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Virtual network embedding based on real-time topological attributes

Key words: Virtual network embedding, Real-time topological attributes, Betweenness centrality, Correlation properties, Network virtualization

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Introduction

- A new embedding algorithm is proposed based on real-time topological attributes and node mapping and link mapping can be well coupled.
- The concept of betweenness centrality in graph theory is borrowed to sort the nodes of VNs, and the nodes of the substrate network are sorted according to the correlation properties between the former selected and unselected nodes.

The virtual network embedding problem

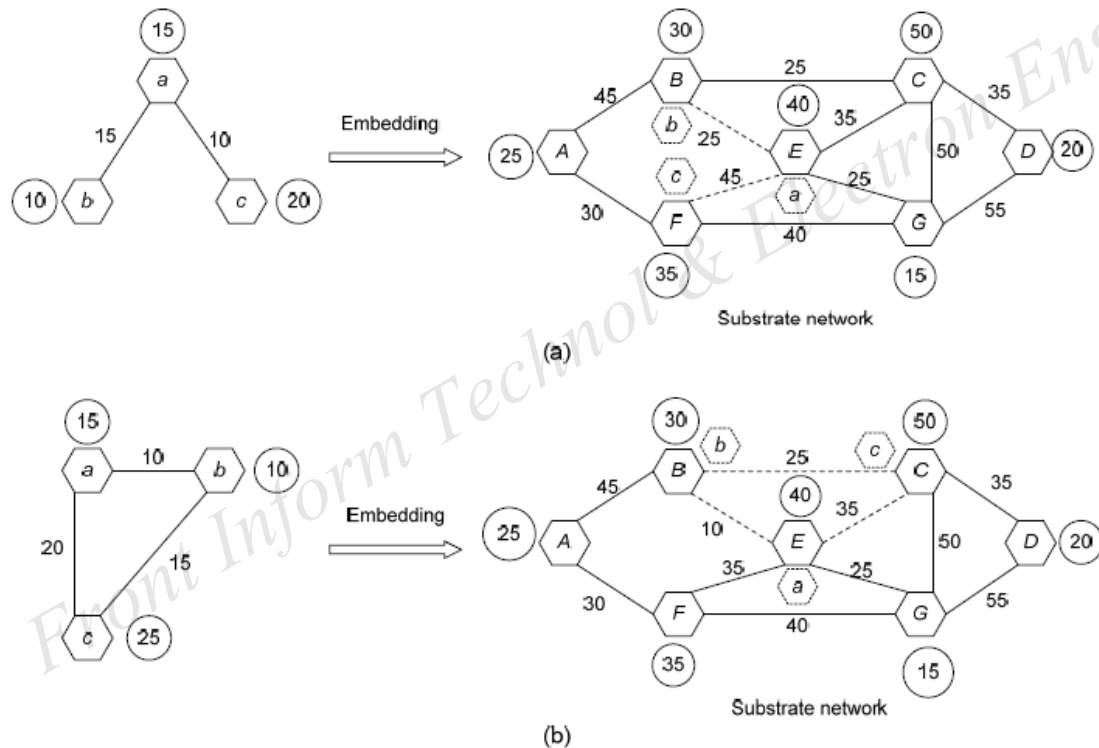


Fig. 1 Mapping virtual networks (VNs) to a shared substrate network: (a) VN request 1; (b) VN request 2
The numbers of available CPU resources of the nodes are given inside circles and the numbers of available bandwidths of the links are beside the edges

The node ranking

- VN

$$\text{Value}_v(n_v) = \text{CPU}(n_v) \cdot \sum_{l_v \in L(n_v)} \text{BW}(l_v) \cdot B(n_v)$$

- Substrate

$$\text{Value}_s(n_s) = \text{CPU}(n_s) \cdot \sum_{l_s \in L(n_s)} \text{BW}(l_s) \cdot C(n_s) \cdot \text{Pro}(n_s)$$

