Programmable Data Collection Networks

Gurdip Singh
Computing and Information Sciences
Kansas State University
Manhattan, KS 66506

Data collection networks

- Application domains
  - Real-time target tracking
  - Environment monitoring
  - Surveillance
  - Global information grid applications

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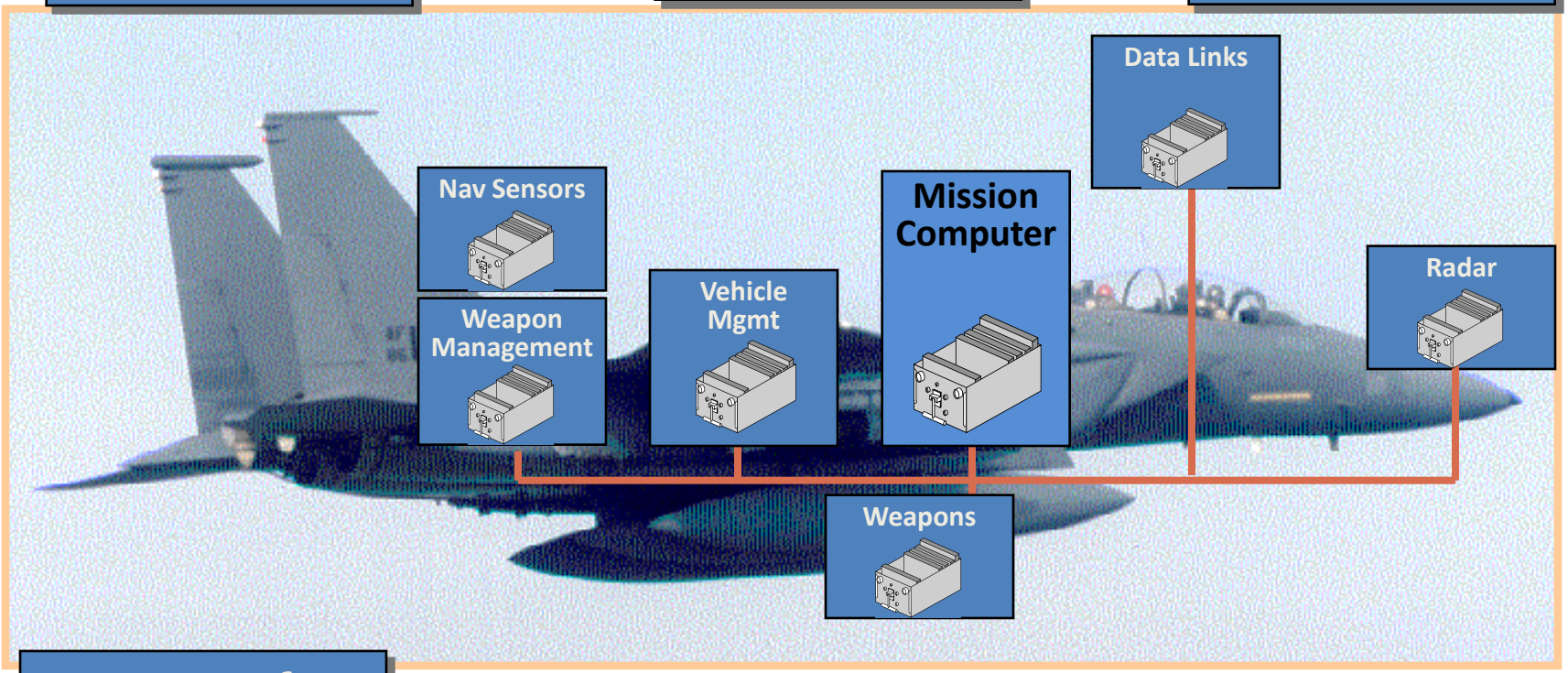
Bold Stroke System: Avionics Display Applications

