

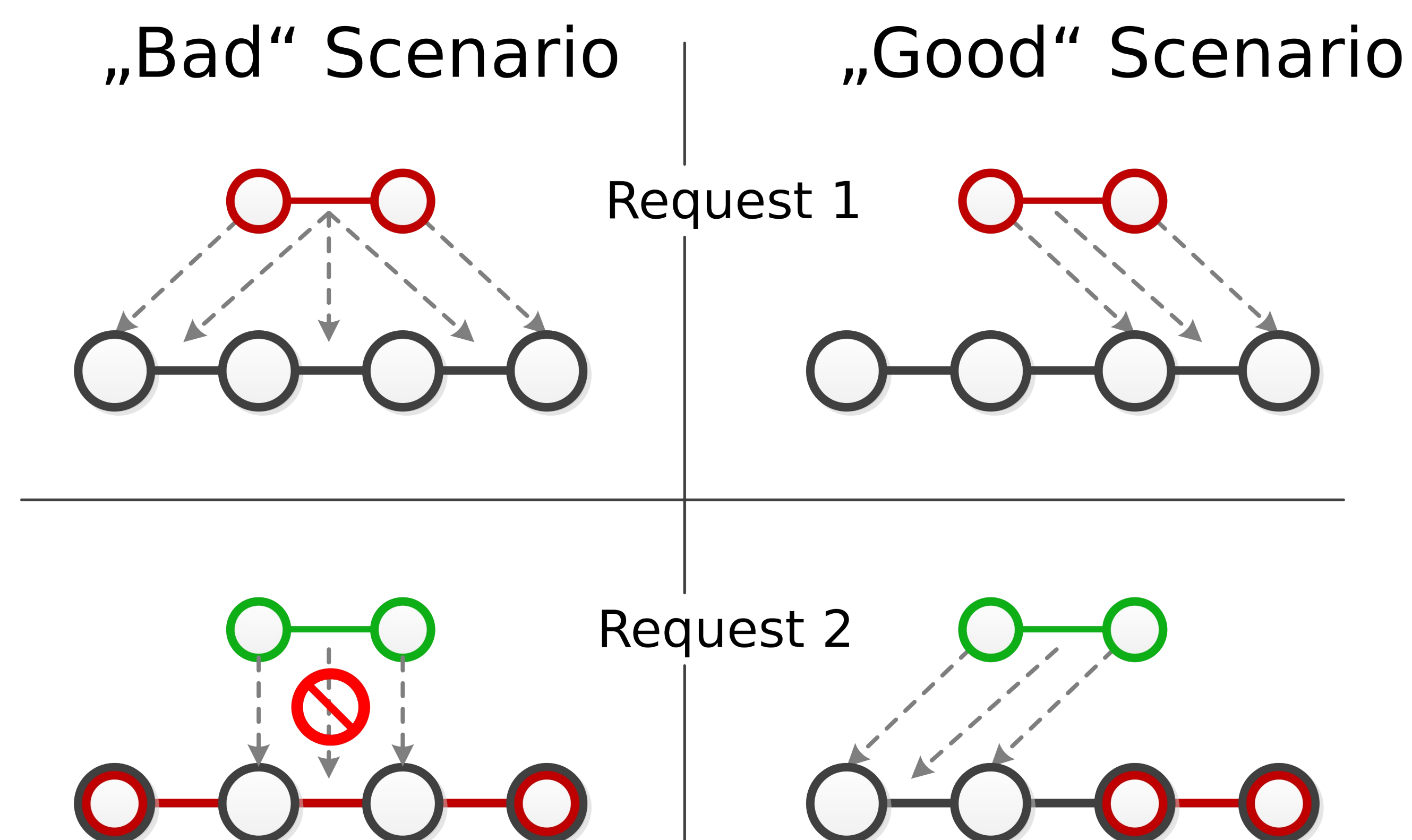
On the Benefit of Collocation in Virtual Network Embeddings

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The Virtual Network Embedding Problem:

