

Dr. Shangping Ren

Who are we and what we do

October 4, 2010

Distributed Systems, Real-Time Embedded Systems, and Cyber-Physical Systems

Funded by

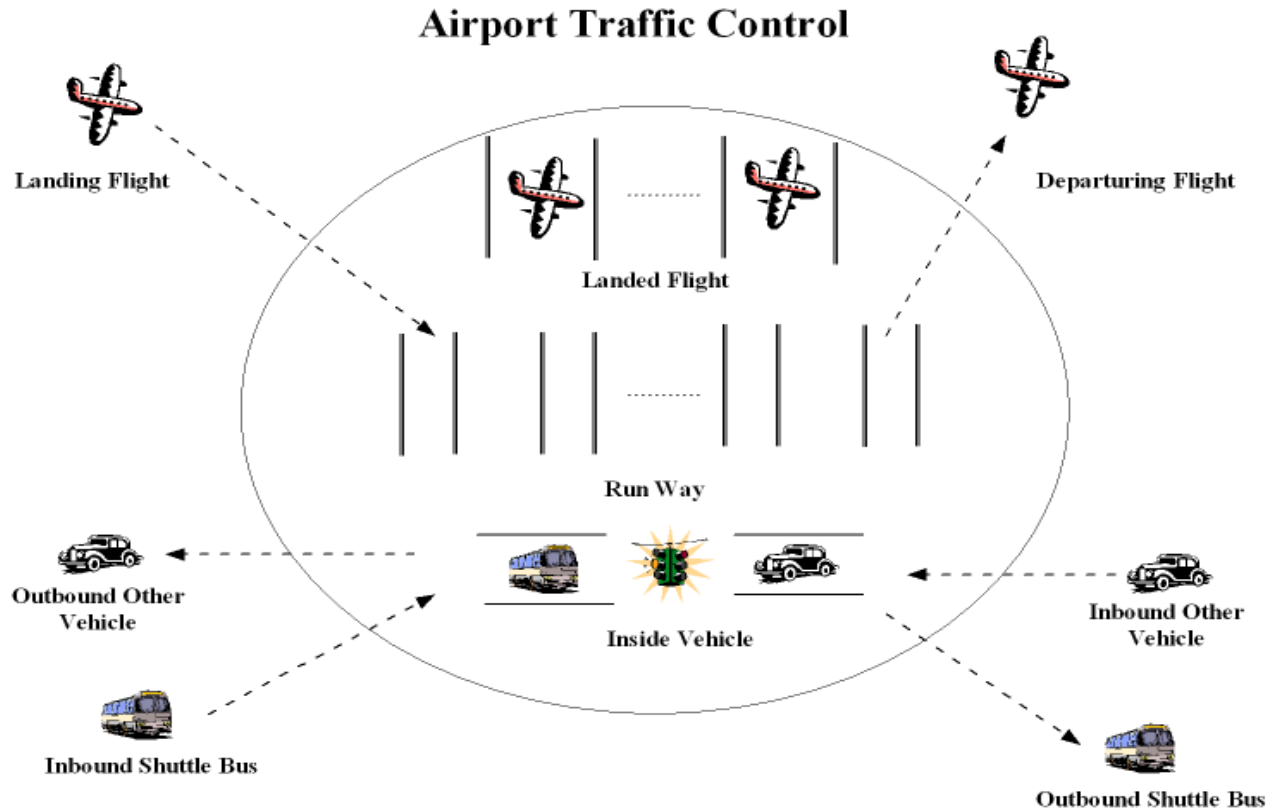
- National Science Foundation
- Air Force Research Laboratory (Summer Faculty Fellowship Award)
- Fermi National Accelerator Laboratory
- Illinois Institute of Technology (ERIF Award)

Current NSF Funded Projects

1. Behavior-Based Coordination for Open Distributed Real-Time and Embedded Computing (CAREER)
2. Application-Aware Many-Core Virtualization for Real-Time Embedded Computing (CNS-Core)
3. Managing Loosely Coupled Networked Control Systems with External Disturbances (CNS-CPS)

