

Server-Storage Virtualization: Integration and Load Balancing in Data Centers

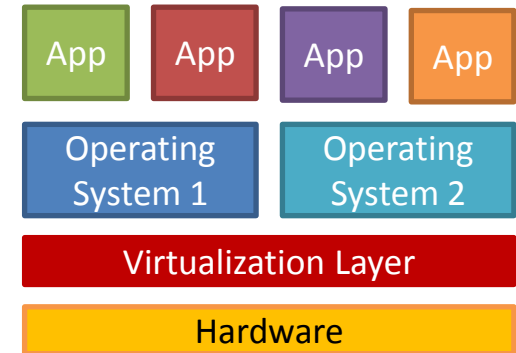
Aameek Singh et al.

Presented by Sangwhan Moon

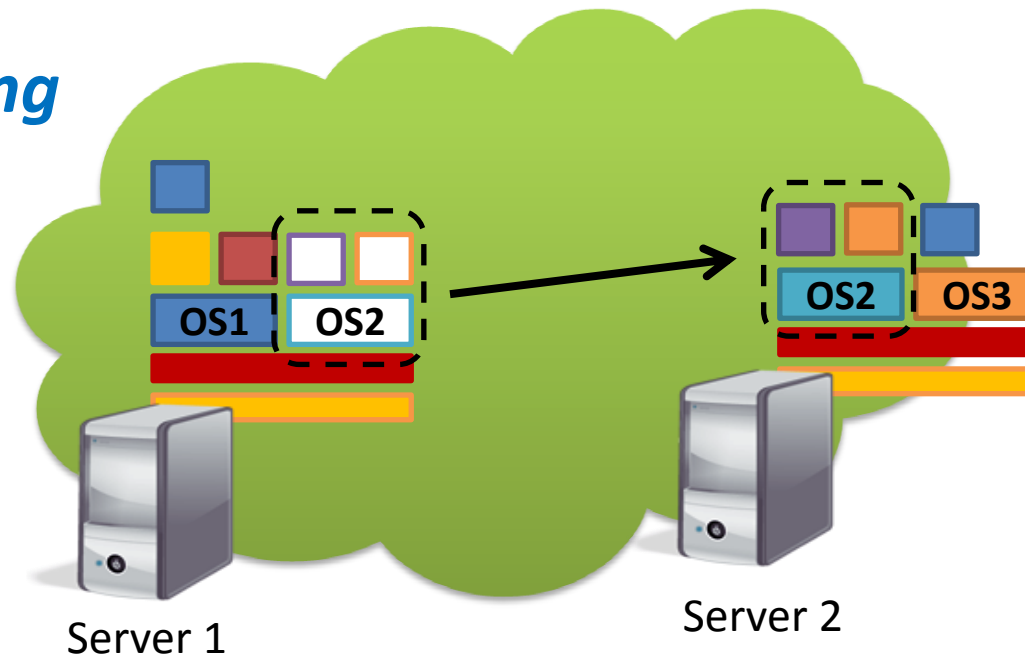
12/01/2010

Introduction (1/2)

- Server Virtualization
 - VMware, Xen
 - OSs Share Server HW
 - OS/Appl. Migration

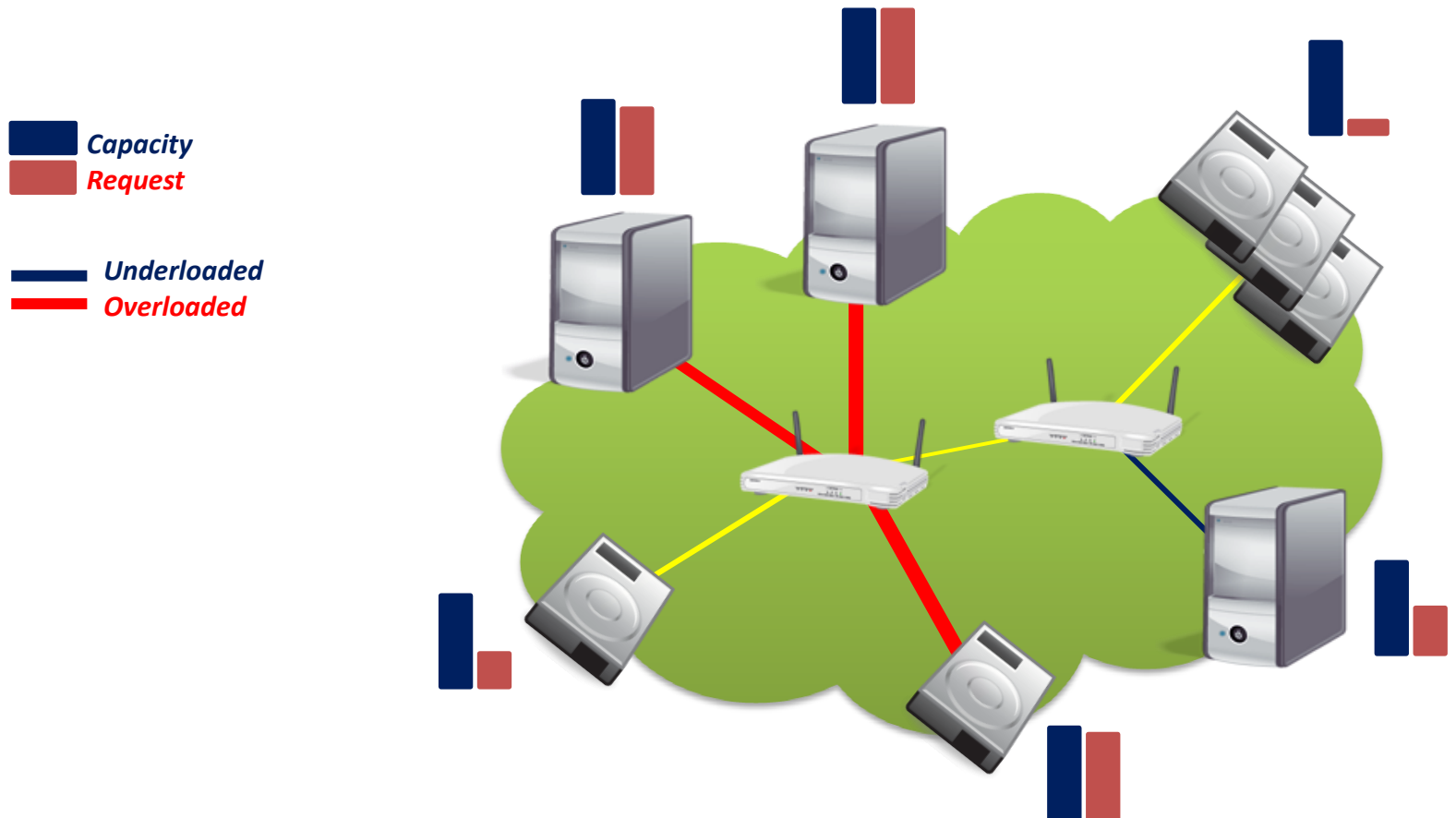


Load Balancing

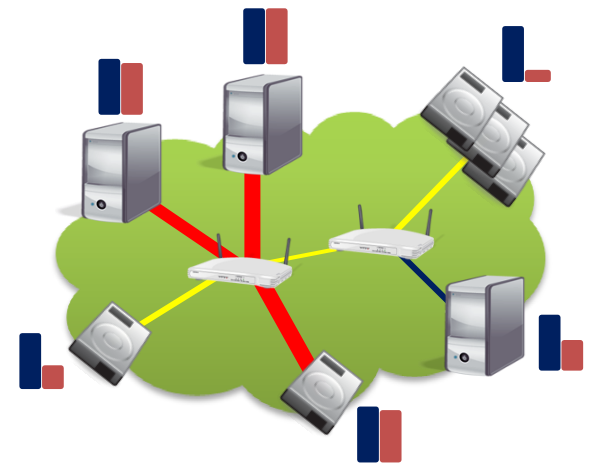
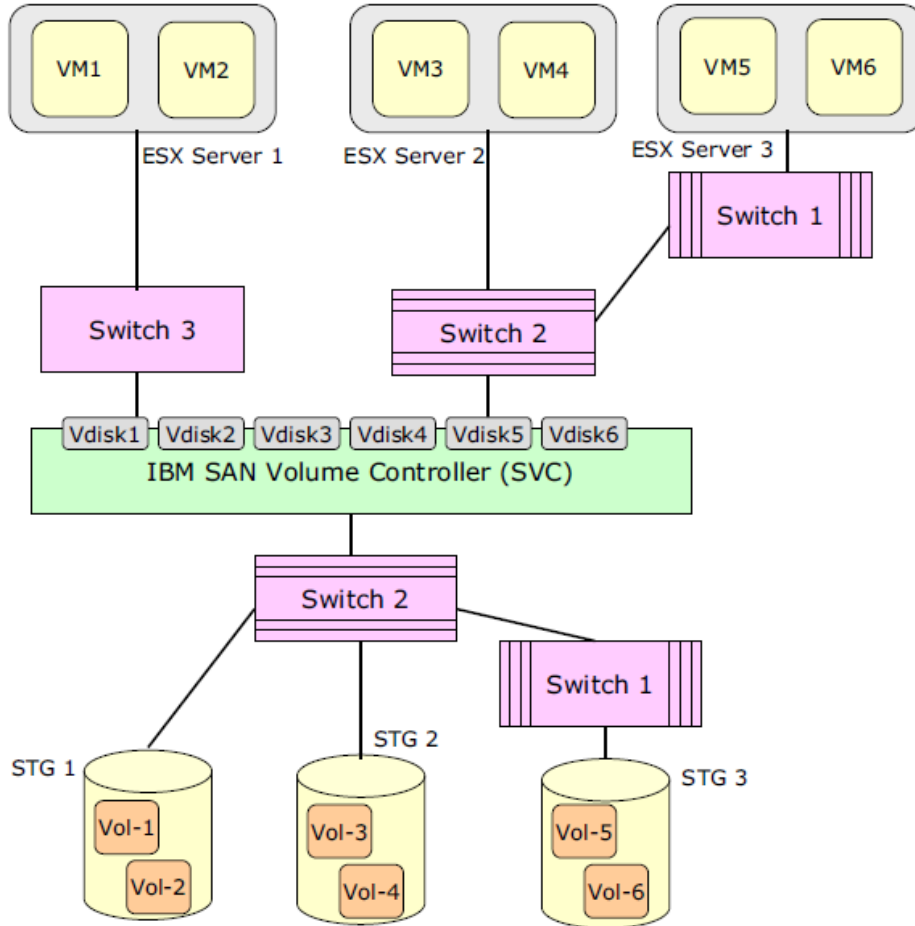


