Grand Challenges Conference Application

Lawrence H. Landweber
University of Wisconsin – Madison
lhl@cs.wisc.edu

1. "Modeling" the Internet:

The Internet is a system of unprecedented complexity. Over the past twenty years, it has been the subject of a great many studies aimed at better understanding its dynamic behavior. This has involved a variety of methodologies including mathematical analysis, computer simulation, laboratory emulation, real-time measurement, and experimentation on research internets. This research has yielded important insights. However, to date, because of such factors as the scale and diversity of its physical infrastructure, the distributed nature of its administrative control, the distributed operation of its protocols, the variability of traffic patterns, the diversity of applications and users, and, most important, the interplay of these and other factors, a coherent understanding of the Internet's behavior has not been developed.

To solve the problem of "modeling" the Internet, a multi-disciplinary approach including engineers, computer scientists, mathematicians, psychologists, application specialists, and others will be required. In this regard, it should be emphasized that what is intended is not a mathematical model, although this could be one outcome, but rather the development of a deep understanding of the scientific and engineering principles underlying the current Internet, in particular, and distributed communications systems, in general. In addition, the outcomes will help us to formulate the questions and understand the characteristics of systems that will come after the Internet.

This is a suitable Grand Research Challenge for a number of reasons:

- The Internet has become very important to the society at large.
- The scientific challenges are immensely difficult.
- A multidisciplinary approach will be required.
- Results can yield important insights into the behavior of other complex systems.

2. The Future "Internet"

Much of the Internet's technology is now thirty years old and while the system has evolved and grown beyond the wildest dreams of its founders, it is not clear that it can serve as the basis for future communications architectures. For example:

- The diversity of administrative control of network components, has led to serious problems with the routing architecture.
- The Internet does not have adequate support for security and indeed much of its architecture makes the incorporation of such capabilities difficult.
- Introduction of quality-of-service capabilities to support such applications as voice over IP has proven to be unexpectedly difficult.

- Advances in fiber optics technology have led to an explosion in data rates and capacity (in all areas except last mile access).
- The widespread adoption of wireless devices will also likely require new protocols and new types of user interfaces, e.g., incorporating technologies such as holography.

- There were a variety of competing networking technologies in the 1970s and 1980s. The Internet won due to its technical superiority and it would be a mistake to revisit technologies that have been abandoned. Indeed, the Internet's use throughout world, in both commercial and academic settings, is unquestioned. However, given the above points a project that looks into the future with a goal of identifying and accelerating the development of revolutionary new technologies and applications would be a worthwhile Grand Research Challenge.

BIO

Lawrence H. Landweber is Professor Emeritus of Computer Science at the University of Wisconsin – Madison where until July 2001 he held the John P. Morgridge Chair. He has been on the faculty of the University of Wisconsin - Madison since 1967, serving as Department Chair during 1977-79 and 1987-90. He received a B.S. in mathematics from Brooklyn College and a Ph.D. in computer science from Purdue University in 1967. In 1995, he was elected a Fellow of the Association for Computing Machinery.

Landweber is a member of the Board of Trustees of the University Corporation for Advanced Internet Development, the parent of the Internet2 project. He also serves as Chair of UCAID's Network Research Liaison Council. He has been President, Chairman of the Board, and Vice President for Education of the Internet Society. He has been a member of the Computer Research Association Board of Directors, the Coordinating Committee on Intercontinental Research Networks, the Office of Technology Assessment Advisory Panel on Information Technology and Research, and National Research Council committees on Computer-Computer Communication Protocols, The Future of the NREN, and Information Technology Strategy for the Library of Congress.

Since 1977, he has worked in the area of computer networks. An underlying goal has been the development of computer networks to support research and education. His first project, TheoryNet (1977), involved an email system for theoretical computer scientists. TheoryNet was funded by the National Science Foundation (NSF).

In 1979, Landweber proposed establishment of CSNET, the Computer Science Network. The goal of CSNET was to build a network for all U.S. university and industrial computer research groups. Funded by NSF ($5 million for 5 years), CSNET served as the first large-scale validation of the Internet concept. Landweber was Chair of the project's management committee during its early years and also led a technical project that designed and implemented an early network-based directory system, "the CSNET nameserver." By 1984, over 180 university, industrial, and government computer science departments were participating in CSNET. Later, Landweber worked with NSF on the development of the NSFNET regional/backbone model, on the network's acceptable use policy, and on other policy issues. From 1987 to 1992, he led the Wisconsin component of the NSF-DARPA-funded Gigabit Testbed Project.

Landweber has been actively involved in the development of the international academic/research Internet. Beginning in 1982, he helped establish the first network gateways between the U.S. and countries in Europe and Asia. This included development of cooperative relationships between CSNET and national network projects. The informal workshops he began organizing in 1983 led to the International Networking Conference, INET, which since 1992 has been the annual conference of the Internet Society. In his capacity as Vice President of the Internet Society he supported the initiation of the Society's Workshops for Developing Countries. These workshops have been a key factor in the spread of the Internet to developing countries.

Over the years Landweber has served as a technical consultant to a variety of companies, with emphasis on computing and communications technologies. Current activities are concentrated on working, in a variety of capacities with technology and ecommerce startups. He serves on the Board of Directors of four companies and on the Technical Advisory Boards of two others. In addition, in 2000 he co-founded an angel investment group that concentrates on business opportunities in the Midwest.

Among other projects led by Landweber were one of the first Internet protocol implementations (1981-84, IBM VM systems), the first publicly available OSI protocol implementation (1984-87 - UNIX), and implementation of the OSI network management protocol and its secure version (UNIX).