

Protocols for High-Speed Networks
A Brief Retrospective Survey of High-Speed Networking Research
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Abstract

This talk considers high-speed networking research from a historical perspective, and in the context of the development of networks. A set of axioms guiding high-speed network research and design are first presented:

1. Know the Past;
2. Application Primacy;
3. High Performance Paths;
4. Limiting Constraints;
5. Systemic Optimization.

A framework of network generations is used as the basis for the historical development of high-speed networking: 1st Emergence; 2nd Internet; 3rd Convergence and the Web; 4th Scale, Ubiquity, and Mobility. Each generation is described in terms of its application drivers, and important infrastructure and architectural characteristics. Woven into this historical thread are the important research thrusts and sub-disciplines of high-speed networking, and their impact on deployment of the Global Information Infrastructure. Based on this historical perspective, a set of Systemic Optimization Principles are identified:

1. Selective Optimization;
2. Resource Tradeoffs;
3. End-to-End Arguments;
4. Protocol Layering;
5. State Management;
6. Control Mechanism Latency;
7. Distributed Data;
8. Protocol Data Units.

We are now in the state where everything has some aspect of high speed networking, and nothing is only about high-speed networking. This is a double-edged sword? while it reflects the maturity of the discipline, it also means that very few people are looking after the performance of the entire Internet as a system of systems. Rather, performance analysis tends to be isolated to individual network components, protocols, or applications. Furthermore, the high-speed networking community is not pushing back at the multitude of deployment hacks by network and application service providers (such as middleboxes) without regard to global network performance effects. Thus, this talk argues that the high-speed networking community should have the future role of caring about high-speed network deployment on a global scale, and throughout the entire protocol stack from layers 1 through 7.

Biography of Keynote Speaker

Dr. James P.G. Sterbenz (jpgs@ieee.org) is a Senior Network Scientist and Research Group Manager at BBN Technologies in Cambridge, Mass. He is a principal investigator and program manager for several DARPA and NASA funded research programs in high-speed, mobile, wireless, and active networks. He worked on gigabit networking and broadband multimedia services at GTE Laboratories in Boston and IBM Research in Hawthorne NY and Milford CT. He received a doctorate in computer science from Washington University in 1991, with dissertation work on the first zero-copy gigabit host--network interface.

He is Senior Member of the IEEE, member of the IEEE Communications and Computer Societies, past chair of the IEEE Communications Society Technical Committee on Gigabit Networking, and been program chair for several Gigabit Networking Workshops (GBN). He is program co-chair of the IFIP International Working Conference on Active Networks (IWAN 2002), chair of the IFIP Protocols for High-Speed Networks International Steering Committee (program co-chair for PfHSN'99). He is a member of a number of ACM SIGs, and was vice-general chair of ACM SIGCOMM'99. He is a member of the Interplanetary Interest Group of the Internet Society. He has been on numerous technical program committees, including IEEE INFOCOM, ICNP, HPCS, HotI, NOSSDAV, and OpenArch, ACM SIGCOMM, and IFIP PfHSN and HPN. He is on the editorial boards of IEEE Network, Computer Networks Journal (North-Holland), and KICS/IEEE Journal of Communications and Networks.

He is principal author of the book *High-Speed Networking A Systematic Approach to High-Bandwidth Low-Latency Communication* (Wiley 2001). He is a co-author and presenter of the tutorial "Active Networks". He has given keynote and invited lectures in high-speed and active networking at PfHSN'94, IEE Towards Gigabit Networking, IZS 2002, ANTA 2002, and PfHSN 2002.