

Killer app? It's the high-speed backbone



Through his work with NASA, Raj Jain has been involved with the world's fastest over-the-air asynchronous transfer mode network using synchronous optical network (Sonet) transmission.

Jain is helping NASA's Lewis Research Center in Cleveland, Ohio, identify and develop traffic management schemes for high-latitude paths. The center operates an experimental ATM network at up to a 622-megabit/sec OC-12 speed between Cleveland and Seattle, over links supplied by NASA's Advanced Communications Satellite.

Jain, a native of India, is a professor in the computer sciences department at Ohio State University in Columbus. Before joining the

university last year, he worked for 16 years at Digital Equipment Corp. He received his doctorate in computer science from Harvard University in 1973 and has taught graduate courses in performance analysis at Massachusetts Institute of Technology.

Jain writes extensively on network performance. He received a Computer Press Association award for his 1991 book, *The Art of Computer Systems Performance Analysis*, published by John Wiley & Sons. His latest book, the 576-page *EDGE Handbook*, was published last year by Addison-Wesley.

Sam Mariani, GCM's senior editor for communications and internetworking, interviewed Jain by telephone.

CBR compression with CBR transmission, CBR compression with VBR transmission, VBR compression with CBR transmission and VBR compression with VBR transmission. All four combinations will work, but they have different levels of complexity.

If you compress something as CBR and transport it over a VBR network, the receiver will wait until it has gotten all the bits. The easiest method is to have CBR compression and CBR transmission. Then the receiver doesn't have to wait, and everything comes right on time. This is the method used currently on leased lines.

On ATM networks, it will be CBR compression and VBR transmission. Given a choice, users don't want variable-quality video—that is, CBR compression, they want constant-quality video, or VBR compression. They would prefer that the provider worry about transmitting variable bits. This is a fight between user and supplier. If somebody came up with good-quality VBR transmission and constant-quality VBR compression, I'm sure people would go for it.

GCM: "Bursty" LAN transmission is growing exponentially. Will available bit rate [ABR] be the hot thing in ATM service in the future?

JAIN: It depends on how long a time you're talking about. The answer clearly is yes in the 1996-97 period. But the more distant future may bring other things that are not what today we call data, such as multimedia.

GCM: Does multimedia require ABR, CBR, VBR or UBR (unspecified bit rate)?

JAIN: It's something between VBR and ABR. Actually, there are two possibilities here, but obviously it's not CBR or UBR. If somebody designs a service between VBR and ABR, then that could be the choice.

GCM: So is UBR useless?

JAIN: No. UBR is designed for such applications as monitoring a remote site over video. Or you're doing network monitoring and you don't receive one packet, but maybe the next packet will give you the information. There are lots of applications where great reliability isn't required, because there's so much redundancy in the information. That's where UBR is useful, but it's not a major market. If your product supports ABR alone, it will sell—but not if it supports just UBR.

GCM: ATM cells are unloaded and then reloaded into Sonet frames at each switching node. Why not just have switched Sonet rather than ATM?

JAIN: Actually, you need a combination of ATM and Sonet. Both have good points, but there are design points in between. Sonet probably wins out in some of the high-speed applications. I would encourage government research agencies to look into the alternatives. ATM works, but it may not be the optimal solution for all distances and all speeds.

GCM: Will ATM win in the LAN and WAN?

JAIN: In the LAN, ATM will have heavy competition from the two new 100-megabit/sec Ethernet standards. But on the backbone, the competition against ATM will be less, and still less on the WAN.

If anybody expects to put in a production network this year, they'll have lots of surprises. If you do it this year, stick with one vendor. As soon as you start mixing vendors, you start hitting holes that the ATM Forum and other standards bodies are trying to fill.

GCM: Interoperability was a big issue with Integrated Services Digital Network services. How big an issue is it with ATM?

JAIN: It's even more of an issue with ATM because none of the previous technologies covered as much space as ATM is covering. For instance, when we work with Ethernet, we worry only about a small area that we control, not about decisions other people are making in other areas. But with ATM, everything is working together. It's very important that things interoperate.

