
# Comparison of Embedding Objectives for Next Generation Networks

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# Introduction

- Network Virtualization (NV), catalyst technology for the new Internet
- From legacy architectures to the versatile Infrastructure as a Service (IaaS)
- The ISP business model broken into the SP and the InP roles
- NV & IaaS lit the spark of the Next Generation Networks (NGNs)
- New virtualization concept emerges: **Virtual Network Embedding**

Paper goals

- Compare the most common proposed embedding solutions
- Evaluate their suitability for serving NGN applications

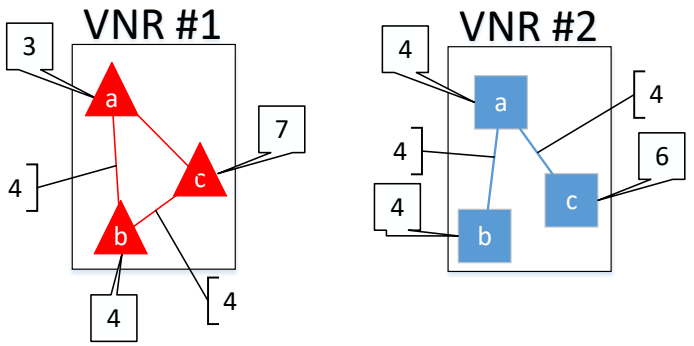
# VNE problem formulation

- Modeling: $SN = (N_s, L_s)$ & $VN^i = (N^i, L^i)$
- Setting capacities of element parameters
- Establishing networking constraints
- Node & link embedding functions:

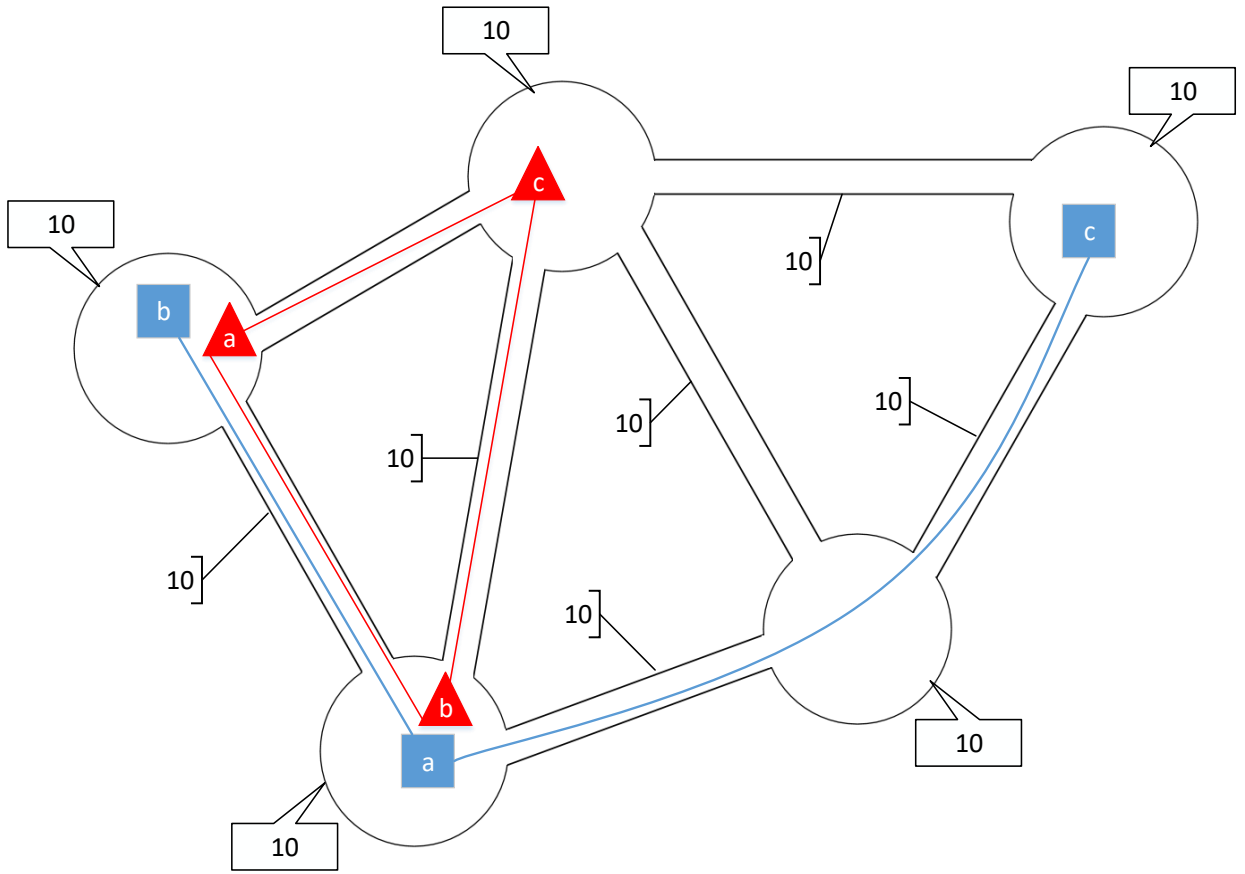
$$f_i : N^i \rightarrow N_S$$
$$g_i : L^i \rightarrow SP \subseteq SN$$

