

# DumbNet: A Smart Data Center Network Fabric with Dumb Switches

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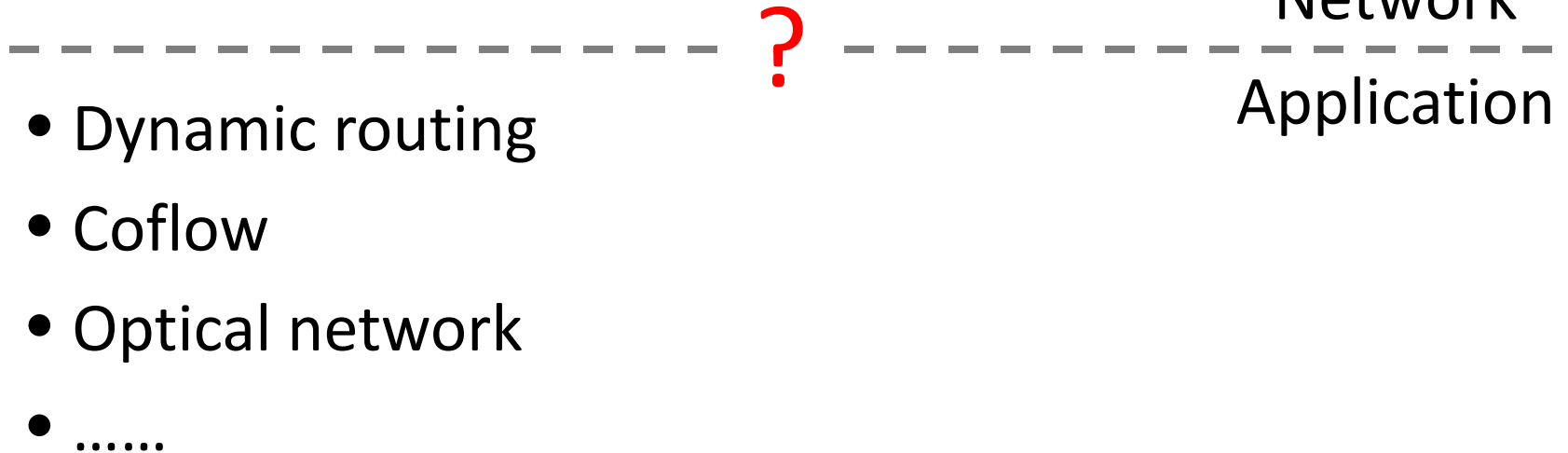
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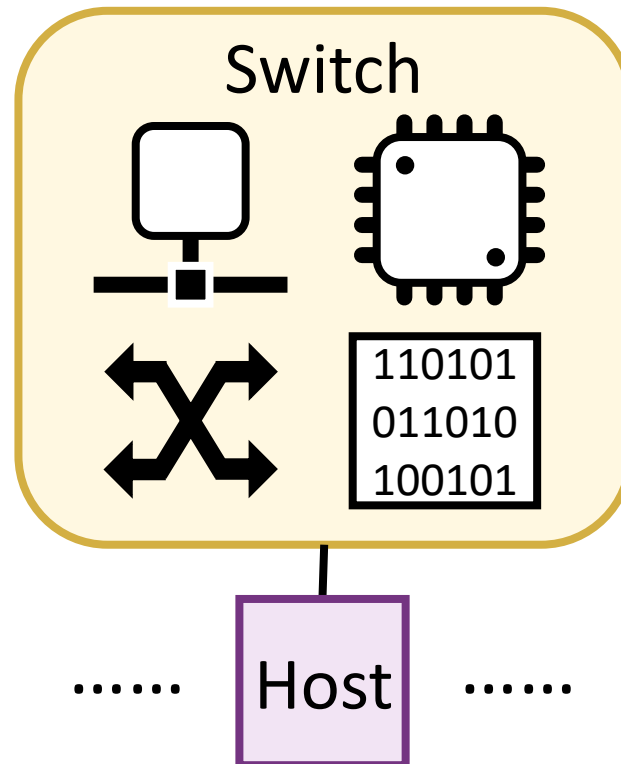
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# Function Division Between Network & Software

- Packet routing
- Network failure handling
- Name service
- .....