Introduction (2/2)

- Data Center (Server + Storage)
 - Efficient Resource Usage is required



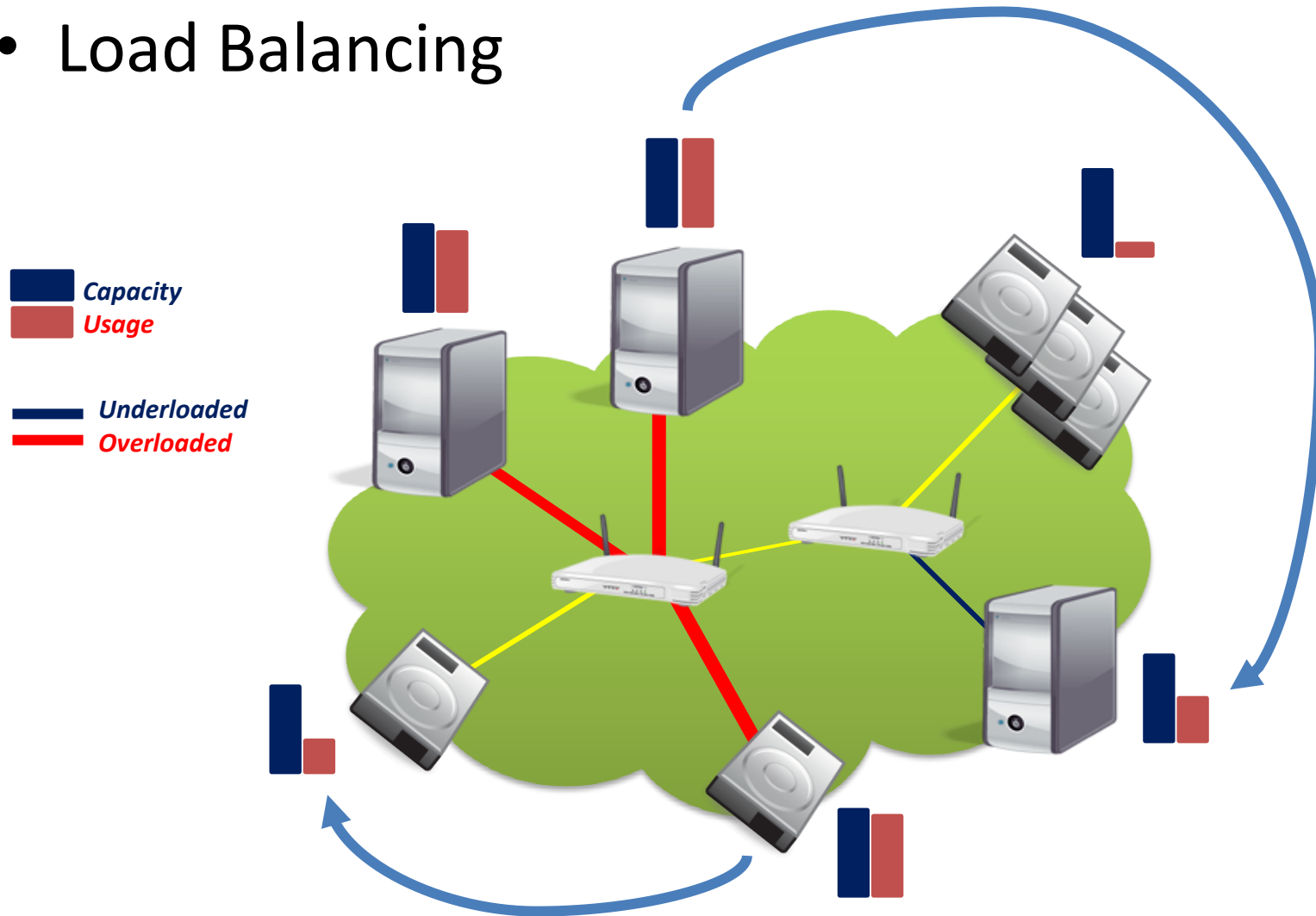
Harmony



HARMONY Testbed

VectorDot

- Load Balancing



Q&A

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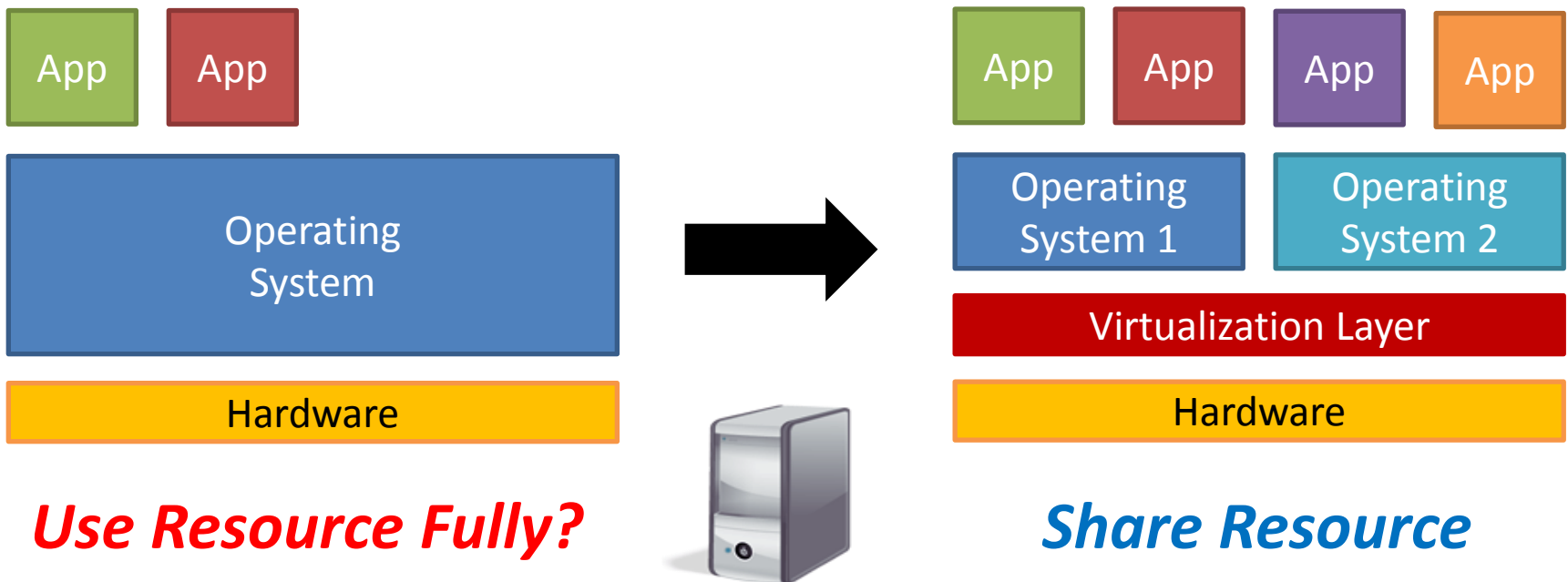
12/01/2010

Outline

- Introduction
- Overview
- Harmony
- VectorDot
- Evaluation
- Discussion

Introduction (1/5)

