

Aniruddha Bohra

141 Hana Road
Edison, NJ 08817
Phone: 732-236-7612
bohra@cs.rutgers.edu
<http://www.cs.rutgers.edu/~bohra>

Deptt. of Computer Science,
Rutgers University,
Piscataway, NJ 08854.
Phone: 732-236-7612

RESEARCH INTERESTS

Operating systems focussing on the network and storage subsystems, network file systems, overlay networks, transport protocols (TCP/IP), availability and fault tolerance in computer systems.

EDUCATION

Ph.D. candidate, Computer Science, Expected December 2007;
“System Architectures Based on Functionality Offloading”
Advisor: Prof. Liviu Iftode
Rutgers University, Piscataway, NJ

M.S., Computer Science, Spring 2002;
“TCP Server Architecture for SMP-Based Systems”
Advisor: Prof. Liviu Iftode
Rutgers University, Piscataway, NJ

B.E., Computer Engineering, Fall 1999
Netaji Subhas Institute of Technology,
Delhi University, New Delhi, India

*Research Assistant,
Distributed Computing Laboratory*

**Rutgers University
Piscataway, NJ
1999 – present**

Dec 2005 —
Present

Research team member for FileWall, which offloads the enforcement of file system policies to an external file system proxy. This system interposes on the client-server path and implements policies through message transformation. It also allows administrators to define file system policies using a high-level language without modifying the client and the server. FileWall can be used to define monitoring, access control, maintenance, and semantic policies which extend the network file systems. Two papers describing FileWall have been published.

Dec 2003 —
Dec 2005

Research team member for Backdoors, a system architecture for non-intrusive remote healing. Backdoors proposes a novel approach for non-intrusive monitoring, recovery, and repair of computer systems by offloading this functionality to a remote monitor. It takes advantage of Remote Memory Communication (RMC) which enables an alternative path for a remote monitor to observe and modify the memory of a remote system. Techniques for remote recovery of internet service sessions and repair of computer systems have been proposed for Backdoors.

Dec 2001 —
Dec 2003

Research team member for Service Continuations, which provides system support for migrating live Internet service sessions. Service Continuations provides support for high-availability in Internet Services by migrating TCP/IP connections to alternative servers transparent to the client applications. Web-services and streaming media services which

are critical to clients have been shown to benefit from the Service Continuation based session migration. A paper describing Service Continuations has been published.

Aug 1999 —
Dec 2002

Worked on offloading TCP/IP processing in a multiprocessor Operating System to improve performance of network servers. Designed an asymmetric Operating System (*TCP Server*) which dedicated a subset of processors to network processing. This study identified and characterized synchronization overheads and indirect overheads due to cache pollution in interrupt driven network processing and proposed a hybrid interrupt-polling based approach. A paper has been published describing the TCP Server design and implementation.

RESEARCH AND
EXPERIENCE

*Research Staff Member,
IP Networks and Distributed Systems*

**NEC Labs America
Princeton, NJ
February 2005 – Present**

Feb 2005 —
Present

Researcher involved in the Grid Networking (GriN) project, which studies the wide area network protocols to take advantage of spatial and temporal diversity in the Internet. The goal of the project is to improve transfer times for large point-to-point and point-to-multipoint transfers.

Contributed to the development of a data dissemination framework for high-bandwidth point-to-multipoint transfers using multiple application-level multicast trees. Techniques to support real-time data dissemination for live media streaming have also been developed. Results reported for experiments using a wide-area network testbed have demonstrated more than two-fold improvement in performance.

Applications of the technology include Wide-Area File Systems, Wide-Area backups, and online stream Replication. Two papers related to this project have been published. Additionally, two patents have been filed and are currently under consideration.

Feb 2005 —
Present

Research team member for the resource allocation framework under the next generation wireless mesh project. The goals of the resource allocation is to improve throughput and fairness in Wireless LAN for spectrum and spatial resources. The key idea is to impose time-slots over the Carrier Sense Media Access/Collision Avoidance (CSMA/CA) IEEE802.11 MAC framework. These time slots are then scheduled according to a resource specific policy.

Contributed to a study evaluating the impact of channel hopping, where clients and access points periodically change channels to improve fairness across a dense, unplanned wireless network. Provided initial system design and implementation for the system and evaluated the performance in the presence and absence of a malicious client which attempts to jam all communication across the WLAN. By periodic channel hopping, the system was able to avoid jamming, supporting up to 70% throughput in presence of a jammer and with minimal loss of throughput without a jammer. A paper discussing the technology has been published.

*Summer Intern,
Information Sciences Research Center*

**Bell Laboratories, Lucent
Technologies
Murray Hill, NJ
May 2000 – Sep 2000**

Studied the behaviour of various memory allocator (malloc) implementations in the context of a long-running file system developed at Bell Labs(Hummingbird), and a snapshot based storage service. The study found that different implementations of malloc result in varying degrees of fragmentation and the overheads of fragmentation are much worse for long running applications. A paper describing the research was published.

Instructor, Computer Architecture

Rutgers University
Piscataway, NJ
Sep 2003 – Dec 2003

Taught the undergraduate course on Computer Architecture for a semester. Was responsible for defining the curriculum, teaching lectures, and administering examinations and projects for two sections. The course involved introducing the fundamental aspects of Computer Systems and its basic building blocks including hardware and Operating System components.

