



maintain networks, should be minimized by developing automated network engineering and management.

**Current HEP Capabilities**

**Evolution to 2006**

**HEP Goals**

## *The Role of Industry in HEP Networking R&D*

Wherever possible, high-end science takes advantage of capabilities that are developed and commercialized by industry. For example, the HEP community has benefited from cost reductions and reliability increases provided by industrial commercialization of individual middleware components, such as databases and well-defined information systems. Also, the HEP community has benefited from the availability of commercial high-end computing systems, high-bandwidth networks, and extensive middleware. It is likely that higher bandwidth will be more affordable in the future due to economies of scale, greater supply, and competition among providers. Carriers are beginning to make individual wavelengths available to major customers. Affordable links between major HEP computer centers should exceed 10 Gbps within five years and may approach 1 Tbps in less than a decade. However, it is likely to be difficult to exploit the available bandwidth using industry-standard transport protocols. TCP/IP requires fixes such as multiple streams to use today's affordable bandwidth. Additional fixes will be needed to accommodate the expected increases in numbers of users, number of nodes, and network traffic. It is possible to develop a new