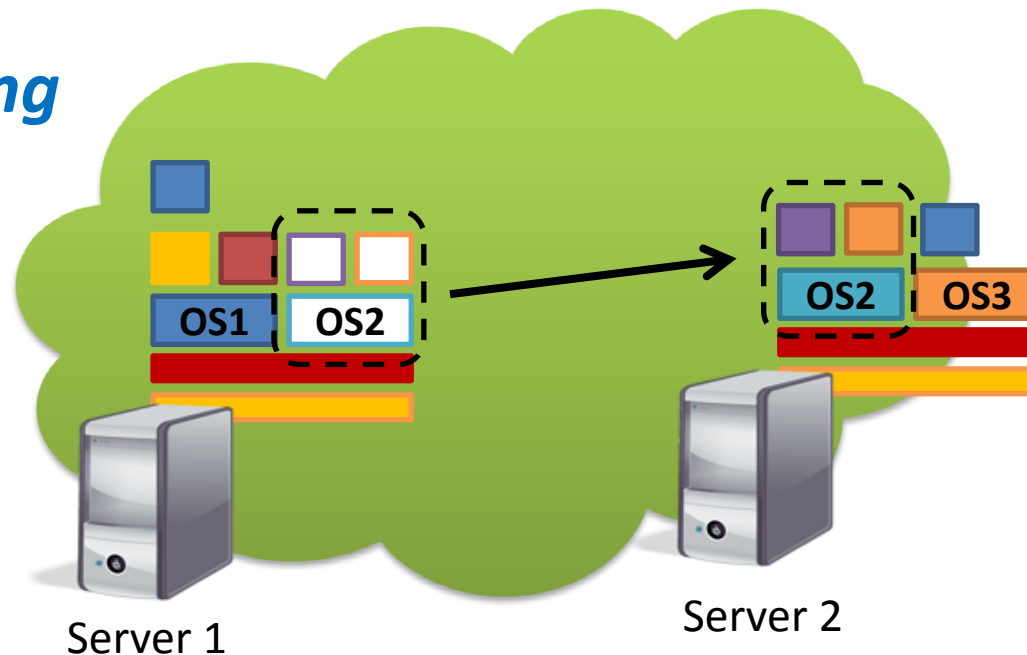
- Server Virtualization
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Introduction (2/5)

- Server Virtualization
 - VMware, Xen
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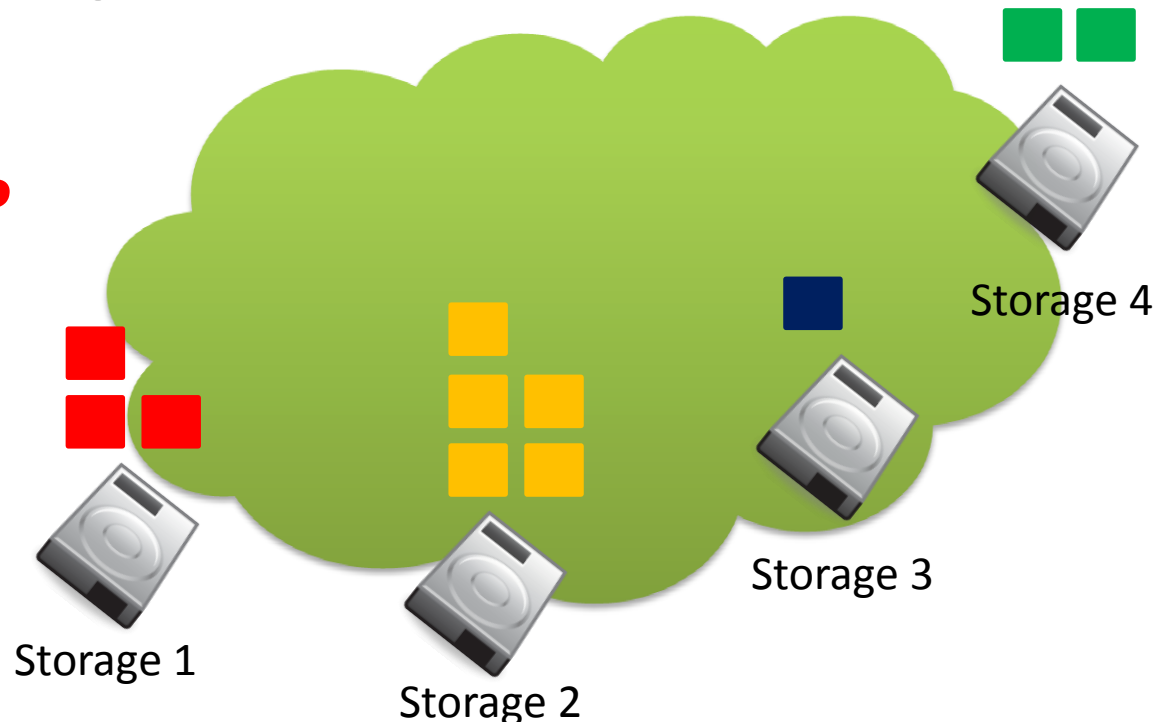
Load Balancing



Introduction (3/5)

- Storage Virtualization
 - IBM SAN Volume Controller (SVC), EMC Invista
 - Share Storage
 - Virtual Disk Migration

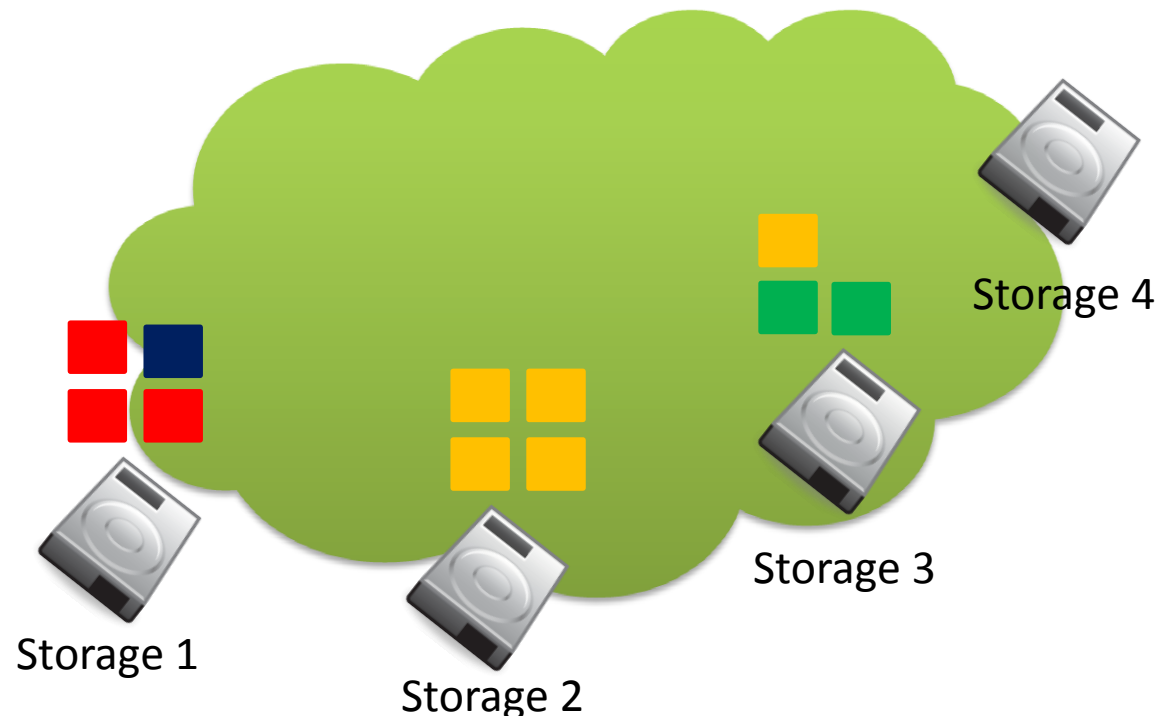
Use Resource Fully?



Introduction (4/5)

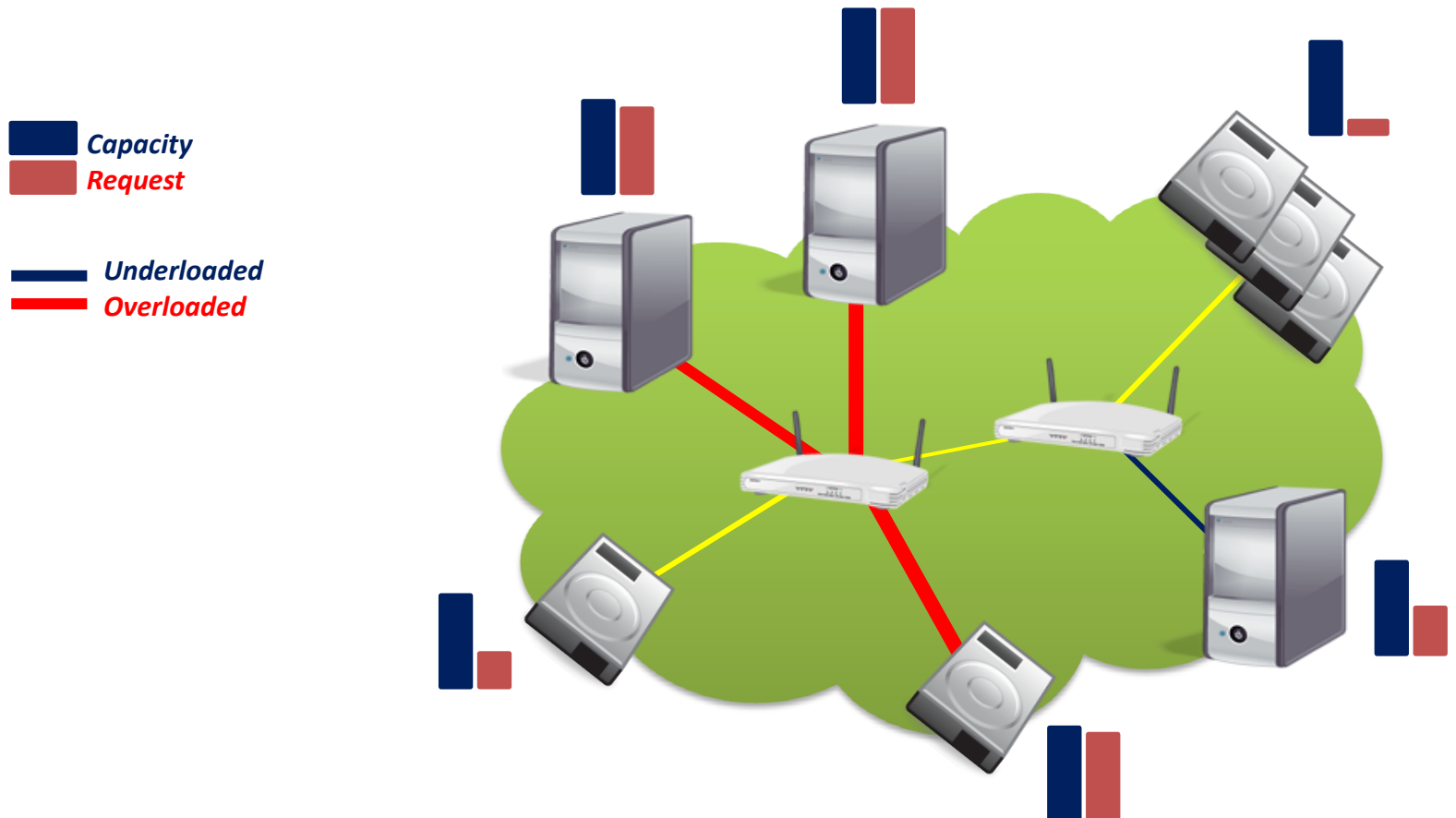
- Storage Virtualization
 - IBM SAN Volume Controller (SVC), EMC InVista
 - Share Storage
 - Virtual Disk Migration