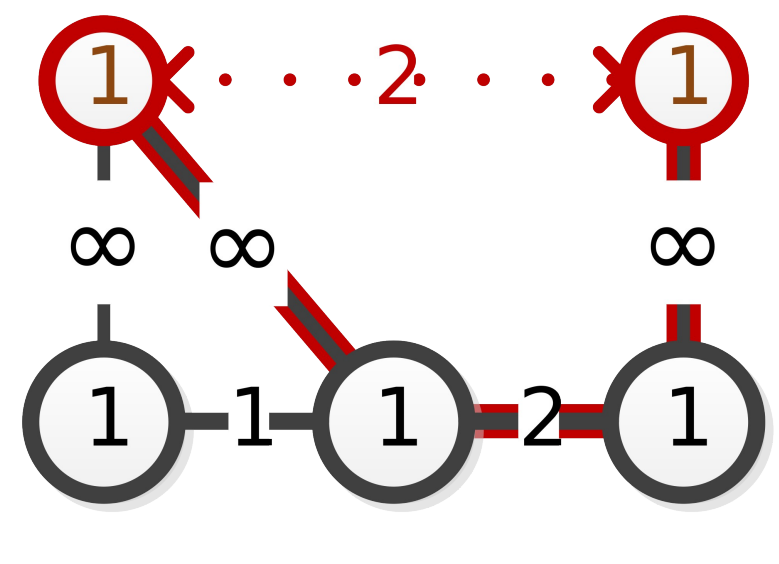
- **Challenge:** Find a mapping of all elements of a virtual network to a physical network, which fulfills the specifications.
- **What is a „good“ embedding?:** There are different metrics to measure the quality of an embedding. E.g. resource consumption, load balancing, etc.
- **Mappings with short distances** between the virtual nodes consume less link resources, and are usually not in contradiction to other objectives. Hence they allow for embedding more requests simultaneously in the future.



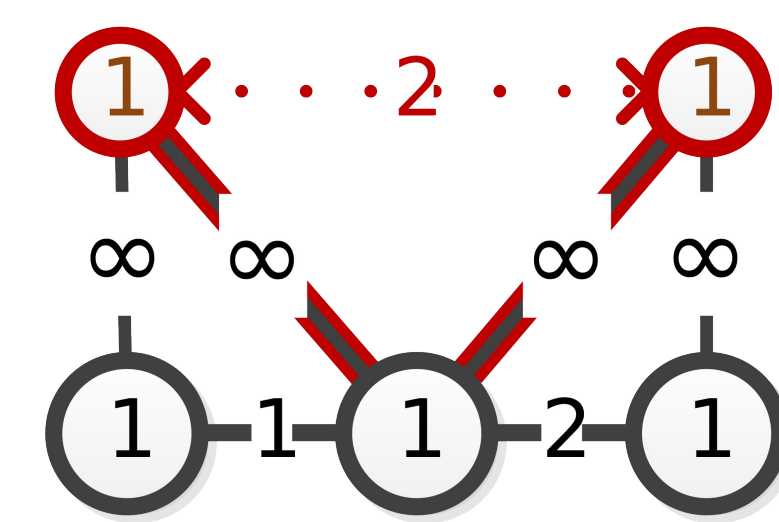
Related Work (Exemplary)

ViNEYard[1]

- Locally distributed
- Coordinated node and link mapping
- Uses flow optimization on an „augmented graph“