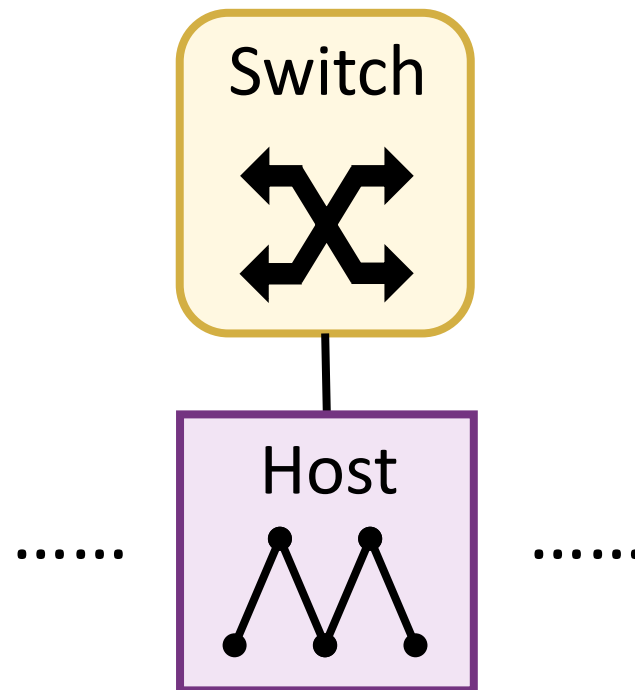


# DCN with Internet Technologies



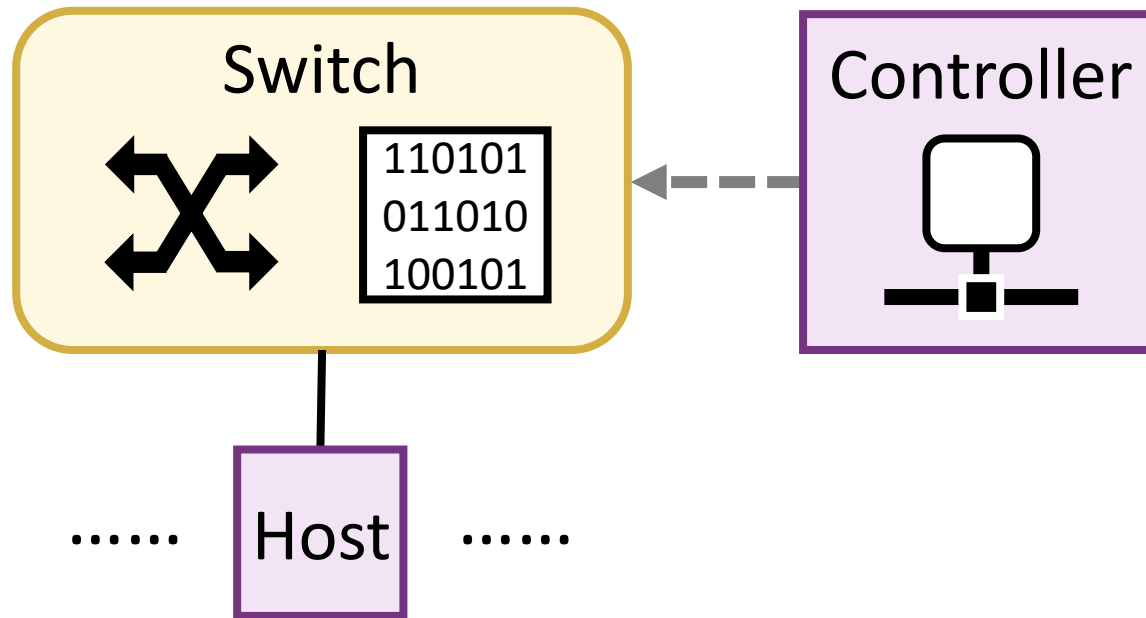
- Internet protocols are too complicated for DCN
- Applications hard to take advantage of network

# Supercomputer Network Adopts Source Routing



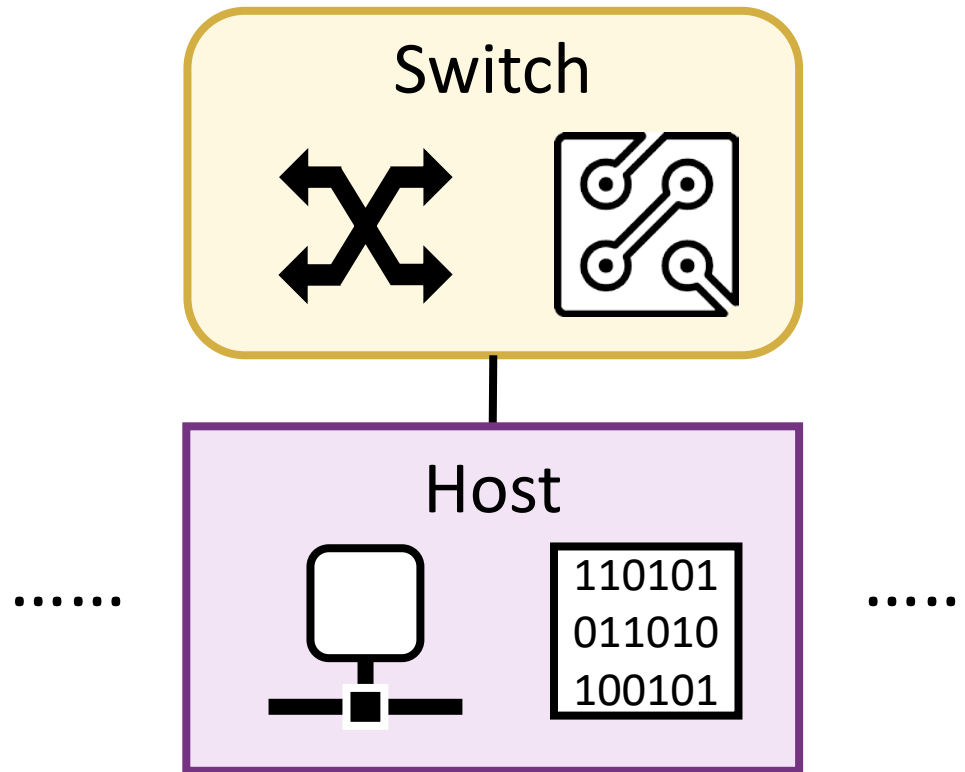
- Only supports fixed topology
- Limited failure-tolerance

