The Price of Specificity in the Age of Network Virtualization

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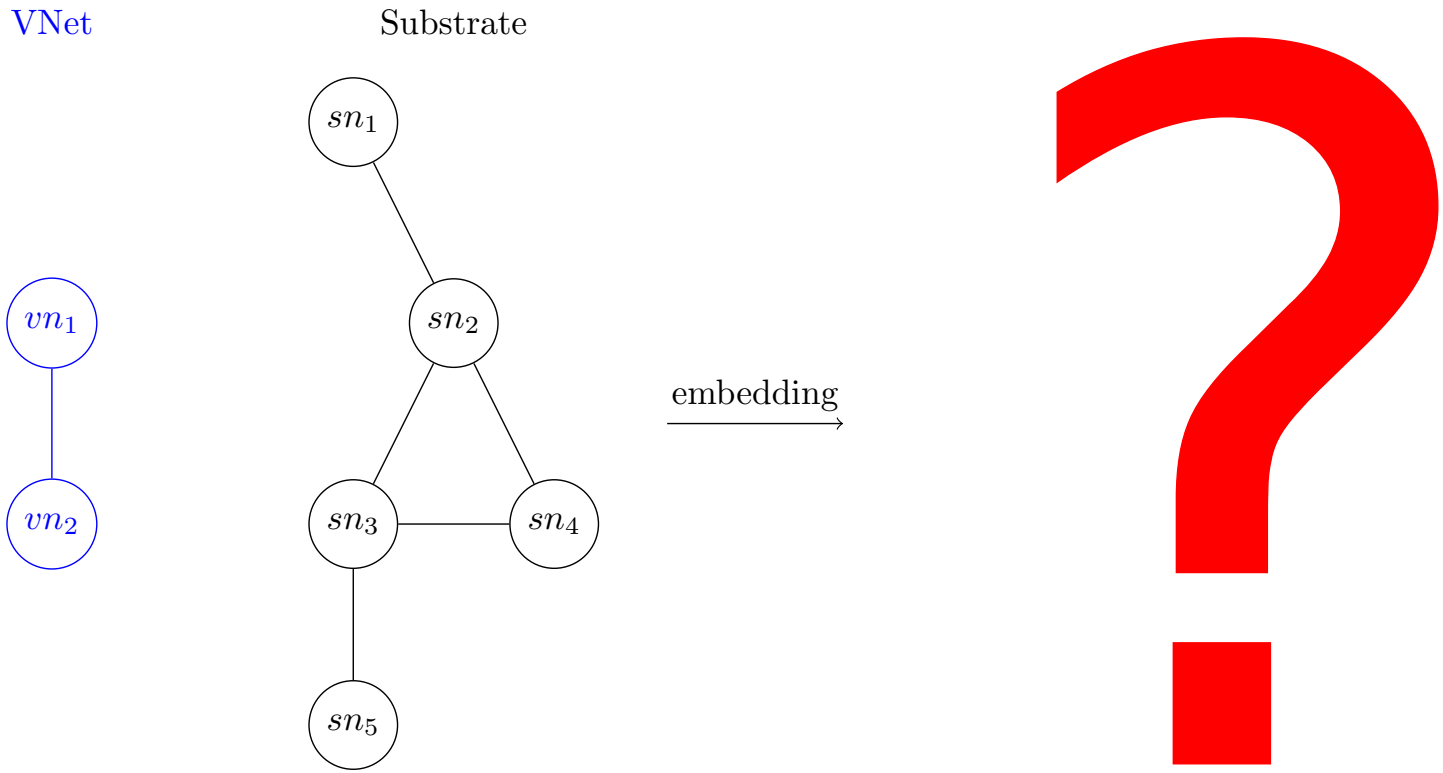
Motivation