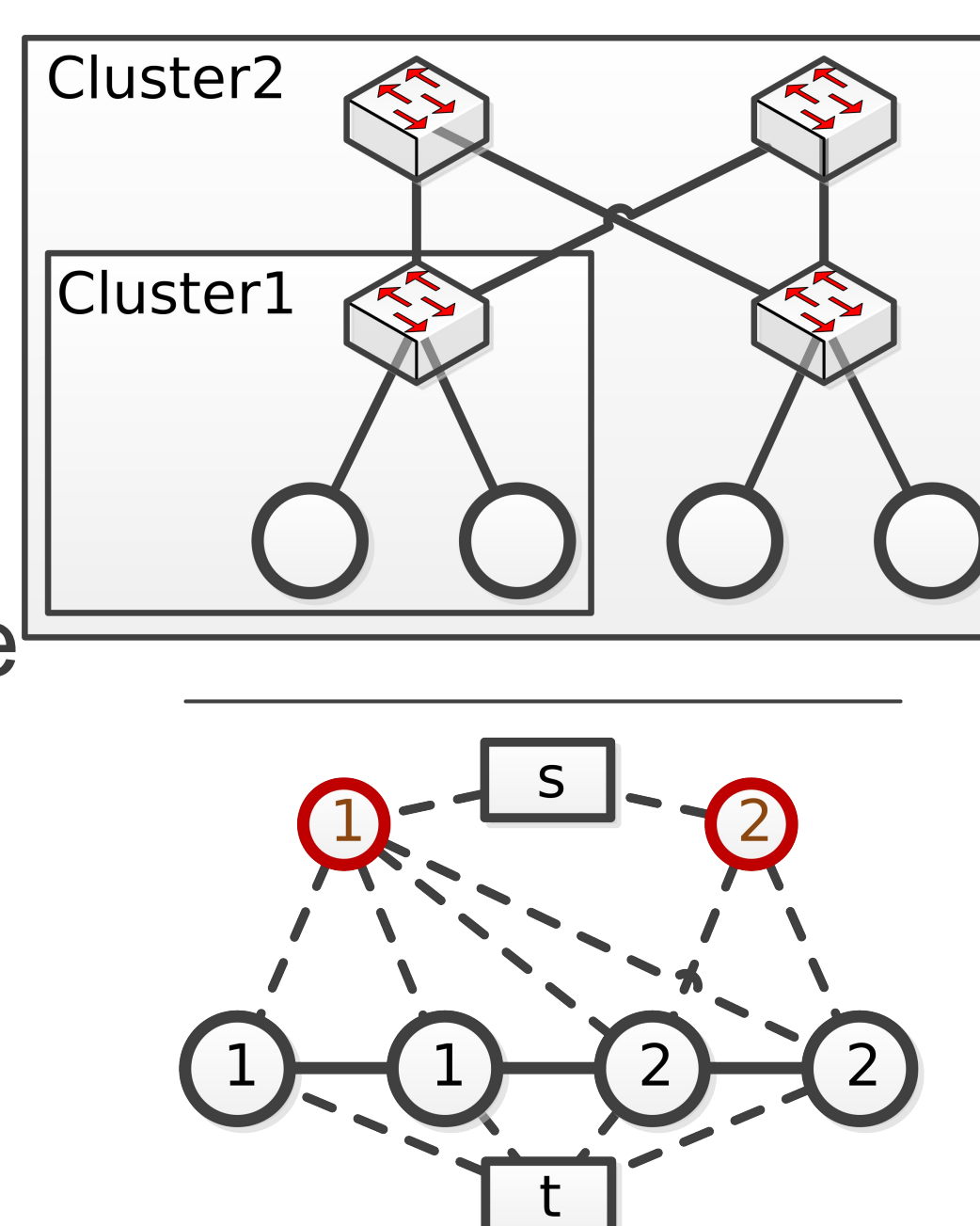
→ problems for overlapping candidate sets



SecondNet[2]

- Datacenter usecase
- Leverages clustering
- Low runtimes
- Topology-semi-aware node mapping

→ problems on general topologies

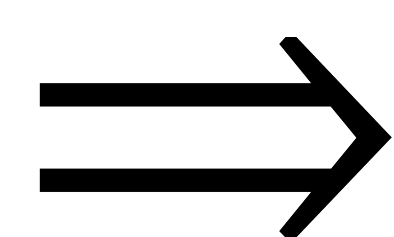


MIP Approach[3]

- Mathematical formulation
- Generates optimal solutions
- Supports migration and collocation

→ problem on runtime

- Resource perspective:
Short distances = good → 0 distance = best
- State of the art algorithms do not leverage collocation



How does this impact the amount of virtual networks that can be embedded?

