

Novel visualisation method for summarising and exploring complex networks

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Research Problem:

Existing visualisation schemes are not always an effective and efficient analysis approach for summarising and exploring complex networks. That is due to large amounts of visual clutter caused by overplotting nodes or links. Although these layouts are becoming popular, effective considering small networks or sparsely connected networks [2], it is difficult to create a data display in a comprehensible and scalable way for complex graphs.

Proposed Solution:

This interdisciplinary project explores the development of **novel visualisation approaches to aid the design, implementation and operation of a large-scale system**. This study aims to enable end-users to perform tasks more easily by implementing a novel approach of node-link visualisation in the context of large complex networks. In order to accomplish this, an optimal visualisation model will be built for complex networks that will allow users to correlate, summarise and explore various kind of entities or information in the network.

Objective:

- To comprehend what an optimal visualisation for the complex graph that should convey the complex data in a compact and unified way.
- To combine graph clustering approach and novel graph layout to represent large complex graph-based data sets in such a way that the viewer can summarise and explore the visualisation more clearly and accurately in screen size.
- To preserve vertices places in the visualisation space for helping the decision-makers regarding *the mental map* preservation.
- To provide a better understanding of the network and features and relationships for end-users by collaborating with *Facebook* network data sets as a use case.

Method:

This study will achieve the combination of nodes aggregation method and restricting node movement with a fixed reference system. For the layout optimality criteria, the sophisticated method of aggregation with a specific clustering algorithm and layout algorithm will be combined to develop a scalable novel graph approach for visualising complex graph-based data. Then, these kinds of data sets will be represented through the proposed layout while preserving the global structure of the complex network.

Novelty:

This study proposes a novel scalable approach in a way that is a visually comprehensible format by collaborating with large, complex data sets in the node-link graph, where nodes denote objects which is a point of the graph and edges show the relationships between two nodes. This study involves applying real Facebook DCN traffic patterns which are based upon the data collected from the fabric network design (a *state-of-the-art*) of the Facebook data centre (see Figure 1). Nevertheless, the proposed visualisation method also would be valid to a diverse range of network data sets and scenarios.

Results:

This work forms the basis of a first-year PhD, and we wish to present to obtain feedback on our ideas and progress to date. During the presentation, we will present our initial results of analysing and visualising the Facebook network traffic [2]. In doing so, we will highlight the challenges of visualising large-scale systems and propose potential solutions.

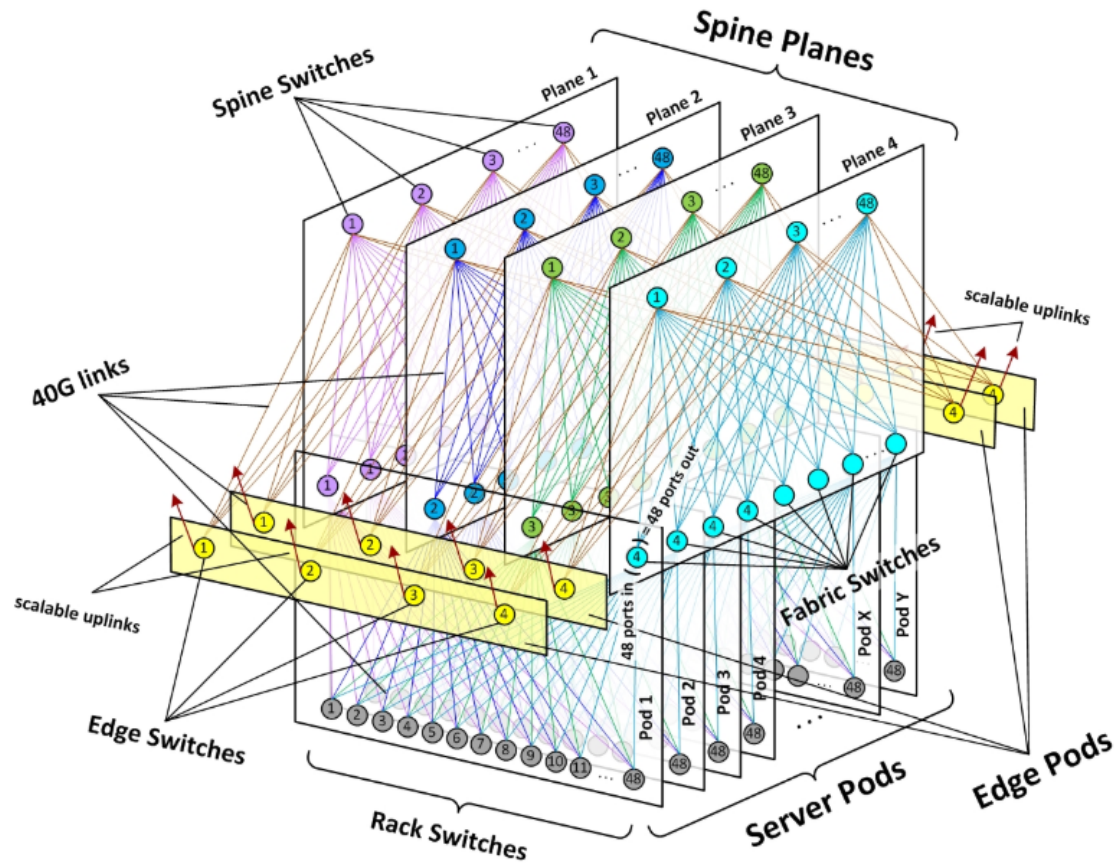


Figure 1. Fabric network design of Facebook data centre [1].

References

- 1- Andreyev, A. Introducing data center fabric, the next-generation Facebook data center network. <https://code.facebook.com/posts/360346274145943/introducing-data-center-fabric-the-next-generation-facebook-data-center-network/>, Nov. 2014.
- 2- Yoghourdjian, V., Archambault, D., Diehl, S., Dwyer, T., Klein, K., Purchase, H. C., & Wu, H.-Y. (2018). *Exploring the Limits of Complexity: A Survey of Empirical Studies on Graph Visualisation*. Retrieved from <http://arxiv.org/abs/1809.00270>