# VNE embedding process

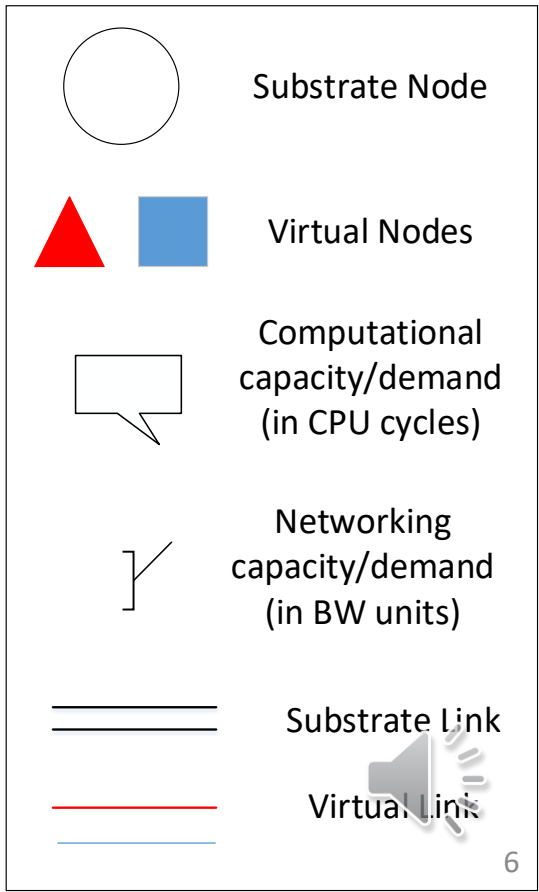
Incoming Virtual Networks (VNs) as Virtual Network Requests (VNRs)




Substrate Network (SN)




Elements



# VNE mapping strategies

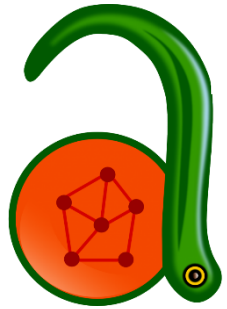
- Performance Metrics
  - Quality of Service metrics
  - Cost-related metrics
  - Resilience metrics

- Variety of embedding objectives:

# Simulation environment & parameters

- Values of physical and virtual parameters

| | Physical Network | | | Virtual Network | | | |
|---|---|---|---|---|---|---|---|
| Scenario ID | Number of nodes | CPU cycles | BW units | Number of VNRs | nodes per VNR | CPU cycles | BW units |
| sid1 | 50 | 100 | 100 | 50 | 3 | 15 | 15 |
| sid2 | 50 | 100 | 100 | 50 | 3 | 30 | 30 |
| sid3 | 50 | 100 | 100 | 50 | 3 | 30 | 50 |
| sid4 | 50 | 100 | 100 | 20 | 10 | 15 | 15 |
| sid5 | 50 | 100 | 100 | 20 | 10 | 30 | 30 |
| sid6 | 50 | 100 | 100 | 20 | 10 | 50 | 50 |



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- Compared embedding strategies

| Notation | Embedding Solution Description |
|---|---|
| GreedykSP | Greedy Available and K Shortest Paths |
| GreedySplit | Greedy Available and Path Splitting |
| CNLMsplit | Coordinated Node and Link Mapping with Path Splitting |
| CNLMkSP | Coordinated Node and Link Mapping with k Shortest Paths |

# Simulation environment & parameters

- Performance Metrics
  - The average acceptance ratio (AR)
  - The cost-revenue relationship (COSTREV)
  - The running time (RT)