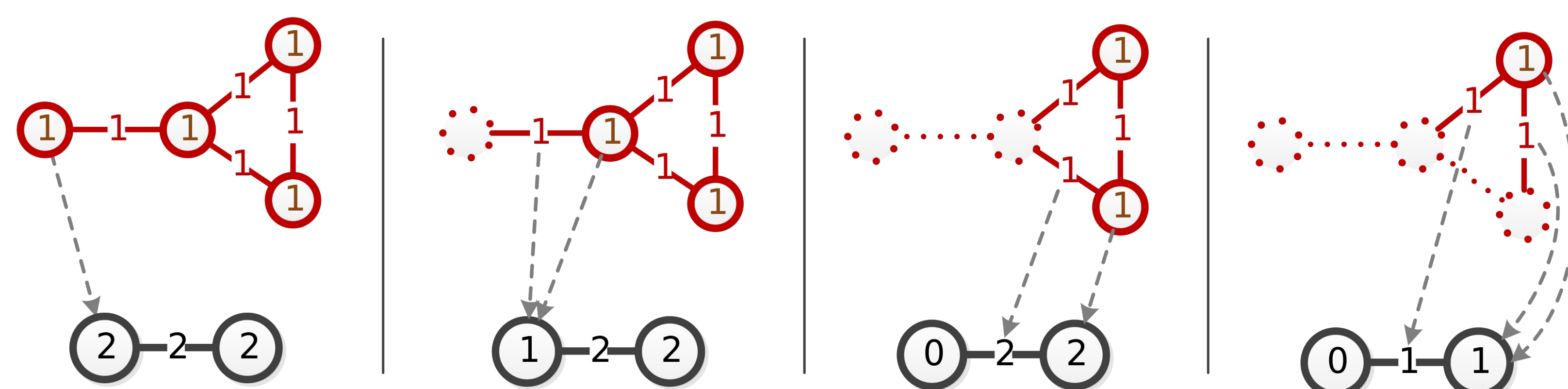
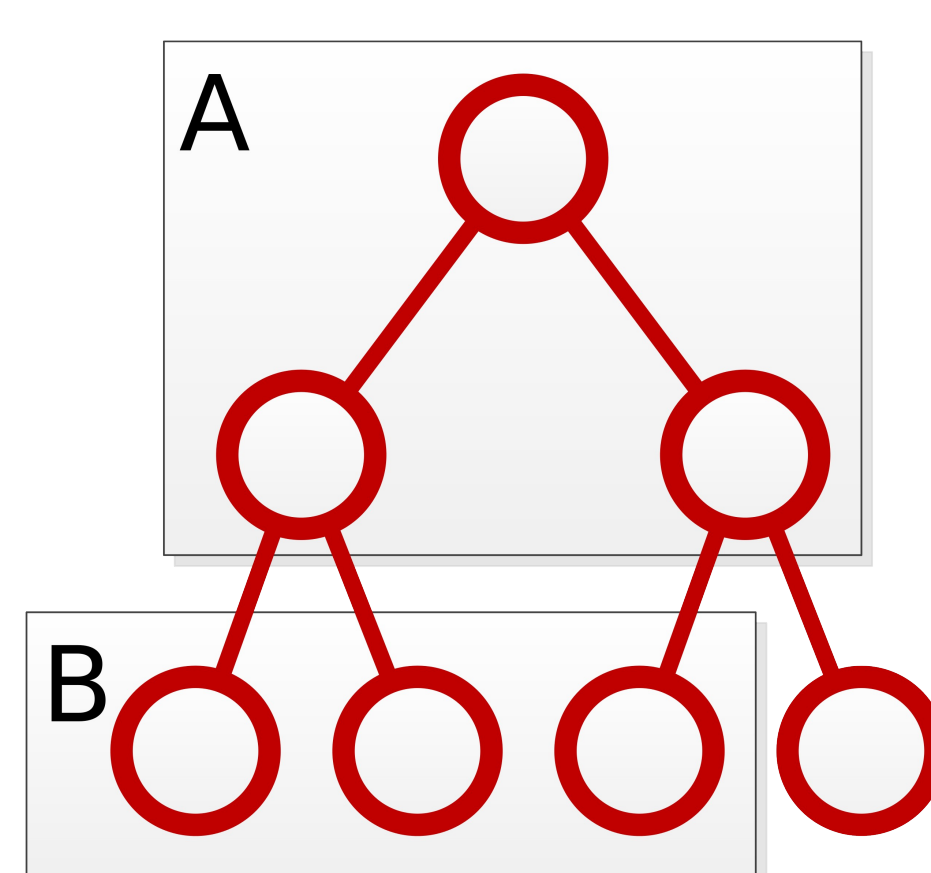
Evaluation

