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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

Contact: Jian Ding
E-mail: buptsky@gmail.com
ORCID: http://orcid.org/0000-0002-9147-8119

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

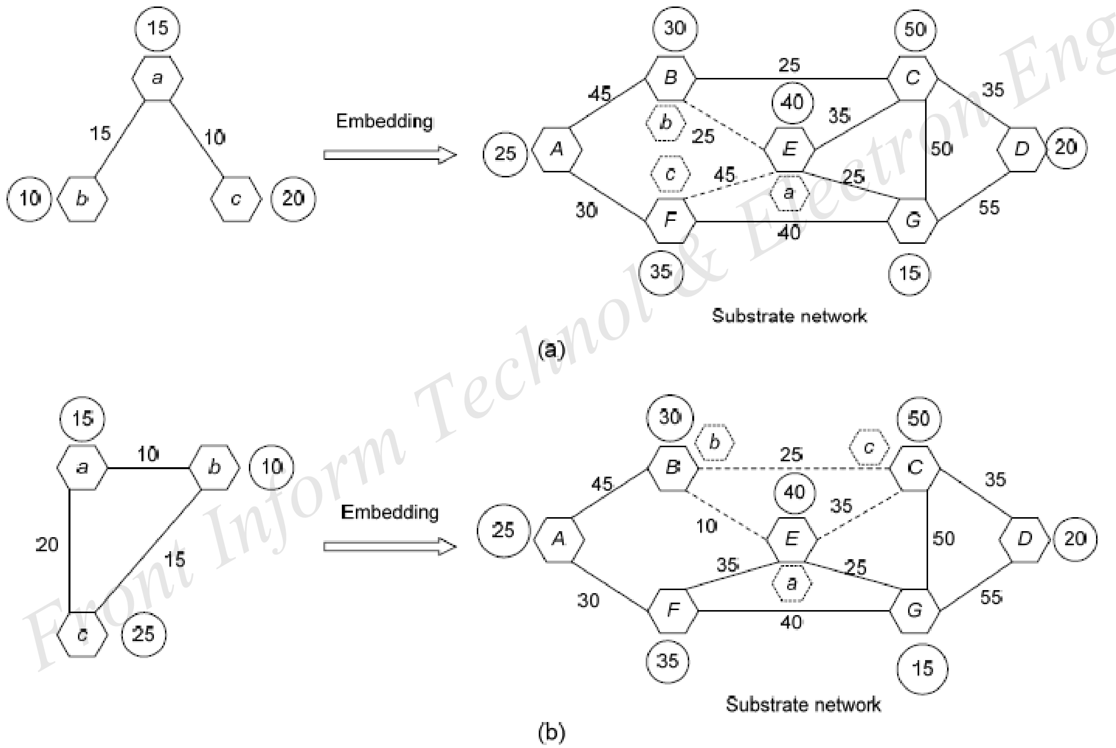

Fig. 1 Mapping virtual networks (VNs) to a shared substrate network: (a) VN request 1; (b) VN request 2
The numbers of available CPU resources of the nodes are given inside circles and the numbers of available bandwidths of the links are beside the edges

The node ranking

- VN

$$\text{Value}_{\text{v}}(n_{\text{v}}) = \text{CPU}(n_{\text{v}}) \cdot \sum_{l_{\text{v}} \in L(n_{\text{v}})} \text{BW}(l_{\text{v}}) \cdot B(n_{\text{v}})$$

- Substrate

$$\text{Value}_{\text{s}}(n_{\text{s}}) = \text{CPU}(n_{\text{s}}) \cdot \sum_{l_{\text{s}} \in L(n_{\text{s}})} \text{BW}(l_{\text{s}}) \cdot C(n_{\text{s}}) \cdot \text{Pro}(n_{\text{s}})$$

