Embedded and Reliable Information Systems (ERIS) Laboratory

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ERIS Conceptual Framework:

Multi-Objective	×	Multi-Discipline	×	Life Cycle
• Dependability • Affordability • Safety • Security • Scalability • Timeliness		• Electronic Hardware • Software • Mechanical Hardware • Control Algorithms • Humans • Society/Institutions		• Requirements • Design • Manufacturing • Deployment • Logistics • Retirement

In the Embedded and Reliable Information Systems Laboratory, our vision is to develop systems and tools that fundamentally improve the effectiveness of embedded computing and networking technologies. To accomplish this requires an extremely broad view of systems, and an appreciation for the complete life cycle of products and processes. Connections among industrial sponsors, class projects, and university researchers are emphasized in order to bring together real-world issues and cutting edge solutions for training tomorrow's engineers.

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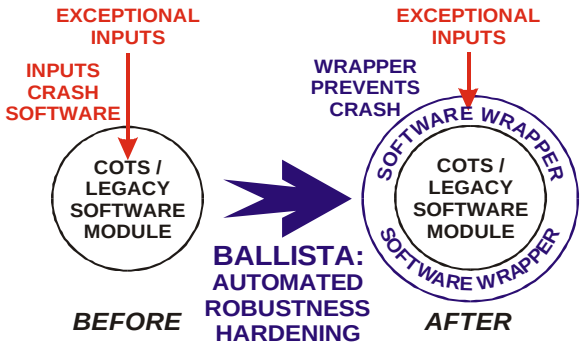
WEARABLE COMPUTERS

The longest established project within ERIS is the Wearable Computer Project. This project has created more than a dozen generations of wearable computers -- one generation per single-semester classroom project plus other systems designed jointly with industry. The wearables are not simply desktop computers shrunk down, but rather represent system-level solutions to varied industry problems such as inventory control, mobile technical support, on-line maintenance manuals (shown in Figure) and real-time natural language translation.

BALLISTA

The Ballista project is a more recent project that is the culmination of over a decade of research in fault tolerant systems. The Ballista Web Server automatically tests off-the-shelf software components for robustness against exceptional conditions, identifying ways that software modules can be made to crash or hang. This server provides for the first time



a scalable, portable way to quantify software robustness. In the next step of this research, automatic pattern detection and creation of hardening "wrappers" will be added to the server. A new related project will test and improve the robustness of communication network switches and interface adapters.

INVICTUS/HARBINGER

The Invictus project applies years of experience with the Harbinger adaptive anomaly detection tool to networked computer intrusion detection. The Harbinger tool has been used in a variety of applications such as wafer fabrication yield management and network performance diagnosis. Harbinger uses statistical methods to identify anomalous behavior without domain-specific knowledge, and is able to adapt to system drift automatically. In addition to intrusion detection for Invictus, Harbinger can be applied to real-time system monitoring applications to generate maintenance alarms.

EMBEDDED NETWORKS

In the Embedded Networks project, smaller scale computer networks based on the Controller Area Network (CAN) protocol and other embedded media access methods are being studied for both perfor-

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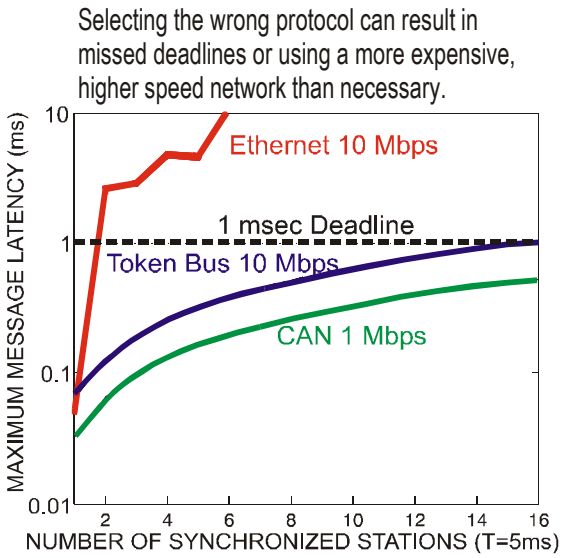
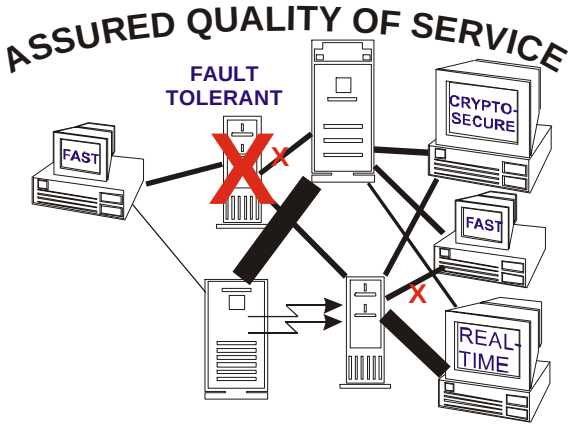


mance and dependability. A web-based network simulator permits developers to make tradeoffs among a number of network protocols to select one that will offer appropriate real-time performance. Additionally, a middleware fault injection system is being developed to characterize system performance in the face of message loss or corruption.

AMARANTH

In the Amaranth project, researchers are exploring ways to provide assured Quality of Service with networked computer systems that are sized for average demand instead of peak demand. A statistical assurance approach will provide guarantees of timeliness, fault tolerance, cryptographic security, and performance even in the face of equipment failures and system overloads. The first phase of the project has involved the creation of both a physical and simulation testbed for developing policies and measurement tools to attain assured levels of service.



Amaranth provides statistical assurances of service quality including fault tolerance for nodes/links, cryptographic security, real-time deadlines, and multimedia application performance.

PROJECT BORG

The Borg project aims to create survivable, secure systems using geographic distribution of information rather than traditional firewall+cryptography methods. Information will be broken up into "puzzle pieces" and geographically distributed, with only a subset of the pieces required for a set of cooperating agents to perform decentralized reconstruction of information when requested. Thus, distributed computing will not only provide scalable performance and storage capacity, but also provide dependability and security without a single-point of failure or performance bottlenecks.

CAPSTONE DESIGN COURSE

A new ECE course, Advanced Embedded Systems, will be offered starting in Fall 1999. It will emphasize system design methodologies, embedded distributed system implementation, and embedded communication networks. Special efforts will be made to work with industrial partners to inject real-world problems, technology, and experiences into the class assignments, including potentially solving real engineering problems in this one-semester course. Additionally, instructional modules can be made available to affiliates for use in industrial training.

FOR FURTHER INFORMATION

The ERIS Laboratory is continually looking for partners in new and exciting projects regarding embedded system design, improving system dependability, and improving system robustness. For more information, please see:
http://www.ices.cmu.edu/thrusts/embed.html

or contact the ERIS Laboratory Director:

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