# Evaluation results

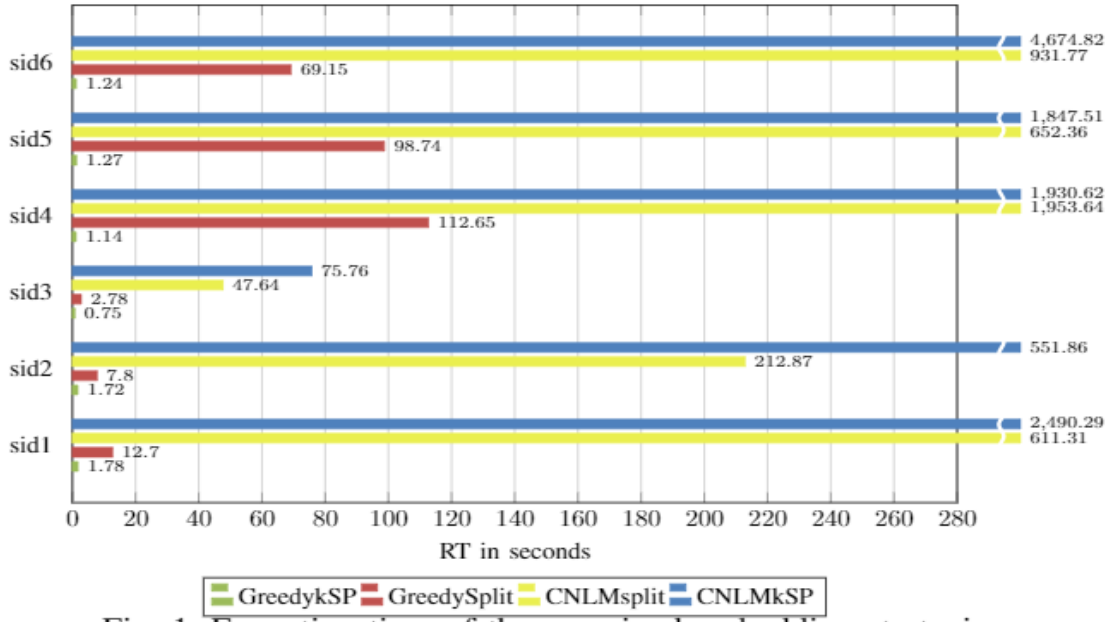


Fig. 1. Execution time of the examined embedding strategies.

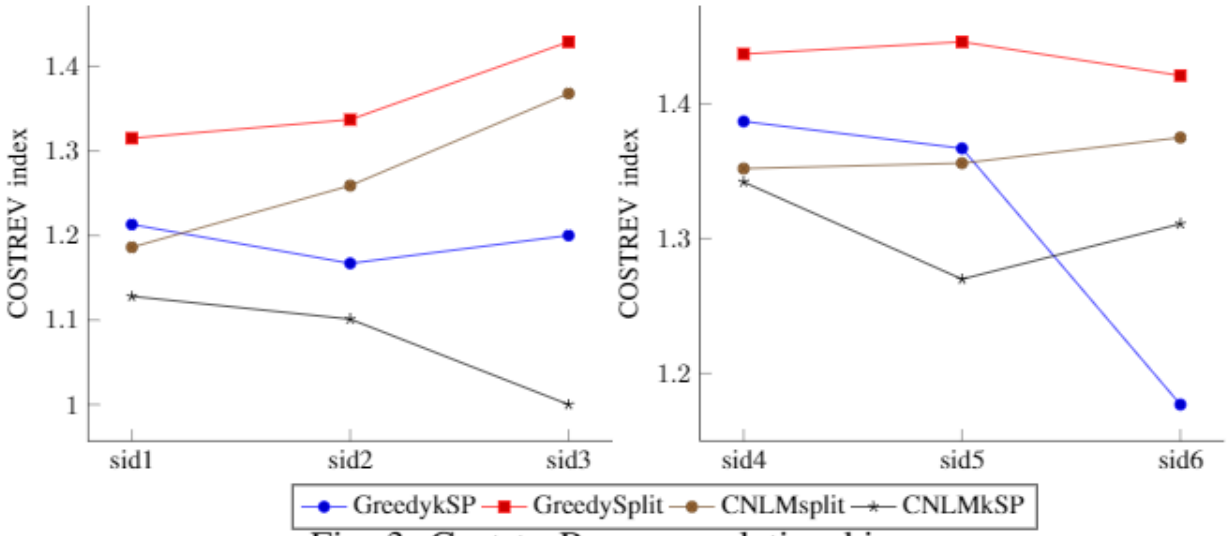


Fig. 3. Cost to Revenue relationship.

