# SDN-based Virtual Machine Management for Cloud Data Centers


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# Agenda

- Motivation
- SDN suits for VM management
- A communication cost reduction scheme
- Design of our SDN-based VM management system
- Experimental results
- Conclusion

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# Motivation

In Cloud Data Centres, **server** and **network** resources have disjoint control mechanisms

# Motivation

## Server Resource Management

- VM
- Energy
- CPU
- Memory
- Hypervisors

## Network Resource Management

- Switches
- Routing
- Middleboxes
- Policies

A **unified server-network control** mechanism is needed

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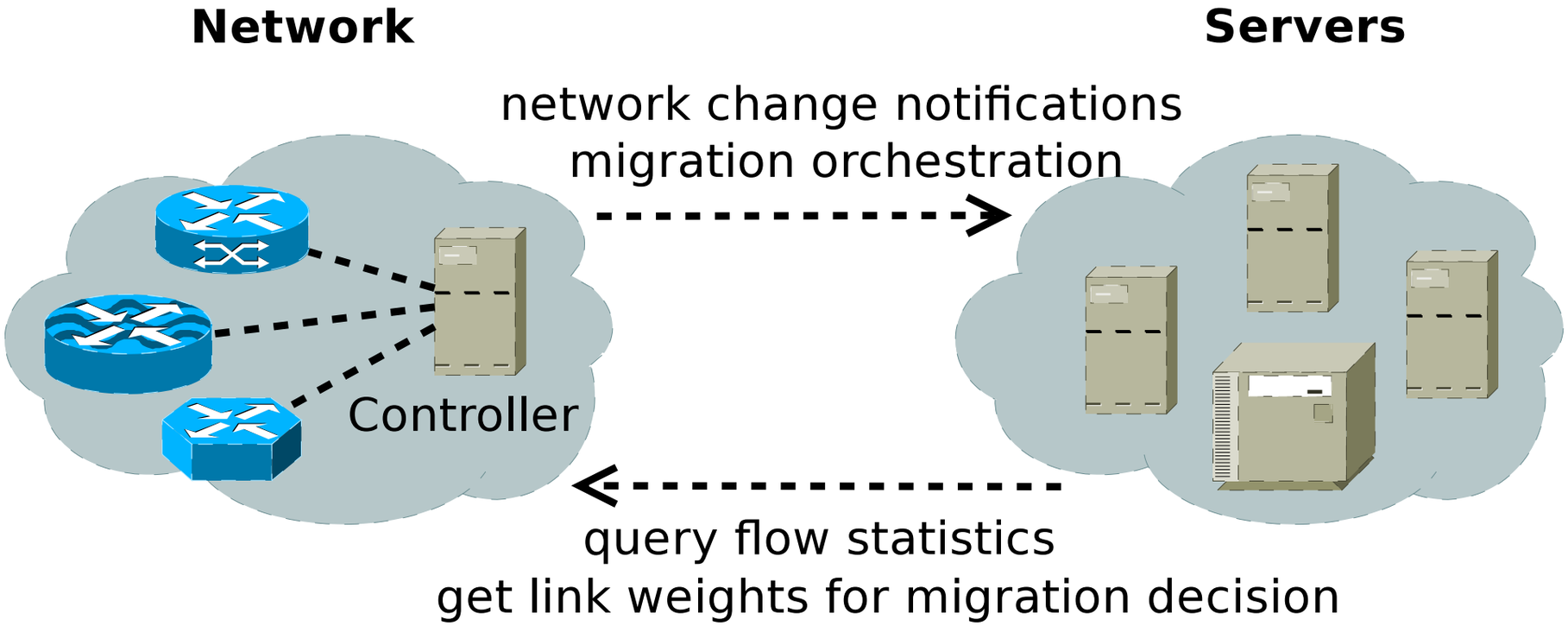
# Unified management of resources



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# In this paper…

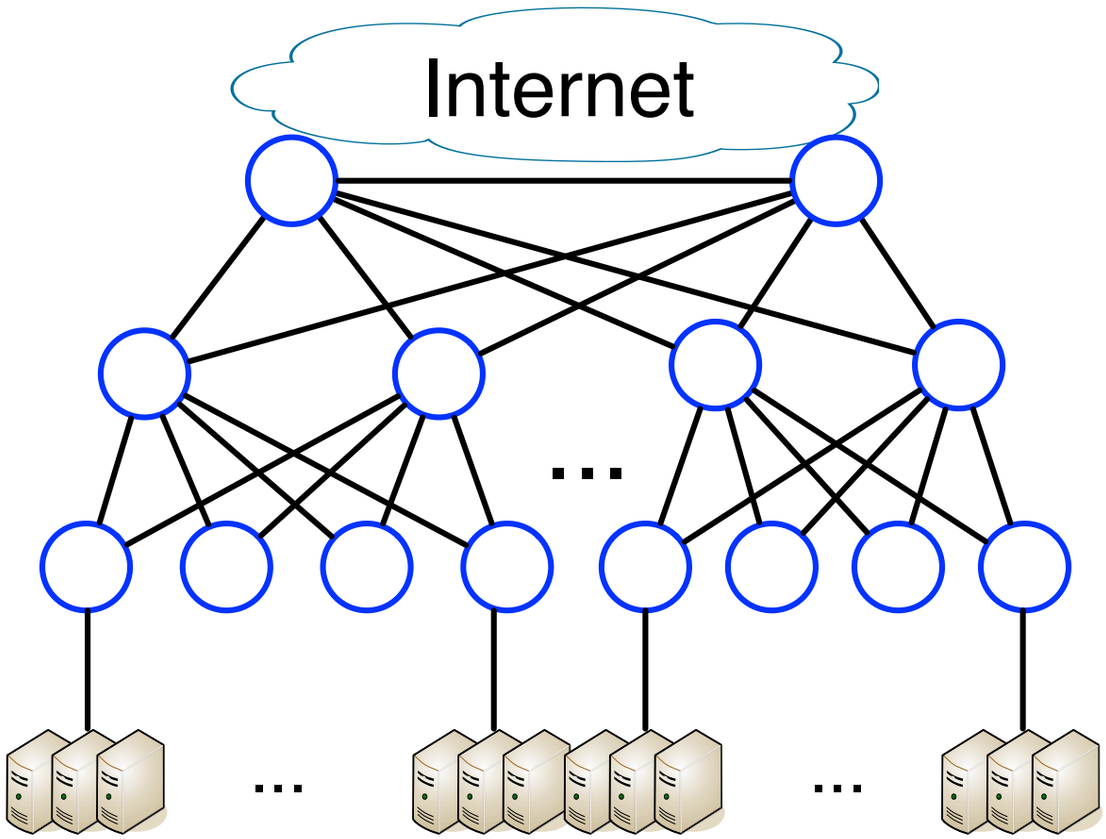
- we propose a converged server-network control framework