Load Balancing Virtual Disk



Introduction (5/5)

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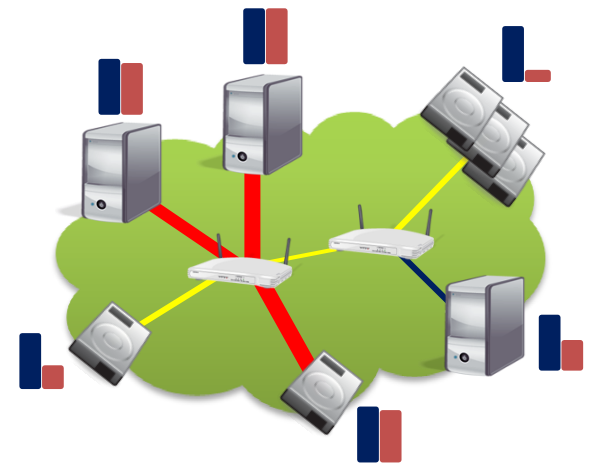
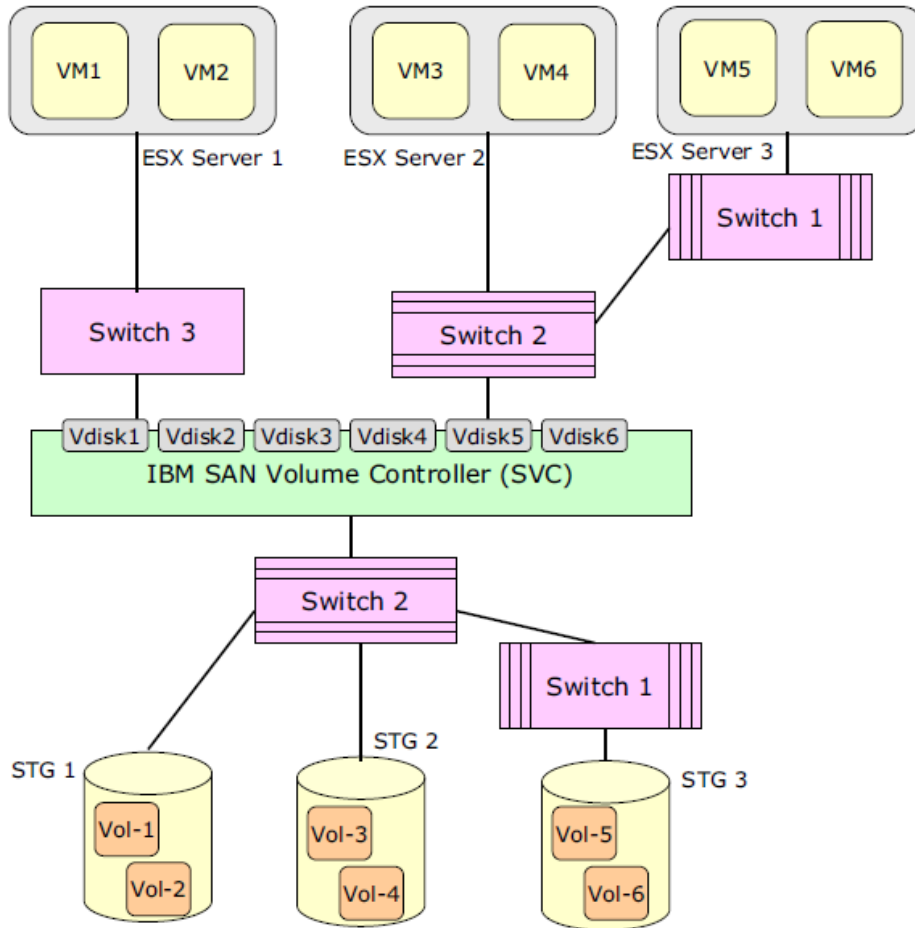


Integration of Server and Storage Virtualization
Load Balancing considering all resources at the same time

Overview

- Harmony (SYSTEM)
 - Integrated system of server and storage virtualization
 - Live-migration of VM and vDisk
- VectorDot (ALGORITHM)
 - Algorithm for load balancing
 - Consideration of multidimensionality and hierarchy constraints

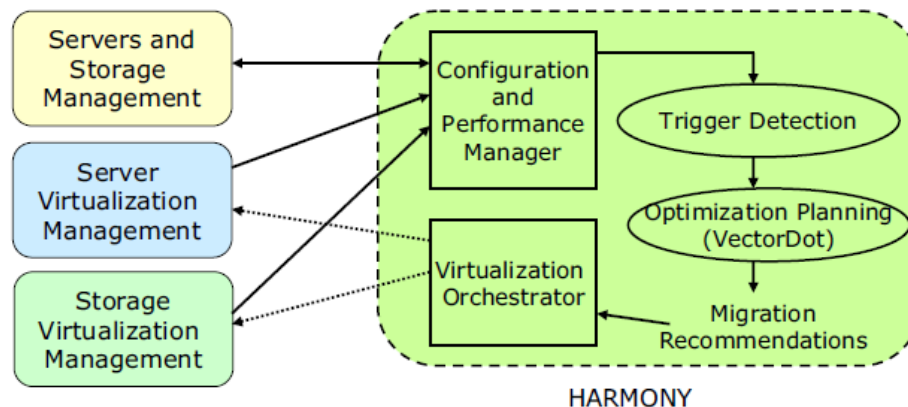
Harmony (1/2)



HARMONY Testbed

Harmony (2/2)