Periodic & Aperiodic

O(10^6) Lines of Code

Hard & Soft Real-Time

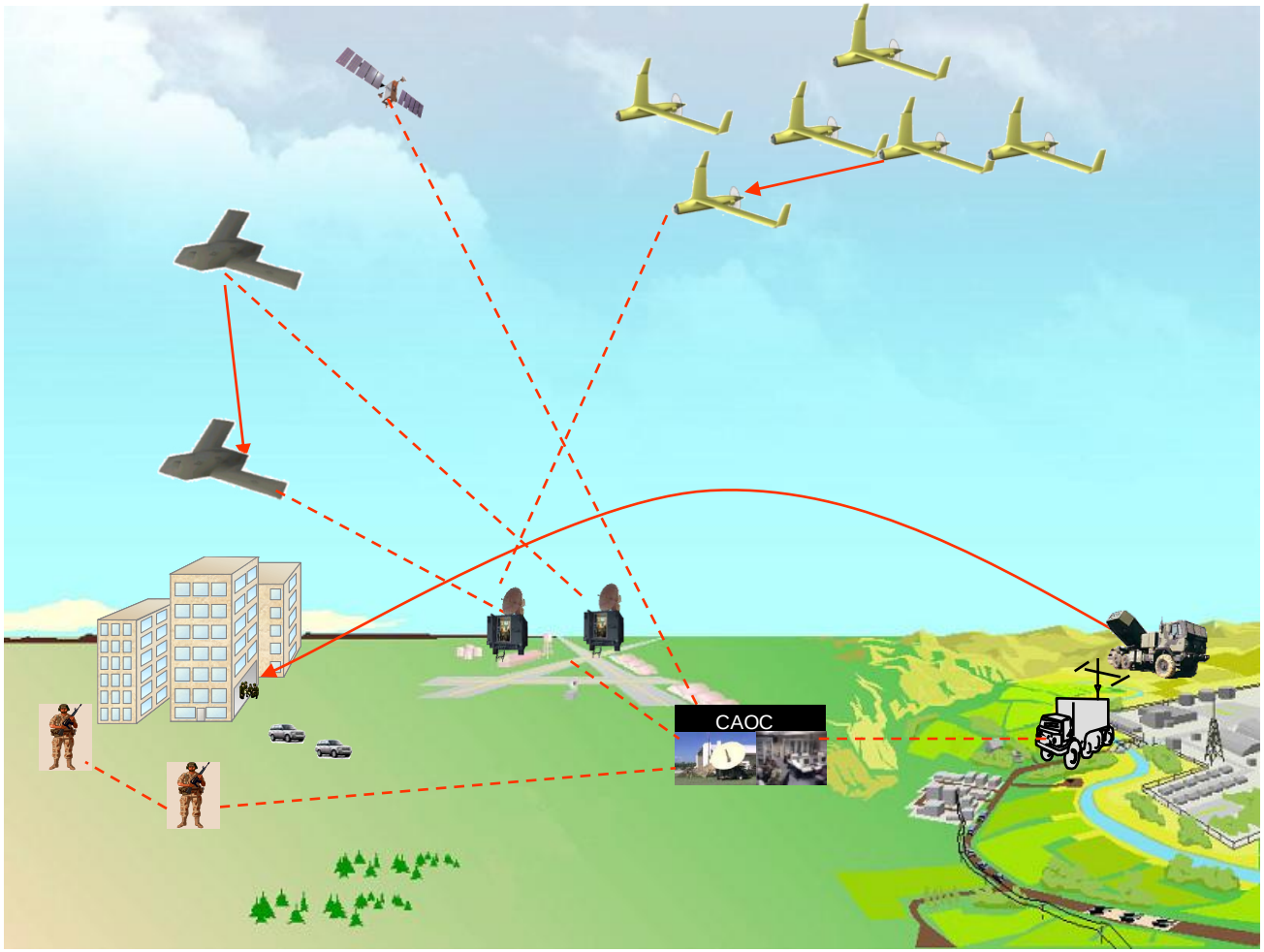


1000s of Components