- that exploits SDN to orchestrate live, network aware VM management

- to reduce the network-wide communication cost

# S-CORE

- Scalable Communication Cost Reduction




oversubscription ratio

**Fung Po Tso, Konstantinos Oikonomou, Eleni Kavvadia, Dimitrios P. Pezaros**
**Scalable Traffic-Aware Virtual Machine Management for Cloud Data Centers**
**IEEE ICDCS 2014**

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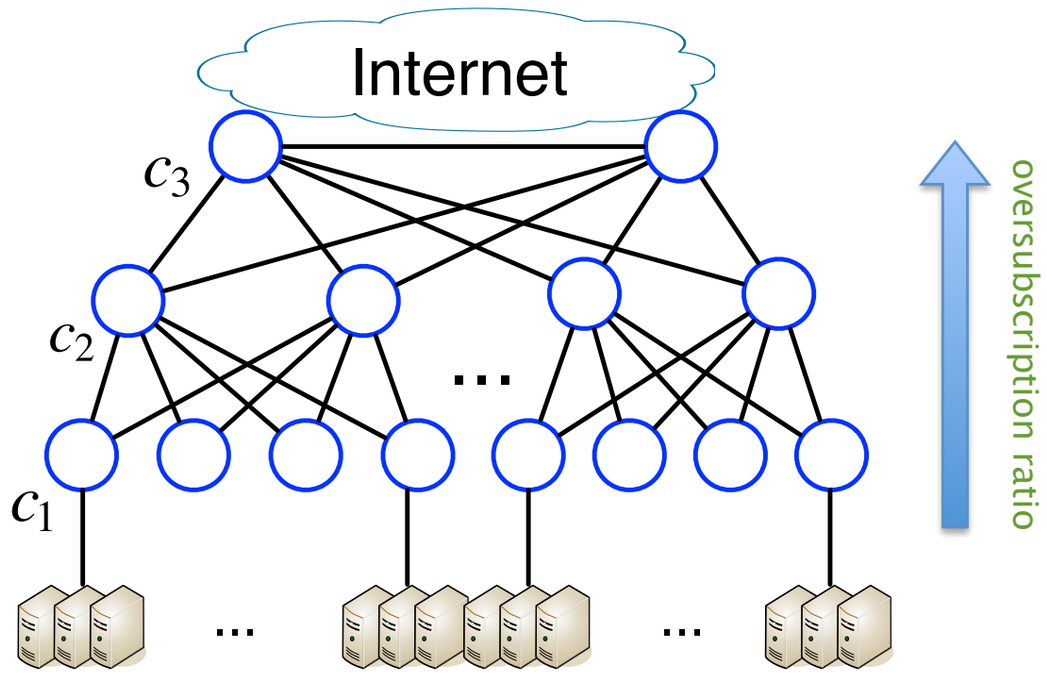
# S-CORE

communication cost
for an allocations *A*

$$C(u,v) = \lambda(u,v) \sum_{i=1}^{\ell^{\mathcal{A}}(u,v)} c_i.$$




$\lambda(u,v)$ is the traffic load per time unit exchanged between VM u and VM v

link weight, *c*, can be set according to hierarchy, bandwidth, or policies but generally $c_1 < c_2 < c_3$

$l(u,v)$ communication level between VM u and VM v



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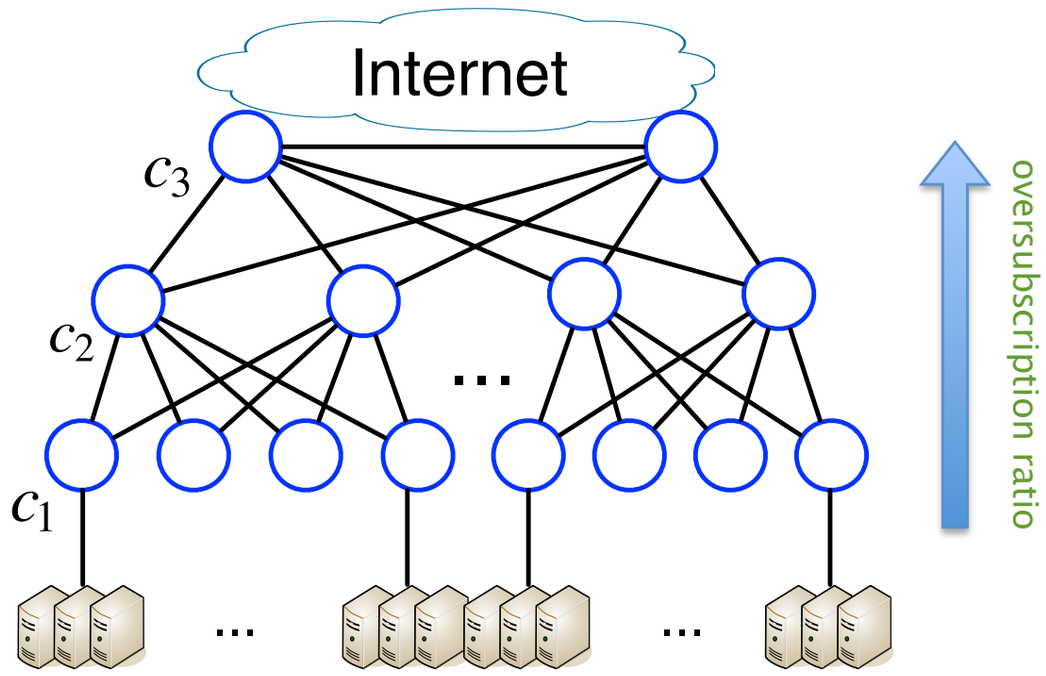
# S-CORE