Behavior-Based Coordination for Open Distributed Real-Time and Embedded Computing

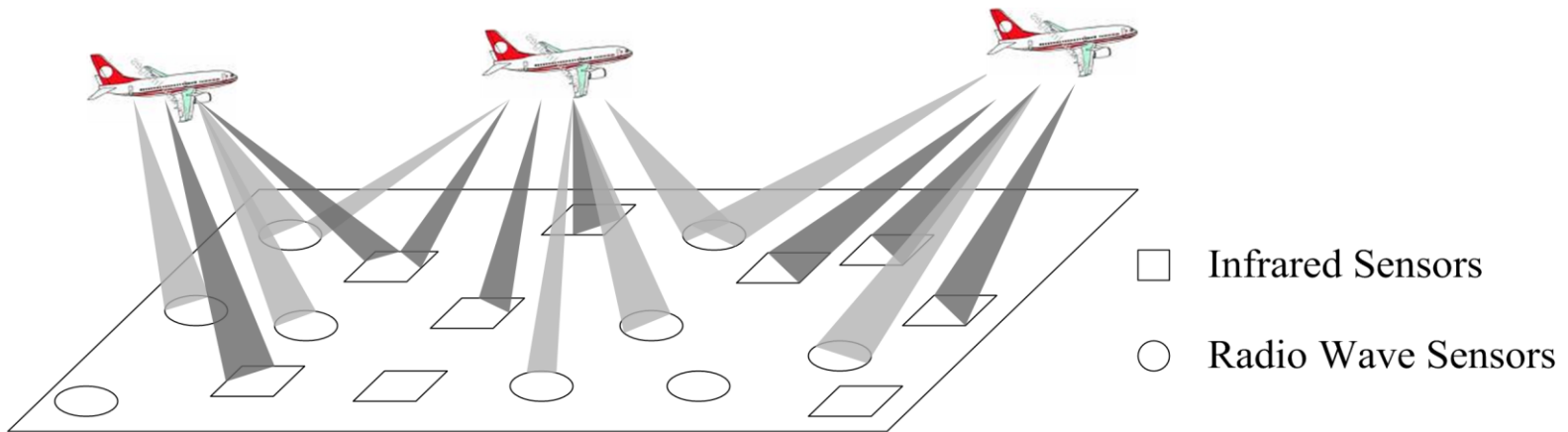
Targeted Problem Domain



Behavior-Based Coordination for Open Distributed Real-Time and Embedded Computing