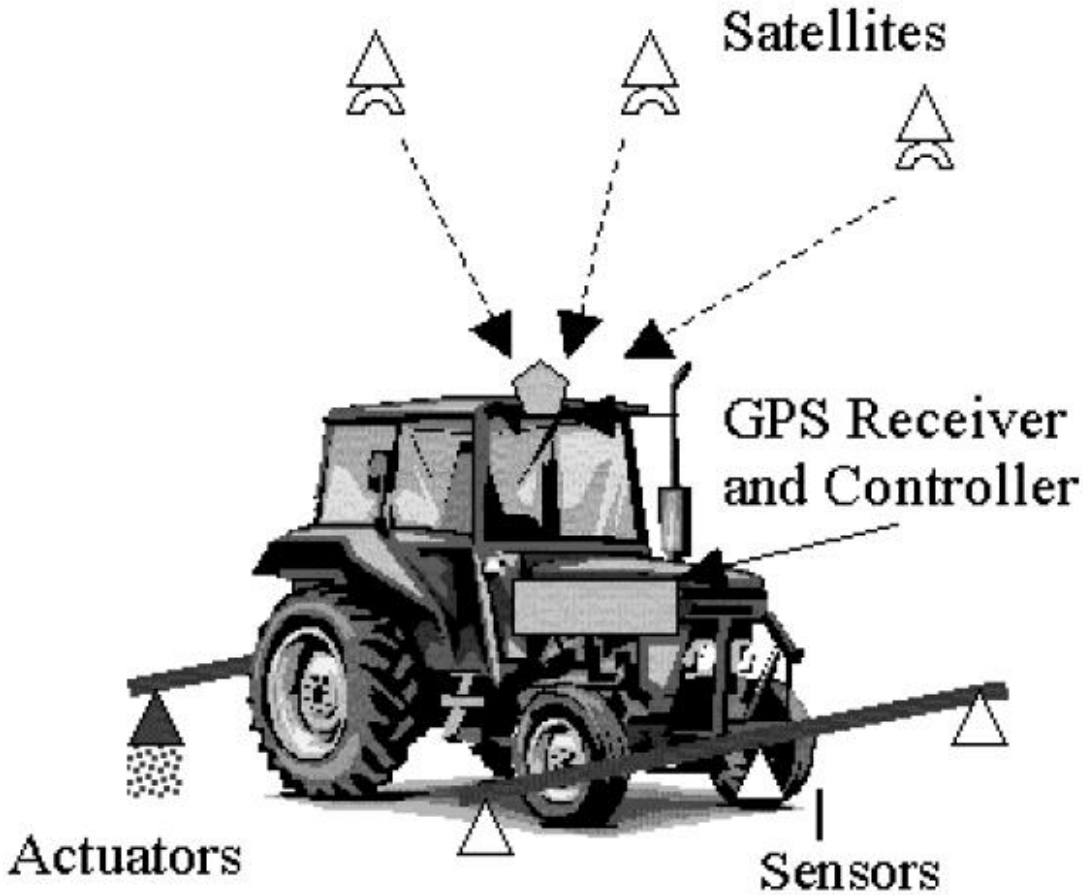
Tracking time critical targets

(Capstone demo for the DARPA PCES program)