Eventually,
overall communication cost

$$C^{\mathcal{A}} = \sum_{\forall u \in \mathbb{V}} \sum_{\forall v \in \mathbb{V}_u} \lambda(u,v) \sum_{i=1}^{\ell^{\mathcal{A}}(u,v)} c_i.$$

Thus, centralised optimal

$$C^{opt} \leq C^{\mathcal{A}}$$

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# Limitations of S-CORE

- duplicates effort in measuring per-flow traffic load for each VM
- link costs are manually set
- network topology is manually set
- tokens for orchestration

# SDN for VM management

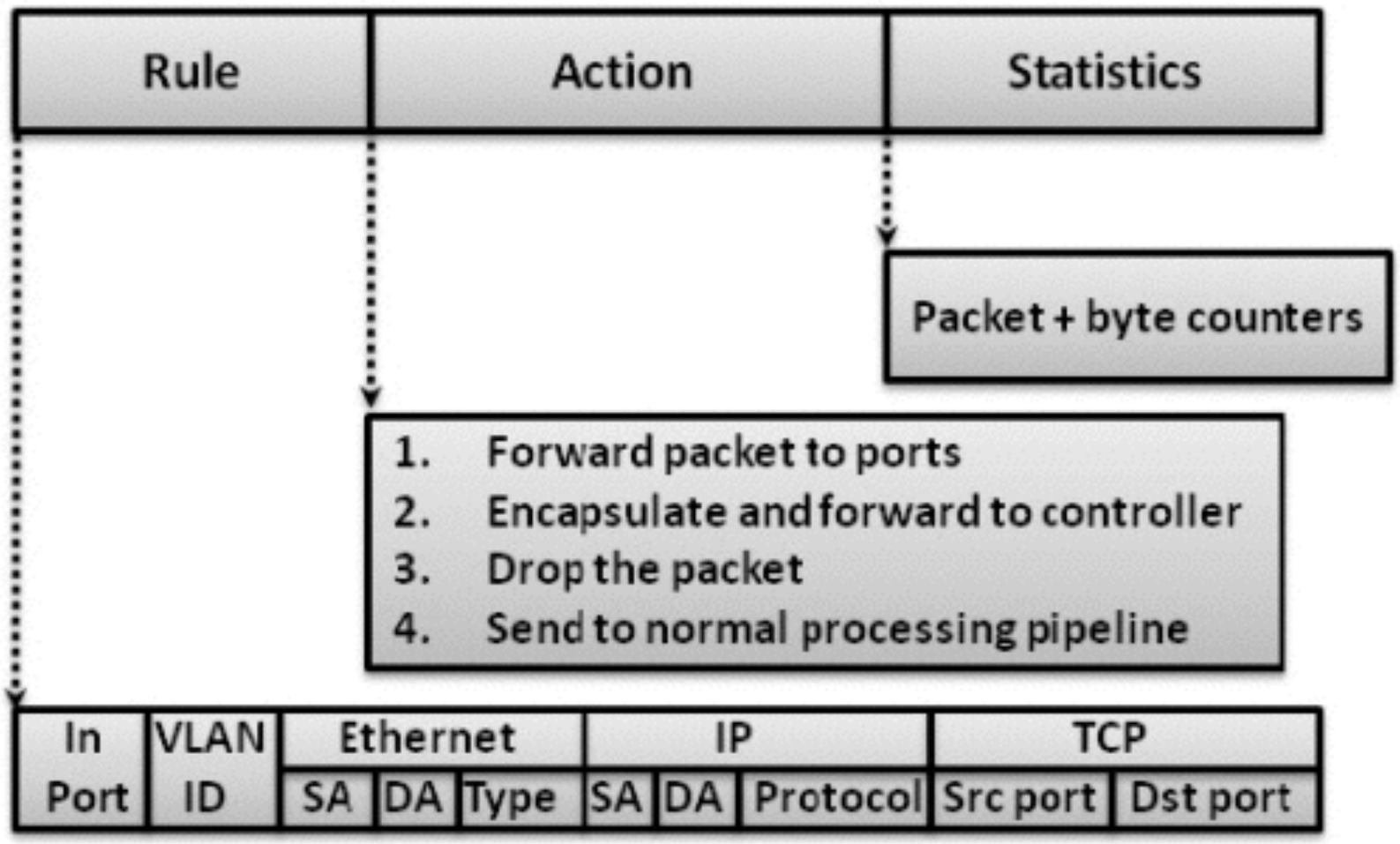
The “Network” has all the information we need to calculate communication costs:

- link costs (levels)
- temporal usage
- topology

**Let’s use SDN to get these information and orchestrate VM migration!**

# OpenFlow

Flow entry contains match rules, actions and stats



# System design

- SDN controller (POX)
  - collecting flow statistics periodically (Statistics Request -> FlowStatsReceived)
  - managing topology, switches, hosts, link weights
  - orchestration of migration
- Hypervisors should support VM migration