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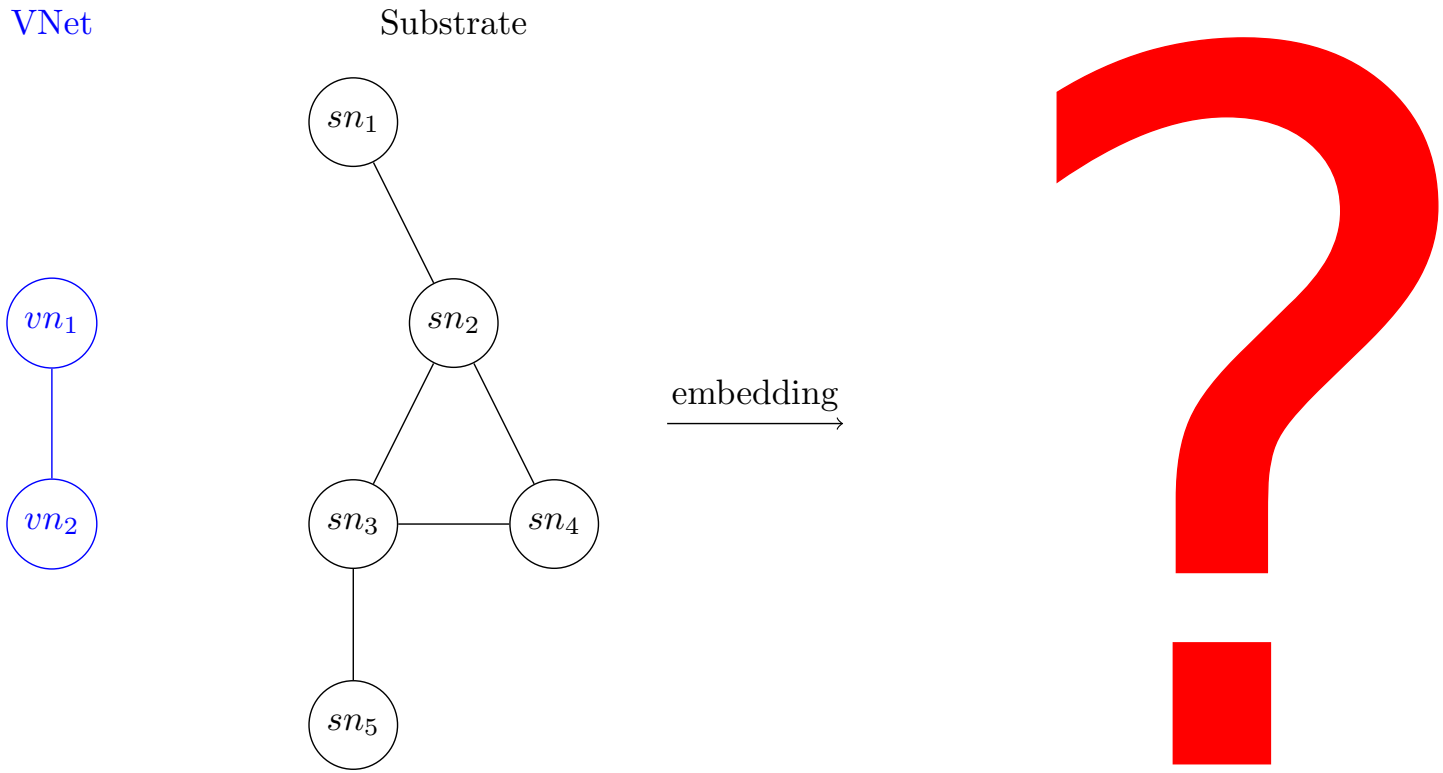