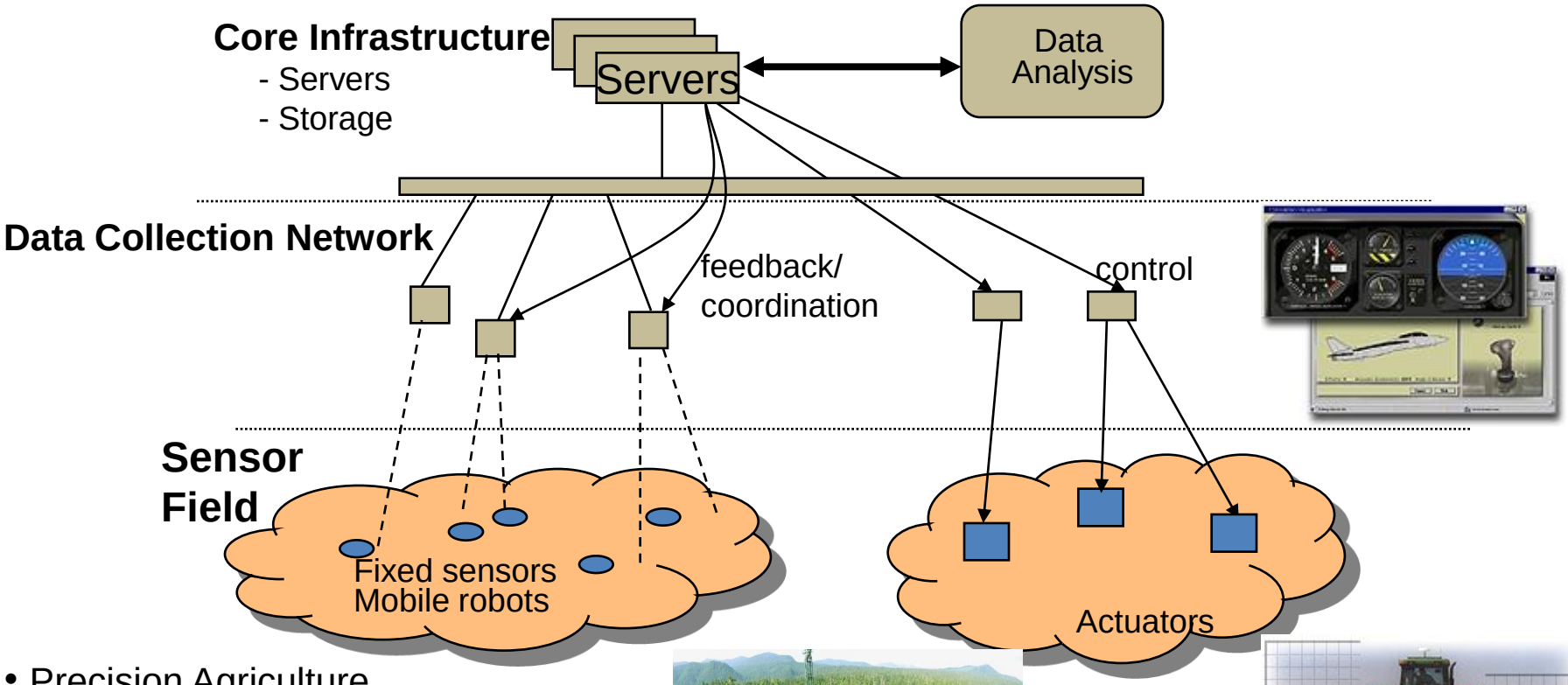
- System of systems



Precision Agriculture



Data Collection Systems

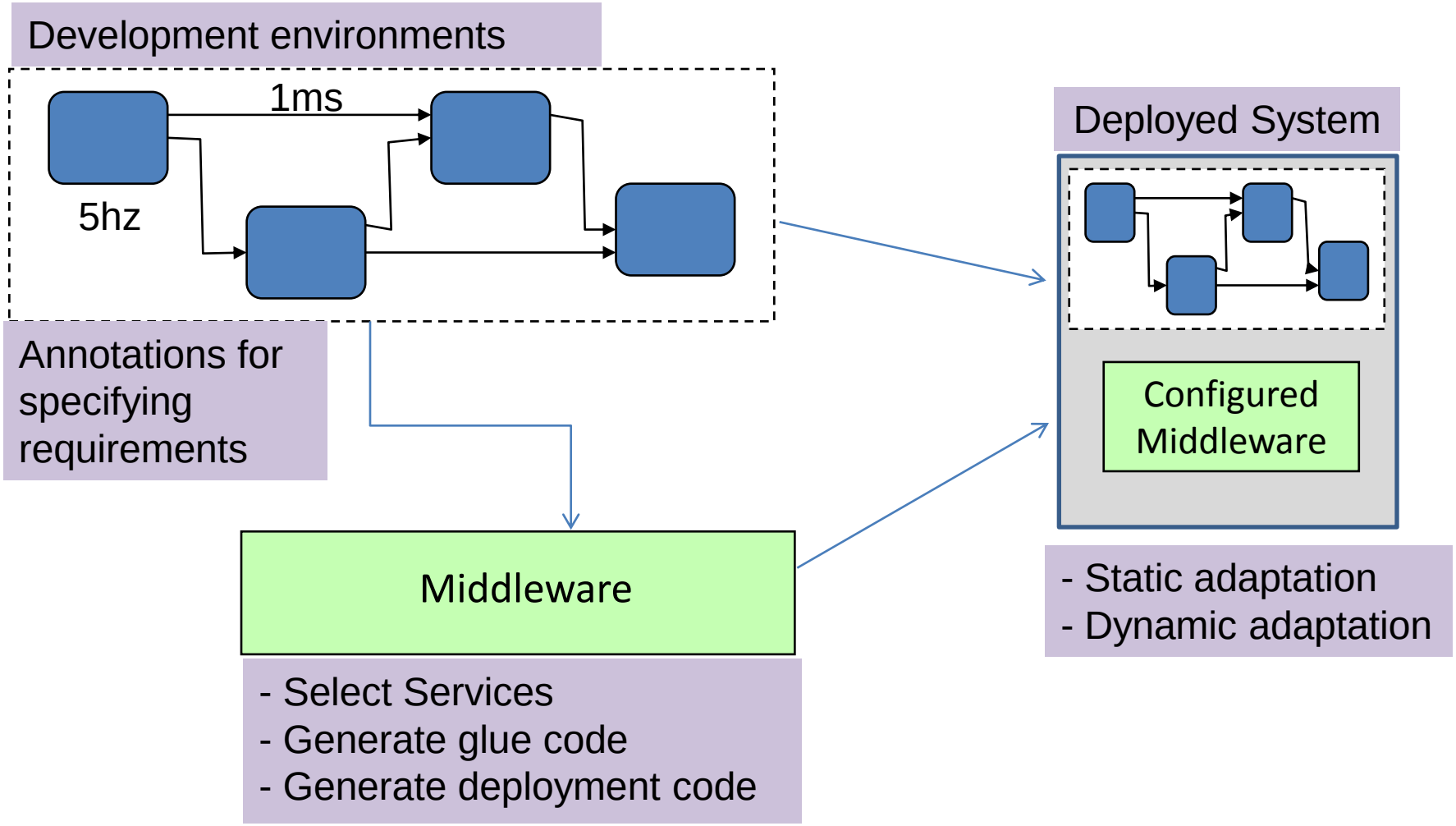


- Precision Agriculture
- Environment monitoring
- Target tracking

Research Challenges

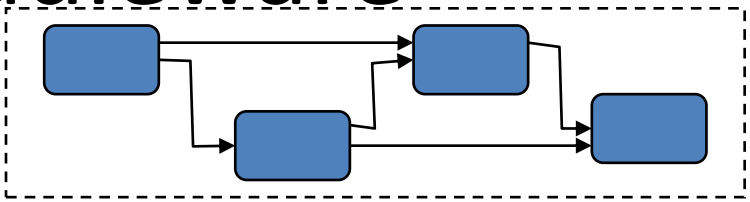
- Real time information delivery
- Anonymous communication
- Large systems of systems
- Energy consumption
- Failures
- Unreliable communication

Model-driven Synthesis



Case study: Publish/subscribe middleware

Attributes: rate, location,…
Event type: # consumers, # producers
Correlated events: *e1 and e2*
Mode behavior



