Conductor: Enabling Distributed Adaptation

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Trend: Heterogeneous Networks

- Household networks
- Internet appliances
- Peer-to-peer applications

Heterogeneous networks benefit from Distributed Adaptation:
- Adapt at various points within the network.
- Use multiple adaptors to solve multiple problems.
- Coordinate adaptations to ensure the desired effect.

Reliability and Adaptation

Adaptation voids the assumption that data is immutable during transmission and introduces new points of failure. Semantic segmentation integrates adaptation and reliability, providing exactly-once delivery of semantic content. Semantic segmentation allows adaptors to express a correspondence between pre- and post-adapted data. Adaptors can also express appropriate points at which adaptation changes can occur. Segmentation is dynamic, automatic, and based on adaptation and data types. Segmentation for a sample HTML adaptation is shown below:

Example 1: Prioritization of Secure Web Traffic

By giving priority to the interactive traffic, Conductor allows nearly the optimal throughput, despite the software downloaded, while also encrypting the data.

Notice that end-to-end encryption would disallow prioritization, which requires access to the stream.

Results were obtained using three real-world web pages: the Apple home page, a Slashdot article, and a photo gallery.

Example 2: User-to-User Photo Sharing

By drastically reducing the image quality, Conductor allows a photo gallery to be downloaded in significantly less time.

While this adaptation would not be appropriate in all cases, Conductor gives the user control over selected adaptation.

Results were obtained from pages containing three different image sizes.

Conductor and Distributed Adaptation

Conductor helps applications provide graceful degradation services in the face of heterogeneous networks with varying bandwidth, latency, jitter, security, reliability, and monetary cost.

Conductor provides an adaptation framework that can be incrementally deployed at a subset of network nodes. Client-server communications are intercepted on the client node and routed through Conductor-enabled nodes, allowing adaptation to occur at various points within the network.

Conductor includes a mechanism for automatic selection of adaptors based on prevailing end-to-end network conditions. This mechanism must be secured to ensure user control over selected adaptations. Conductor must provide a variety of levels of security for different users and different streams. Since Conductor crosses administrative domains, a variety of authentication mechanisms must be supported.

The secure planning protocol depicted below ensures:
- The selected security mechanism is used by the planner.
- Trusted nodes can be identified.
- Untrusted nodes cannot influence planning.
- An authentic plan can be deployed.