- offline / online
- heuristic approaches / optimal solutions

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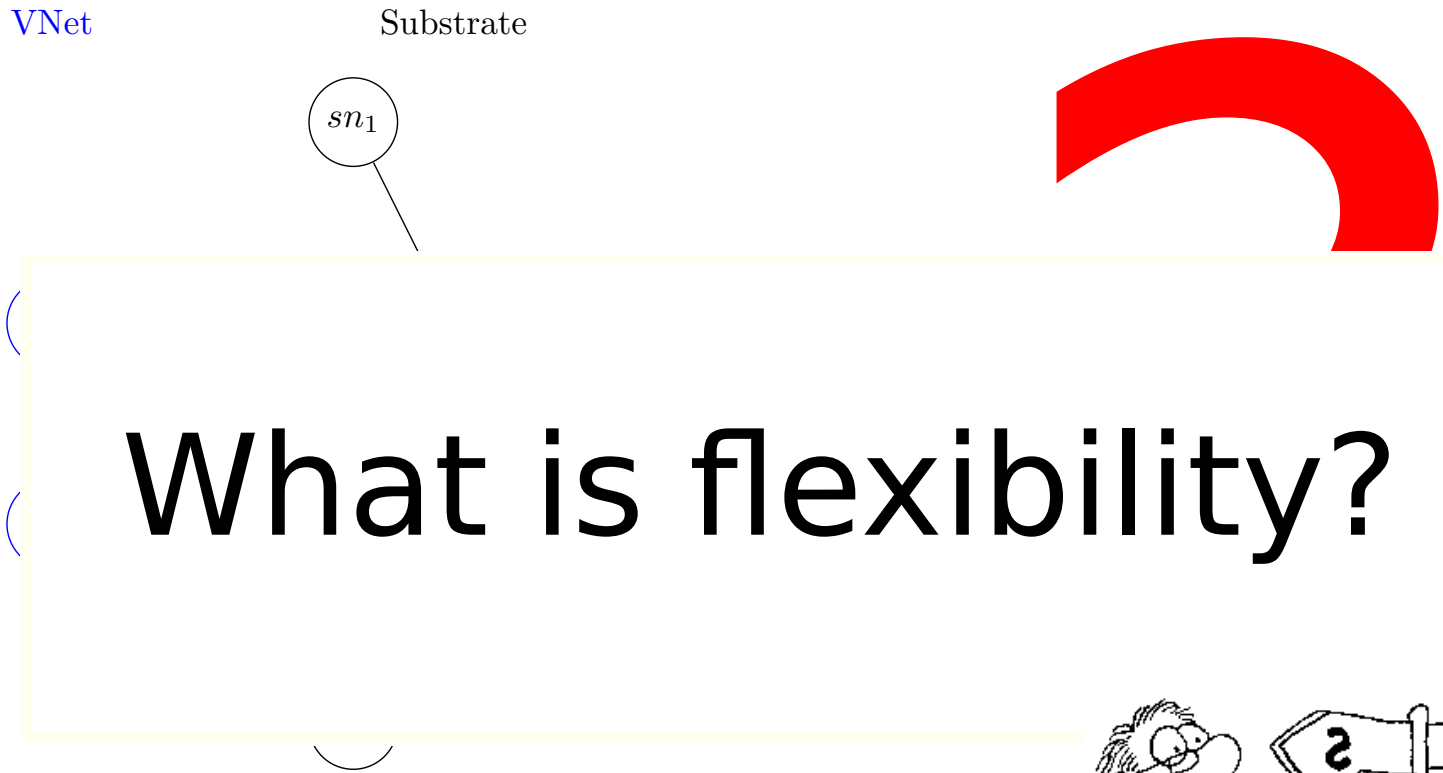
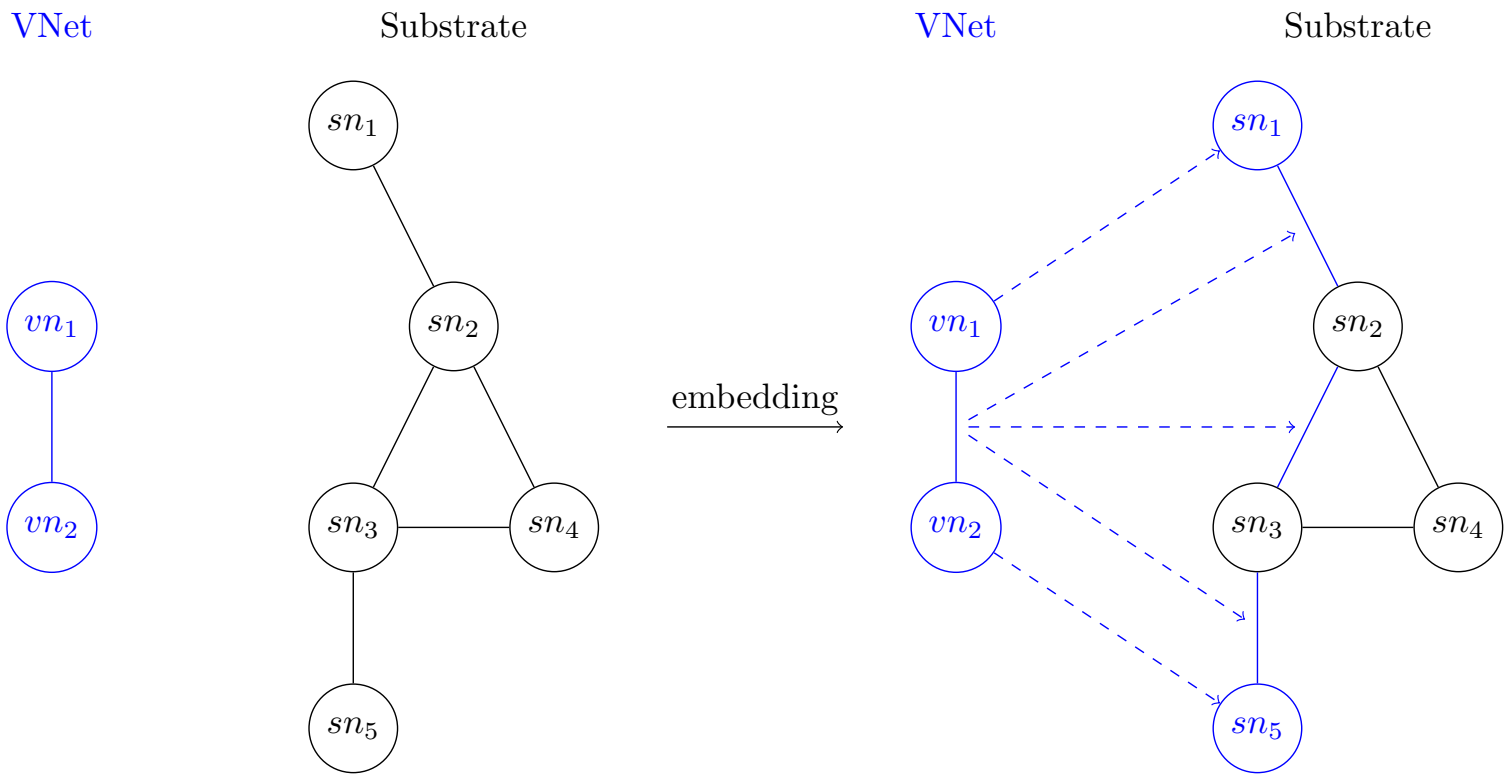