Assembled Application

Analysis Algorithms

Configured Event Channel

XML Metadata

Configuration

Code synthesis

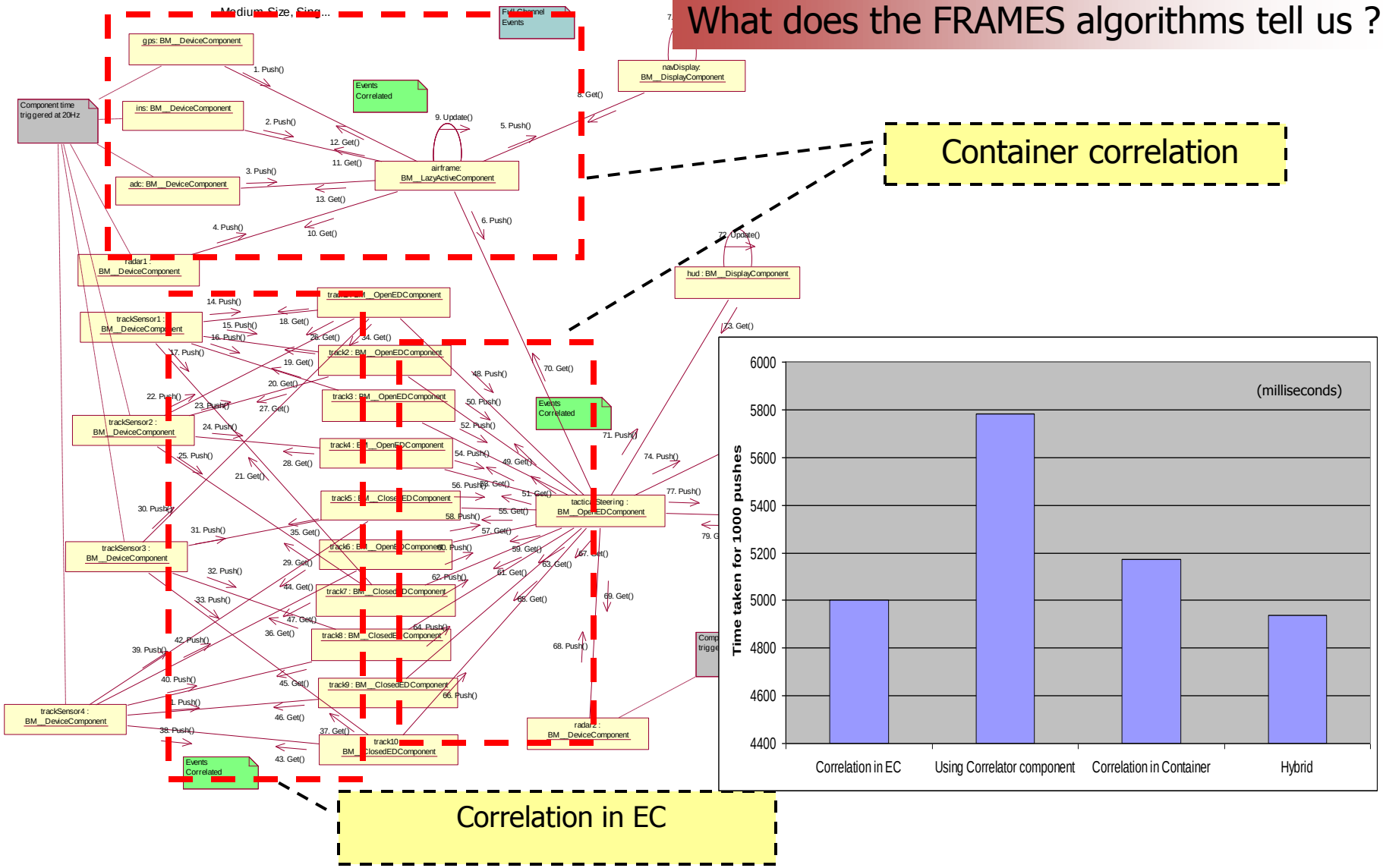
Code weaving

FRAMES: Configurable event channel

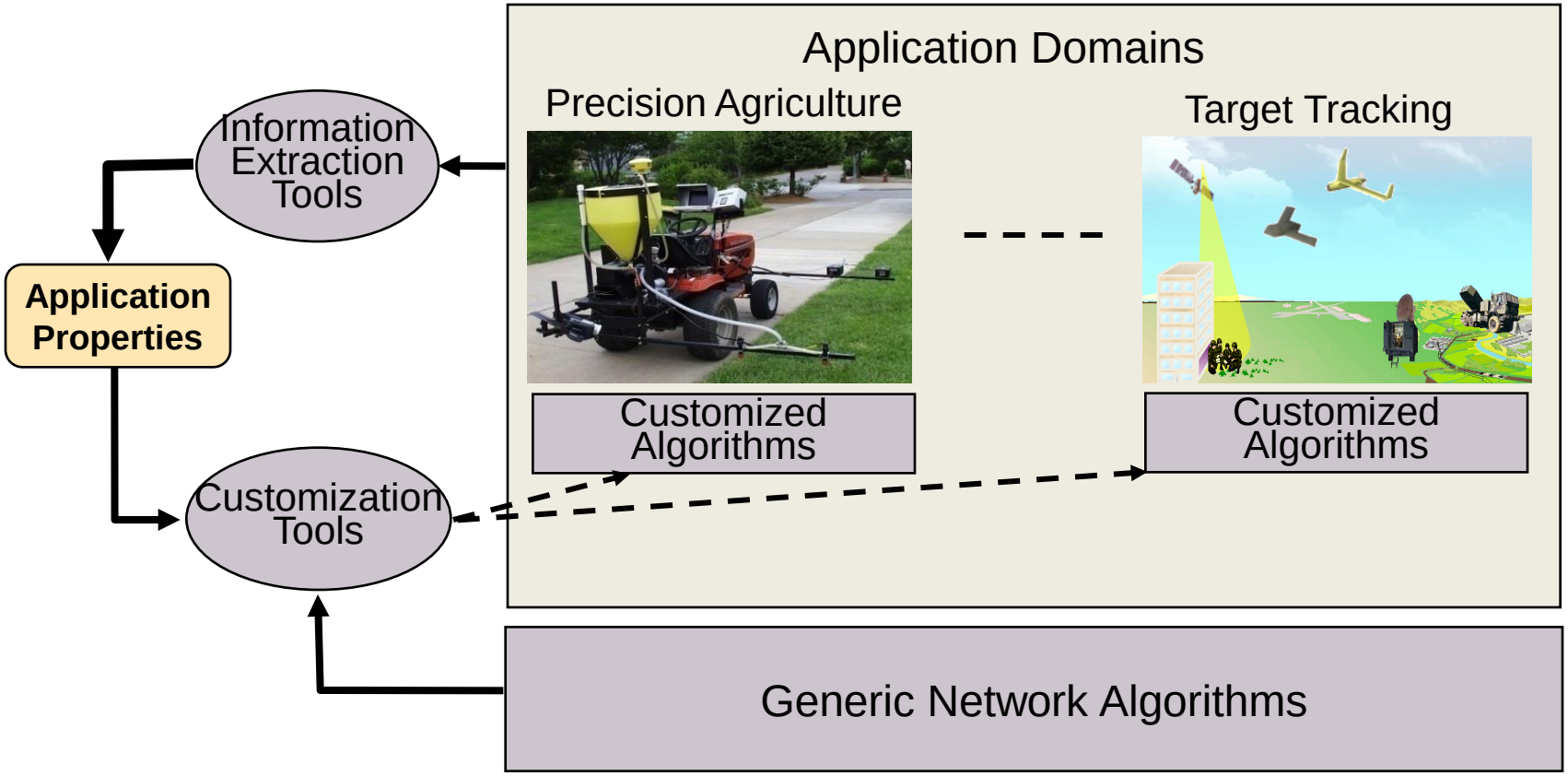
Subscriber lists: Direct Dispatch vs EC dispatch
Gateways for distributed notifications
Correlation
Distributed Correlation: Filter placement
Mode-awareness

OEP Scenarios - MediumSP

What does the FRAMES algorithms tell us ?