Measurement results

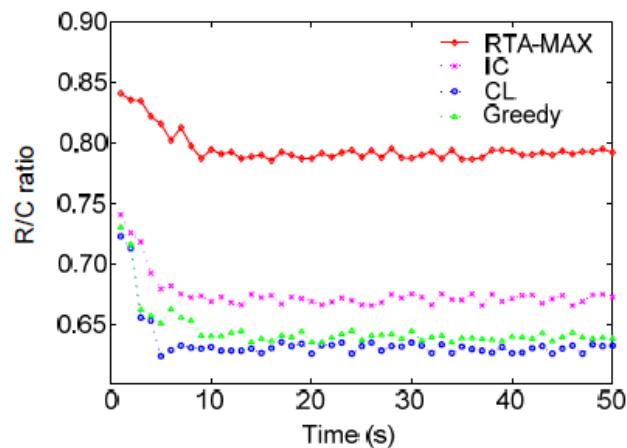


Fig. 3 R/C ratio comparison

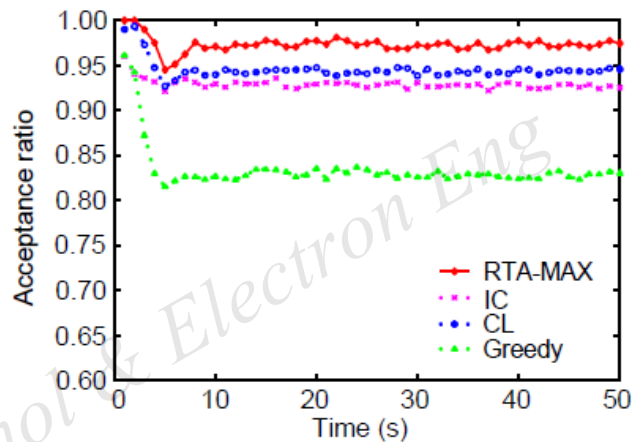


Fig. 4 Acceptance ratio comparison

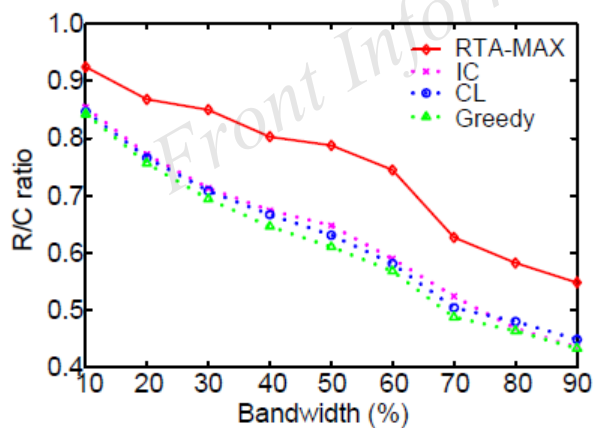


Fig. 5 R/C ratio with increasing bandwidth

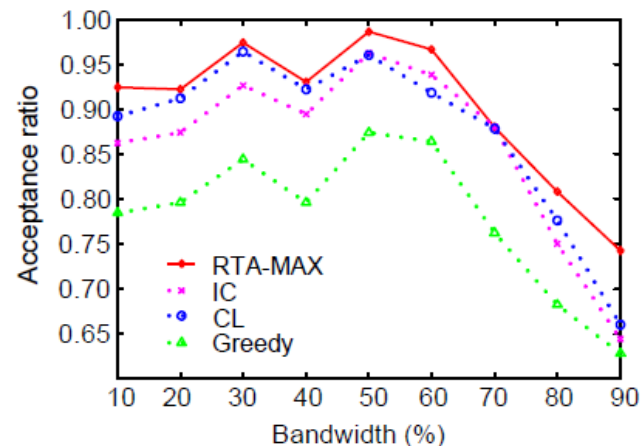


Fig. 6 Acceptance ratio with increasing bandwidth

Measurement results (Con'd)