What is flexibility?

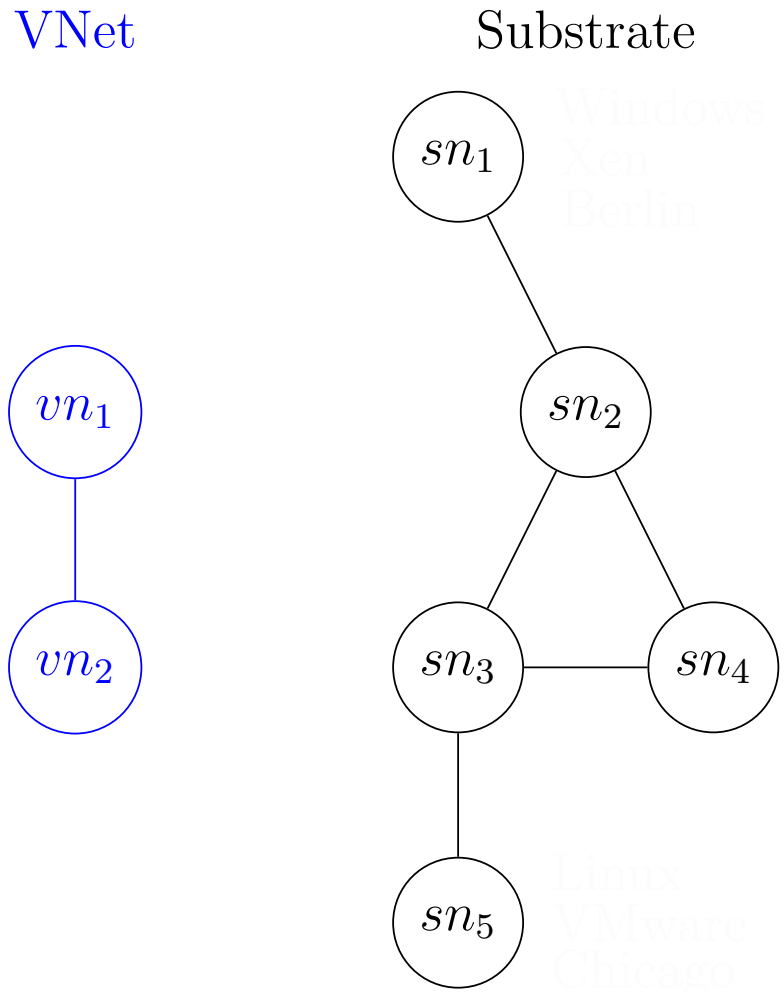
- offline / online
- heuristic approaches / optimal solutions

Embedding example



What is flexibility?