# Evaluation

- Mininet
- nping for traffic generation (static)
  - 50 byte TCP packets, 10 pps
- Two orchestration algorithms:
  - Round Robin
  - Load Aware

# Evaluation

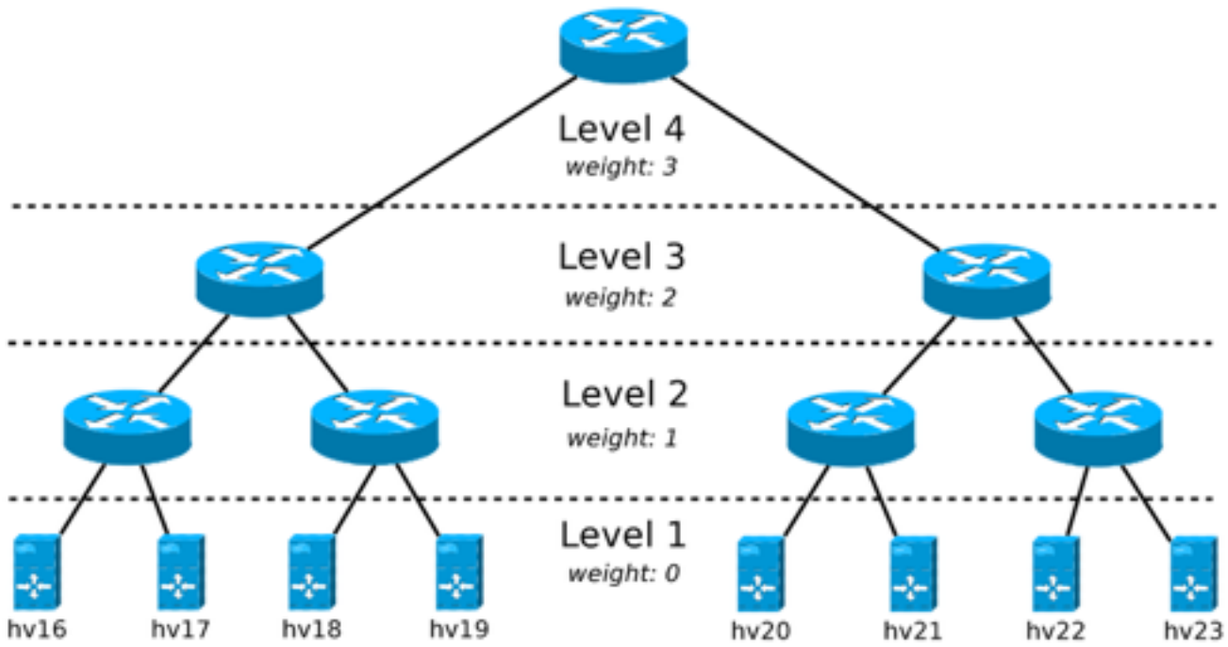
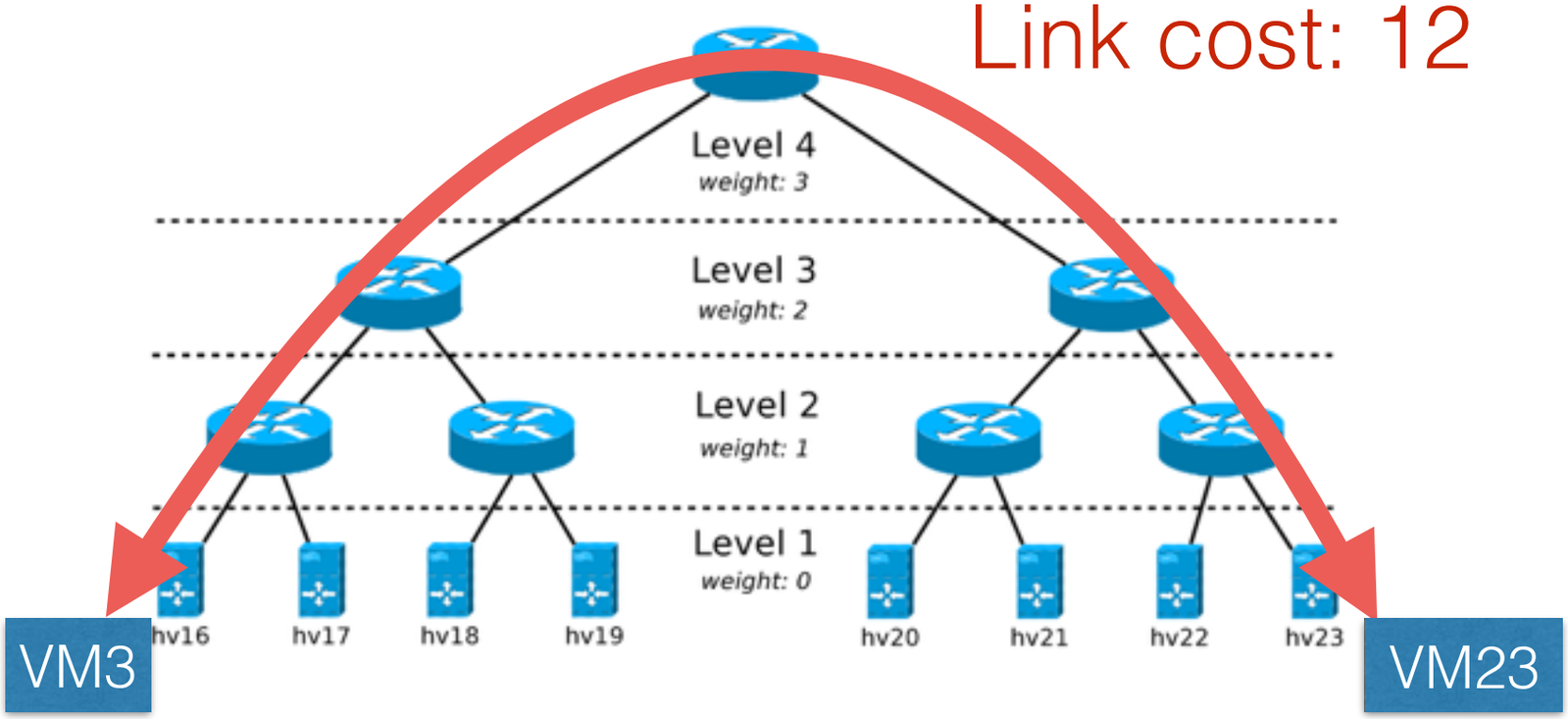