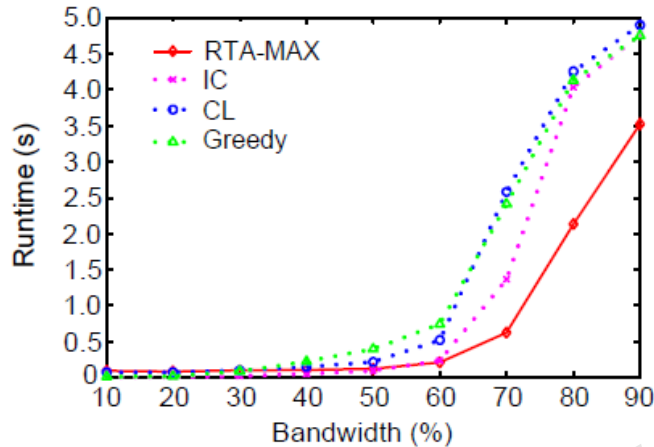


Fig. 7 Runtime with increasing bandwidth

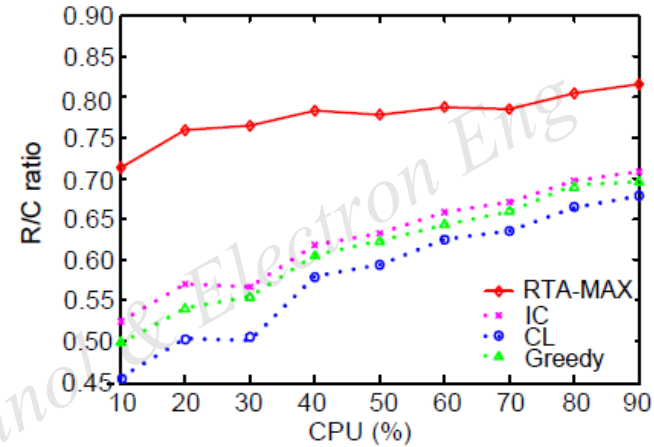


Fig. 8 R/C ratio with increasing CPU

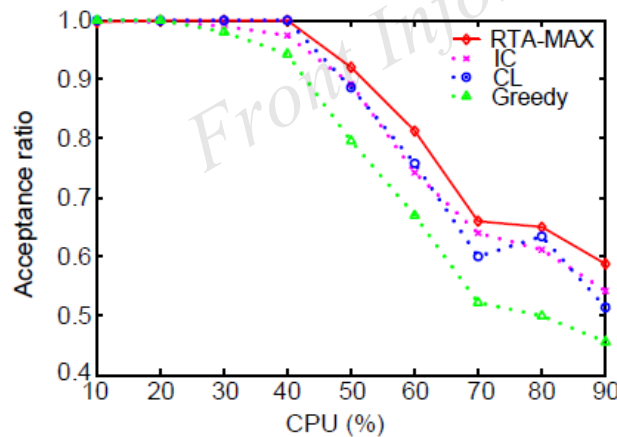


Fig. 9 Acceptance ratio with increasing CPU

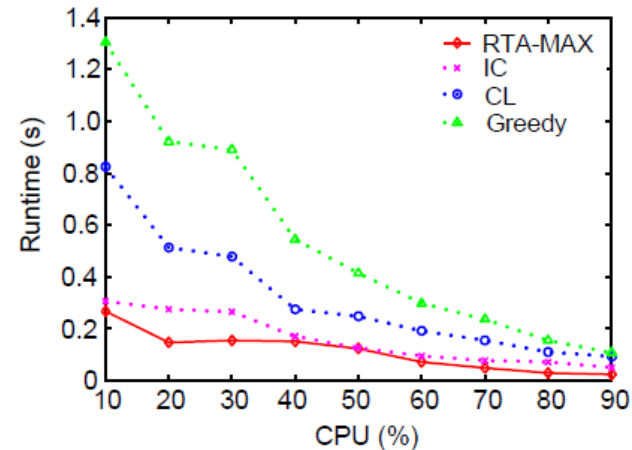


Fig. 10 Runtime with increasing CPU

Conclusions

- This paper proposes a new algorithm based on real-time topological attributes in the network, which introduces betweenness centrality to analyze the virtual network and the correlation properties for the substrate. Theoretical network analysis and evaluation show that the new algorithm RTA-MAX greatly improves the embedding performance under almost all conditions of both CPU capacity and bandwidth. Moreover, the runtime is reduced.