

A GIS-Based Simulation for Emergency Response and Crisis Management

Zhi Zhai, Timothy Schoenharl, Ryan McCune, Ryan Bravo,
Alec Pawling and Greg Madey

Department of Computer Science and Engineering
University of Notre Dame

GIS DAY 2008

November 21, 2008

Acknowledgment: Supported in part by the National Science Foundation
Under Grant No. CNS-050348

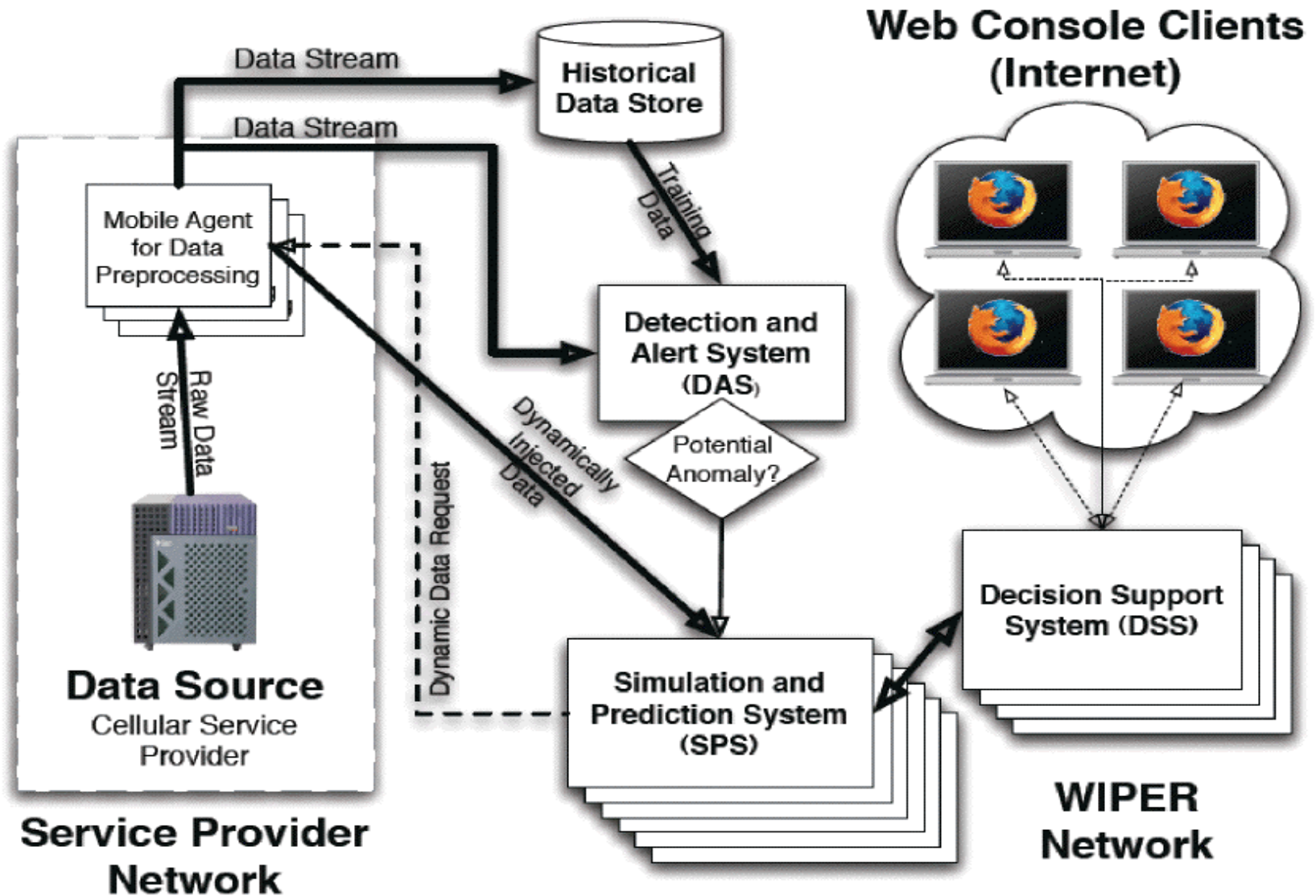
Outline

- WIPER Simulation
- Simulation Tools
- Movement Models
- Applications of GIS
- Conclusions

