

Graph augmented protection algorithms for multicast sessions against single link failures

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ABSTRACT

In this thesis, we study the problem of enhancing the survivability of the multicast tree in a network when a single link failure occurs. Due to the incremental demand for multicast in networks, how to enhance the survivability against link/node failures becomes an important issue. Current research on this topic often used edge-disjoint path-pairs to construct a survivable multicast tree. This approach may lead to the increase the length of primary transmission paths and then transmission delays. Therefore, in this thesis, we try to improve the survivability for an already built multicast tree. In other words, for a best suitable multicast tree, we will try to add as few links as possible to make this tree 2-edge-connected and then against single link failure. According to different link-adding strategies, we get two heuristic algorithms: the first one is Low Cost Survivable Multicast (LCSM), which gives a near-optimal solution; the other one is called Fast Discovery Survivable Multicast (FDSM), which is faster but need more links than LCSM.

Keywords : multicast、 survivable、 2-edge-connected

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REFERENCES

- [1] V. S. Irava, and C. Hauser, "Survivable Low-Cost Low-Delay Multicast Trees", in Proceedings of the IEEE Global Telecommunications Conference, pp. 110-115, Dec. 2005.
- [2] N. K. Singhal, L. H. Sahasrabudhe, and B. Mukherjee, "Provisioning of survivable multicast sessions against single link failures in optical WDM mesh networks," Journal of Lightwave Technology, vol. 21, no. 11, pp. 2587 – 2594, Nov. 2003.
- [3] J. W. Suurballe, "Disjoint paths in a network," Networks, vol. 4, pp. 125 – 145, 1974.
- [4] T. Mashima and T. Watanabe, "Graph augmentation problems with degree- unchangeable vertices," IEICE Trans. Fundamentals, vol. E84-A, no. 3, pp. 781 – 793, March 2001.
- [5] S. Khuller and R. Thurimella: Approximation Algorithms for Graph Augmentation. J. Algorithms 14(2), pp. 214-225, 1993.
- [6] T. Fukuoka, T. Mashima, S. Taoka, and T. Watanabe, "A linear time algorithm for bi- connectivity augmentation of graphs with upper bounds on vertex-degree increase," IEICE Transactions, 88-A(4), pp. 954-963 2005.

- [7] J. Cheriyan and R. Thurimella, "Fast Algorithms for k-shredders and k-node connectivity augmentation," *Journal of Algorithms*, vol. 33, no. 1, pp. 15 – 50, Oct. 1999.
- [8] J. Bang-Jensen, M. Chiarandini, and P. Morling, "A computational investigation on heuristic algorithms for 2-edge-connectivity augmentation," *Networks*, in print.
- [9] R. Bhandari, *Survivable Networks: Algorithms for Diverse Routing*, Springer, 1999.
- [10] A. Fei, J. Cui, M. Gerla, and D. Cavendish, "A dual-tree scheme for fault-tolerant multicast," in *Proceedings of IEEE International Conference on Communications*, vol. 3, pp. 690 – 694, June 2001.
- [11] S. Ramamurthy and B. Mukherjee, "Survivable WDM mesh networks, part I—Protection," in *Proc. IEEE INFOCOM*, vol. 2, Mar. 2003, pp.744-751.
- [12] T. H. Corman, C. E. Leiserson, and R. L. Rivest, *Introduction to Algorithms*, 2nd ed. Cambridge, MA: MIT Press, 2001.
- [13] H. Takahashi and A. Matsuyama, "An approximate solution for the steiner problem in graphs," *Math. Japonica*, pp. 573 – 577, 1980.
- [14] N. K. Singhal, L. H. Sahasrabudhe, and B. Mukherjee, "Provisioning of survivable multicast sessions against single link failures in optical WDM mesh networks," *Journal of Lightwave Technology*, vol. 21, pp.2587-2594, 2003.
- [15] S. L. Hakimi, "Steiner 's problem in graphs and its implications," *Networks*, vol. 1, no. 2, pp. 113 – 133, 1971.
- [16] C. Lu and L. Li, "Shared protection in multicast optical networks," *Communications, Circuits and Systems*, pp.577-581, 2008.