SERVICE

Reviewer for Architectural Support for Programming Languages and Operating Systems (ASPLOS), File and Storage Technologies (FAST), Usenix Annual Technical Conference, High Performance Computer Architecture (HPCA), High Performance Distributed Computing (HPDC), ACM Transactions on Computer Systems, IEEE Distributed Systems Online.

SKILLS

- Expert knowledge of systems programming in C, C++. Experienced in developing and debugging OS extensions for the FreeBSD OS, including the network stack, device drivers, and the CAM/XPT framework. Familiar with the Linux kernel, specifically the networking stack and network file system implementation.
- Knowledge of the RDMA based programming environments. Have implemented systems using in-kernel and user-level RDMA based transports – VIA and Infiniband
- Scripting languages, e.g. Python, Perl. Application development in Java/C/C++ for reliable internet services and application aware session migration in Web Servers - Apache and Flash web servers.

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- PATENT APPLICATIONS
- S. Ganguly, A. Bohra, R. Izmailov, Y. Kikuchi “CoDist: Coding Based Distribution of Large Datasets” Filed March 2005
- R. Kokku, A. Bohra, S. Ganguly, and R. Izmailov “A Multipath Routing Architecture for Background Transfers” Filed March 2006
- PUBLICATIONS
- A. Bohra, S. Smaldone, and L. Iftode “FileWall: A Firewall for Network File Systems” *Proceedings of IEEE Dependable Autonomic and Secure Computing, DASC 2007*
- A. Bohra and L. Iftode “Improving Network Stack Concurrency using TCP Servers” *Proceedings of IEEE Network Computing and Applications, NCA 2007*
- A. Bohra, S. Smaldone, and L. Iftode “FRAC: Implementing Role-Based Access Control for Network File Systems” *Proceedings of IEEE Network Computing and Applications, NCA 2007*
- R. Kokku, A. Bohra, S. Ganguly, and V. Arun “A Multipath Background Network Architecture” *Proceedings of IEEE Infocom, 2007*
- V. Navda, A. Bohra, S. Ganguly, and D. Rubenstein “Using Channel Hopping to Increase 802.11 Resilience to Jamming Attacks” *Proceedings of IEEE Infocom Minisymposium, 2007*
- J. Liang, A. Bohra, H. Zhang, S. Ganguly, and R. Izmailov “Minimizing Metadata Access Latency in Wide Area File Systems” *Proceedings of IEEE High Performance Computing HiPC’06, 2006*
- F. Sultan, A. Bohra, P. Gallard, I. Neamtiu, S. Smaldone, Y. Pan, Neamtiu, and L. Iftode. “Recovering Internet Service Sessions from Operating System Failures.” in *IEEE Internet Computing, ICSI-0116-0804 Special Issue - Recovery-Oriented Approaches to Dependability*.
- A. Bohra, I. Neamtiu, P. Gallard, F. Sultan, and L. Iftode. “Remote Repair of Operating System State Using Backdoors.” *Proceedings of First IEEE International Conference on Autonomic Computing (ICAC’04). 2004.*
- F. Sultan, A. Bohra, I. Neamtiu, and L. Iftode. “Nonintrusive Remote Healing Using Backdoors.” *Proceedings of First Workshop on Algorithms and Architectures for Self-Managing Systems (Self Manage’03), June 2003.*
- F. Sultan, A. Bohra, and L. Iftode. “Service Continuations: An Operating System Mechanism for Dynamic Migration of Internet Service Sessions”. *Proceedings of IEEE Symposium on Reliable Distributed Systems, SRDS 03.*
- A. Bohra and E. Gabber. “Are Mallocs Free of Fragmentation?” *Proceedings of Usenix Annual Technical Conference, Freenix Track, 2001.*
- TECHNICAL REPORTS
- S. Smaldone, A. Bohra, and L. Iftode “Implementing Network File System Policies

with FileWall” *Rutgers University, Department of Computer Science, Technical Report DCS-TR-605, Nov. 2006.*

A. Bohra, A. Baliga, and L. Iftode “Orion: Looking for Constellations in Physical Memory.” *Rutgers University, Department of Computer Science, Technical Report DCS-TR-569, January 2005.*

F. Sultan, A. Bohra, and L. Iftode. “Autonomous Transport Protocols for Content-based Networks”. *Rutgers University, Department of Computer Science, Technical Report, DCS-TR-479, March 2002.*

M. Rangarajan, A. Bohra, K. Banerjee, E. V. Carrera, R. Bianchini, L. Iftode, and W. Zwaenepoel. “TCP Servers: Offloading TCP/IP Processing in Internet Servers.” Design, Implementation, and Performance, *Rutgers University Department of Computer Science Technical Report, DCS-TR-481, March 2002.*

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REFERENCES

Prof. Liviu Iftode
iftode@cs.rutgers.edu
Rutgers University, Department of Computer Science
110 Frelinghuysen Road
Piscataway, NJ 08854

Prof. Ricardo Bianchini
ricardob@cs.rutgers.edu
Rutgers University, Department of Computer Science
110 Frelinghuysen Road
Piscataway, NJ 08854

Dr. Samrat Ganguly
samrat@nec-labs.com
NEC Labs America,
4 Independence Way, Suite 200
Princeton, NJ 08540