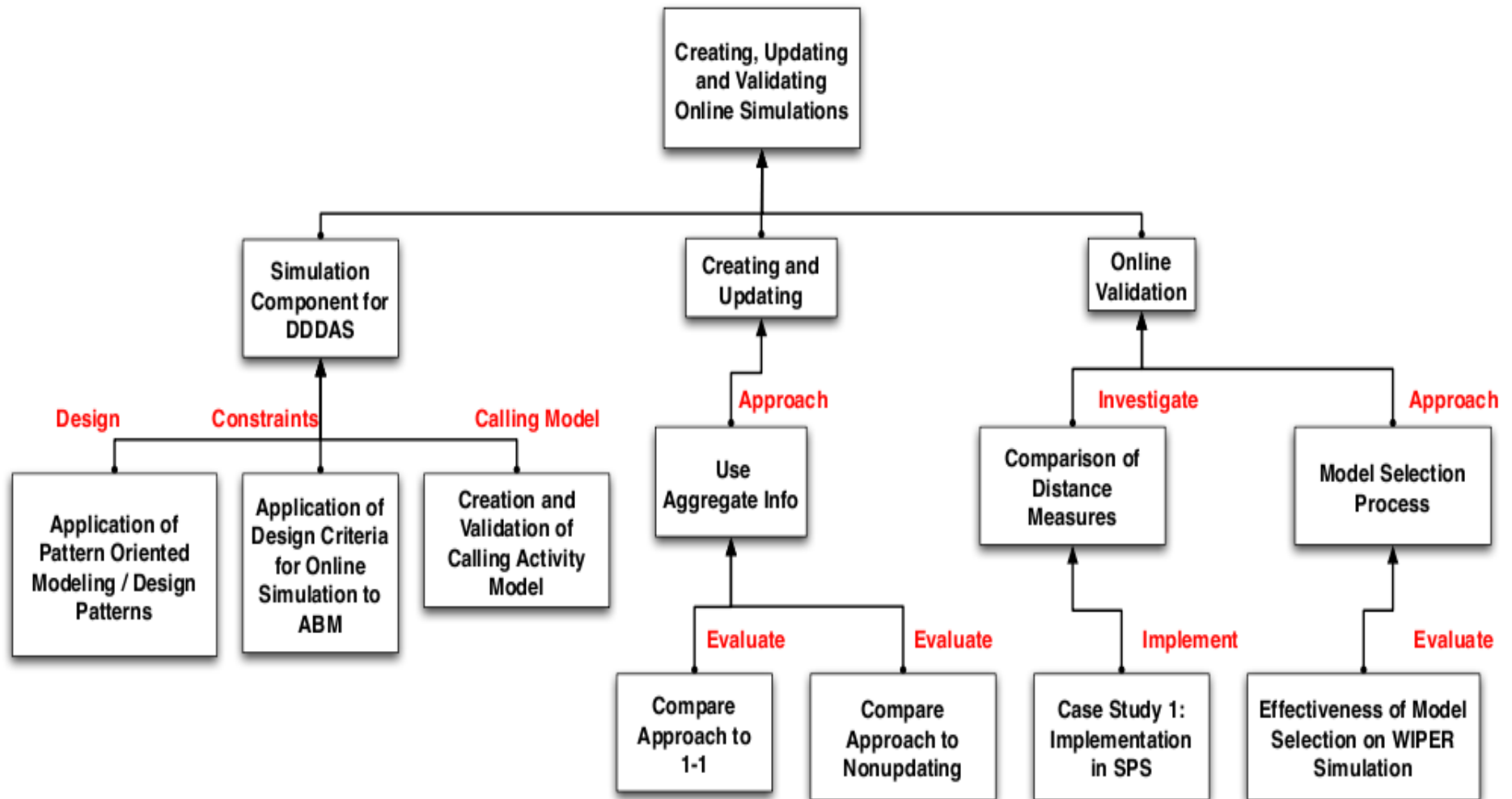
Wireless Phone Based Emergency Response System (WIPER)

- Laboratory prototype: Proof-of-Concept
- Monitors a real-time stream of cell phone activity
- Evaluates crises using Agent-Based Models (ABM)
- Presents results and guidance for emergency responders

Architecture of WIPER System



Architecture of WIPER Simulation



Cell Phone User Activity



Hurricane Evacuation



Simulation Tools

- ***Eclipse*** Software for developing Java code
- ***GeoTools*** Loading geometrical information from shapefiles
- ***Repast*** Agent-based modeling toolkit for simulating agent behaviors
- ***OpenMap*** Display tool for geographic information
- ***PostGIS*** Works with *PostgreSQL* as a spatial database
- ***GRASS*** Tool for geo-spatial data management and analysis

