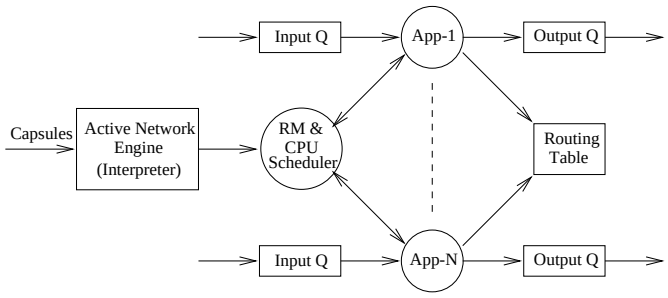

Figure 1: Active Application Gateways

1 Project Description

1.1 Active Network

Under an NSF grant titled "Communication Experiments for Widely Distributed Environments", we have conducted experiments over wide-area network environments for emerging applications. We have developed a WANCE (Wide Area Network Communication Emulation) tool [ZB93]. We have developed a scheme called MpTP (Multi-pass Transmission Policy) for effective transmission of large multimedia data. Based on our experimental study, we are designing and implementing an active network architecture that will provide a dynamically adaptable, programmable, and extensible execution environment for video packets processing. Specifically, we plan to design protocols and experiment with adaptable routing, flow control, and congestion control that will exploit the network's computational capabilities to enhance performance and provide a custom tailored service to users.

An active network traffic analysis tool which combines the emulation [ZB93] and simulation approaches is being developed. The tool consists of four modules: *network simulator/emulator*, *event scheduler*, *active router simulator/emulator* and *active script evaluator*. The tool will be used for the followings:

- Study various active techniques to achieve the adaptability of internet traffics, including self-transforming packets, self-identifying packets, selective automatic retransmission, etc.
- Design and evaluate protocols for stream synchronization, buffering, and traffic control that will use computational capabilities of active networks.
- Performance evaluation and prediction effort to evaluate, predict, and optimize the performance of the synchronization mechanisms, and traffic control algorithm.

Active networks open up opportunities for new Quality of Service (QoS) control strategies. For example, QoS parameters and other application-level parameters can be dynamically tuned on each individual node along the communication path. QoS tradeoffs (e.g., tradeoff between CPU load and network bandwidth) can be conducted at any node simultaneously, based on its current working state. Traffic at heavily congested nodes can be detoured to less congested nodes at run time. Various policies can be defined and enforced dynamically at different nodes to quantify the QoS tradeoff, routing services, or the integration of the two.

1.2 Electronic Commerce

We are experimenting with stock trading transactions and their impact on communication and bandwidth. We are studying the impact of active networks on the QoS requirements (Timeliness, Accuracy and Precision) of this application. Figure 1 shows an experimental active network prototype on top of our campus network [LB97].

The active network consists of a set of active application gateways, a set of end systems, and a set of dispatchers all of which can be placed on arbitrary network nodes. Such an active network

is virtual because it does not exists physically; it is built on top of conventional IP networks. The end users are aware of the logical entities (e.g., routes, connections) in the active network. To avoid kernel changes within the routers of an active network and super user permission, we use UDP instead of IP as the networking service initially. The active gateway will be incorporated into the adaptable NV software.

Contribution Claims

Our experimental research in active network directly addresses IBM key technology interests in communications technology and development and issues in Electronic Commerce and Internet II. The innovative technologies that will be developed in the project include:

1. A new class of routing, congestion control, and QoS provision algorithms that will exploit the user-programmable features of active networks to provide a tailor-made QoS and communication services to applications such as electronic commerce.

2. A software infrastructure which allows rapid deployment of active network technologies among the network nodes for the purpose of testing and tuning the performance of the protocol parameters and deployment/testing of the new technologies with the existing protocols.

3. New mechanisms for adaptability in active networks will be proposed and evaluated. Those mechanisms will enable both the applications and network software to respond to traffic, congestion and bandwidth anomalies and reconfigure the network to adapt to the new situation based on some QoS requirements.

IBM contacts

Shunge Li, a PhD student in our Lab, was an intern at IBM in 1996 under the supervision of Mr. Joe Benas at IBM Poughkeepsie, NY and have been actively interacting with researchers in IBM. We are also in touch with Dr. Liba Savadova at IBM Zurich, Switzerland. I plan to visit her in July 1998.

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We will electronically transmit the reports of the research results to IBM.

References

[LB97] Shunge Li and Bharat Bhargava. Active Gateway: A facility for video conferencing traffic control. In *Proceedings of IEEE COMPSAC'97*, August 1997.

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