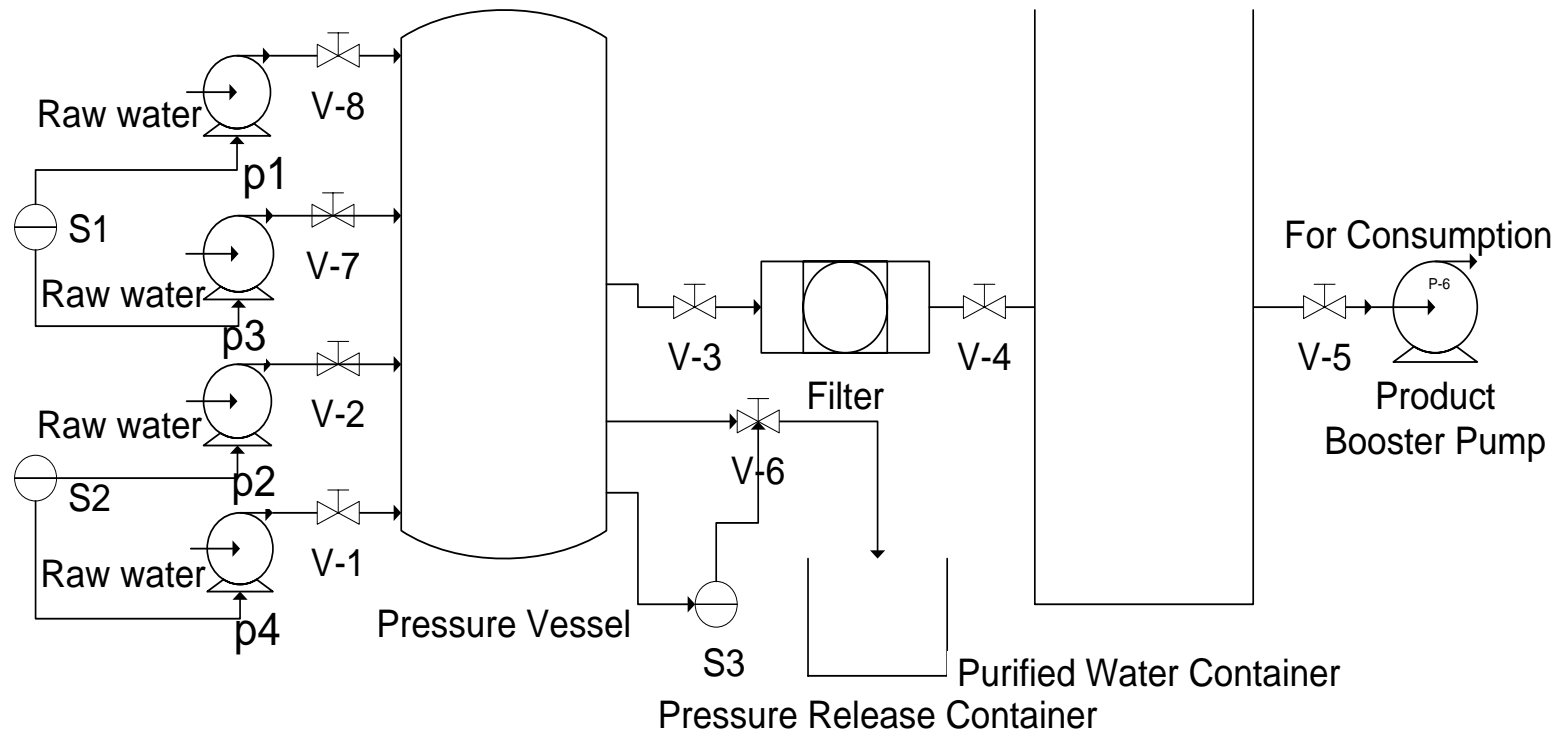
Targeted Problem Domain

Open Space Surveillance



Behavior-Based Coordination for Open Distributed Real-Time and Embedded Computing

Another Issue: protecting legacy critical Infrastructures against **coordinated** attacks



Behavior-Based Coordination for Open Distributed Real-Time and Embedded Computing