# SDN Uses Centralized Controller



- State limits port number and hard to manage
- State consistency problem

# DumbNet Moves Logics and States into Hosts



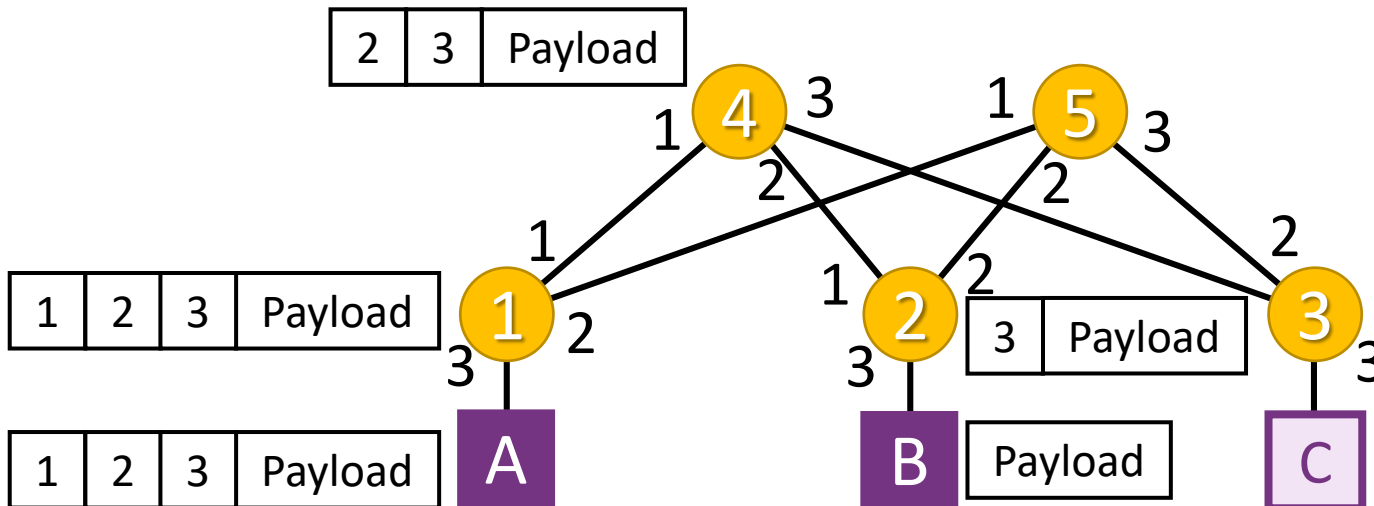
- Switch has fixed simple logics for performance

# Challenges

- Topology discovery
  - Host-based topology discovery using probe packets
- Topology change
  - Two-stage topology maintenance protocol

