
  
 $\frac{3}{8}$  37.5%


  
**Replica 2**
  
 $\frac{4}{8}$  50%


  
**Replica 3**
  
 $\frac{1}{8}$  12.5%

# Connection Affinity

- C3
- C2
- C1



C2 → Replica 2
C1 → Replica 1
00* → Replica 2
Switch

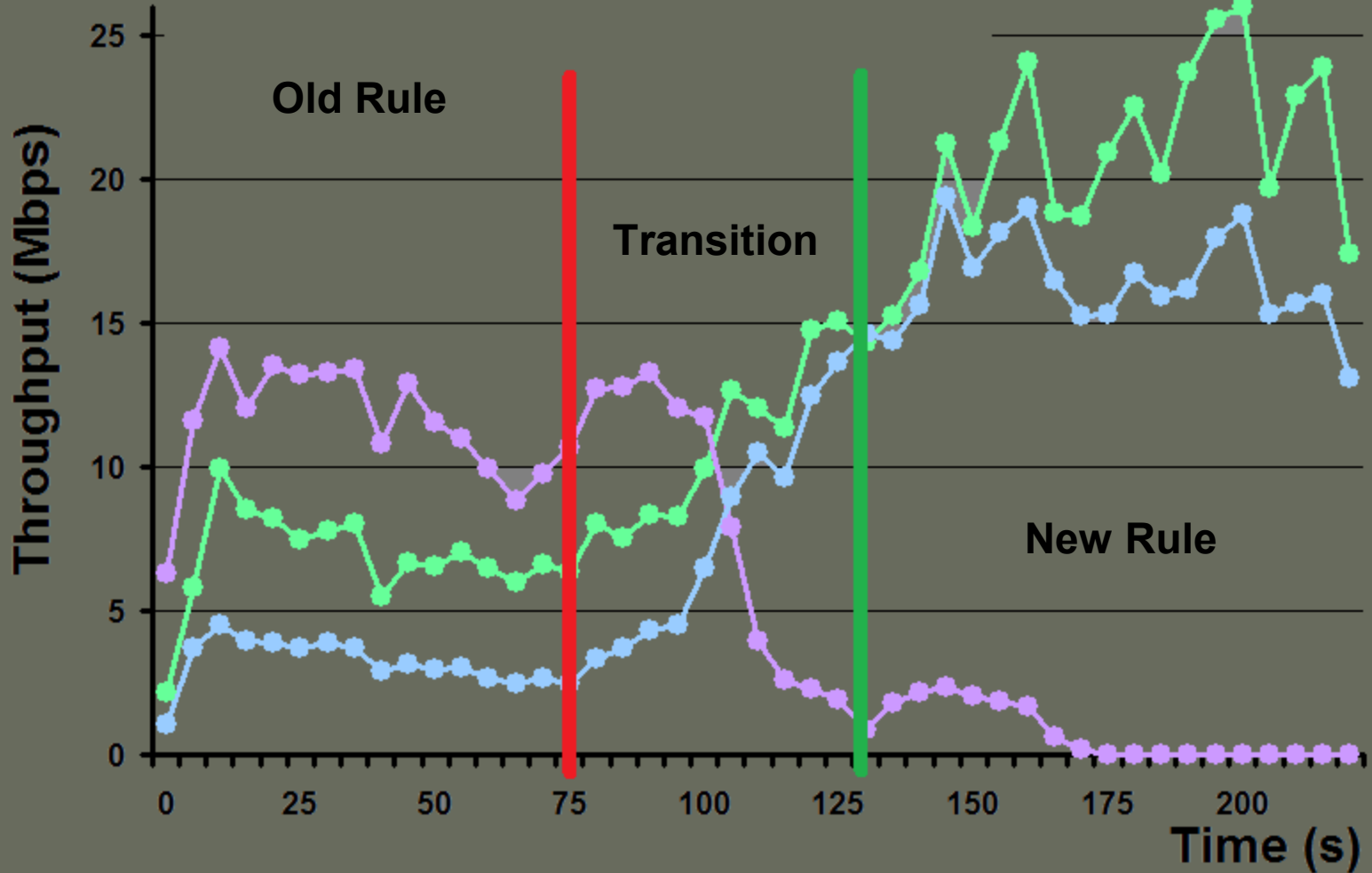
# Evaluation

Before

Replica 1

