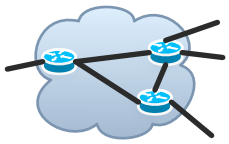
Pathfinding with Aggregated Topologies

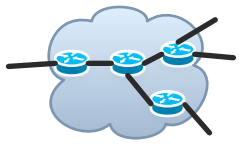
in inter-domain optical networks

Network Topology Aggregation Strategies

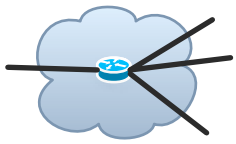
Topology sharing is necessary for optical inter-domain pathfinding. Networks often do not wish to share their full topology description with other domains, for scalability, business, security or other reasons. There are several different aggregation strategies for topologies.



Full Mesh
All the border nodes with their inter-domain links are preserved. The internal network is represented with a full mesh between the nodes.



Star
All the border nodes with their inter-domain links are preserved. All the border nodes are connected to a virtual central node.



Single Node
All information about the internal topology is discarded and the whole domain is represented as a single node.

Routing with Aggregation

When aggregated topologies are used, nodes in the network have to route based on incomplete information. The starting node in a pathfinding operation will use his view of the network to determine a path through the inter-domain network. When a path is found through the inter-domain network, a reservation request is sent. Each of the domains along the path locally expand the aggregated path to a real path, applying any local policies they may have.

Simulation

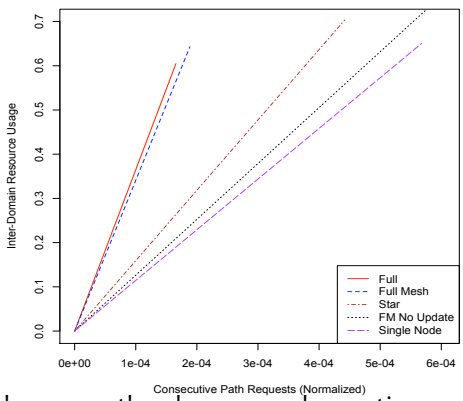
The graphs in the simulation were randomly generated using the Barabasi-Albert graph generation algorithm to ensure realistic random networks. On each topology we used several randomized pair set and compared the results of each of the aggregation strategies.
The path in the aggregated network is translated back to the underlying network, and inter-domain link usage and path-lengths are then measured.

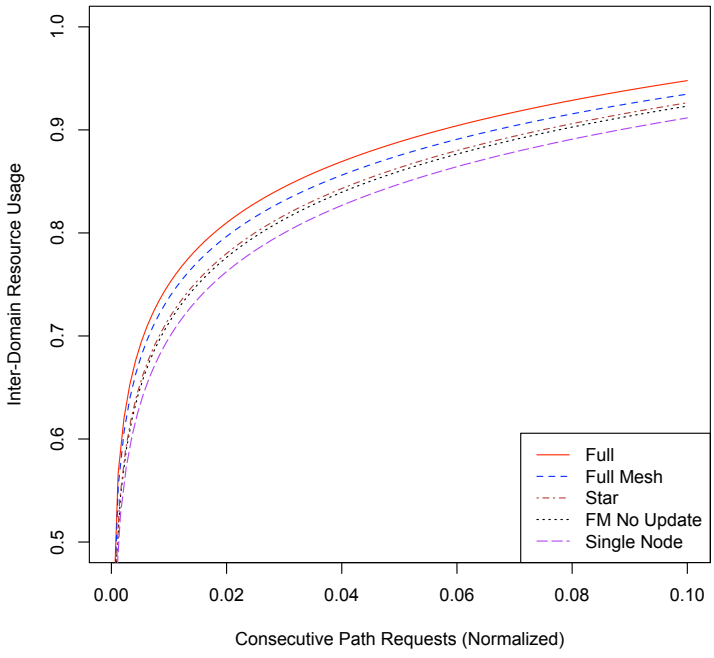
Conclusion & Future Work

Our simulations have quantified the performance of the different aggregation strategies. We can conclude that there is a negligible impact of using Full Mesh aggregation in optical inter-domain networks. However, network operators should be aware that using increased aggregation will have an impact on pathfinding, producing both false-positives, and false-negatives. In future simulations we are are planning to add crank-back algorithms, updating delay, and mixing aggregation strategies in the inter-domain network.

Simulation Results

The results in our experiment show a clear division in the data. Initially the inter-domain resource usage grows linearly, shown on the left. After the network fills to about 60%, the growth slows, and continues logarithmically, shown on the right.
Full is the control, using full topology information, all others are results from the aggregation strategies.
The *FM No Update* is the Full Mesh aggregation, without any intermediate updates on the availability of internal links. In all cases full information on the inter-domain network is available to the pathfinding algorithm.





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