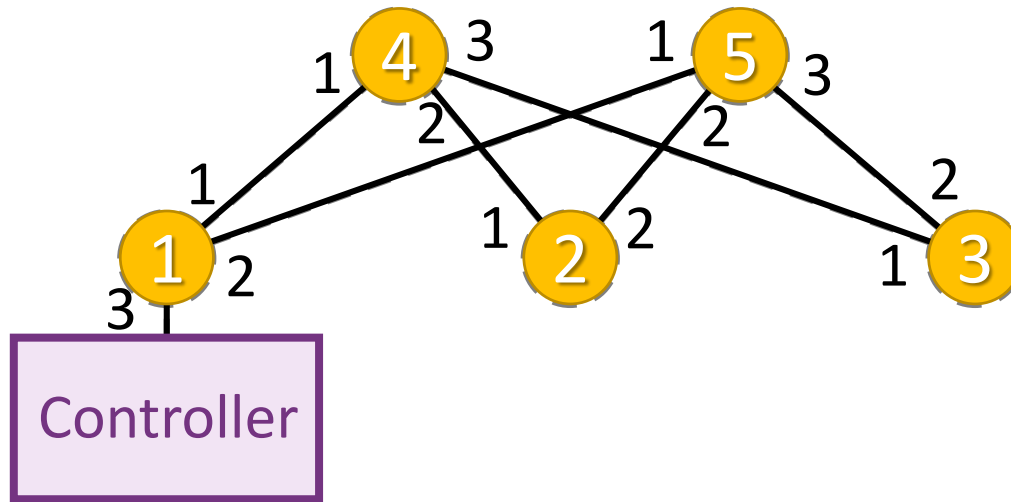
# DumbNet Tag-Based Routing

1. Host queries controller for destination
2. Host agent adds tags according to query result
3. Tags are popped at each hop





