

RUI: Survivable, Adaptive, and Scalable Distributed Systems



Kim P. Kihlstrom

<http://homepage.westmont.edu/kimkihls/>

In order to design, implement, configure, and maintain survivable systems, we are working to develop a fundamental, **scientific basis** for understanding and evaluating these systems. We are developing a body of knowledge that will allow us to categorize and reason about these systems in a systematic manner. We are articulating desirable qualities and characteristics, and investigating engineering tradeoffs inherent in the design of such systems.

We are designing and implementing a **new system architecture** that is survivable, scalable, and adaptive. One of the chief contributions of this system architecture is its design as a synergistic combination of subsystems providing different modes of operation, each of which is characterized by different guarantees and employs different tradeoffs.

Computer systems today are increasingly complex, employing vast numbers of nodes connected over large geographic areas, supporting critical applications such as banking and commerce systems, the national power control grid, air traffic control, and medical monitoring and support systems. The size and distribution of these systems make them vulnerable to attack and compromise, and their complexity makes them difficult to design, configure, analyze, characterize, maintain, and secure.



Project Objectives

Research Objectives

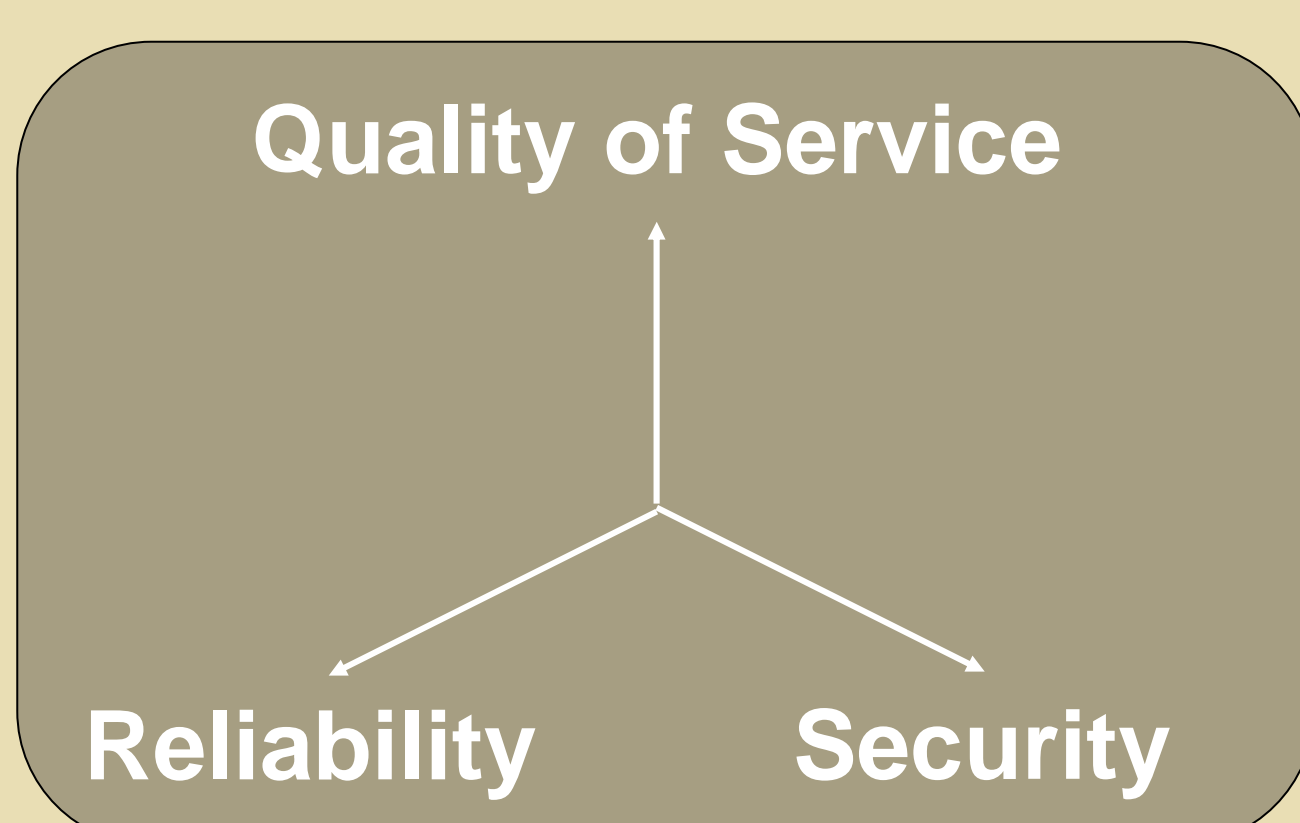
- Develop framework to characterize survivable systems
- Design and implement survivable system architecture

Educational Objectives

- Engage students in research and coursework in survivability
- Increase number and diversity of students in computer science

Survivability Framework

- Multi-dimensional survivability space
 - **Security**: confidentiality, integrity, availability
 - **Reliability**: tolerance to various types of system faults
 - **Quality of service**: performance, adaptability, and scalability
- Each dimension is itself a multi-dimensional subspace



¹Some starfish species have the ability to regenerate a lost arm

Starfish System Design & Implementation

- Three regions with different reliability, security, and quality of service tradeoffs
 - **Body** provides a stringent security model and tolerance to malicious faults
 - **Arms** provide high performance but lower security and reliability; can be removed and regrown¹ as needed
 - **Shoulders** provide intermediate model