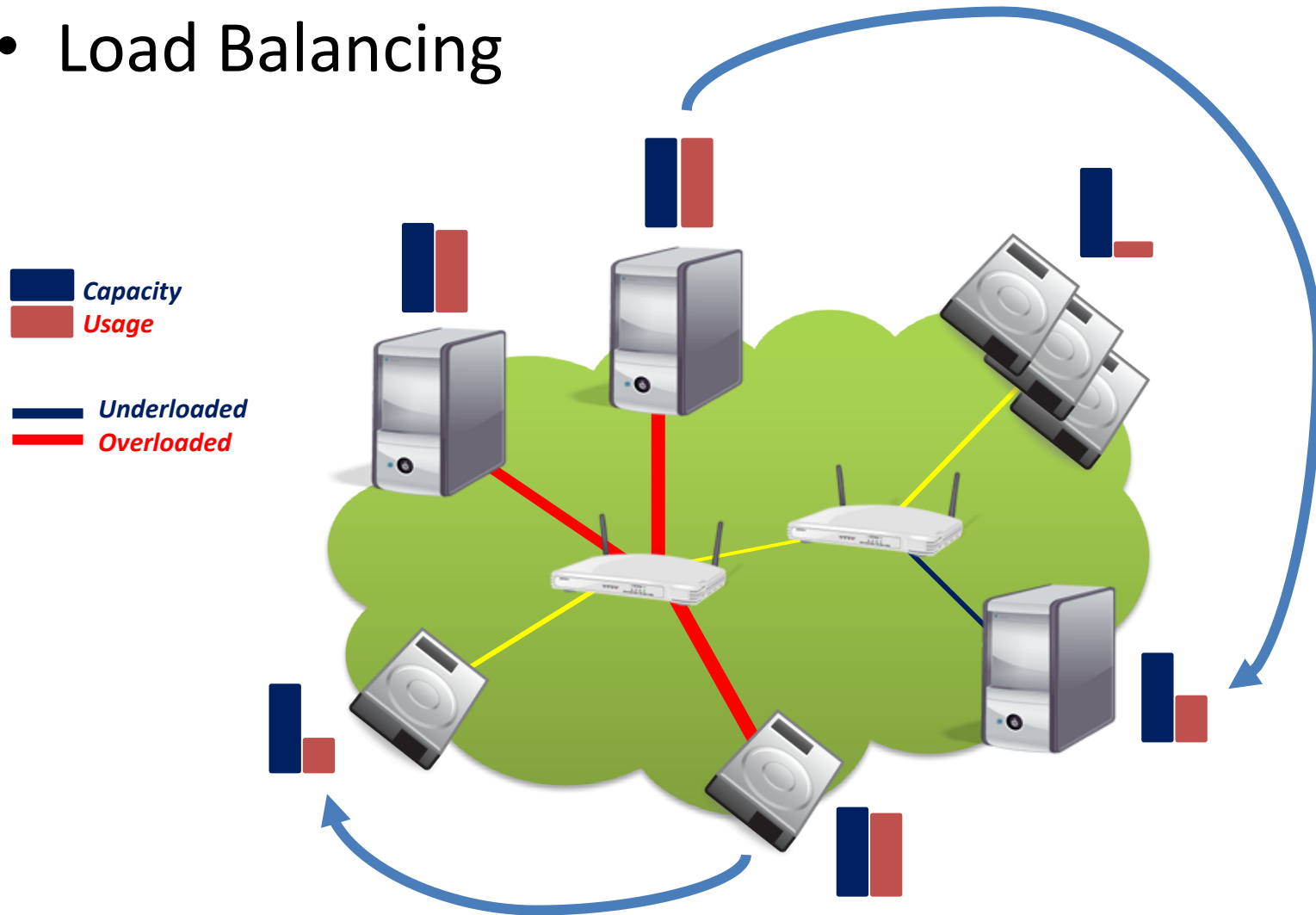
- Configuration and Performance Manager
 - Maintain topology
- Trigger Detection
- Optimization Planning
- Virtualization Orchestrator
 - Determine



HARMONY Architecture

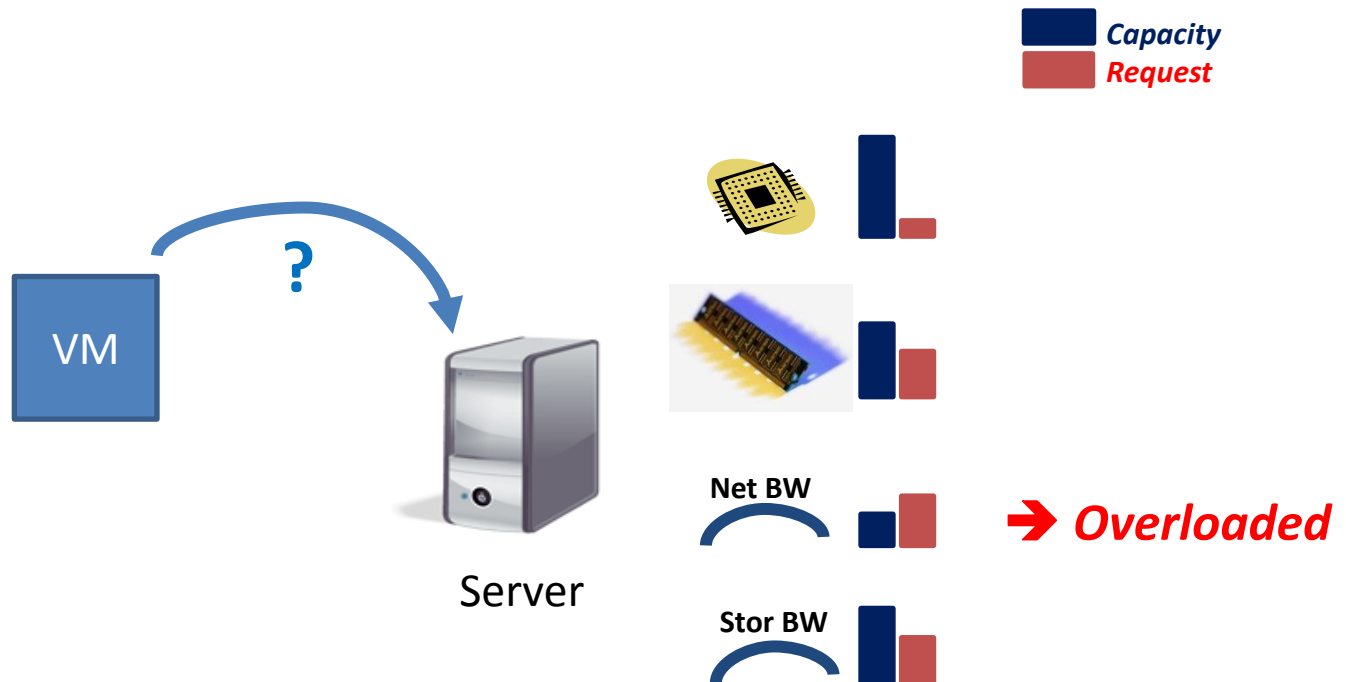
VectorDot (1/6)

- Load Balancing



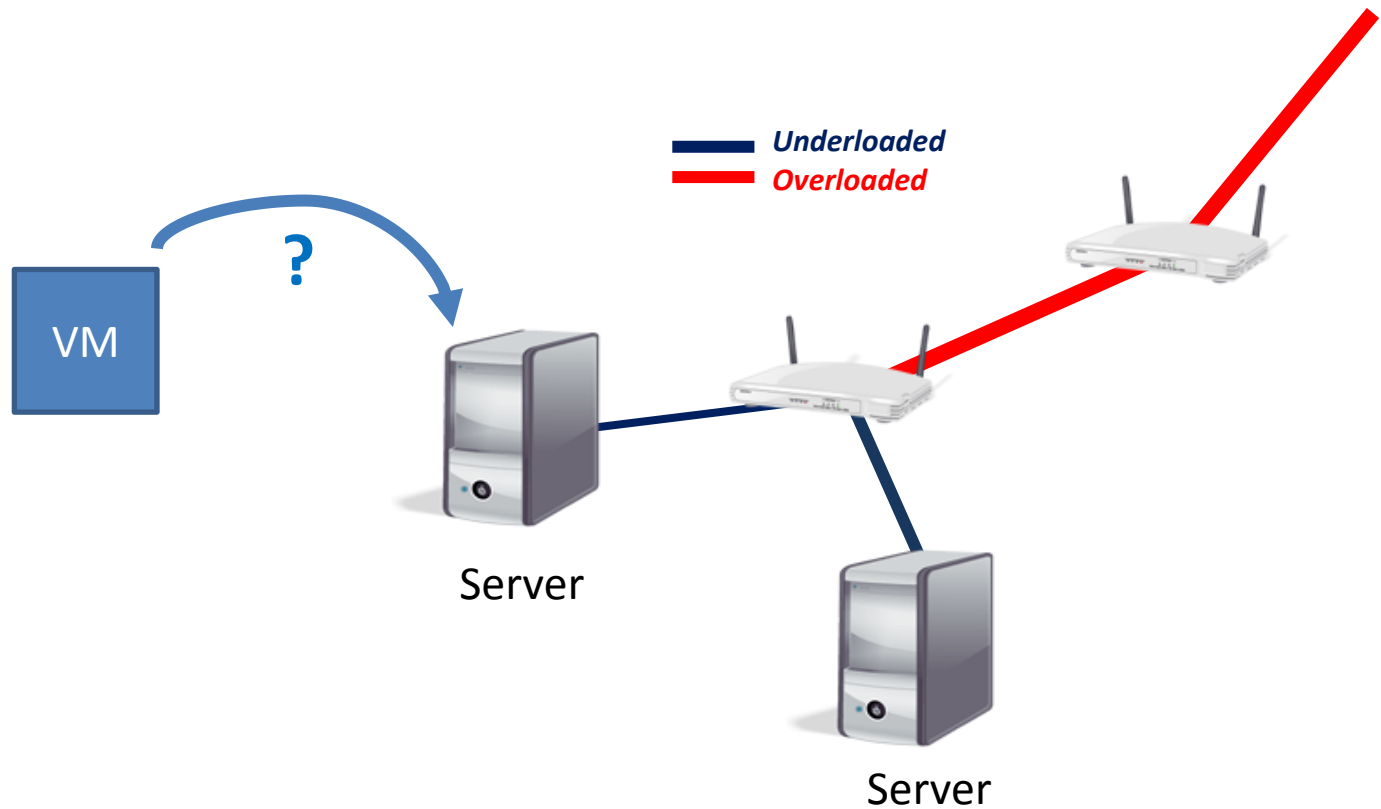
VectorDot (2/6)

- Multidimensionality



VectorDot (3/6)