Properties



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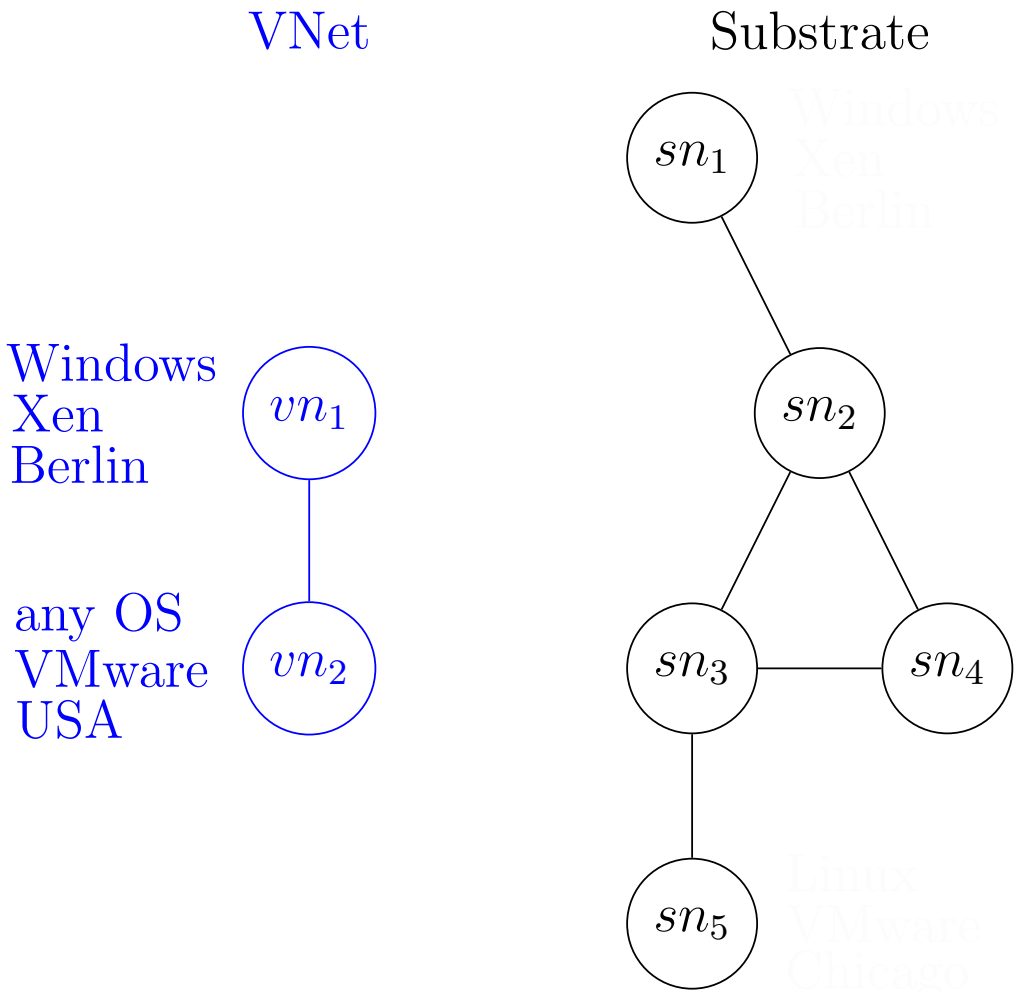
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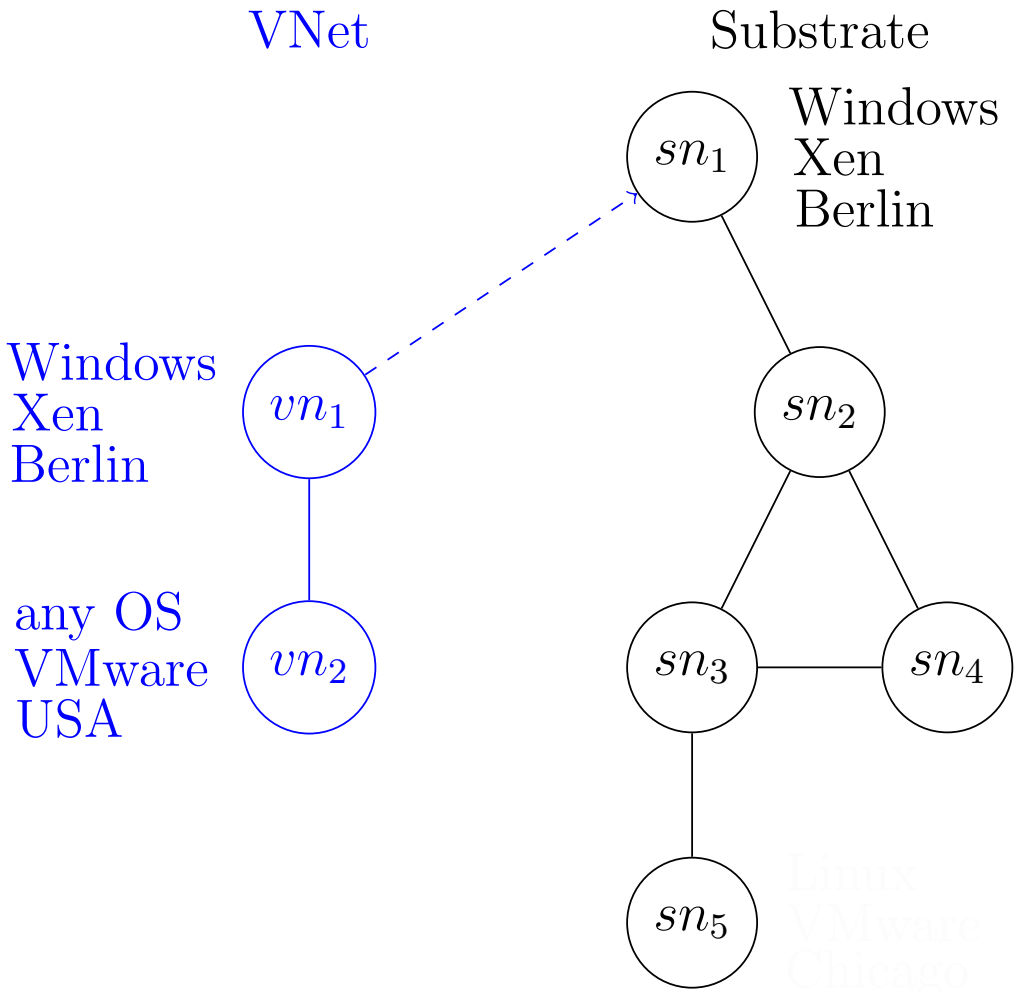
Substrate
Windows
Xen
Berlin
vn_1
any OS
VMware
USA
vn_2
sn_1
sn_2
sn_3
sn_4
sn_5
Windows
Xen
Berlin
Linux
VMware
Chicago