# Topology Discovery Solution: Host-Based Probe



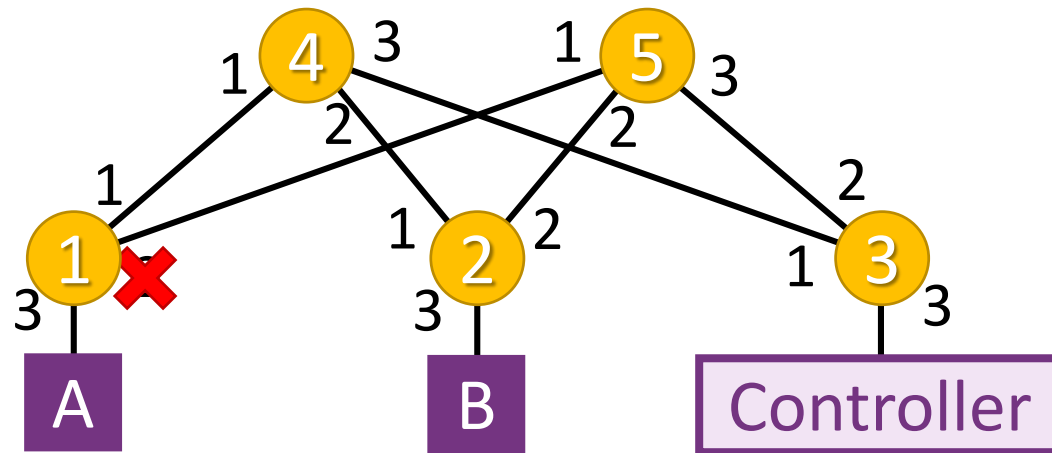
Breadth-first search

Queue 1

Probe 1 , 2 , 3 ..... n

# Topology Change Solution: Update Notification

1. Limited range hardware broadcast by switches
2. Notification flood by hosts

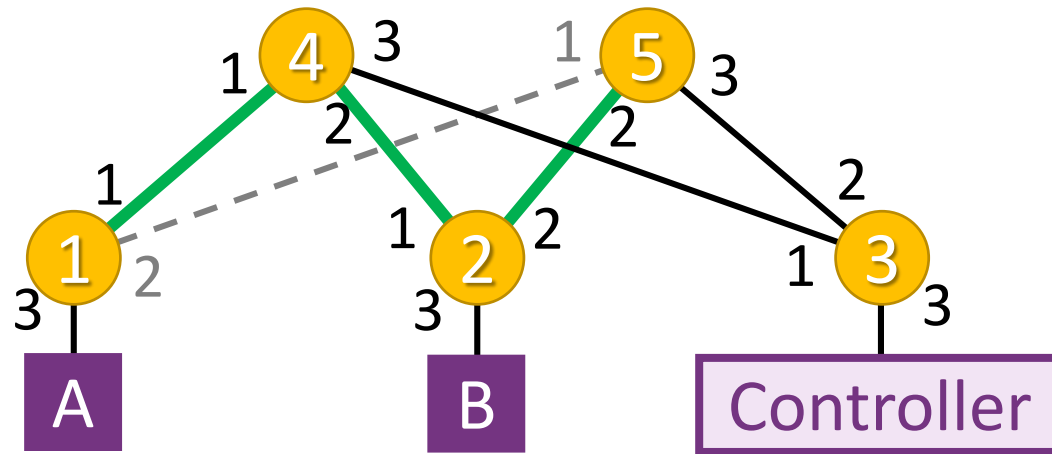


1 sends **Failure 1[2]** to 4 5 A

A floods **Failure 1[2]** to B Controller

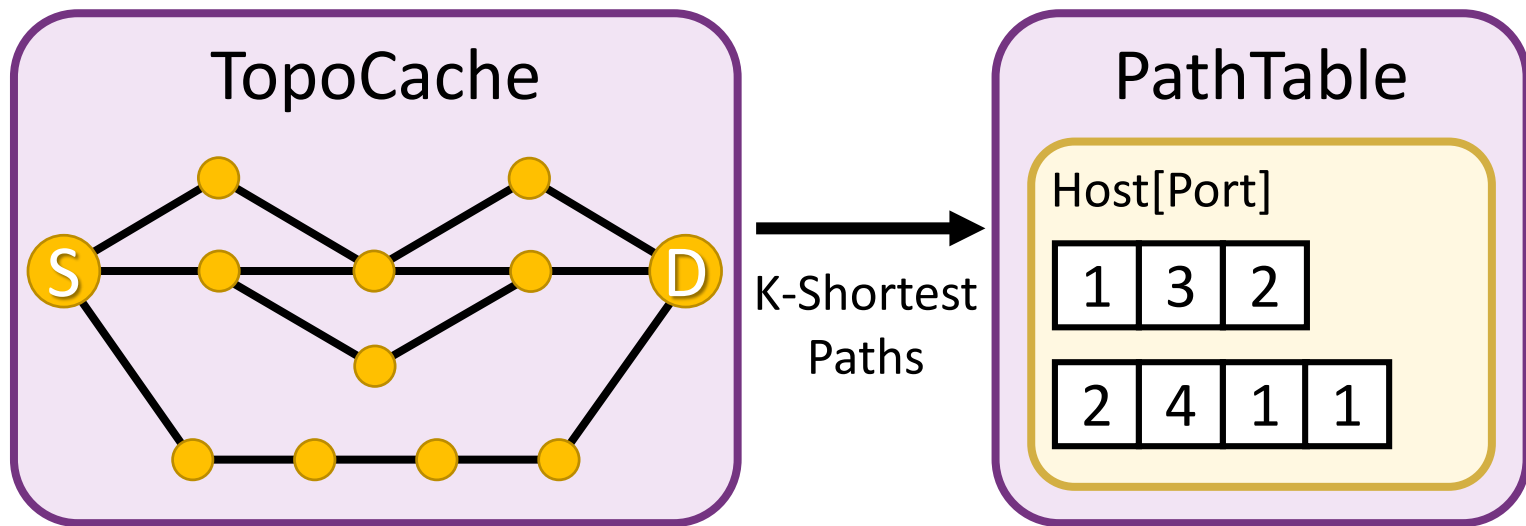
# Topology Change Solution: Quick Fix Patch