- FlowPath, Hierarchy Constraints

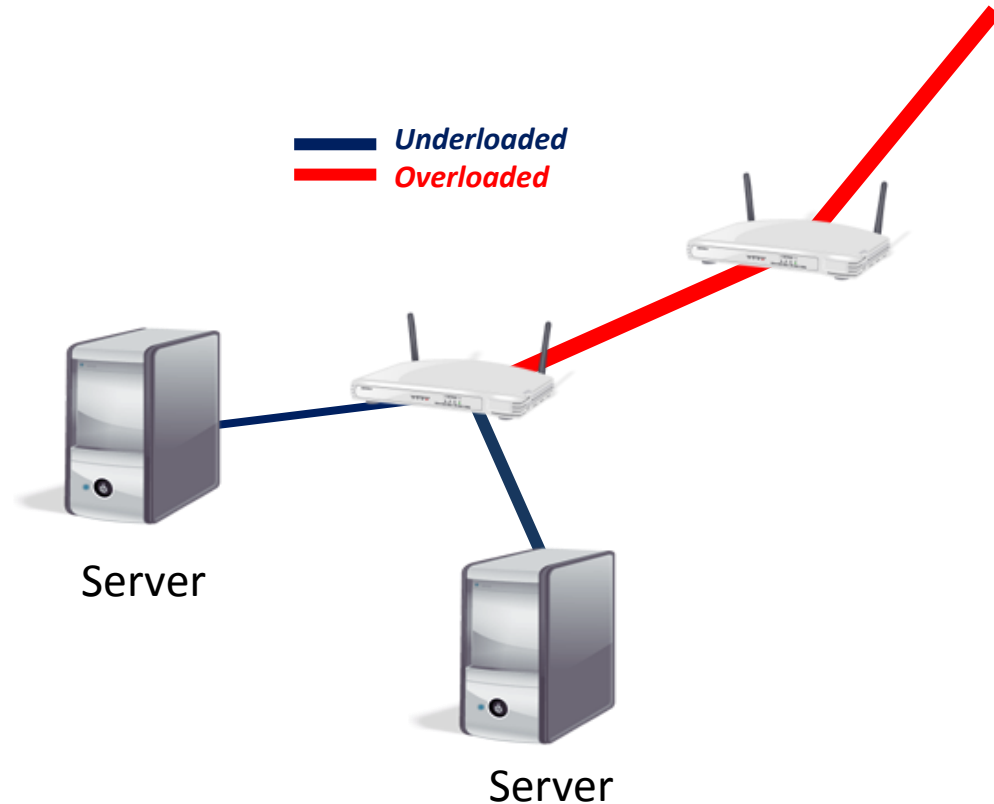
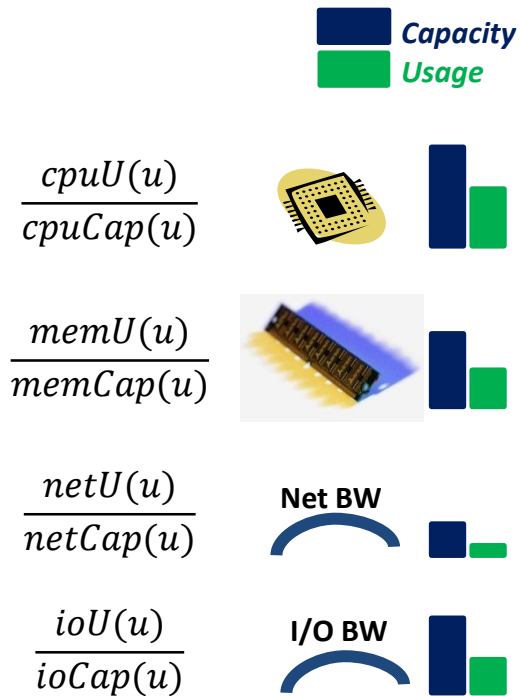


VectorDot (4/6)

$$f(u) = \left\langle \frac{cpuU(u)}{cpuCap(u)}, \frac{memU(u)}{memCap(u)}, \frac{netU(u)}{netCap(u)}, \frac{ioU(u)}{ioCap(u)} \right\rangle$$

$$T(u) = \langle cpuT(u), memT(u), netT(u), ioT(u) \rangle$$

$$IBscore(u) = \begin{cases} 0 & \text{if } f < T(u) \\ e^{(f(u)-T(u))/T(u)} & \text{otherwise} \end{cases}$$

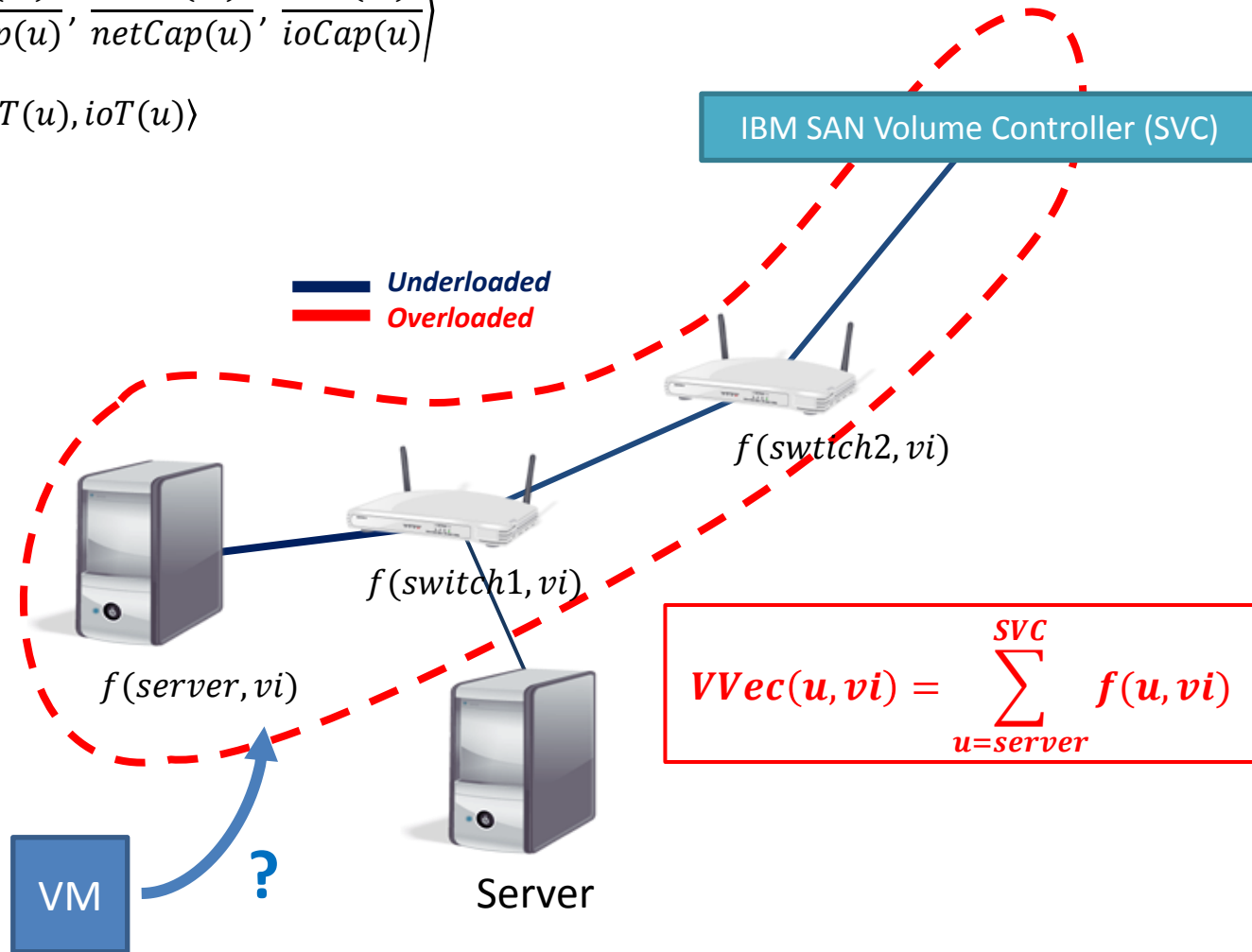
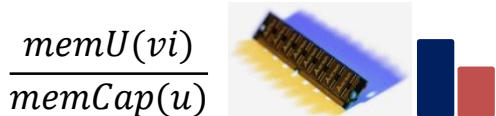
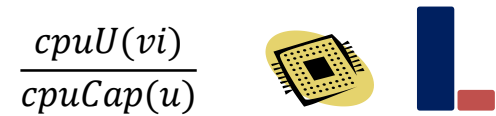


Estimate System as imbalanced if $\text{sum}(IBscore) > \text{Threshold}$

VectorDot (5/6)

$$f(u, vi) = \left\langle \frac{cpuU(vi)}{cpuCap(u)}, \frac{memU(vi)}{memCap(u)}, \frac{netU(vi)}{netCap(u)}, \frac{ioU(vi)}{ioCap(u)} \right\rangle$$

$$T(u) = \langle cpuT(u), memT(u), netT(u), ioT(u) \rangle$$



VectorDot (6/6)

- Extended Vector Product

$$EVP(u, vi) = IBscore(u) \cdot VVec(u, vi)$$

- Find a node to which system migrates VM(vi)

FirstFit(vi)

BestFit(vi)