Properties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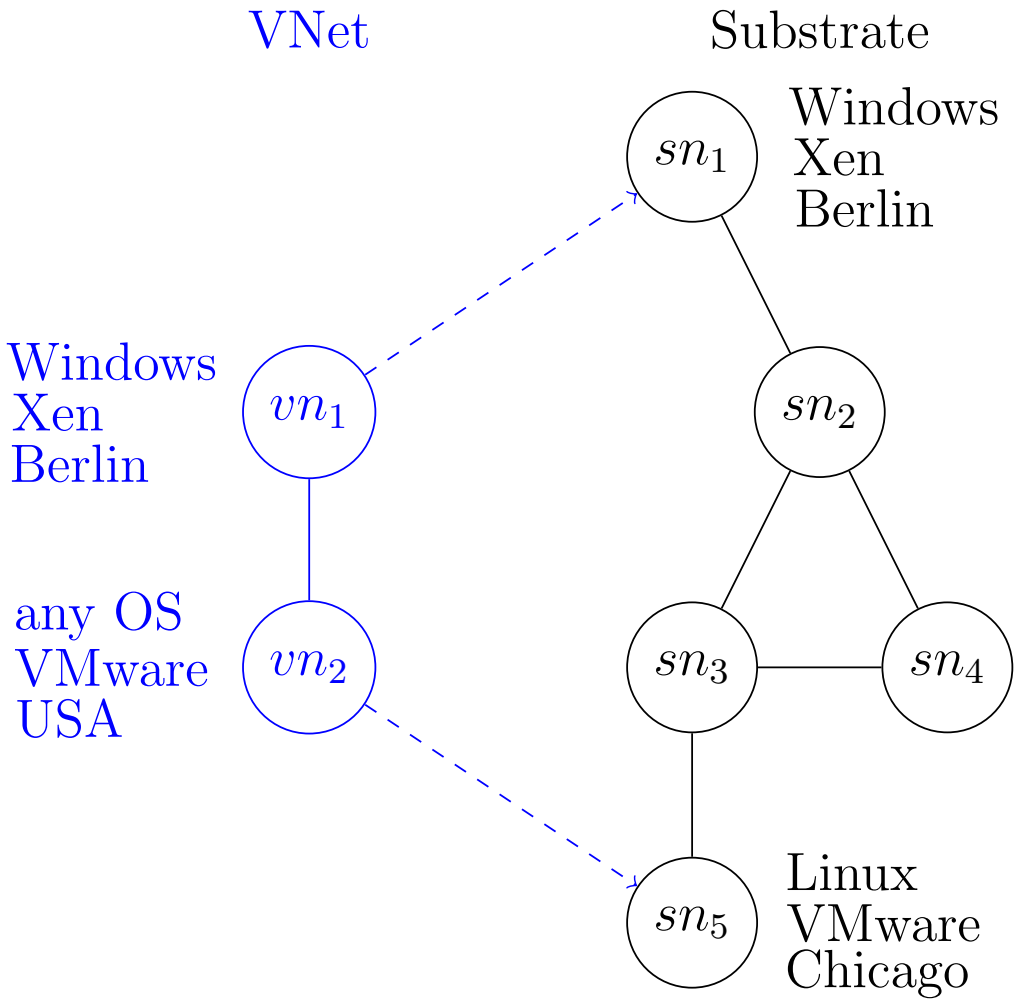
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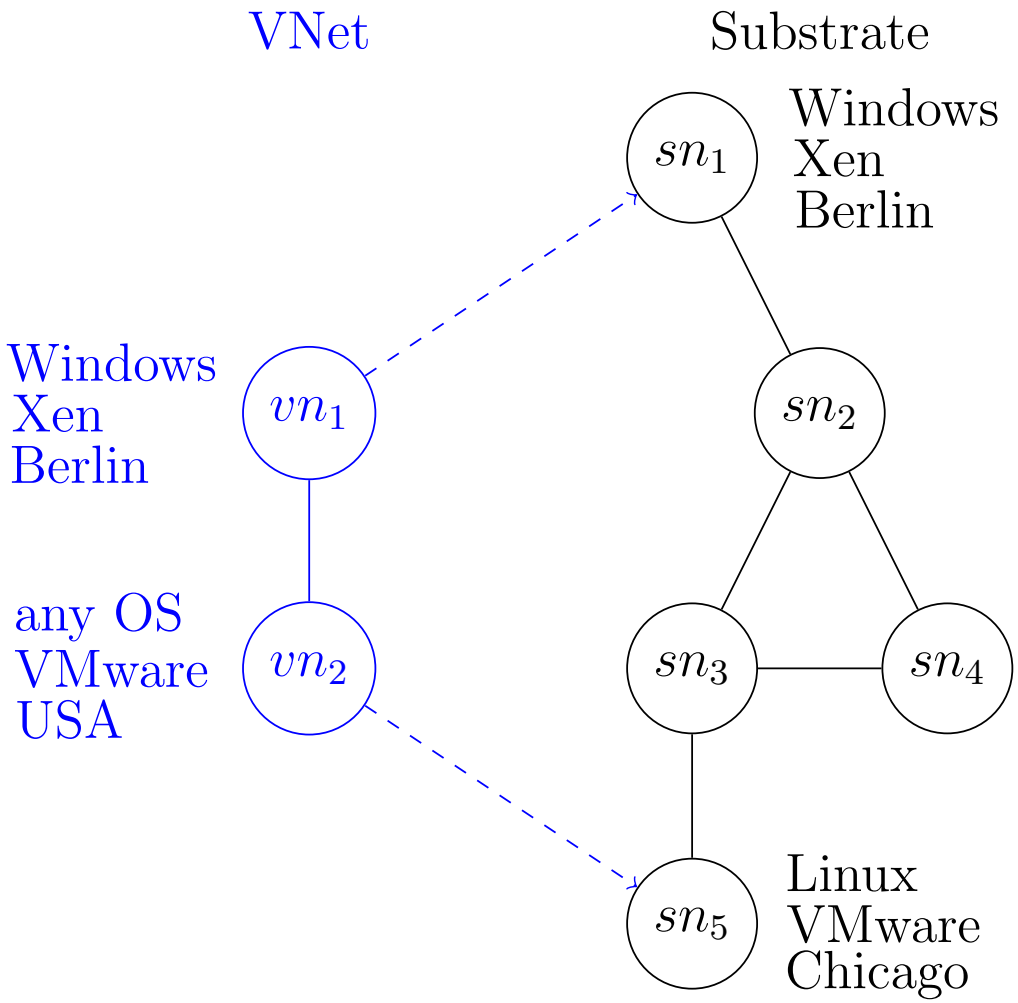