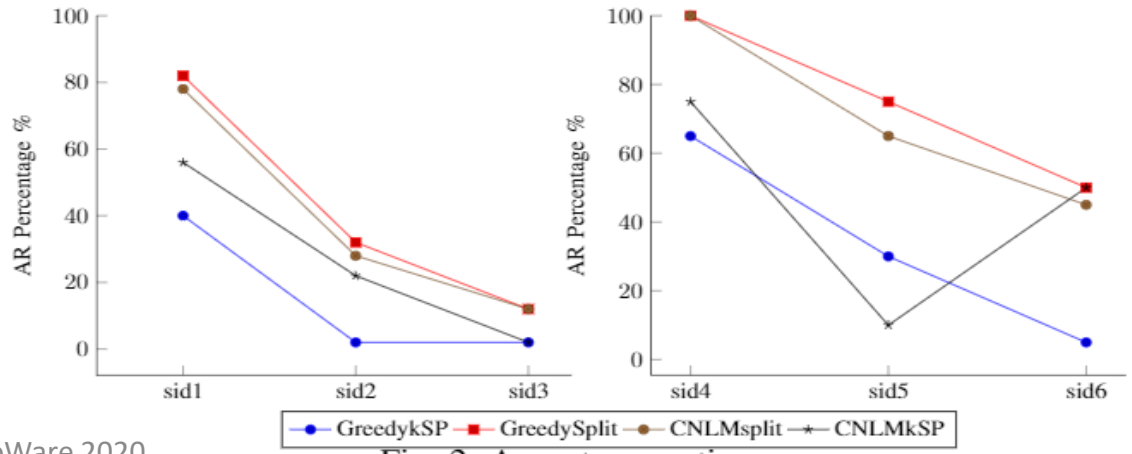


Fig. 2. Acceptance ratio.

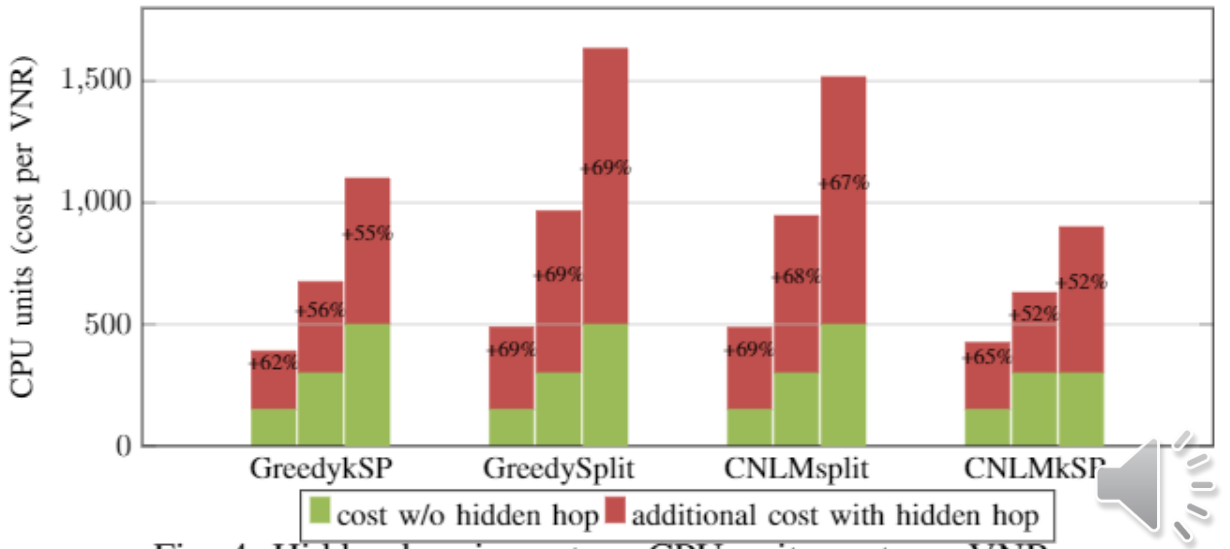


Fig. 4. Hidden hop impact on CPU units cost per VNR.

# Conclusions

| Techniques | Best fitted for | Not qualified for |
|---|---|---|
| Coordinated node and link mapping | applications with a long term life-cycle, expecting high quality results no matter the RT cost | stateless, express request serving applications |
| Link mapping with path splitting | applications demanding redundancy and robustness | applications with green footprint |
| K shortest path link mapping | stateless request serving grids like ad-hoc | fault-sensitive applications |

**Future work**

- Scale experimental environment for real life volume of results
- Develop a modular VNE algorithmic toolbox for customized end-to-end services


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