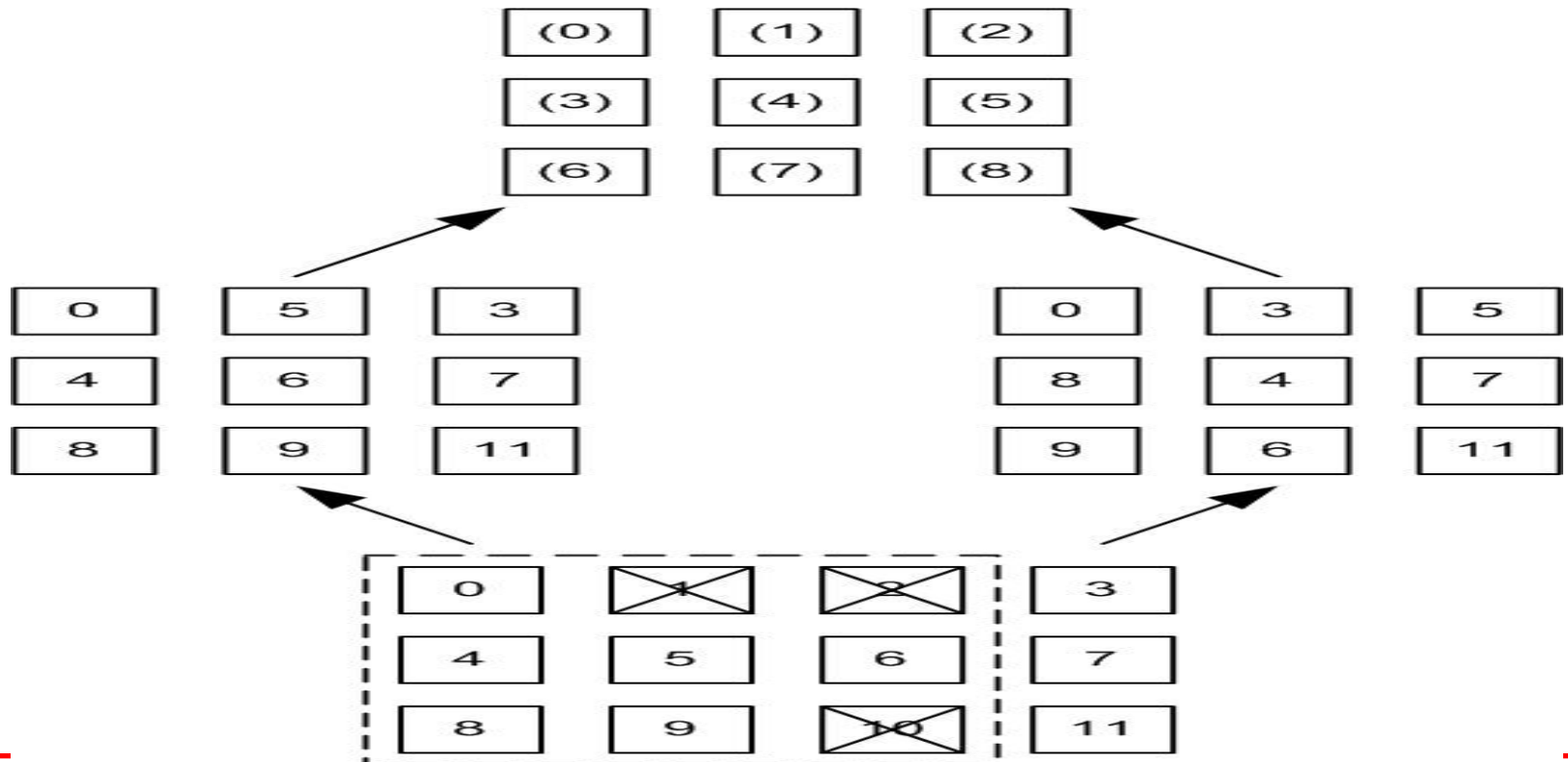
- Characteristics and challenges of the targeted problem domain
 - Open
 - Dynamic
 - Large scale of autonomous and concurrent entities
 - Hard **QoS** requirements
 - **Running in a real world environment which is sometimes unpredictable**

- Research Focus

Develop **models, software architecture** and **programming language support** to facilitate the design and development of such systems and further be able to verify the correctness of the systems.