TABLE II. INITIAL TRAFFIC GENERATION IN OUR TEST SETUP.

| Source VM | Source HV | Destination VM | Destination HV | Link cost |
|---|---|---|---|---|
| 10.0.0.1 | hv16 | 10.0.0.6 | hv17 | 2 |
| 10.0.0.2 | hv16 | 10.0.0.10 | hv19 | 6 |
| 10.0.0.3 | hv16 | 10.0.0.23 | hv23 | 12 |
| 10.0.0.6 | hv17 | 10.0.0.11 | hv19 | 6 |
| 10.0.0.9 | hv18 | 10.0.0.22 | hv23 | 12 |
| 10.0.0.21 | hv23 | 10.0.0.5 | hv17 | 12 |

# Evaluation

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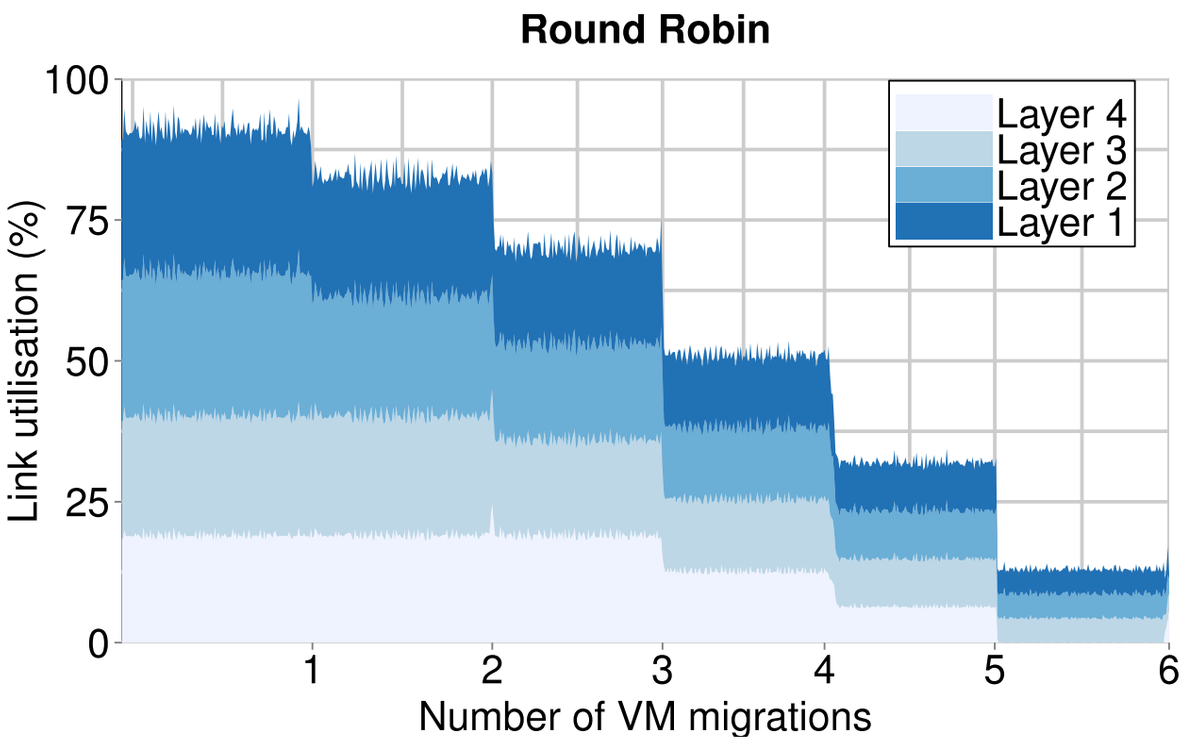
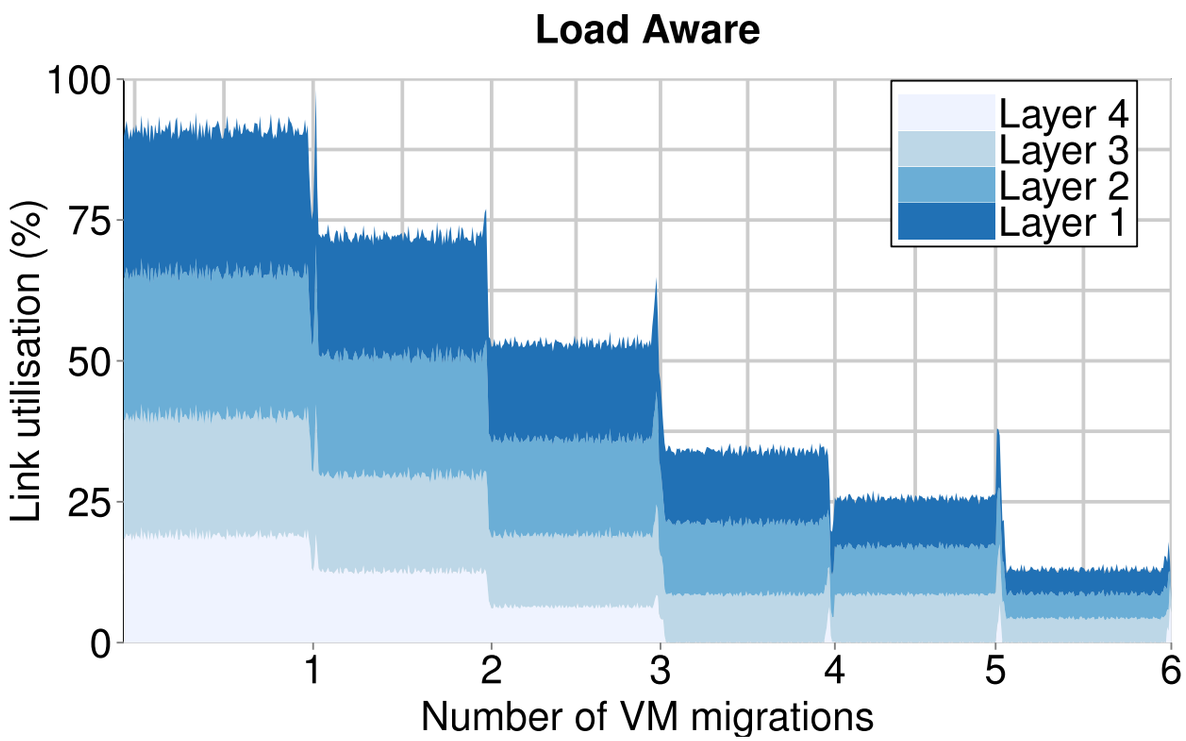
# Experimental Results