Simple benchmarking algorithm which allows node collocation

Algorithm 1 The LoCo Algorithm

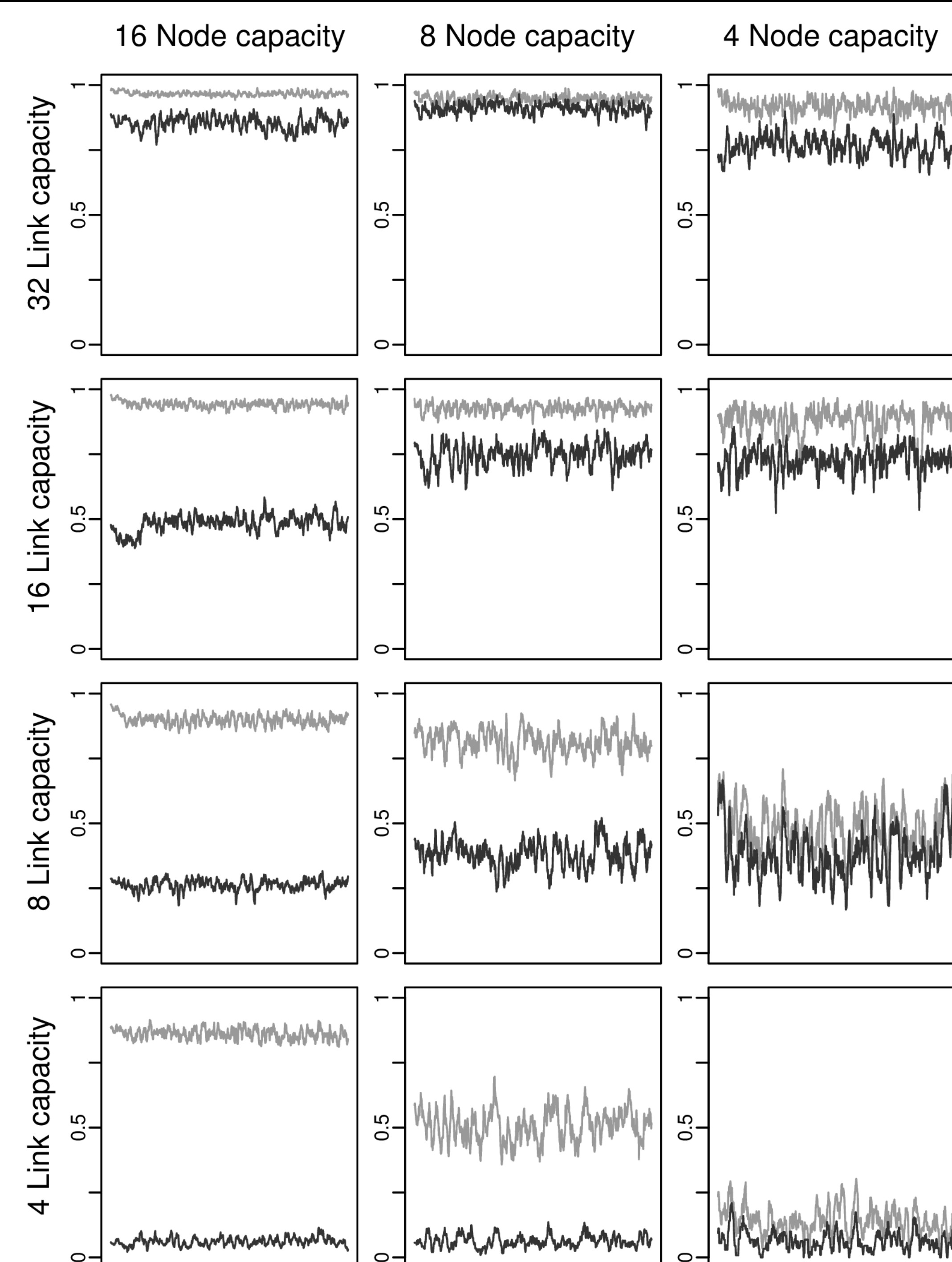
Require: VNet $G = (V, E)$, $M = \{s\}$ for some $s \in V(G)$,
 $P = (\Gamma(s))$
while $|P| > 0$ **do**
 sort P (* decreasing link capacities *)
 choose $u = P[0]$ (* next node to map *)
 map u (* forward checking *)
 map $\{u, v\} \quad \forall v \in M, \text{ where } \{u, v\} \in E(G)$
 $M = M \cup \{u\}$ **and** $P = P \setminus \{u\}$
end while
if (embedding failed), **backtrack** on s

Problem case:



Conclusion

- For high node and low link resources collocating algorithms can easily outperform the state of the art algorithms.
- Virtual network requesters should be able to *specify* whether collocation violates their constraints.



Resource utilization against time
black: SecondNet; grey: LoCo

[1] Chowdhury et al. *Virtual Network Embedding with Coordinated Node and Link Mapping*, INFOCOM 2009

[2] Chuanxiong Guo et al. 2010. *SecondNet: a data center network virtualization architecture with bandwidth guarantees*. In Proceedings of the 6th CoNEXT '10

[3] Schaffrath, Gregor et al. (2012). *Optimizing Long-Lived CloudNets with Migrations*. IEEE/ACM International Conference on Utility and Cloud Computing (UCC '12)