- Controller generates and sends patch



Controller sends Patch 1-4-2-5 to A B

# Improve Host Agent Tag Insertion by Caching

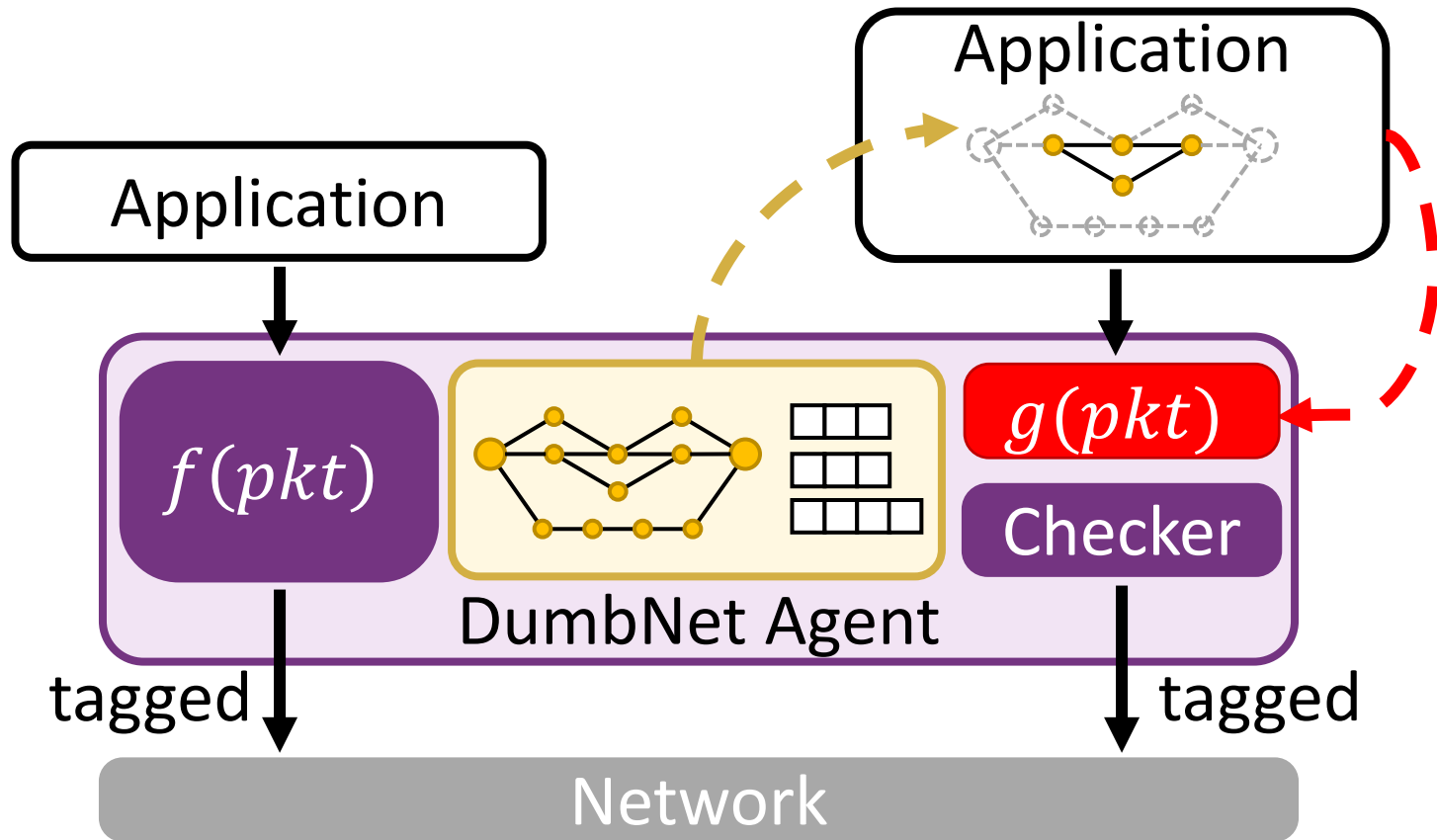


- Controller returns subgraph with multiple paths
- K-shortest paths cached in PathTable

# Flowlet Implements Easily on DumbNet

- Supporting flowlet in router
  - Remember available paths
  - Track flow states
  - Extra logics
- **DumbNet**: adds timestamp to paths in PathTable
  - Use previous path if it is recently used
  - Otherwise randomly select from k-shortest paths

# DumbNet Helps Integrate Network & Software



# DumbNet Implementation is Simple

- C/C++ implementation

Agent	Discovery	Maintenance	Graph	Total	+Flowlet
5000	600	200	1700	7500	100

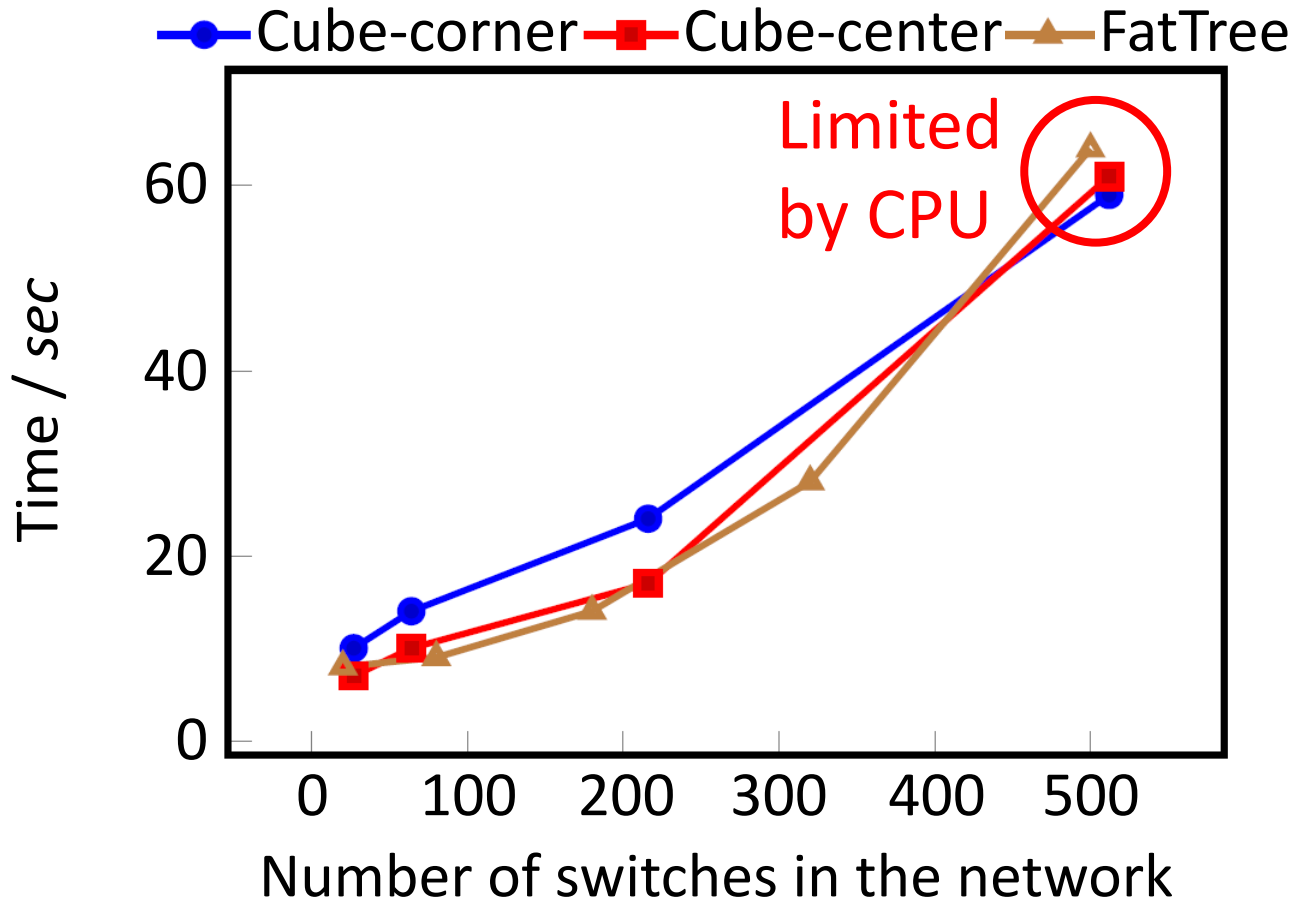
- FPGA implementation
  - 90% less resource consumption of OpenFlow demo (4-port)

