GOA COLLEGE OF ENGINEERING

"Bhausaheb Bandodkar Technical Education Complex"

Tutorial No: 3

Q1) Implications of ATM networks on distributed systems

The availability of ATM networks at 155 Mbps, 622 Mbps, and potentially at 2.5 Gbps has some major implications for the design of distributed systems. For the most part, the effects are due primarily to the enormously high bandwidth suddenly available, rather than due to specific properties of ATM networks. The effects arc most pronounced on wide-area distributed systems.

To start with, consider sending a 1-Mbit file across the United States and waiting for an acknowledgement that it has arrived correctly. The speed of light in copper wire or fiber optics is about 2/3 the speed of light in vacuum, so it takes a bit about 15 msec to go across the US one way. At 64 Kbps, it takes about 15.6 sec to pump the bits out, so the additional 30 msec round-trip delay does not add much. At 622 Mbps, it takes 1/622 of a second, or about 1.6 msec, to push the whole file out the door. In the best case, the reply can come back after 31.6 msec, during which time the line was idle for 30 msec, or 95 percent of the total. As speeds go up. the time-to-reply asymptotically approaches 30 msec, and the fraction of the available virtual circuit bandwidth that can be used approaches 0. For messages shorter than 1 Mbps, which are common in distributed systems, it is even worse.

The conclusion is: For high-speed wide-area distributed systems, new protocols and system architectures will be needed to deal with the latency in many applications, especially interactive ones. Another problem is flow control.

Suppose that we have a truly large file, say a videotape consisting of 10 GB. The sender begins transmitting at 622 Mbps, and the data begin to roll in at the receiver. The receiver may not happen to have a 10 GB buffer handy, so it sends back a cell saying: STOP. By the time the STOP cell has gotten back to the sender, 30 msec later, almost 20 Mbits of data are under way. If most of these are lost due to inadequate buffer space, they will have to be transmitted again. Using a traditional sliding window protocol gets us back to the situation we just had, namely, if the sender is allowed to send only 1 Mbit and then has to wait for an acknowledgement, the virtual circuit is 95 percent idle. Alternatively, a large amount of buffering capacity can be put in the switches and adaptor boards, but at increased cost. Still another possibility is rate control, in which the sender and receiver agree in advance how many bits/sec the sender may transmit. A different approach to dealing with the now-huge 30 msec latency is, to send some bits, then stop the sending process and run something else while waiting for the reply.

The trouble with this strategy is that computers are becoming so inexpensive, that for many applications, each process has its own computer, so there is nothing else to run. Wasting the CPU time is not important, since it is cheap, but it is clear that going from 64 Kbps to 622 Mbps has not bought a 10,000-fold gain in performance, even in communication-limited applications. The effect of the transcontinental delay can show up in various ways. For example, if some application program in New York has to make 20 sequential requests from a server in California to get an answer, the 600-msec delay will be noticeable to the user, as people find delays above 200 msec annoying.

Alternatively, we could move the computation itself to the machine in California and let each user keystroke be sent as a separate cell across the country and come back to be displayed. Doing this will add 60 msec to each keystroke, which no one will notice. However, this reasoning quickly leads us to abandoning the idea of a distributed system and putting all the computing in one place, with remote users. In effect, we have built a big centralized timesharing system with just the users distributed. One observation that does relate to specific properties of ATM is the fact that switches are permitted to drop

cells if they get congested. Dropping even one cell probably means waiting for a timeout and having the whole packet be retransmitted. For services that need a uniform rate, such as playing music, this could be a problem. (Oddly enough, the ear is far more sensitive than the eye to irregular delivery.) As a consequence of these and other problems, while high-speed networks in general and ATM in particular introduce new opportunities, taking advantage of them will not be simple. Considerable research will be needed before we know how to deal with them effectively.