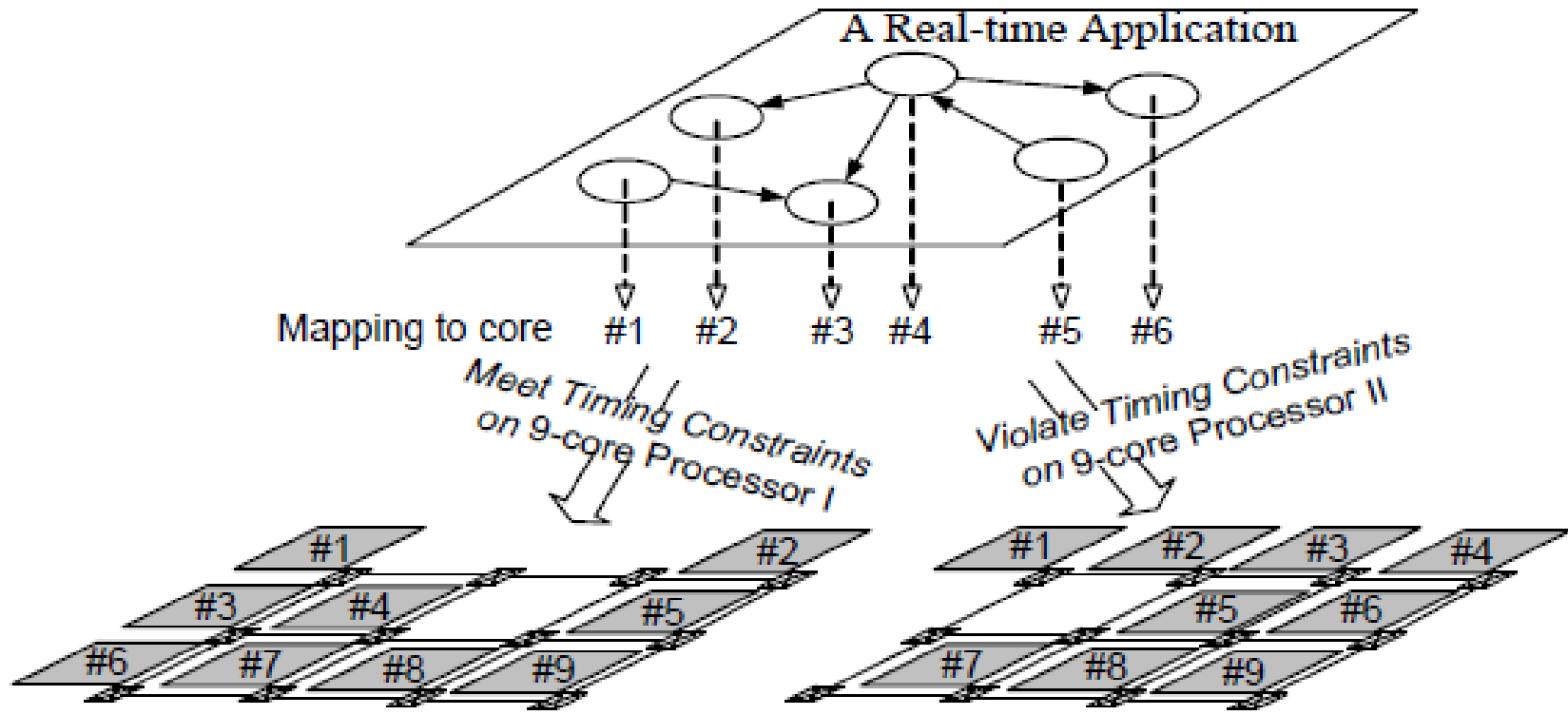
Application-Aware Many-Core Virtualization for Real-Time Embedded Computing

Targeted Problem Domain: different hardware reconfigurations exist, then which one is 'better'?