# Performance Evaluation Setup

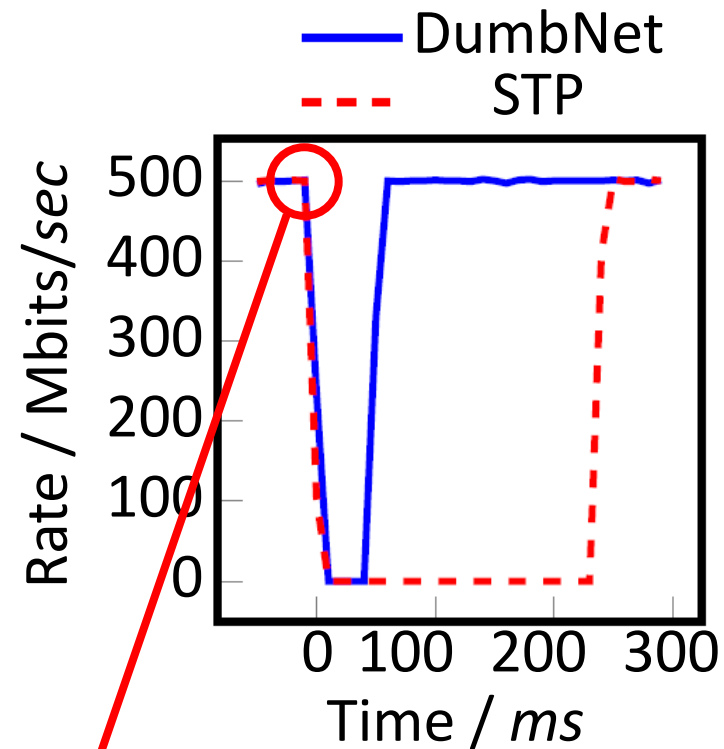
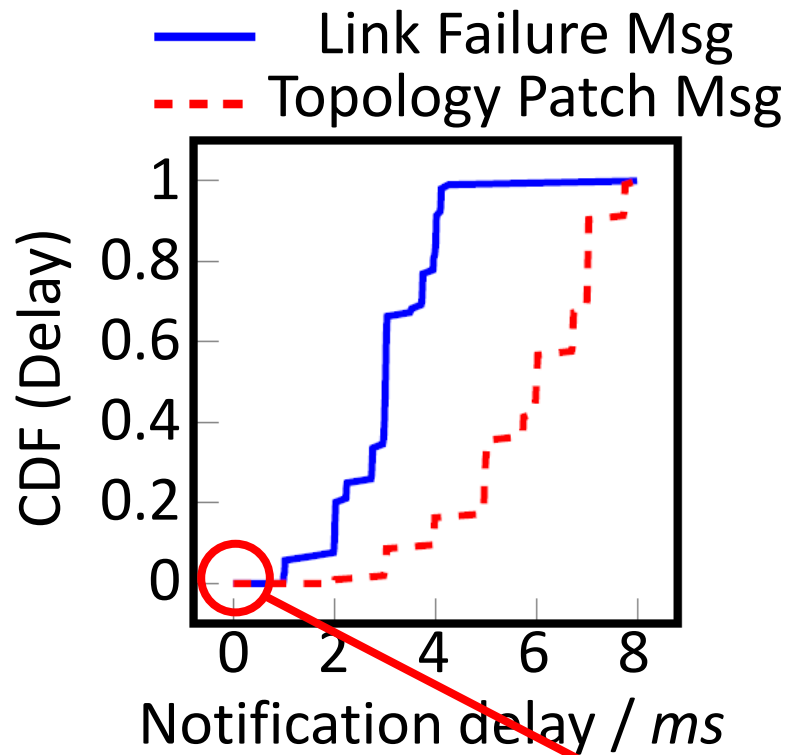
- Emulation
  - 24-core Intel CPU
- Experiment
  - 7 × Arista 7050, 64-port, 10GE
  - 27 × servers, 6-core Xeon E5, 128GB, 10GE
  - DPDK + MPLS



