A Hierarchical Algorithm for Link-Sharing, Real-Time and Priority Services

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The emerging integrated services networks will support applications with diverse performance objectives and traffic characteristics. While most of the previous research on integrated services networks has focused on guaranteeing QoS, especially real-time requirements, for each individual session, several recent work has argued that it is also important to support hierarchical link-sharing service.

With hierarchical link-sharing, there is a class hierarchy associated with each link that specifies the resource allocation policy for the link. A class represents some aggregate of traffic streams that are grouped according to administrative affiliation, protocol, traffic type, or other criteria.

In this paper, we study hierarchical resource management models and algorithms that support both link-sharing and guaranteed real-time services with decoupled delay (priority) and bandwidth allocation. We extend the service curve based QoS model, which defines both delay and bandwidth requirements of a class, to include fairness, which is important for integration of real-time and hierarchical link sharing services. The resulting Fair Service Curve link-sharing model formalizes the goals of link-sharing and real-time services and exposes the fundamental tradeoffs between these goals. In particular, with decoupled delay and bandwidth allocation, it is impossible to simultaneously provide guaranteed real-time service and achieve perfect link-sharing. We propose a novel scheduling algorithm called Hierarchical Approximating Service Curve (H-ASC) that approximates the model closely and efficiently. The algorithm always guarantees the performance for leaf classes, thus ensures real-time services, while minimizing the discrepancy between the actual service provided to the interior classes and the services defined by the Fair Service Curve link-sharing model. We implemented the H-ASC scheduler. By performing simulation and measurement experiments, we evaluate the link-sharing and real-time performances of H-ASC, and determine the computation overhead.