

# Overview of Research in Dependable Computing Systems Lab

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<http://shay.ecn.purdue.edu/~dcs1>

## Dependable Computing Systems Lab

- **Sponsors**

- National Science Foundation
- Purdue Research Foundation
- Avaya Labs
- Motorola Labs
- Intel

- **Members**

- Nipoon Malhotra
- Gunjan Khanna
- Padma Varadharajan
- Yu-Sung Wu
- Issa Khalil
- Mark Krasniewski
- Yen-Shiang Shue
- Jin-Yi Wang
- Bingrui Foo
- Bryan Rabeler
- Tyler Olsen
- Blake Matheny

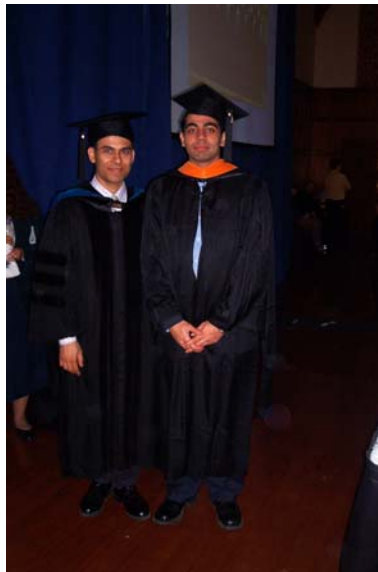
## Where is DCSL?

- **EE 34**
  - 5 Linux machines
  - 2 PCs
  - HP Laserjet 1500 printer
- **Physics 50**
  - Sensor network testbed with 8 Berkeley Mica motes
  - 1 Linux machine (ibase5)
- **Civil G239**
  - Sensor network testbed with 16 Berkeley Mica 2 motes
  - 2 Linux machines (pyxis & carina)

## Who's Who in DCSL?

- Provision keeper: Gunjan (Fall 03), Gunjan (Spring 04)
- Librarian: Issa (Fall 03), Issa (Spring 04)
- Webmaster: Hank (Spring 04)
- Welcome to grad school for Bingrui and congrats on his undergraduate honor

## What happened to Gunjan?



## Logistics

- Planning document detailing goals, deliverables (publications, code) to be submitted by each of you by January 28 (2 weeks from today). Find the document at:  
[www.ece.purdue.edu/~sbagchi/Research/GroupInternal/Admin/spring2004\\_plan.doc](http://www.ece.purdue.edu/~sbagchi/Research/GroupInternal/Admin/spring2004_plan.doc)
- Weekly (or bi-weekly) meeting slots to be finalized by end of this week (January 16)
- Code checkin to CVS
  - At every major point in the project, typically at least once a month
- Writeups
  - 3-5 page writeups on work to be submitted 2<sup>nd</sup> and 4<sup>th</sup> Monday of the month
  - I will review the writeups and send back to you with edits and comments

## Project #1: Distributed Disruption Tolerant System

- Distributed e-commerce platform subjected to natural failures and malicious attacks to services
- Disruptions = Attacks + Failures
- Objective is to tolerate disruptions, not just detect
- Different phases: Detection, Diagnosis, Containment, Response.
- E-commerce testbed with multiple servers (web, application, etc.) installed in MSEE 206 (Distributed Multimedia Systems Lab)
- Project Members:
  - Here: Arif Ghafoor, Eugene Spafford, Yu-Sung Wu, Bingrui Foo, Blake Matheny, Tyler Olsen
  - Outside: Tim Tsai, Sachin Garg, Navjot Singh (Avaya Labs)

## Project #1: Distributed Disruption Tolerant System

- Paper:
  - "Collaborative Intrusion Detection System (CIDS): A Framework for Accurate and Efficient IDS"
    - Appeared in ACSAC, December 2003.
    - Hank presented in Las Vegas on December 9, 2003.
  - "ADEPTS: Adaptive Intrusion Containment and Response using Attack Graphs in an E-Commerce Environment"
    - Submitted to IEEE Dependable Systems & Networks (DSN) in Italy June 28-July 1, 2004.
    - Appeared as CERIAS Tech Report TR2003-32.
  - "SCIDIVE: A Stateful and Cross Protocol Intrusion Detection Architecture for Voice-over-IP Environments"
    - Submitted to IEEE Dependable Systems & Networks (DSN) in Italy June 28-July 1, 2004.
    - Appeared as CERIAS Tech Report TR2003-33
- Goals for this semester:
  - JOURNAL
    - \* ACM Transactions on Information and System Security (TISSEC)  
<http://www.acm.org/tissec/>  
Internal deadline: April 15
  - CONFERENCE
    - \* ACM CCS: Deadline - May 3, Conference - Oct 25-29, DC; URL:  
<http://www.acm.org/sigsac/ccs/CCS2004/>  
Internal deadline: May 2

## Project #2: Self-Checking Network Protocols

- Goal is to provide highly available network services (e.g., SIP, reliable multicast) in distributed environment
- Challenges in today's distributed systems
  - Large number of network protocol participants
  - No access to source code or machine on which code is running
  - Often soft real-time guarantees
- Our Approach:
  - Distributed monitor to observe external interactions and diagnose misbehavior or malfunction
  - A rulebase using temporal logic and fast matching algorithms
  - Hierarchical monitor structure to monitor local and global interactions
- Project Members
  - Here: Gunjan Khanna, Padma Varadharajan
  - Outside: Ravi Iyer, Zbigniew Kalbarczyk (UIUC)
- Status:
  - Implementation single level monitor done
  - Limited support for multi-level monitor and filtering at lower level
  - Experiments (scalability and accuracy) performed with system running reliable multicast