Movement Models

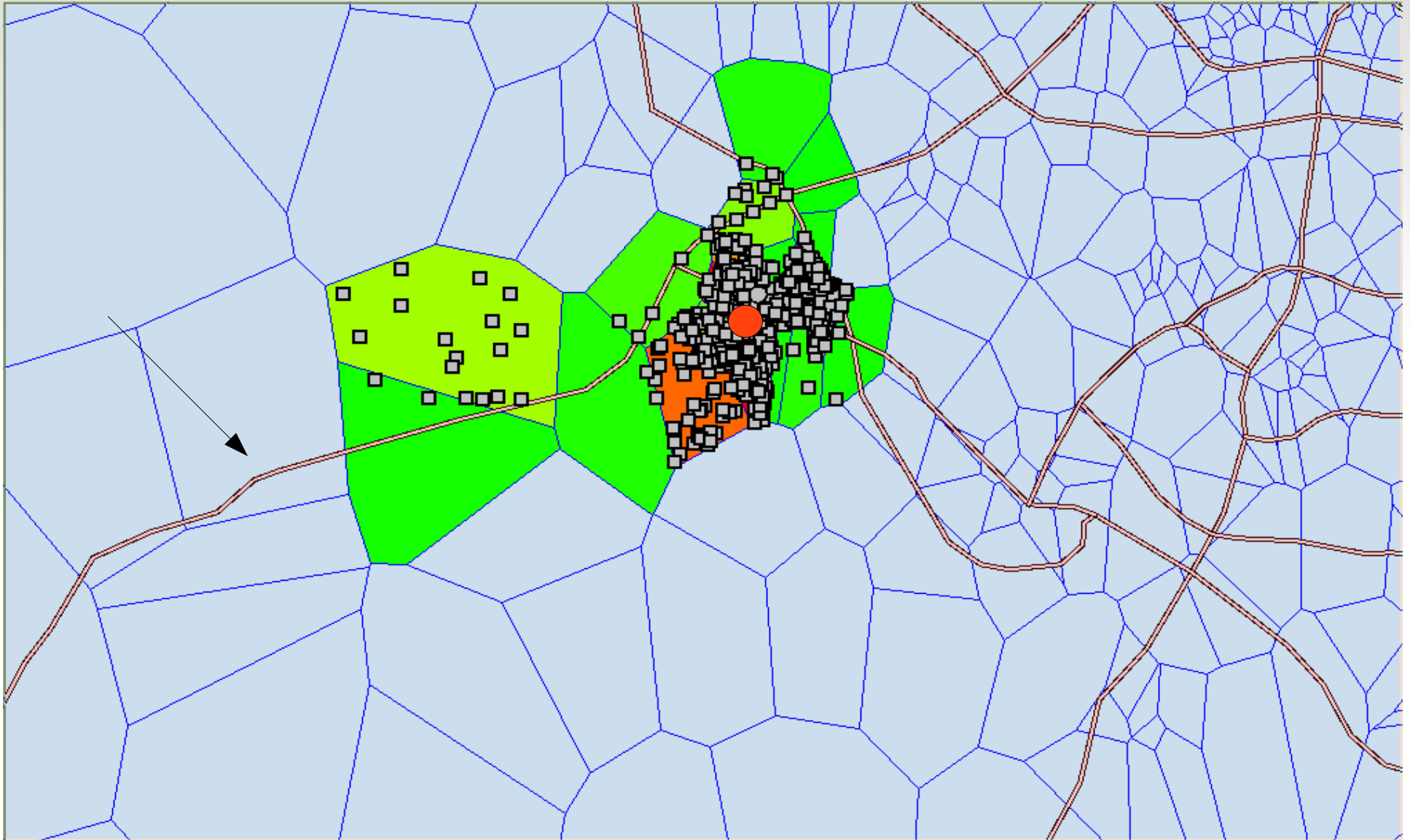
- Fundamental Models

- *Null Movement* A placeholder, no movement
- *Random Movement* Moving in a random fashion
- *Move And Return Movement* Back and forth between home and work location
- *Basic Flee Movement* Moving along a straight line.
- *Bounded Flee Movement* Agents stop after they reach a safe distance