Optimizing Network Algorithms



Configurable Infrastructure

Sensors

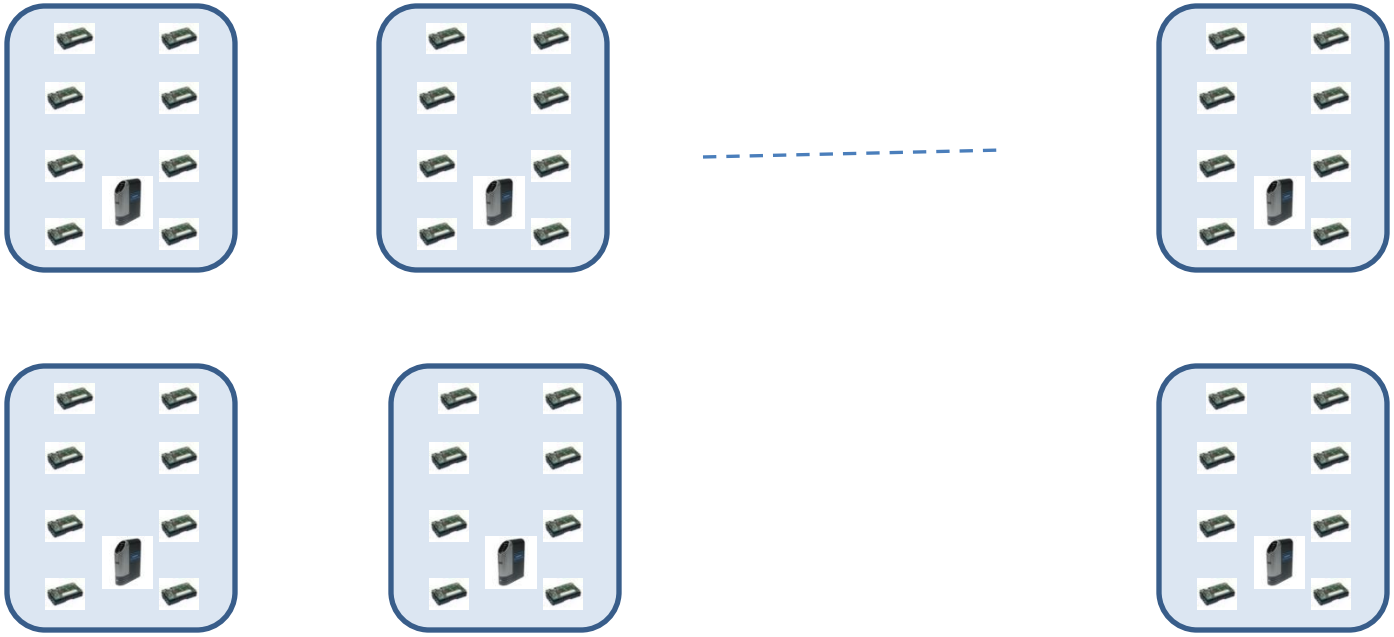
Wireless Modules (200+)

Gateways

Robots

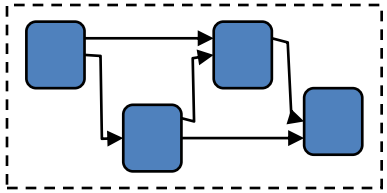
- Flexible topology setup
- Remote reprogramming
- Remote monitoring
- Protocols for middleware services

Configurable Sensor Grid



Model-driven development

Application



Application Domains

Target tracking

Workplace applications

Middleware Infrastructure (collection of algorithms)

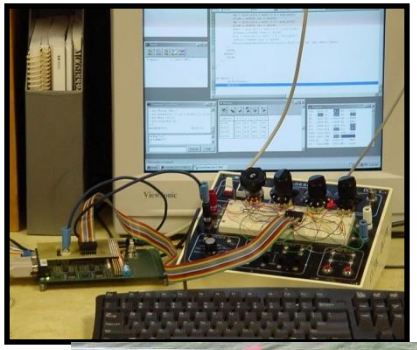
Configured Test-bed

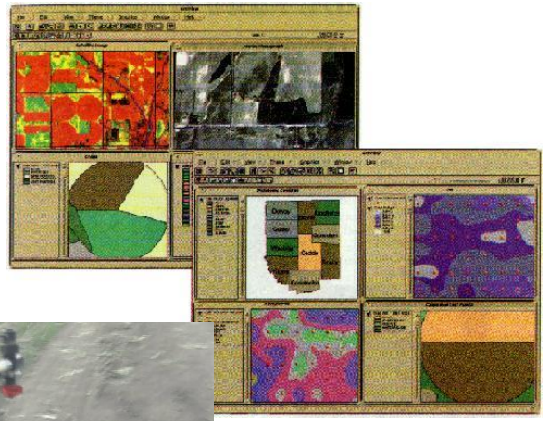
Selected Algorithms

1. Identify subsystems
2. Select algorithms for each subsystem
3. Rules for dynamic adaptation

Real-Time Sensor Systems Education

- Graduate Certificate Program in Real-time Embedded System Design (with EECE,BAE).
- NSF CRCD - Combined Research and Curriculum Development.
- Sensor Networks courses





Sensor Networks program:

- Partially sponsored by K-State Targeted Excellence Program.
- Multidisciplinary projects involving several departments from Engineering, VetMed, and Agriculture.
- Leveraging expertise already developed
  - Hydrology
  - Heat treatment technology with Grain Science
  - Micro-climate monitoring
  - Precision Agriculture

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Conclusion

- Programmable middleware infrastructure
  - Selection from alternative implementations of services in each sub-system
  - Optimization of individual implementations
- Multidisciplinary applications
- Embedded systems education