## Project #2: Self-Checking Network Protocols

- **Papers**
  - "Failure Handling in a Reliable Multicast Protocol for Improving Buffer Utilization and Accommodating Heterogeneous Receivers", Accepted for publication in the 10<sup>th</sup> IEEE Pacific Rim Dependable Computing Conference in Tahiti, Mar 3-5, 2004.
  - "Distributed Monitors for Detection of Misbehavior in Large Scale Distributed Systems", In submission to IEEE Transactions on Parallel & Distributed Systems.
- **Goals for this semester**
  - IEEE SRDS: Deadline - April 2; Conference - Oct 18-20, Brazil; URL: <http://www.srds2004.ufsc.br/>  
Internal deadline: Apr 1

## Project #3: Dependable Ad-hoc and Sensor Networks

- Ad-hoc and sensor networks built of unreliable components and deployed in hostile or uncertain environments
- Goal is to provide middleware that provides a robust platform keeping environment constraints in mind
  - Energy constraint
  - Computational power constraint
  - Security constraint
- **Project Members:**
  - Here: Ness Shroff, Nipoon Malhotra, Michael Krasniewski, Longbi Lin, Issa Khalil, Bill Chappell, Catherine Rosenberg
- This project is funded by Intel's equipment grant and NSF's Engineering Directorate's grant under the Sensors program

## Project #3: Dependable Ad-hoc and Sensor Networks

- **Papers:**
  - “Analysis and Evaluation of Topological and Application Characteristics of Unreliable Mobile Wireless Ad-hoc Network”, To appear in the 10<sup>th</sup> IEEE Pacific Rim Dependable Computing Conference in Tahiti, Mar 3-5, 2004.
  - “Fault Tolerant Energy Aware Data Dissemination Protocol in Sensor Networks”, Submitted to IEEE Dependable Systems & Networks (DSN) in Italy June 28-July 1, 2004.
  - “SECOS: Key Management for Scalable and Energy Efficient Crypto On Sensors”, Submitted to IEEE Dependable Systems & Networks (DSN) in Italy June 28-July 1, 2004.
- **Goals for this semester:**
  - **JOURNAL:**
    - \* IEEE Journal on Special Areas in Communication (JSAC)  
Special issue on Security in wireless ad-hoc networks: Deadline Oct 1, 04, Acceptance June 1, 05; [http://www.argreenhouse.com/society/J-SAC/Calls/security\\_adhoc.html](http://www.argreenhouse.com/society/J-SAC/Calls/security_adhoc.html)  
Internal deadline: Summer 2004
  - **CONFERENCES:**
    - \* ACM Mobicom: Deadline - Mar 15, Conference - Sep 26-Oct 1, Philadelphia; URL: <http://www.sigmobile.org/mobicom/2004/>  
Internal deadline: Mar 14
    - \* ACM Sensys: (For prev year) Deadline - Apr 8; Conference - Nov 5-7, Los Angeles; URL: <http://www.cens.ucla.edu/sensys03/>  
Internal deadline: April 7

## Project #3: Dependable Ad-hoc and Sensor Networks

- **Mobility to help network characteristics**
  - Intelligent mobility patterns to improve connectivity, coverage, diameter
- **Robust data aggregation from sensor nodes to base station**
  - Robust to failures of intermediate nodes and compromised nodes
  - Sensitive to energy budget of each node
- **Secure message communication in sensor networks**
  - Efficient protocol for encryption of messages
  - Scalable and energy parsimonious key distribution protocol
- **Testbed of 20 Berkeley motes**



## Project #4: Architecture Approach to Software Robustness

- Goal: Use idle hardware resources, such as additional execution contexts in SMT or CMP, for checking software
- Memory checks are biggest bang for buck
  - Large class of software errors
  - Easy to automate
- Approach
  - Devise detection routines
  - Minimize synchronization between detection and application routine
  - Devise hardware extensions that enable fast information transfer from one to the other
- Story so far:
  - SMT based simulator created for simple monitoring routines
  - Performance results show substantial improvement over baselines – all monitoring in software running in same execution context
- Project Members: Prof. T. N. Vijaykumar, Yen-Shiang Shue, Jin-Yi Wang, Yu-Sung Wu

## New Projects

- Reliability for OpenMP applications
- Members: Rudi Eigenmann, Bryan Rabeler
- Motivation is to have reliability for OpenMP applications running on Software Distributed Shared Memory
- Novelty: Use SDSM for reliability, rather than performance
- Goals for this semester
  - ACM Supercomputing: Deadline - Apr 19; Conference - Nov 6-12, Pittsburgh; URL: <http://www.sc-conference.org/sc2004/>
  - Internal deadline: Apr 18

## Reading Group Spring 2004

- **EE 317 Wednesday 5-6.30**
  - Possibility of change to accommodate schedule conflicts?
- **Format change:**
  - We will discuss a focused topic instead of individual papers.
  - The topic may involve multiple papers, typically between 3 and 5.
  - The discussion may take 2-3 meetings.
  - I will provide an initial set of papers, but you will need to augment it.
- **First topic: Intrusion detection in wireless networks**
  - Discussion leader: Issa