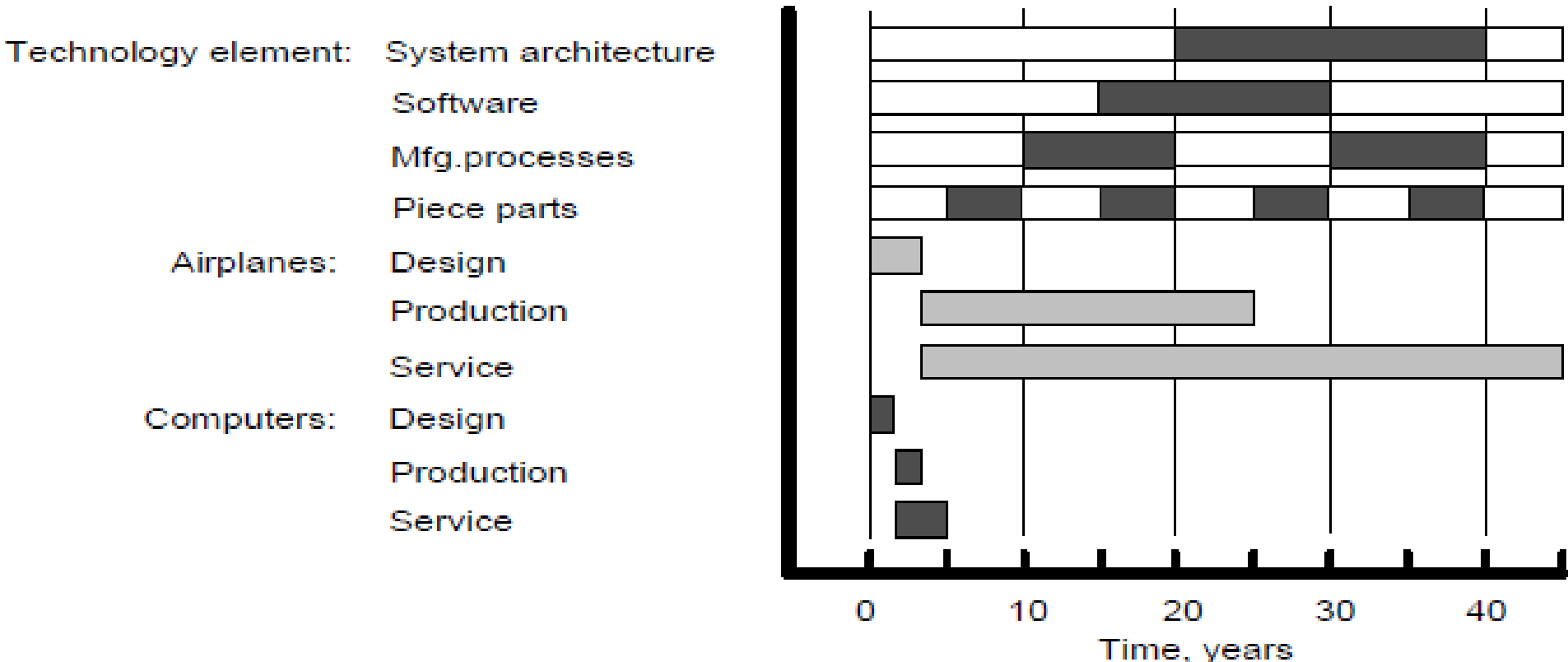
Application-Aware Many-Core Virtualization for Real-Time Embedded Computing

Targeted Problem Domain: For real-time applications, different mapping may cause different timing behavior



Application-Aware Many-Core Virtualization for Real-Time Embedded Computing

Targeted Problem Domain: Service time of machinery outlives electric components



Technology, Airplane, and Computer Lifetimes [10]

Application-Aware Many-Core Virtualization for Real-Time Embedded Computing

- Characteristics and challenges of the targeted problem domain
 - Exponential number of choices
 - Criteria for “better”, i.e., timing behavior similarity, is yet to be defined
 - Other factors that may impact reconfiguration strategies: temperature, power consumption, etc.