- Link utilisation



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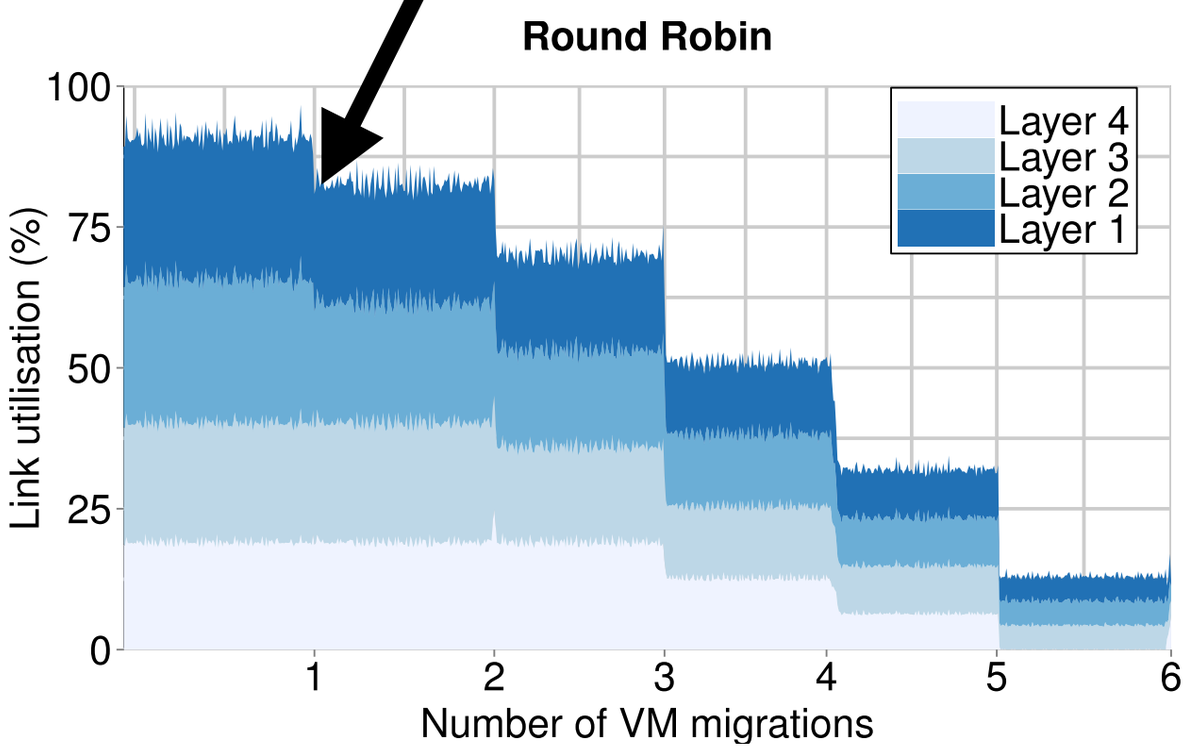
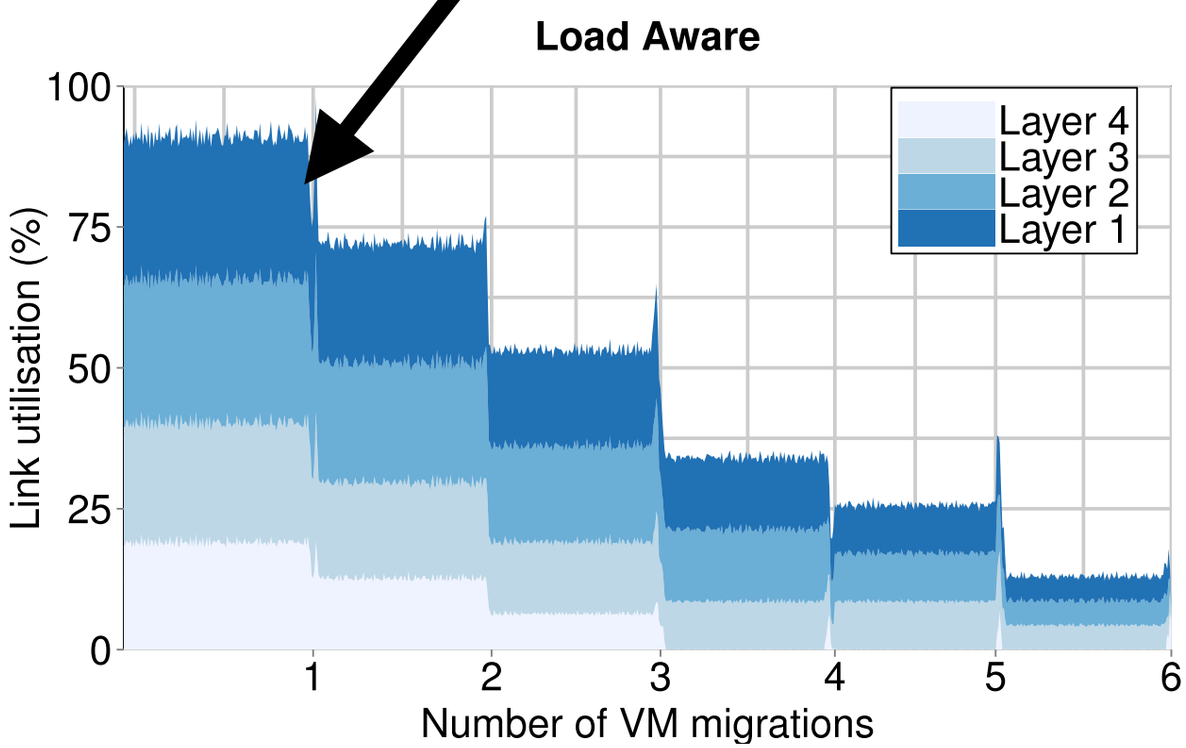
# Experimental Results