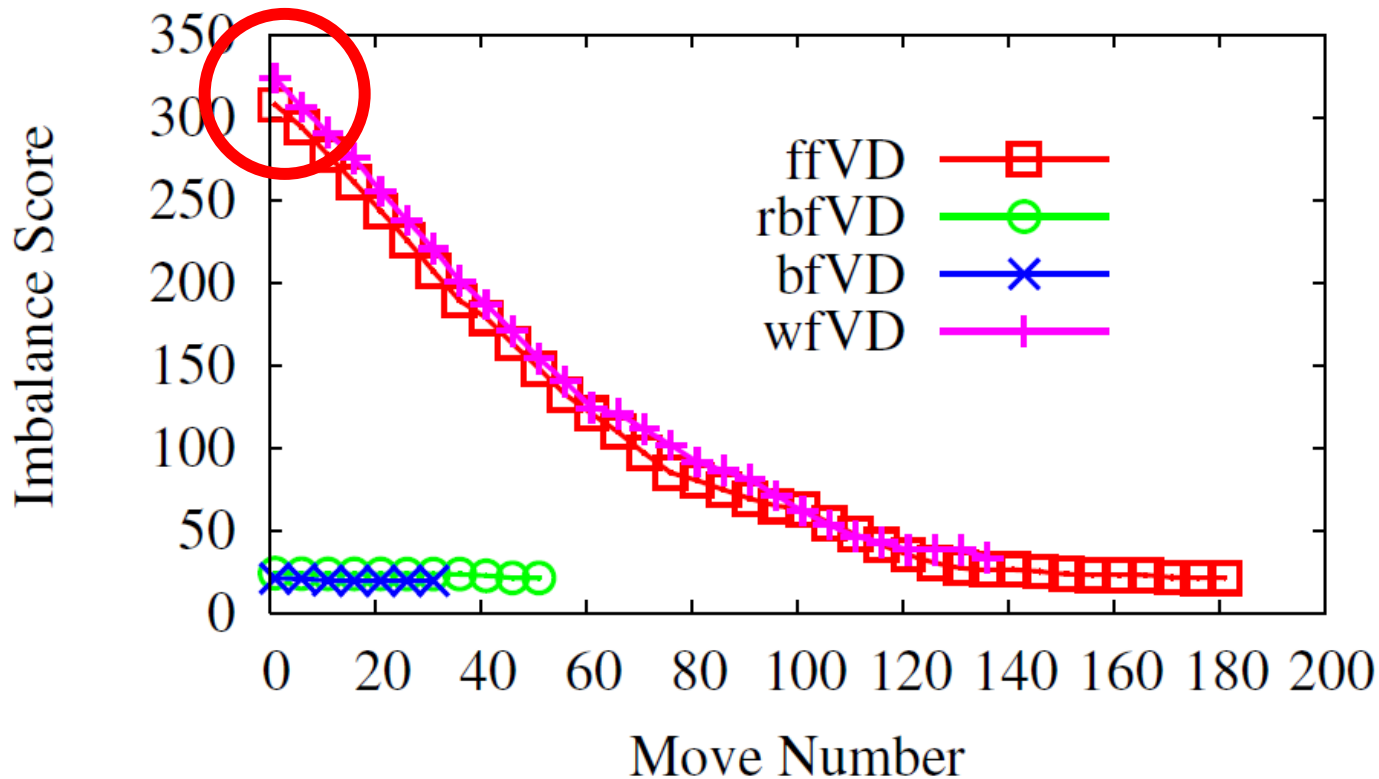
WorstFit(vi)

RelaxedBestFit(vi)

Evaluation (1/5)

- Imbalance Score of picked node by algorithms

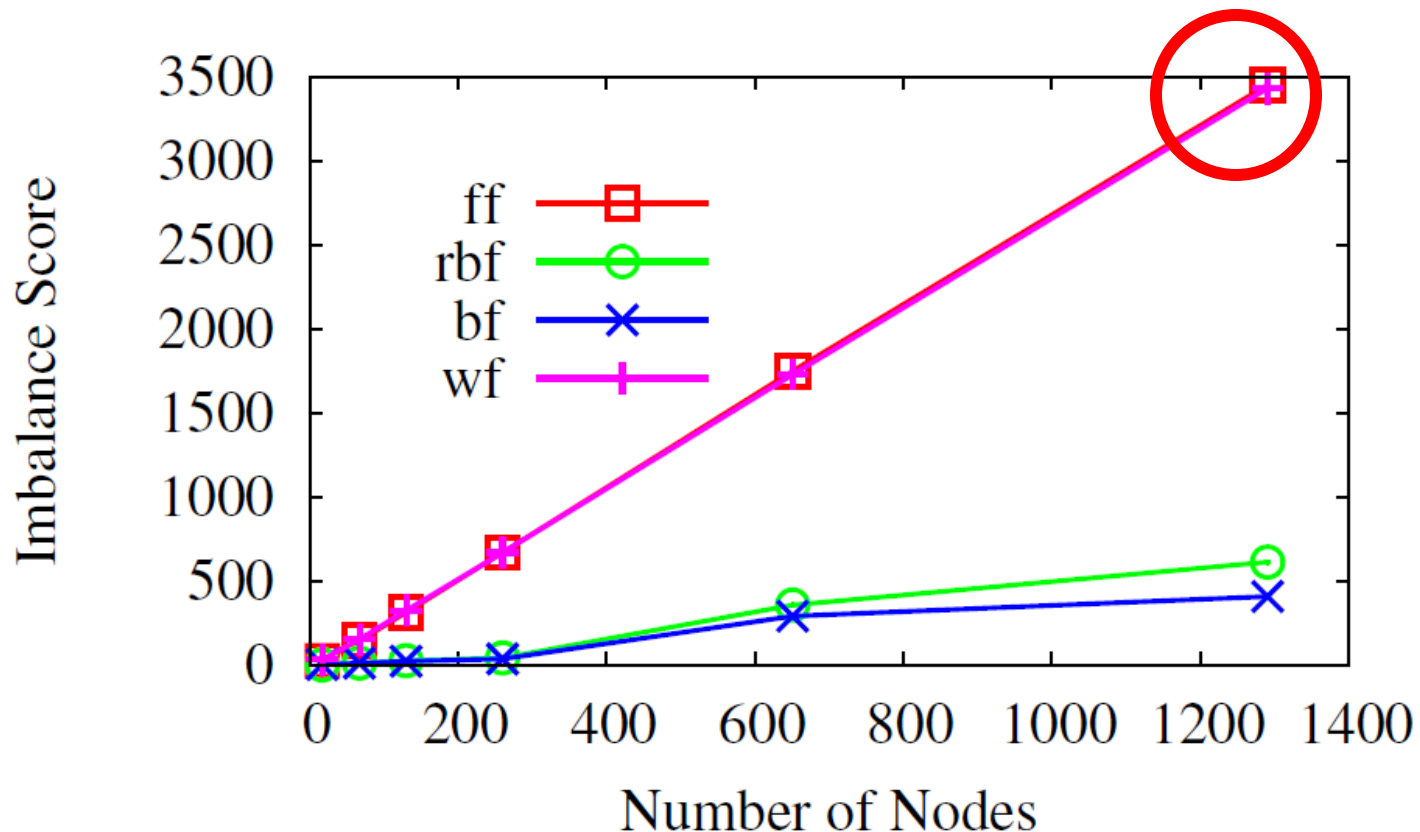
Pick a node with high Ibscore → migration has a little improvement



Evaluation (2/5)

- Imbalance Score of picked node by algorithms

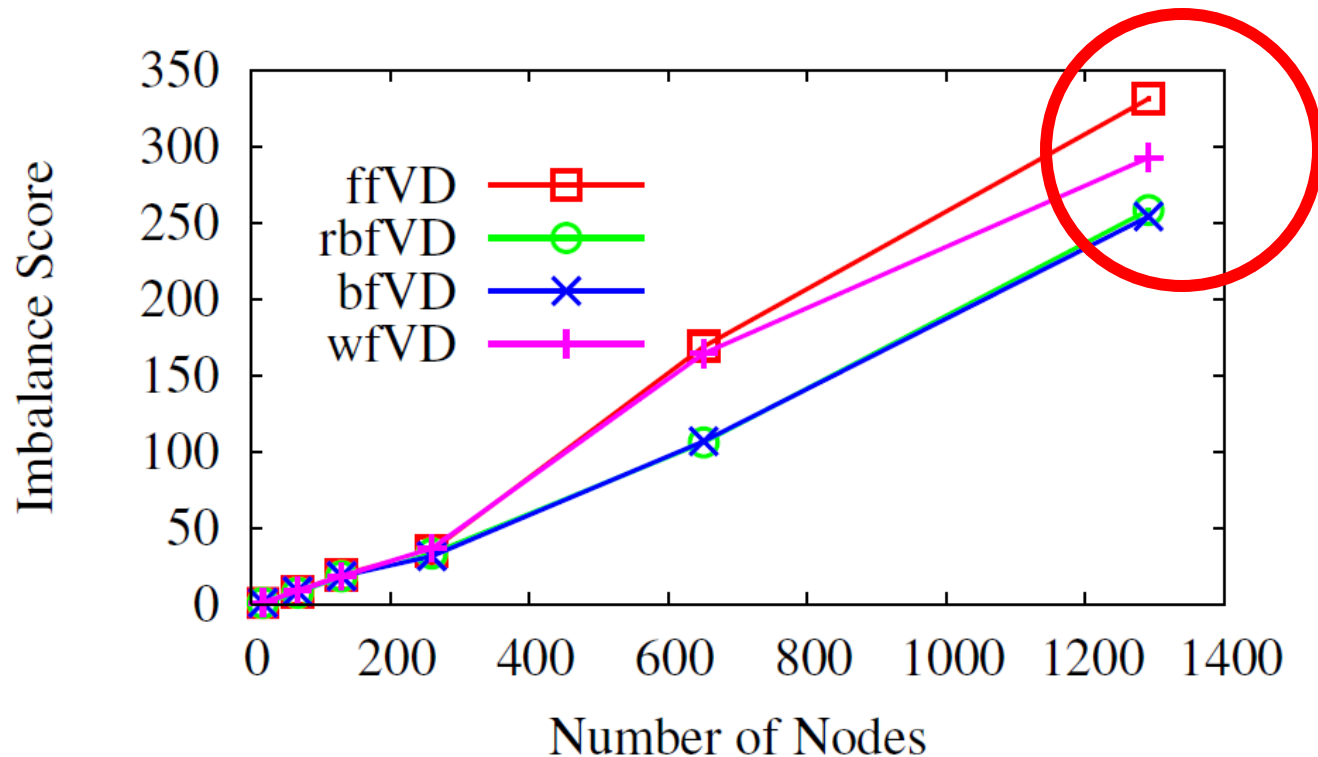
Pick a node with high lbscore → migration has a little improvement



