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# The Elusive Last Mile to the Internet

V. Sridhar

Indian Institute of Management, Lucknow, India

Piyush Jain

Indian Institute of Management, Lucknow, India

## EXECUTIVE SUMMARY

As organizations continue to Web-enable mission-critical network-centric information systems, reliable and high bandwidth connectivity to the Internet is essential. While glut of Internet bandwidth is being witnessed in the developed countries, Internet services are still in their infancy in developing countries. Getting high-speed access to the Internet, especially in the remote areas of developing countries, poses challenges due to poor telecommunications infrastructure. With limited bandwidth available from service providers, network managers have to find ways other than simple raw bandwidth increments to meet the increasing demand from the users, especially for improved Web performance. While metrics for measuring Internet performance are being refined by researchers, defining service level agreements with the Internet service providers based on these metrics is challenging, especially in an evolving market. This case highlights the experiences and lessons learned from such an exercise at the Indian Institute of Management located in Lucknow, India.

## ORGANIZATION BACKGROUND

The Indian Institute of Management Lucknow (IIML) is one of the six national-level management institutes set up by the Government of India in Lucknow, India, in 1984. The Institute's mission is to help improve the management of the corporate and the non-corporate sectors and also the public systems in the country, through pursuit of excellence in management education, research, consultancy, and training. In order to fulfill its objectives, the Institute undertakes a diverse range of academic and professional activities.

IIML has a large information technology (IT) infrastructure and has an annual budget of about 16.7 million Indian Rupees (INR) (equivalent to about \$334,000) allocated in recent years for the development of information technology resources. The details of the annual budget allocated for the computer services of IIML for 2002-2003 is given in Appendix A. Students, faculty, and staff of IIML use Internet resources quite extensively for teaching, research, consulting, and administrative activities.

The Institute has about 1,000 computers, connected to the campus intranet spread over a 50-acre campus, situated well outside the city limits. The Computer Center (CC) at the Institute is responsible for all IT services in the campus. CC employs one manager and six system analysts who are involved in the maintenance of IT services of the Institute.

Students, faculty, and staff of IIML use Internet resources quite extensively for teaching, research, consulting, and administrative activities. The IIML website (<http://www.iiml.ac.in>) is viewed by prospective students, alumni, researchers, and scholars at various institutions and corporations around the world. The website also provides information to about 120,000 potential candidates who apply every year for the MBA program offered by the Institute. Apart from World Wide Web (WWW), e-mail is another Internet application widely used by faculty, students, and staff of the Institute. E-mail communication by students and faculty spans across geographical boundaries and is one of the mission-critical Internet services of the Institute.

## SETTING THE STAGE

There were 142.3 million Internet users in the U.S. in 2001, representing 49.95% of the population (ITU, 2002). By contrast, in developing countries such as India, there were 7 million Internet users who represent 0.69% of the population. However, the Internet service provider (ISP) industry has seen a phenomenal growth of subscriber base at a Compounded Annual Growth Rate (CAGR) of 41.13% over the period 1998-2002, thanks to deregulation and competition introduced by the Indian government in 1998. The ISP market is still in its infancy in India. While the U.S. and other developed countries boast of glut in Internet bandwidth, the domestic bandwidth in India crawls at 2.5 Gbps and the international bandwidth at 3 Gbps (Voice & Data, 2002). Educational Institutes in the U.S. and other developed countries typically have very high Internet access bandwidth in the order of 1.5 to 45 Mbps (Utsumi & Varis, 2003). Because of a low level of Internet infrastructure development in the area, IIML was only able to get a meager 64 Kbps Internet connectivity from the erstwhile government-owned monopoly operator, Bharat Sanchar Nigam Limited (BSNL), in 1997.

A typical Internet connection to a campus network, such as that of IIML, includes an access loop normally referred to as “last mile” to the Internet point of presence (POP). The “last mile” connectivity is typically provided by the basic telecom operator (BTO), (similar to the local exchange companies in the U.S.). The Internet consists of many individually managed networks that are interconnected to each other. The ISPs have “peering” arrangements among themselves for exchange of Internet traffic. In India, the erstwhile monopoly BSNL has the largest Internet backbone network in the country. The new entrants typically have interconnect agreements with BSNL. The ISPs have been allowed to deploy their own international gateway (satellite or submarine optic fiber

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