- Link utilisation

VM1 migrated from hv16 -> hv17

VM3 migrated from hv16 -> hv23



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# Experimental Results

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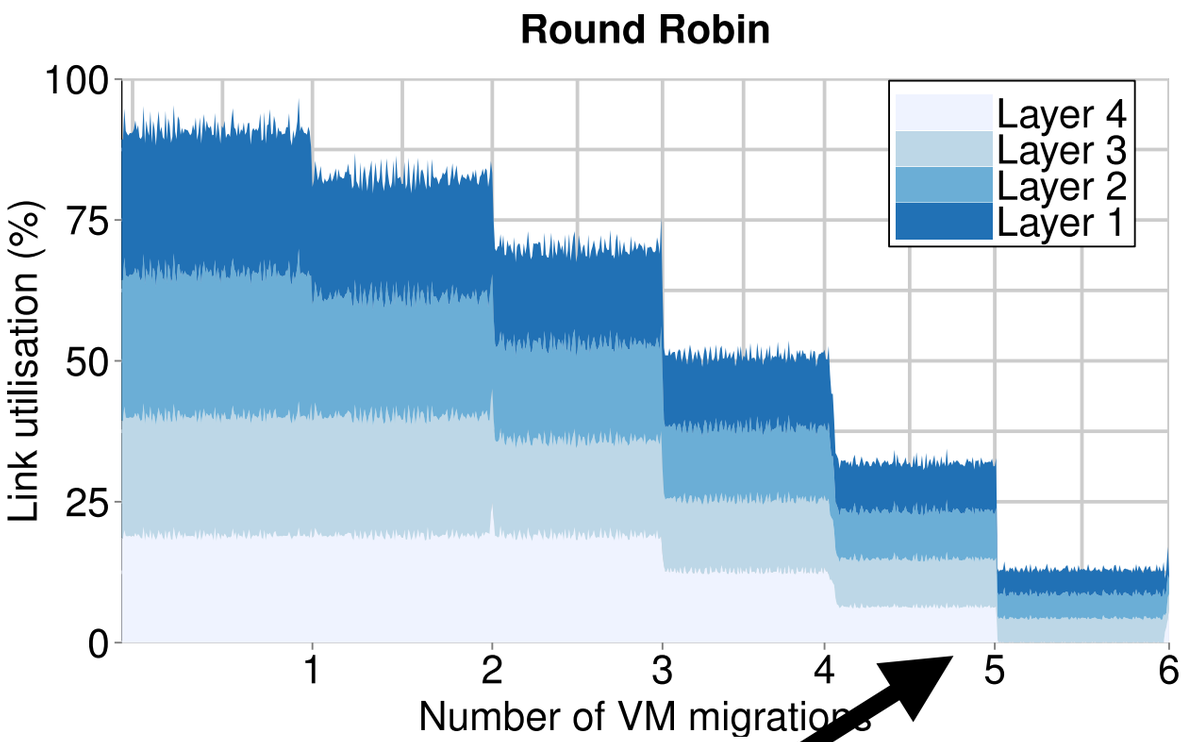
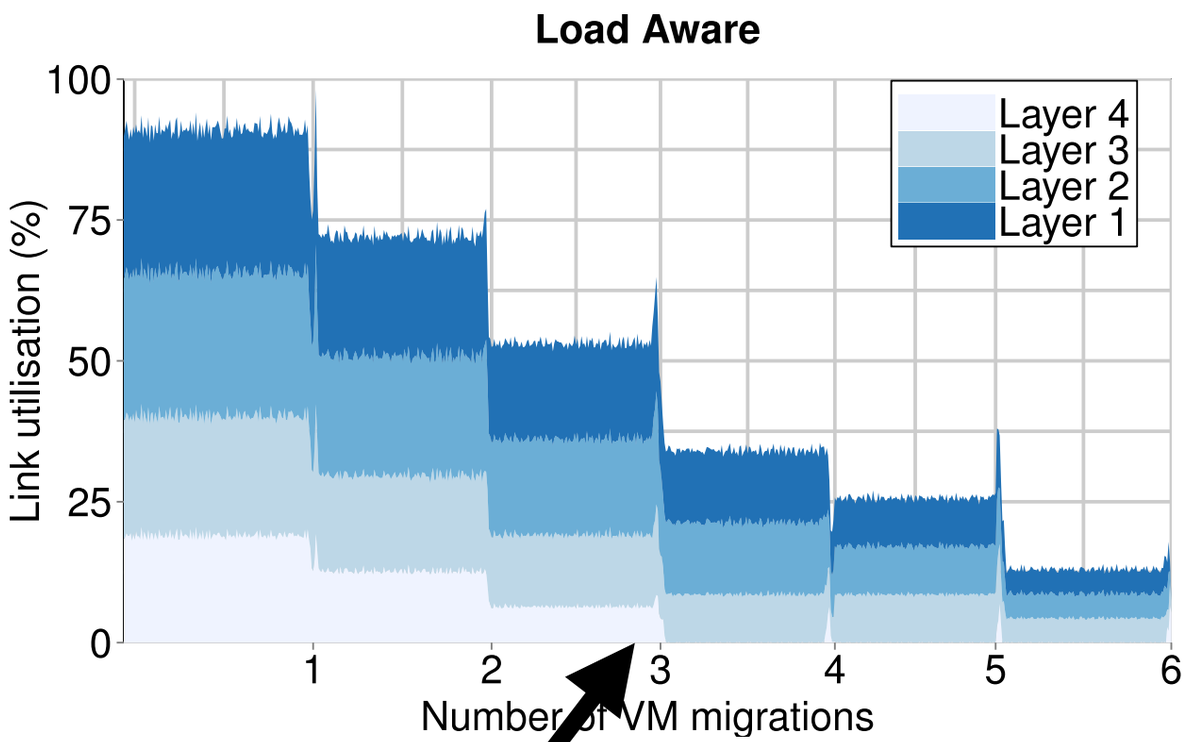