Measurement results

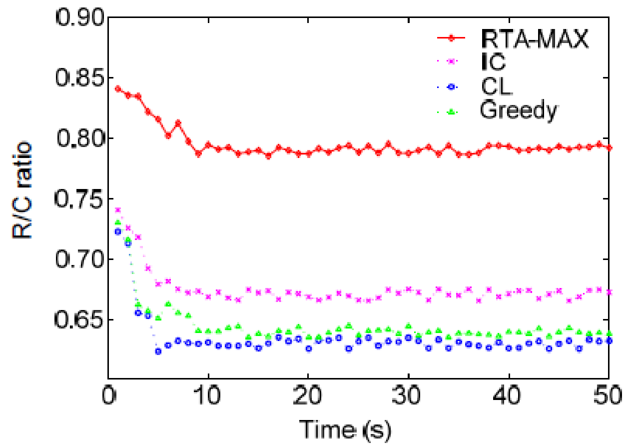

Fig. 3 R/C ratio comparison

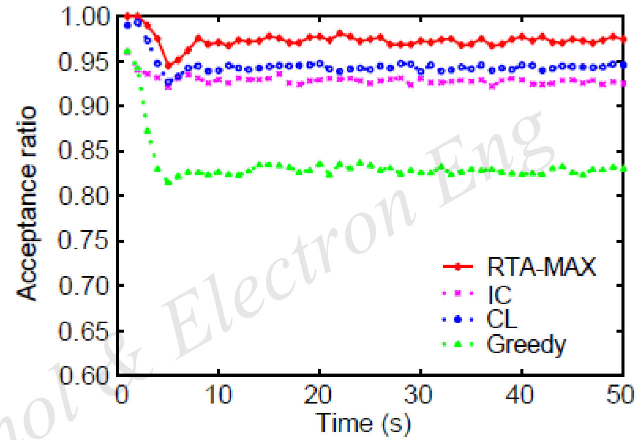

Fig. 4 Acceptance ratio comparison

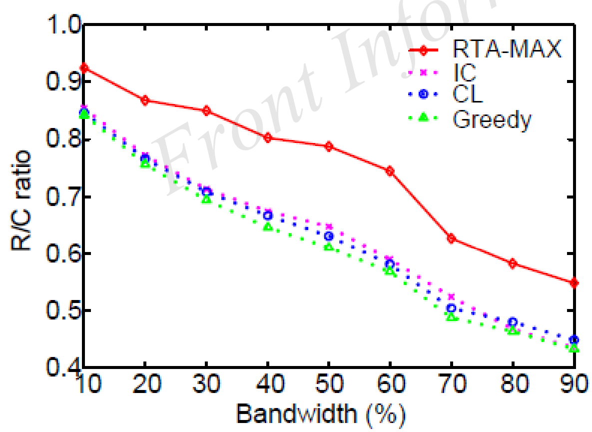

Fig. 5 R/C ratio with increasing bandwidth

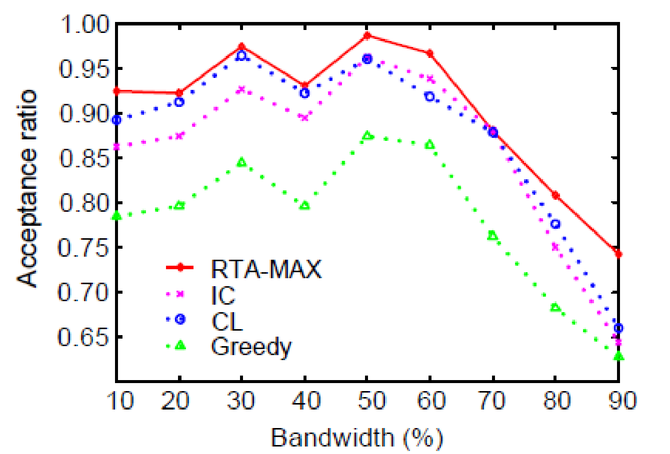

Fig. 6 Acceptance ratio with increasing bandwidth

Measurement results (Con’d)

