Dyamic Network Control

Thir sreport summarizes loose ideas in view of dynamic control of networks. These ideas are connected to initial works done in the context of optimization of network configurations. In the latter, the search is aimed at finding those network architectures that are most easily converted to another configuration (which is well-performing under certain environmental conditions) by means of node and edge addition and deletion. Put otherwise, this initial work is aimed at finding the best initial configuration from where all possible target configuration can be reached most efficiently. Within this context, we can call this flexibility. The following stages in development are in progress:

* Stage 1: Define target configuration by architectural definition. E.g. 3-node hubs, 5-node hubs, line, star,... This assumes that (1) the target configurations satisfy certain targeted objectives for network performance (e.g. efficiency, robustness) and (2) that an exact link function exists which links target configuration with expected performanc
* Stage 2: Here, the previous assumption, namely that the link between architectural definition and network objectives is know, is omitted.
* Stage 3: Here, an integral objective is created which puts the flexibility, robustness and efficiency into one weighted objective function

The description above is only made to set the scope. It is clear that from the discussion above, best initial configurations can be found. Yet, it is not immediately clear how one should move from one configuration from the other. Indeed, the flexibility is measured as the number of nodes/edges that need to be deleted and added without perspective in which order this should be done. However, one can argue that a robust way of reconfiguration is to add all additional nodes/edges first and then to remove those that can be deleted. Given that a maintenance cost can be associated with all active nodes and edges, one can easily see that this is also the most costly way of reconfiguration, i.e. the least efficient path to the new reconfiguration. Alternatively, the most efficient way is to delete all unnecessary edges/nodes first and then add all those necessary. Clearly, this is the least robust fashion of reconfiguration. As such, a need exists to define an optimal way of reconfiguration given the bargain weights for robustness and efficiency throughout the reconfiguration period.

Also in this case, a stage-wise procedure is likely to lead to the best understanding:

* Stage 1: Assume that current network and target network are both completely known and assume that the transition will be completed no matter how, i.e. the target configuration is not changed during he transition period. Now find the sequence of transitions that give the optimal balance between efficiency and robustness given the bargain weights. For additive costs, a dynamic programming approach can be used to order the sequence.
* Stage 2: Remove the assumption that the target network is completely known, i.e. one does not know the exact configuration of the final network. One does know the target minima for robustness and efficiency of the final network and one does know the target minima throughout the transition period. The dynamic programming needs to be adjusted for a different objective and for absence of knowledge of finality, i.e. one does not know the number of sequences to be made.
* Stage 3: Remove the assumption that the target is reached first before a new target can be set.