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ADAPTIVE TRAFFIC MANAGEMENT MODEL FOR INTERNET/ELECTRONIC COMMERCE

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Abstract

The success of E-commerce critically depends on the reliability of the Internet, and the speed with which real-time data and multimedia applications may be allowed to transmit over it. This would require an effective strategy for Internet Traffic Management. The paper suggests the Resource ReSerVation Protocol (RSVP), a standard developed by the Internet Engineering Task Force (IETF), as a suitable solution for handling time-critical traffic.

Introduction

The heavily subsidised creation of subnetworks for science and research, falling access costs and the broad availability of early implementations of the corresponding transmission protocols has led to an exponential growth of the *Internet*.

However, this external growth has also drastically aggravated the allocation problem with regard to scarce bandwidth resources. When the network becomes congested, the Internet packet switching technology causes considerable delays in data transmission time for all users. Traditional applications like electronic mail or file transfers can react in an elastic fashion to such deviation in available bandwidth. On the other hand, new time-critical applications like medical imaging, voice transmission and video conferencing cannot, therefore causing employment to be severely limited in such situations. The paper aims to analyse the Internet Model and discuss the suitability of RSVP for E-commerce.

The Internet Model

Say a certain web-site experiences a certain number of hits from different IP addresses each day. If a hit is defined as an object (Web page, graphic object, Java or ActiveX control object, etc.), the connection model may be thought to resemble an art project where each nail on the board is an IP address or Internet Object (see Figure 1 below) [1].

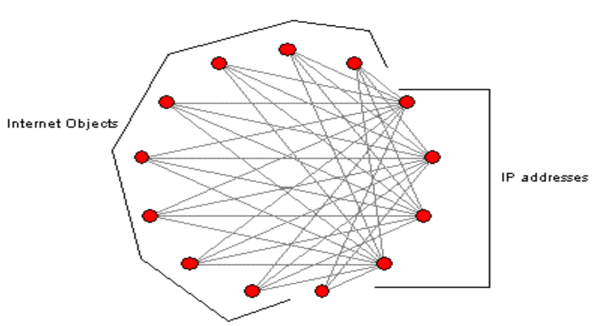

Figure 1 Over-simplified Internet Model

Each string between the IP address and Internet object is a packet path.

The structure of the model can now be improved to better represent the true nature of the Internet (see Figure 2). It is rare for any packet to travel only a single hop (straight path) to its destination. Instead, we need to add new nails to the board, defining points that the string needs to pass through to get to the final destination; each nail therefore represents a router or switch on the Internet.

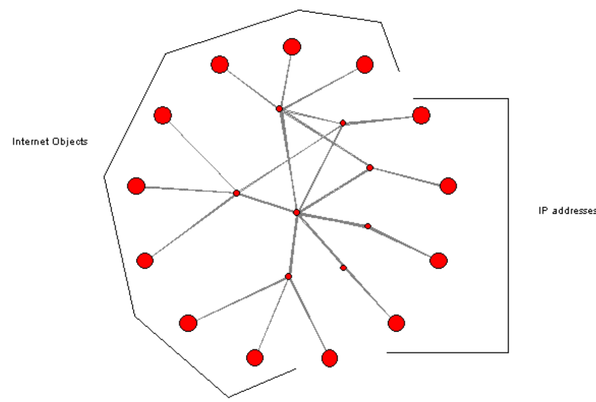

Figure 2 Simplified Internet Model

As we add each string or packet/path, the router at each intermediary point requires enough capacity to allow each packet to pass through. Let us think of the router as a nail that is a few inches in height. Each packet is like a string. When it passes through the router, it takes a little of the vertical space on the nail. At some point, the space is filled. This means leaving incoming packets will disappear from the network when this congestion point is reached. As more packets are forced through a given router, the probability of that router's capacity overflowing increases, just as forcing a number of strings onto the same nail would fill the nail to capacity.

Since the Internet is actually a dynamic space, each packet occupies space in the router for an instance, but the sheer numbers of packets passing through the Internet makes this problem very tangible and similar to the string and nail in the artwork project. This demonstrates the topology and throughput problem of the Internet.

A Fresh Look

A fresh look would be useful here. Perhaps it is time to build super-fast routers supporting 100 gigabits per second or higher speed links. Maybe we should use a high degree of parallel processing and “very wide switch architecture instruction sets” to help achieve the target high performance. Since signalling for Quality of Service (QoS) tends to be complicated, we may just construct simple "tolled" network highways for premium services, or deploy "traffic conditioners" capable of managing network bandwidth automatically. If router buffers will never be large enough to handle the large number of expected TCP flows, maybe routers should restrict the number of allowed connections, or even better, deploy link-flow to avoid buffering at all!