Focus on node properties

- types, not values
- Substrate node exactly one type per property
- VNet nodes several types per property

What is the metric for flexibility?

Specificity (σ) - Definition

$$\textit{specificity} = 1 - \frac{\text{allowed configurations}}{\text{all configurations}}$$

$\Rightarrow$ percentage of lost alternatives

specificity:

- 0: free choice of node
- 1: only nodes with exactly defined types

VNet specificity: average specificity of its nodes

Price of Specificity (PoS) definition

- G_V: given VNet
- Cost_0: cost without specification constraints
- Cost_σ: cost under a given specificity $\sigma(G_V)$

Price of Specificity definition:

$$PoS = \text{Cost}_\sigma / \text{Cost}_0$$

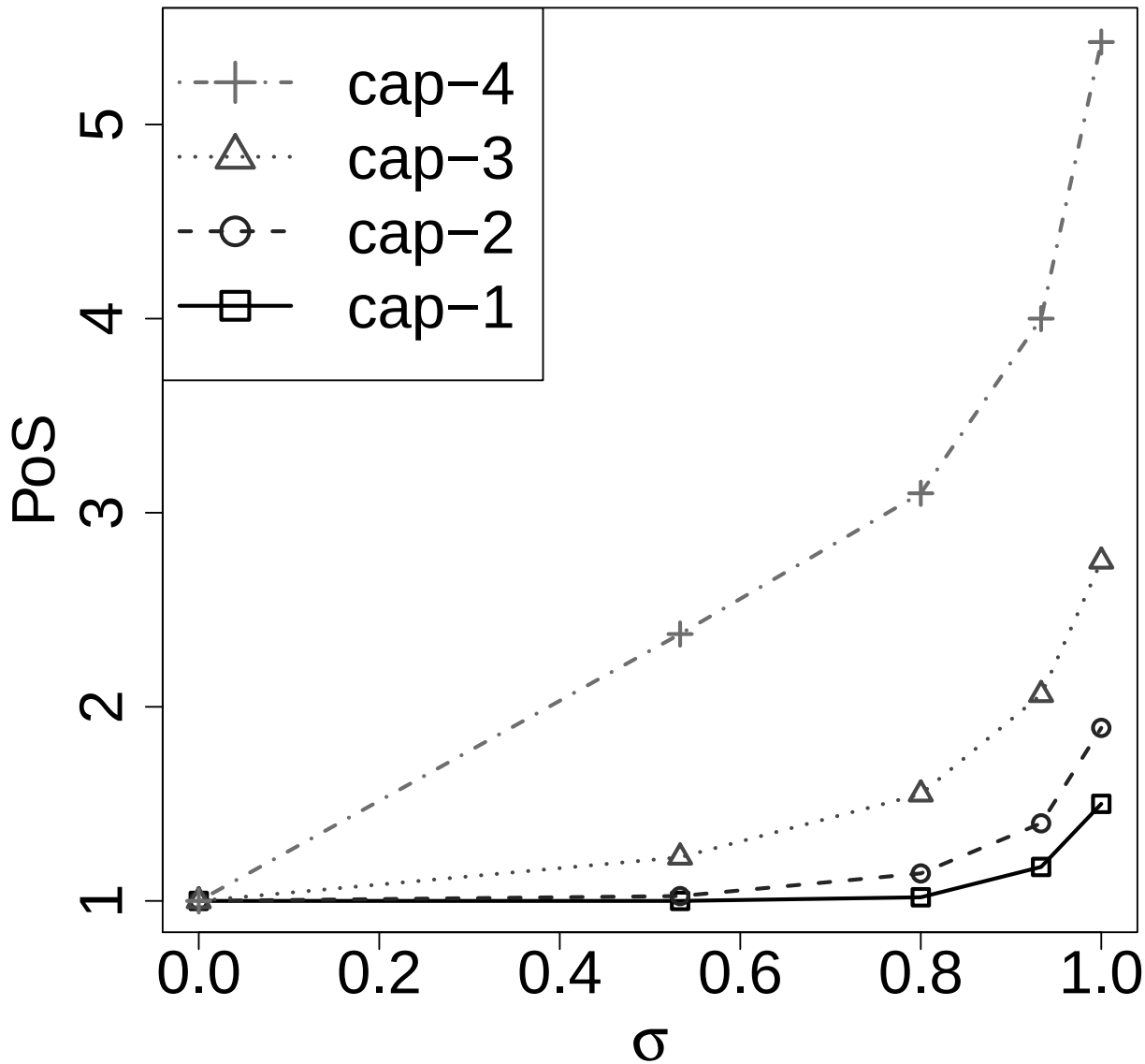
How to study the impacts of flexibility?

Setup

Architecture

- Embedding by MIP
- Objective function: minimize resource costs
- PoS regarding link costs (hops)

Node Capacity



Migration

- Lower resource costs overall

Migration “Paradoxon”:

There are scenarios where migration can increase the resource costs.

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Link/Node capacity=1
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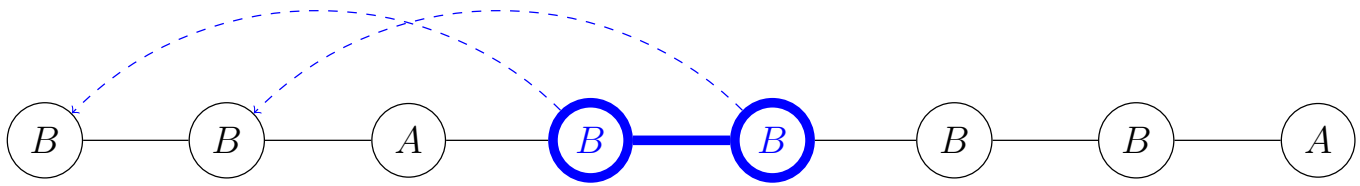

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Conclusion

- First step for virtual network specification flexibility on the embedding cost
- Flexibility can reduce the resource costs
- PoS, tool to adjust pricing and embedding (especially for competitive markets)

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Impact of	*Modification*	*PoS*
Substrate size	↓	↑
Substrate load	↑	
VNet size	↑	
Type distribution	↔	