# Topology Discovery Scales Well

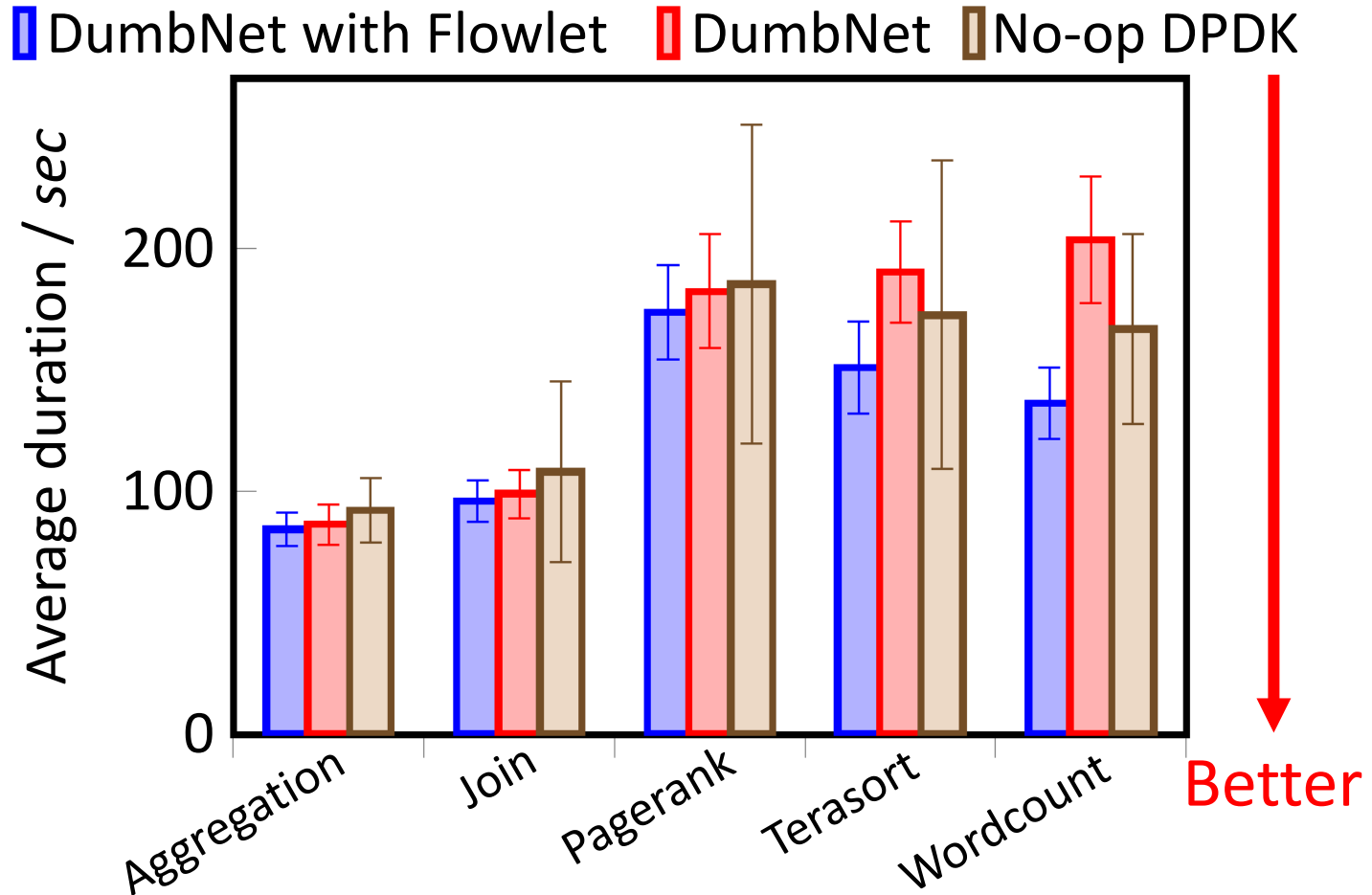


# Topology Maintenance Execution Time



Link Failure

# DumbNet Based Flowlet Easily Optimizes Real World Application Performance



# Conclusion

- How to divide responsibilities between switches and hosts?
- How to better integrate network with software?
- What else must we add back to the dumb switches?

Thanks!  
Q&A