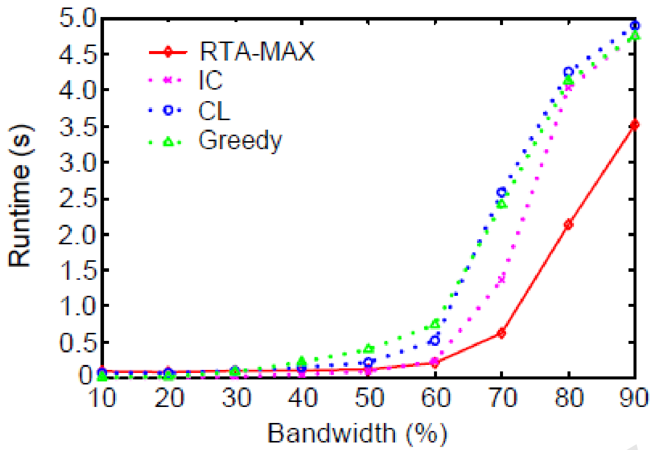

Fig. 7 Runtime with increasing bandwidth

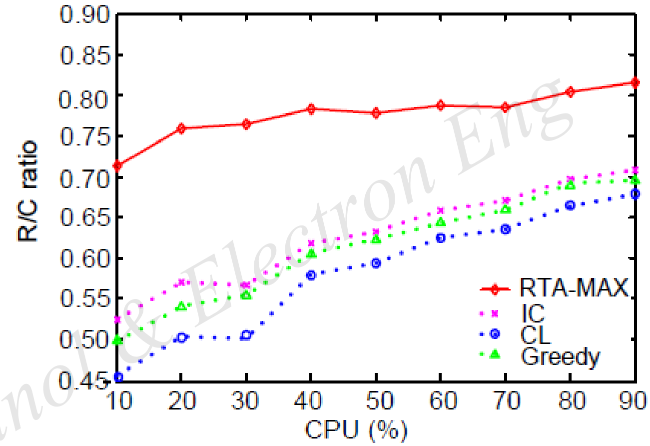

Fig. 8 R/C ratio with increasing CPU

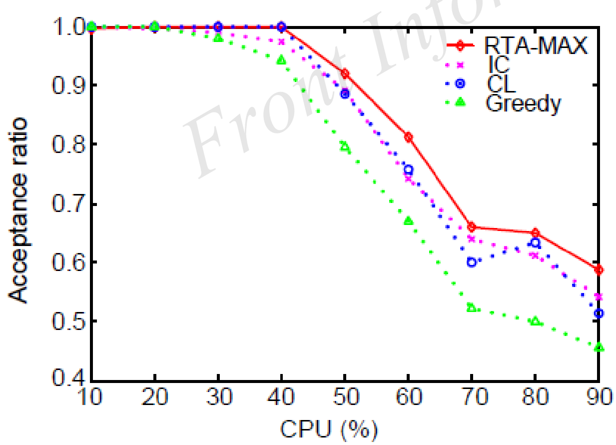

Fig. 9 Acceptance ratio with increasing CPU

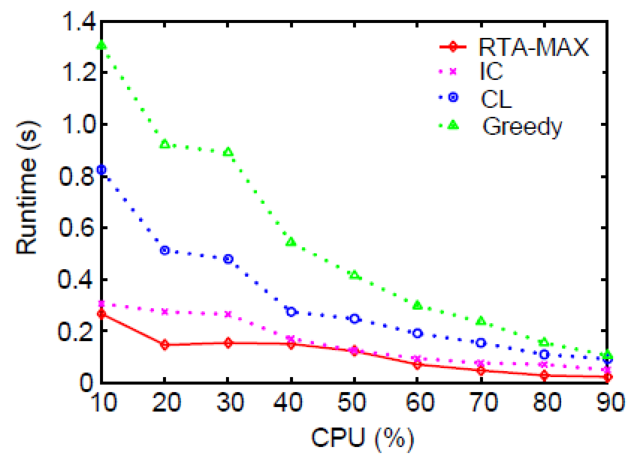

Fig. 10 Runtime with increasing CPU

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.