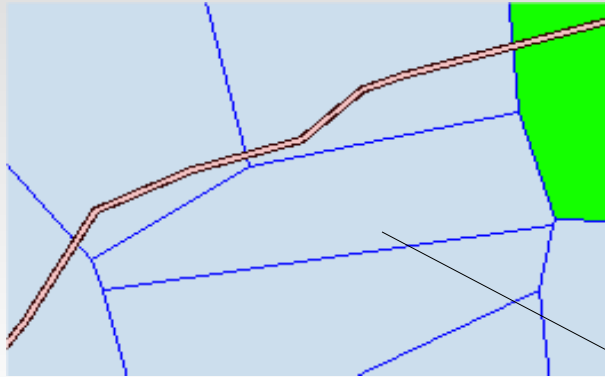
- Extended Models

- *Road Flee* Moving path constrained by road network
- *Congestion Flee* Limited road sources generate traffic jams
- *Mixed Flee* Pedestrians and cars evacuate simultaneously

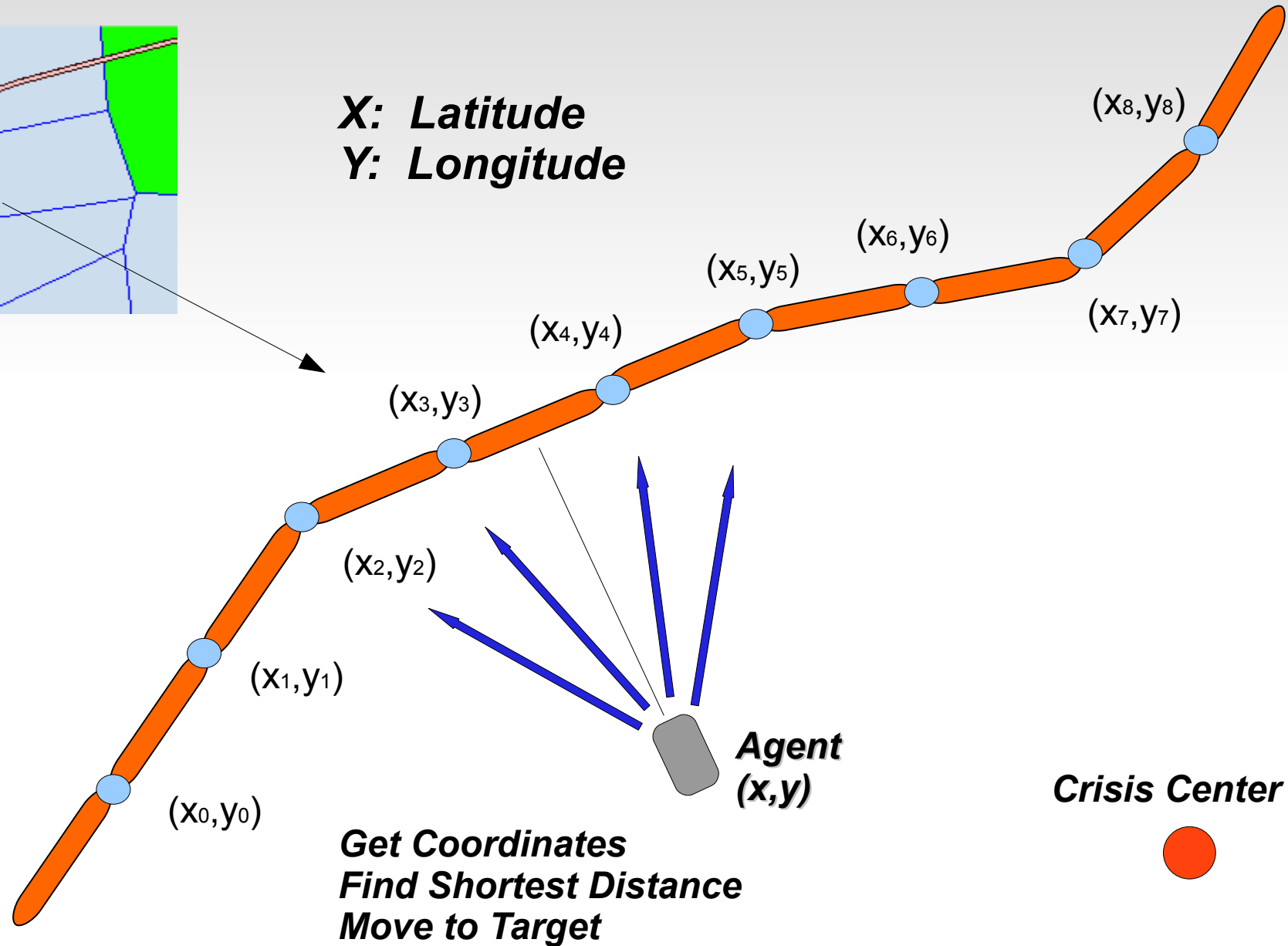
Road Network Around Crisis Center

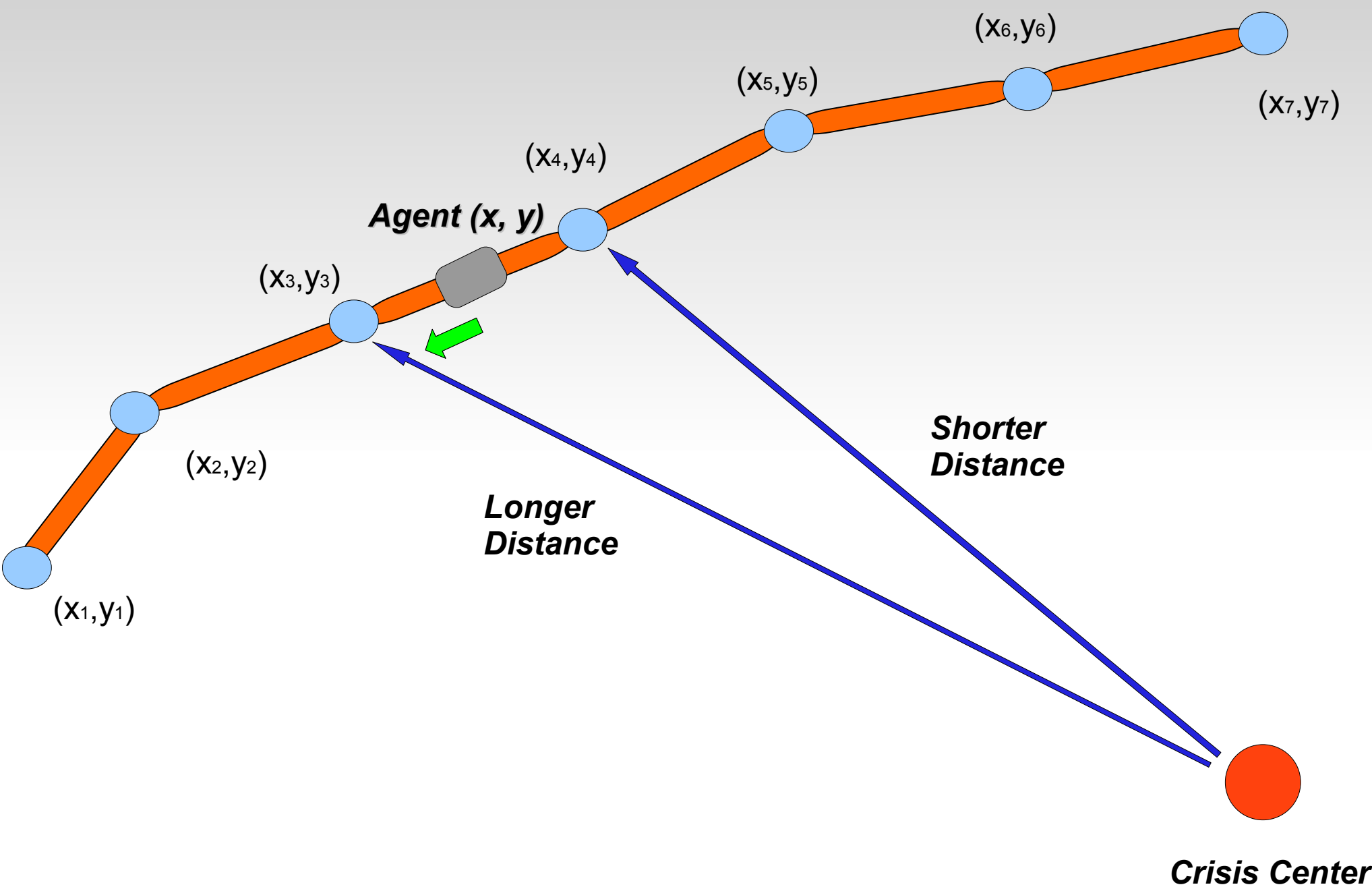