Resource ReSerVation Protocol (RSVP)

The Real Time Protocol (RTP) can carry real time traffic across a TCP/IP network. Real time traffic usually has tight time constraints, and must reach its destination within a certain time period. On its own, RTP is at the mercy of the Internet Protocol's delivery service, and IP is an unreliable protocol, as it only makes a *best effort* to deliver data. RSVP comes to aid by reserving network resources. Once reserved, these resources are dedicated to the application.

RSVP is a protocol through which the receiver can request a resource reservation along the path between the source and the receiver for particular data streams or flows. Routers establish and maintain state to provide the requested service, and deliver QoS control requests to all nodes along the path.

Working

Figure 3 shows a real-time video stream for Electronic Commerce traversing the network. To keep the video acceptably smooth, say the application requires 31 Mbit/s (30 frames/s * 1024000 bits) of network bandwidth. A router inside the network must support the video traffic as well as other traffic on the network. As the Figure shows, say a separate file transfer is temporarily peaking at 30 Mbit/s. Since the ATM network only has an access rate of 51 Mbit/s (< [31+30] Mbit/s), the router cannot support both traffic flows at flow speed. To efficiently share the limited resource of 51Mbps, it would be better for the router to maintain the video transfer of 31Mbps by limiting the file transfer to 20Mbps. The file transfer will take longer but will still be acceptable. Many routers are capable of making the `right' allocation of bandwidth, but they have to know what that allocation is. That is where resource reservation comes in.

With resource reservation, an application gives advance notice of the network resources (say 31Mbps for the real time video) that it requires while the affected hosts and routers commit to providing these resources. Resource reservation can also indicate when the necessary resources are not available. E.g. If the real time video tried to reserve 62 Mbps of bandwidth, the routers would refuse the reservation because the network, with 51 Mbps ATM link, clearly cannot support that requirement.

Critical Issues

RSVP supports multicast or unicast simplex data delivery. It handles heterogeneous receivers. It is receiver-oriented and is not a routing protocol. It adapts to changing group membership as well as changing routes. In many ways RSVP provides a unique architecture for applications to secure reservations for QoS over the network elements (routers, switches etc.). RSVP can be implemented on top of any routing protocol.

However, RSVP has certain limitations of its own. It needs the help of other protocols (like RTP) to operate. Unlike services like ATM, RSVP can only request for allocation of resources. It cannot guarantee that these resources will be available. RSVP is not of much use with non-RSVP compliant routers. A router must be capable of separating streams so that it can give priority to real-time traffic and forward it before forwarding data traffic, for example. Upgrading all routers to comply with the RSVP protocol is a time-consuming and costly affair.

Conclusions

Internet congestion is a critical hurdle in the effective transfer of data for electronic real-time transactions in the Internet. The paper showed how RSVP can be promising in this regard.

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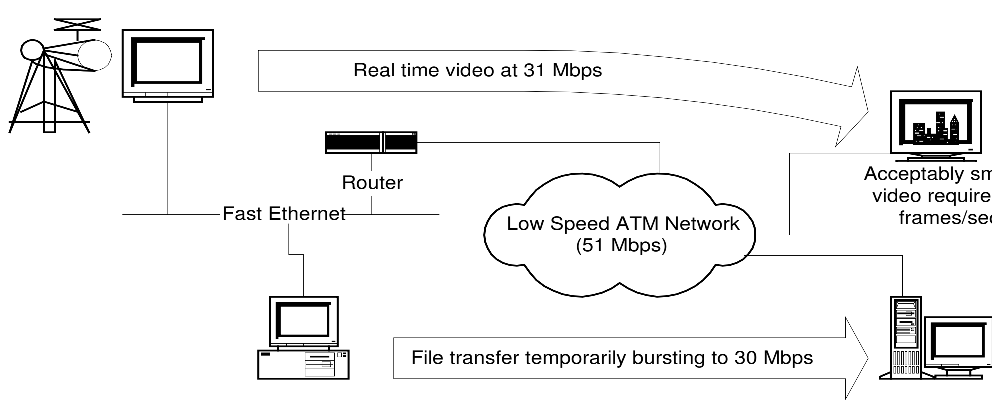

Figure 3 Real-time Video Application for E-commerce – an example