Evaluation (3/5)

- IBscores after load-balancing

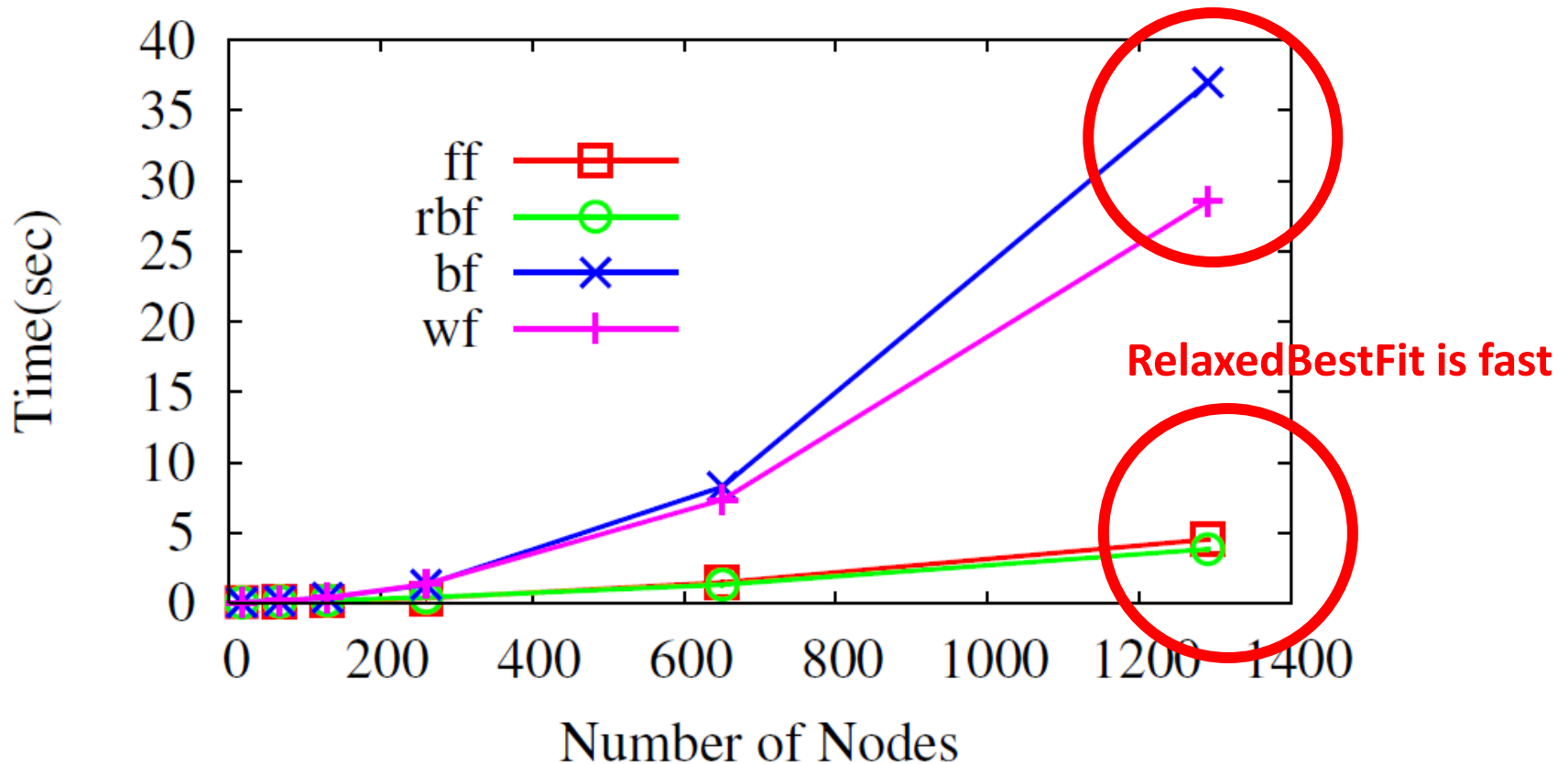
Still bfVD and rbfVD pick better one after load-balancing



Evaluation (4/5)

- Running time of each algorithms

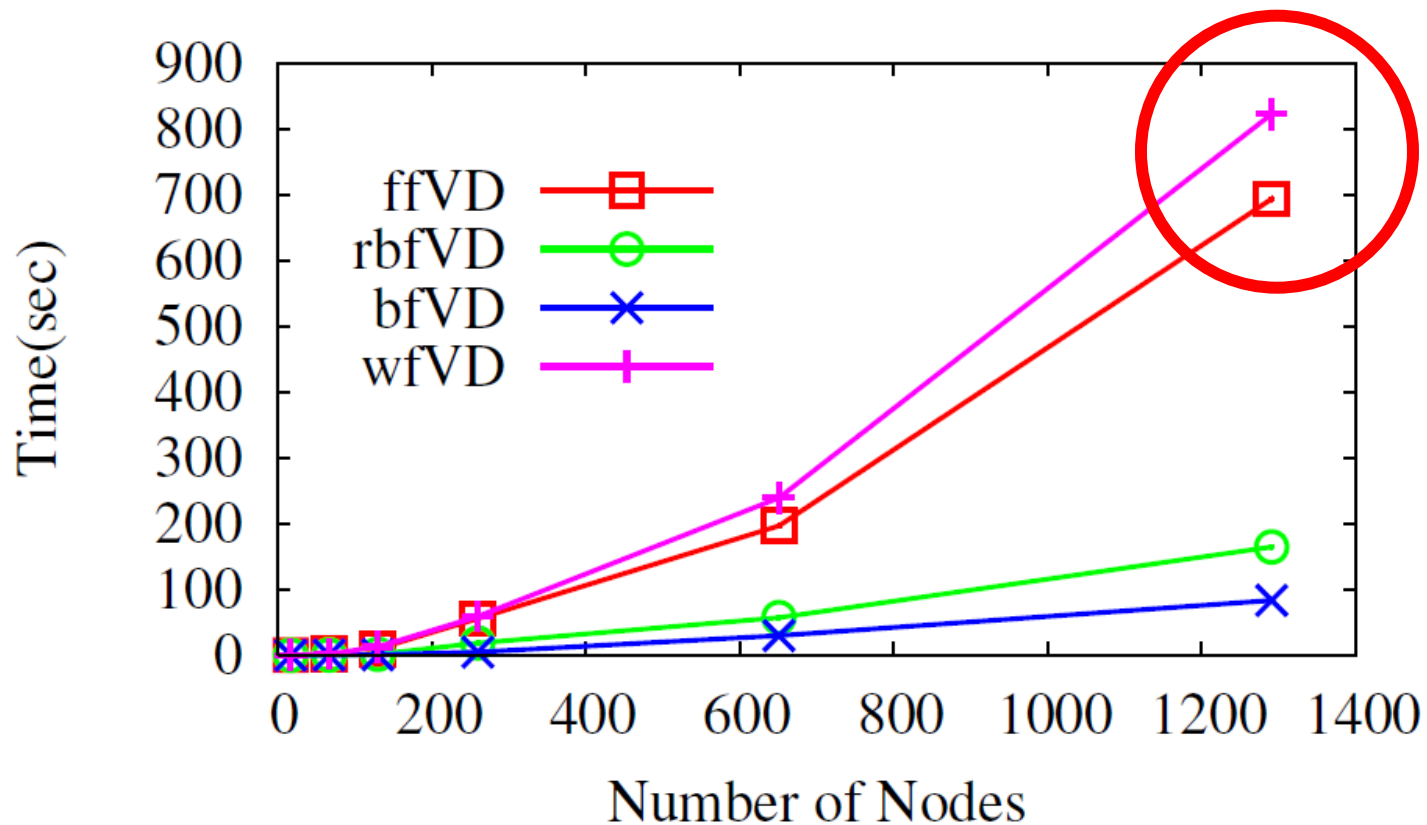
Take time to find a node using BestFit



Conclusion

- Running time of each algorithms
 - After load-balancing

FirstFit is worsened by load-imbalance



Conclusion

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Q&A