GIS For Guiding Agents

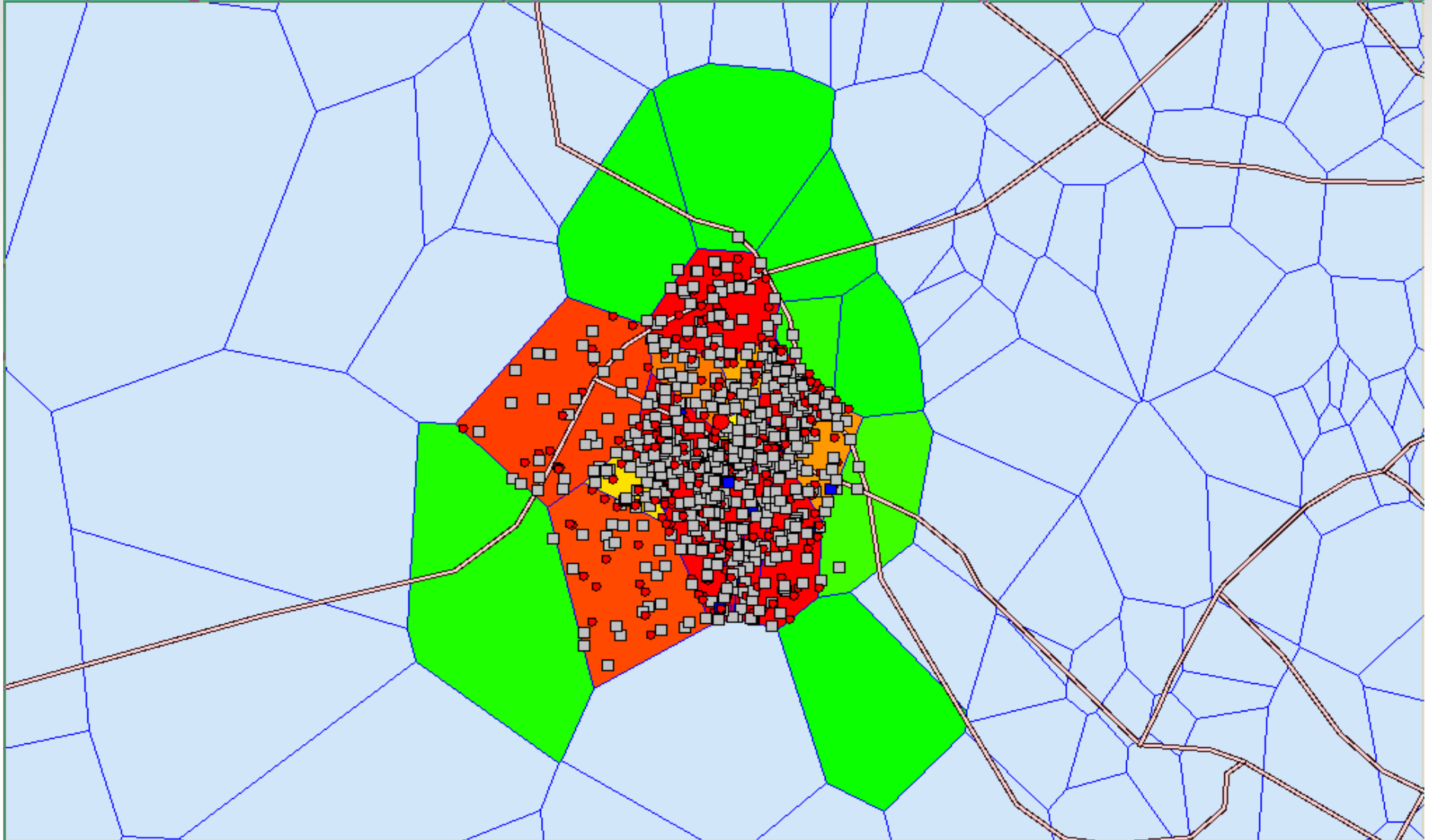


***X: Latitude
Y: Longitude***





Mixed Flee Movie



Conclusions

- Integrates GIS-enabled Agent-Based Simulations and visualization tools together.
- More realistic simulation: accurate Geo-spatial constraints on agent behavior.
- Enhance the decision making process of emergency management.

- Questions? Comments?

Geographic Information System(GIS)

- GIS is an information system that integrates, stores, analyzes, and displays geographic information
- Multiple applications:
 - Emergency response in the event of disasters
 - Land protection from pollution
 - Infrastructure Construction