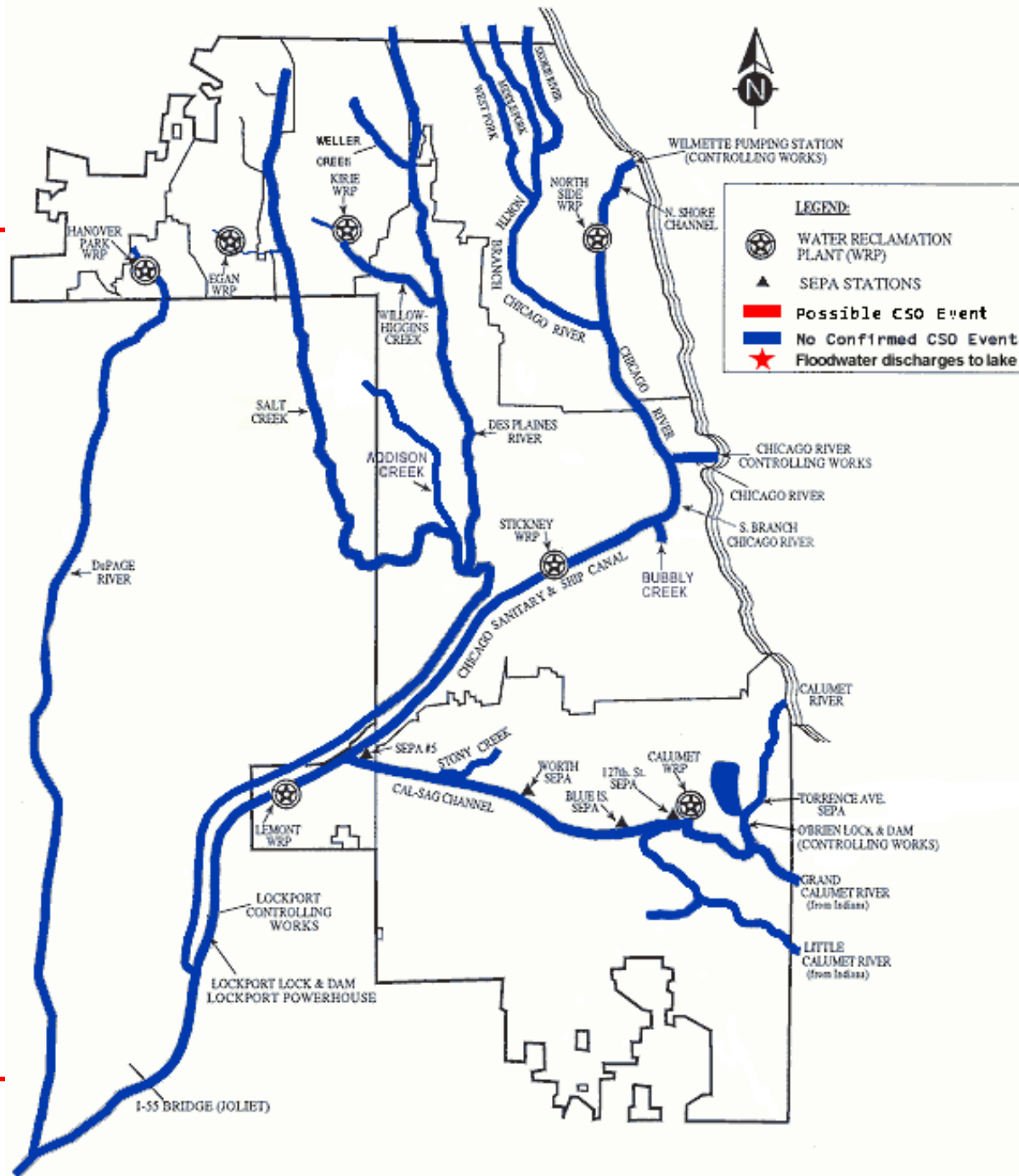
- Research Focus

Develop **measurements, heuristics, and efficient search processes** to find optimal many-core configurations that is not only able to tolerate core variations, but also meet real-time application and its embedding environment constraints.

Managing Loosely Coupled Networked Control Systems with External Disturbances

This is a joint project with Professor Xiangyang Li (CS), Professor Fouad Teymour (ChE) and Professor Paul Anderson (CE).

Professor Xiangyang Li is the lead.



Managing Loosely Coupled Networked Control Systems with External Disturbances

- Characteristics and challenges of the targeted problem domain
 - Widely distributed physical systems
 - Has historical data, but also has large unpredictable factors
 - Wide range of timing granularities
 - Large spectrum of abstraction levels for events

- Research Focus

Develop **algorithms and timing analysis approaches** to ensure that loosely coupled networked control systems satisfy timing constraints with different timing granularities; and develop **event model** to model and reason about events at different abstraction levels, ranging from simple sensor signals, to human control actions.

Thank you!

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Questions?

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