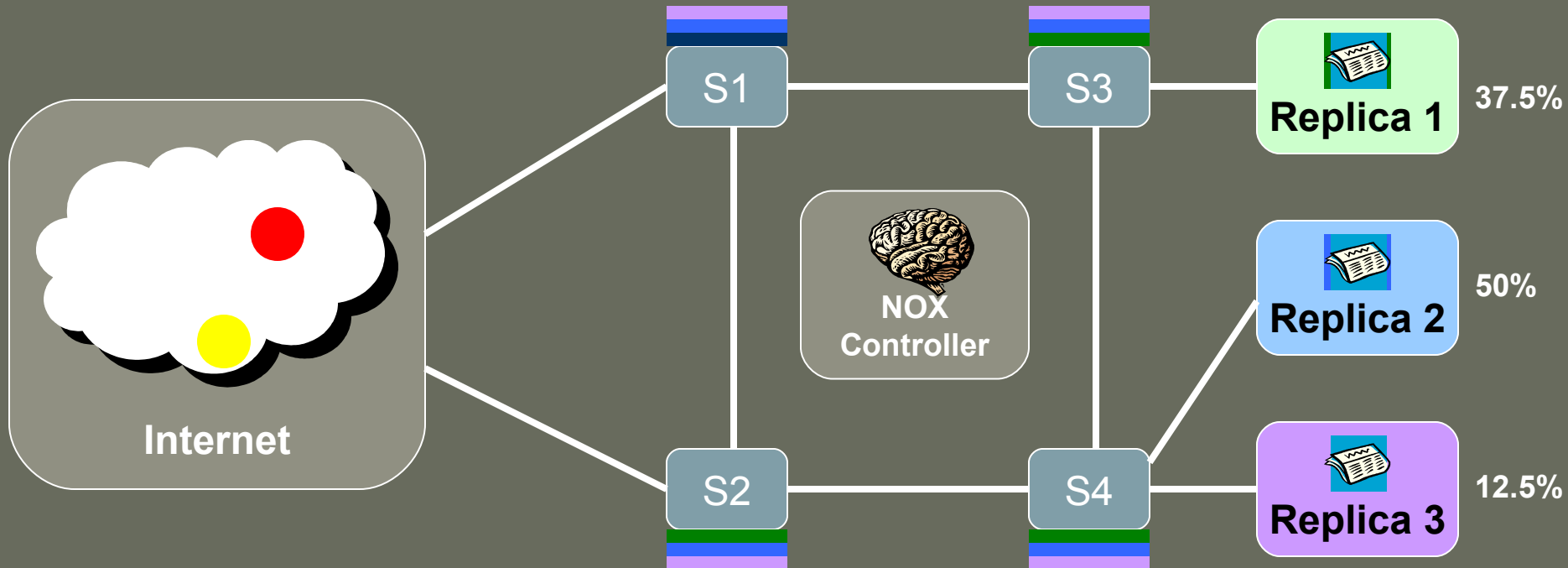
Replica 2

Replica 3



36 Clients, 16 MB File, WGET every 10 s

# Multiple Switches

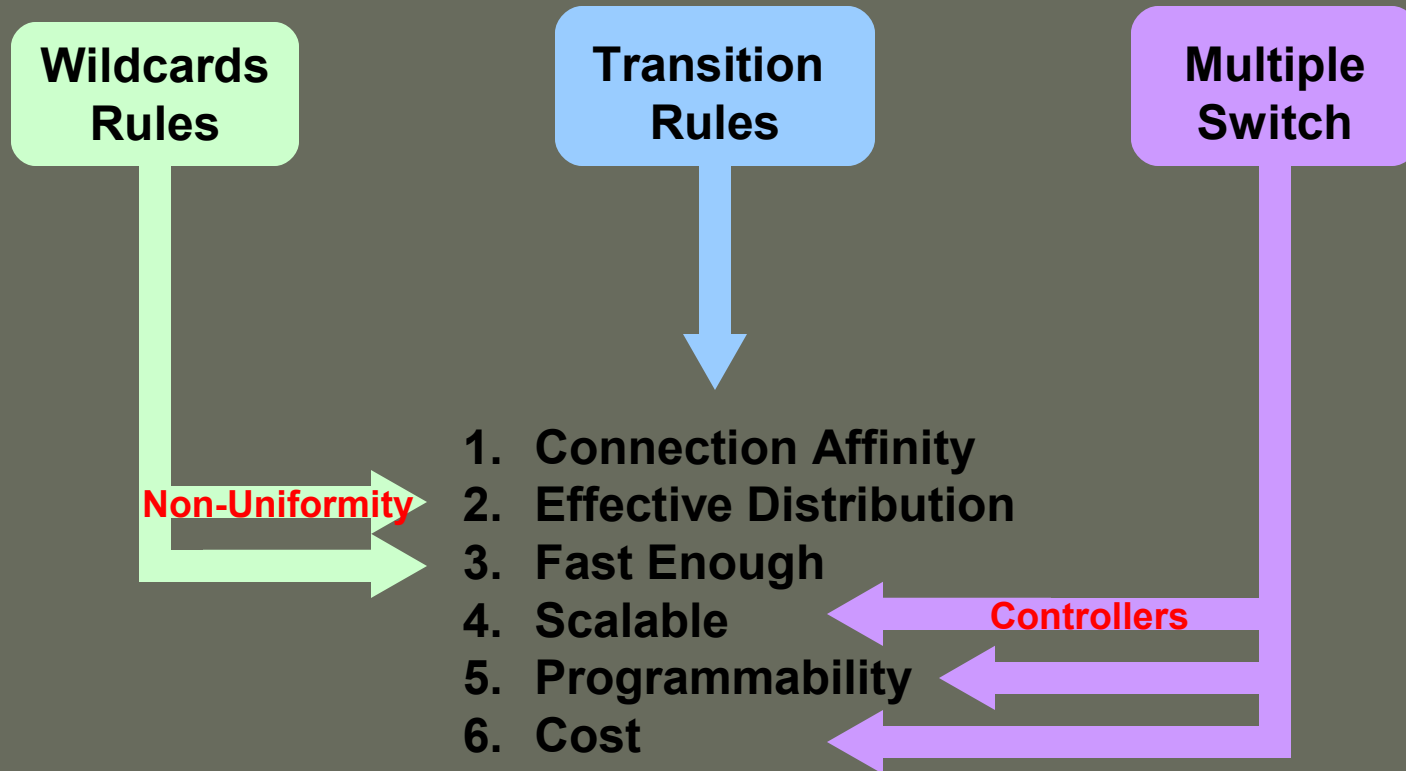


Minimize Number of Rules

Opportunistically Combine Wildcard Rules

# Conclusion

- Proactively Installing Rules in Openflow



Questions?