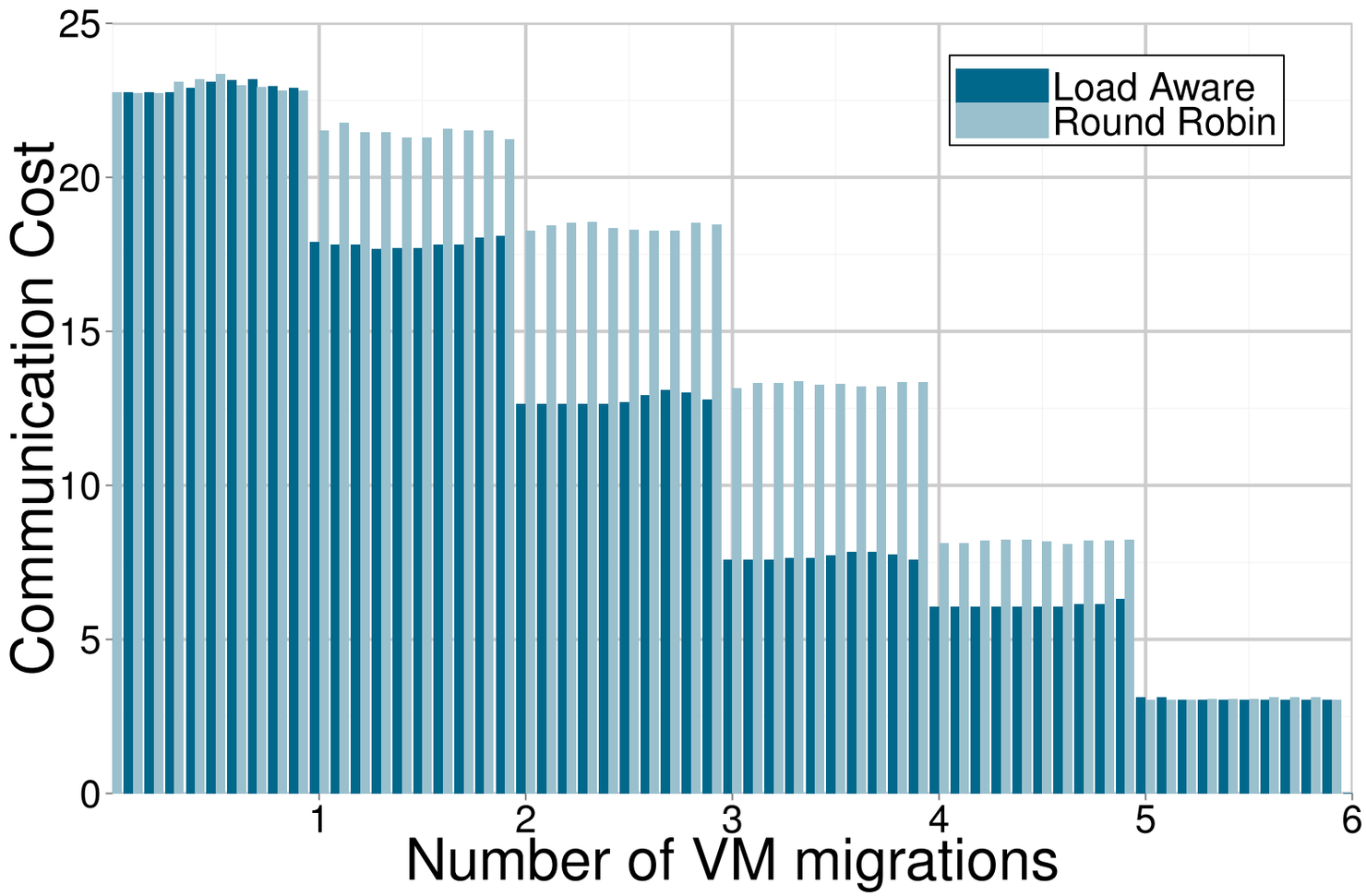

still uses the core layer




end of core layer use

# Experimental Results

- Overall communication cost



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# Future work

- Larger, more realistic experiments with OpenStack and OpenDaylight
- Dynamic traffic generation between VMs
- Stability improvements of the migration

# Conclusion

- we presented a converged control plane that integrates server and network resource management

- SDN was used to calculate communication cost for each VM and we reallocate them to minimise the cost

# Thank you
# for your attention


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