GCM: ATM vendors are starting to support LAN emulation, but is there interoperability with the various implementations?

JAIN: LAN emulation interoperability is in exactly the same position as any another service. The LAN emulation group in the ATM Forum is working on a standard everyone will implement. When UNI 4.0 comes later this year, it will include LAN emulation, and maybe next year's products will be interoperable. If you see LAN emulation this year, it's proprietary. The same goes for congestion control and traffic management.

LAN emulation requires services like traffic management, which is being standardized right now. So although LAN emulation is pretty far along in terms of standardization, there still are questions like how you manage the traffic. I'd say we will see interoperable products the latter part of next year.

GCM: The Defense Department generally has invested in dedicated networks. Should it do the same with ATM?

JAIN: For DOD, the issue probably is security. It may not want to share the network. For DOD, security often outweighs every other consideration, but the other departments have to worry about other technical issues.

I'd say if [DOD] sticks with one vendor, things might work. But I know of a customer who stuck to one vendor, and when the ATM products were put onto a production network, things didn't work out. There was no traffic management, no congestion control. So the ATM products had to be taken off the network, and the old stuff had to be put back.

GCM: We've got two standards bodies, the International Telecommunications Union and the ATM Forum. The latter is moving faster than ITU. Is there a danger here?

JAIN: This is a very sensitive issue. Nobody in an official position would agree that there are two standards bodies. The ATM Forum isn't officially a standards body, yet practically speaking, the forum is doing things that go beyond interoperability. So yes, there is a danger here. Does a product satisfy one or both of the standards? It would be nice if we could control things and have just one body, because right now we see proposals going to both bodies and getting rejected by one and not the other.

GCM: If ATM is going to be cheaper than leased lines, then what inducement do the carriers have to offer ATM, and how are they going to make any money from it?

JAIN: It's a matter of volume. The way the computer industry makes money today is by selling lots of computers, whereas previously

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it sold fewer computers with less performance at higher cost. The same thing is going to happen in telecommunications.

The volume of traffic, particularly data traffic, is going to be several orders of magnitude greater than voice traffic today. Carriers will make money because of the volume.

GCM: To store video economically, it must be compressed. Is variable bit rate (VBR) ATM or constant bit rate (CBR) ATM more suitable for video?

JAIN: There are several possible combinations. You can compress video for CBR so every frame results in the same number of bits, or compress it for VBR so each frame results in a different number of bits, depending upon what was in the previous frame.

With CBR compression, the video quality varies. VBR compression results in constant video quality.

Both types of video streams can be sent over a network with either CBR or VBR transport. The choice of compression and the transport are independent.

So there are four possible combinations:



GCM: Will we see ATM take hold first in the LAN or in the WAN?

JAIN: We should see it in the LAN first, because very few technologies go downward from the WAN to the LAN. Most of them start in the small area, then move on the wide area. I expect the same will happen for ATM. But there's also a middle area, the campus, which needs more bandwidth but doesn't have that many solutions for it.

So the right answer would be the campus backbone, where the only current solution is a 100-megabit/sec Fiber Distributed Data Interface network.

GCM: You've said a technology must meet several criteria to succeed—one being that it should have a killer application. What's the killer app for ATM?

JAIN: People say the killer app for ATM will be multimedia, and that might be true. But at this time, the killer app is the backbone where there is a need for high speed. What will happen is that as ATM satisfies that need and the prices come down to start competing with other technologies, then ATM for multimedia will become more of a requirement.

GCM: The government has been a big driver behind ATM. Is it time for most agencies to seriously consider using ATM?

JAIN: In every agency, you have people who look ahead and plan for the future, and then there are people who have to see what's there that they can use today for networking. What is being done with ATM today is experimental rather than production in nature.

The standards for ATM are still coming out. This year we'll have the User-Network Interface (UNI) Version 4.0 standard, which will bring more compatibility, interoperability and so on. ATM isn't yet in a production mode. About the middle or end of 1996 is when the production units are expected. They will be standards-compliant and interoperable, and they will have congestion control and traffic management.