Multicast Routing under Optical Network Constraints

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Extended Abstract

We consider all-optical multicasting. All-optical networks offer low delay and high bandwidth to data transmission. Light-path routing in such kind of network must take into account specific light wave constraints (wavelength continuity over a light channel, wavelength uniqueness in one optical fiber, etc). We can forecast multicasting into all-optical networks may benefit of the same advantages and constraints. Moreover multicast routing in all-optical networks becomes a difficult issue when the light splitting capacity of some optical switches is limited. In an all-optical network it is likely that some optical switches will have limited or no light splitting capacity because of the cost and complexity of light splitter devices. Indeed the computation problem of the minimum cost multicast routes under optical constraints is NP-difficult.

To compute multicast routes, most of the multicast algorithms propose to use light-trees or a set of trees called light-forest. To solve the optimal multicast routing problem under physical constraints, we propose a new all-optical multicast structure, called light-hierarchy. In a light-hierarchy, the multicast route can traverse the same optical switch several times using the same wavelength. Ligth-hierarchy improves the quality of multicast routing in sparse splitting WDM networks. A light-hierarchy is a set of consecutive and directed fiber links occupying the same wavelength, which is rooted from the source and terminated at some destinations. A same node may appear several times in a light-hierarchy. Different from a light-tree, a light-hierarchy structure accepts cycles. It benefits of the Cross Pair Switching capability of Multicast-Incapable (MI) nodes: an MI node may serve several destination nodes on the same wavelength through different input and output port pairs. Light-hierarchy structure overcomes the inherent drawback of the traditional light-tree structure, so that the splitting constraint is relaxed to some extent. This is why it outperforms the light-tree in term of cost. We showed that the optimal multicast structure for minimizing the wavelength channel cost is not a set of light-trees, but a set of light-hierarchies rooted at the source. Numerical results verified that the light-hierarchy structure is the cost optimal solution for all-optical multicast routing with sparse splitting constraint. Using light-hierarchies, fewer wavelengths on average are required for establishing a set of multicast sessions.