

**IEEE GLOBECOM ACCESS '09  
Business Forum**

**Session 201: Knowledge Management, Social Networks,  
and Global Communities**

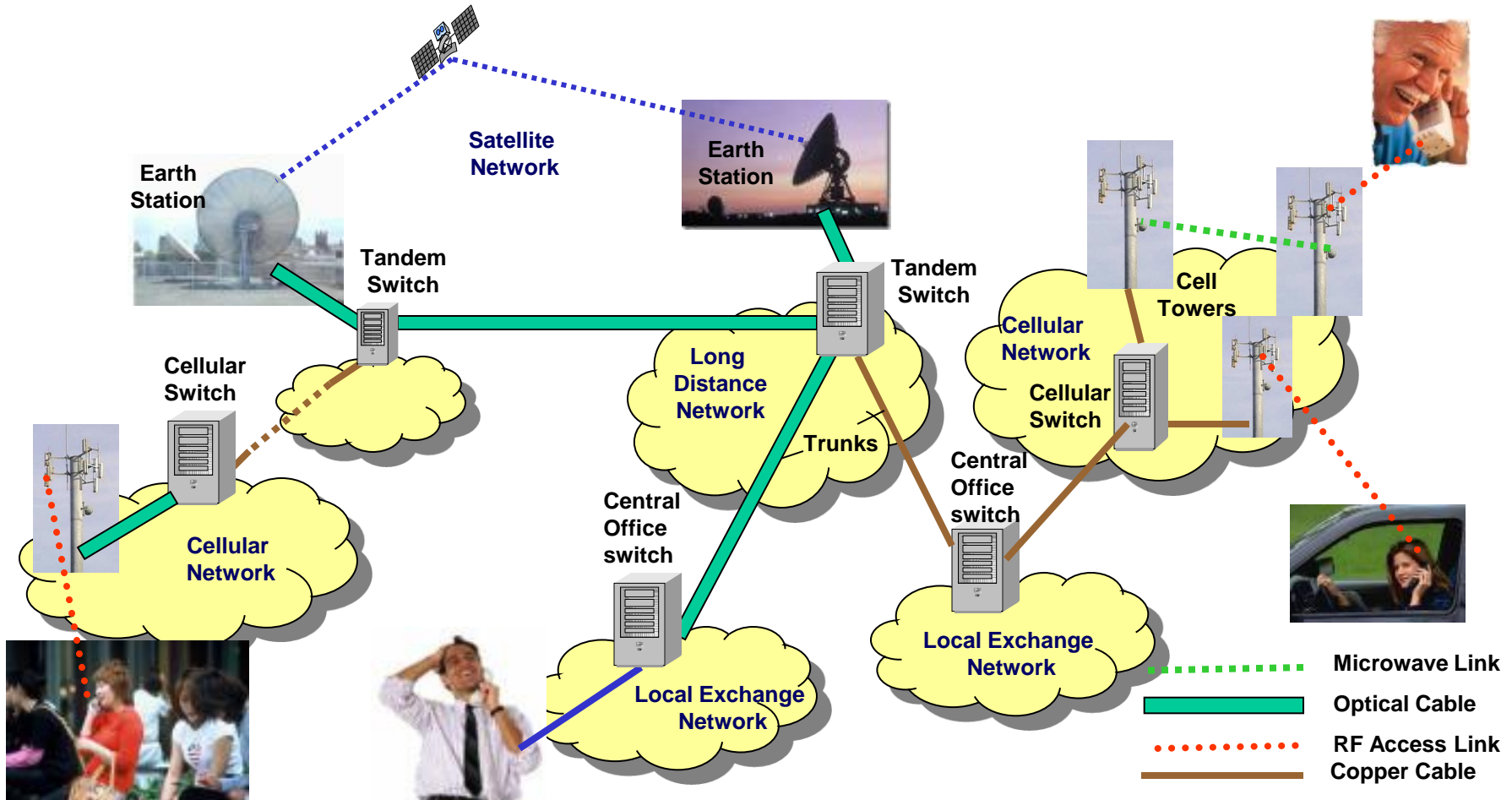
**Real Time Collaborative Networks of Intelligent  
Agents (Humans or Machines)**

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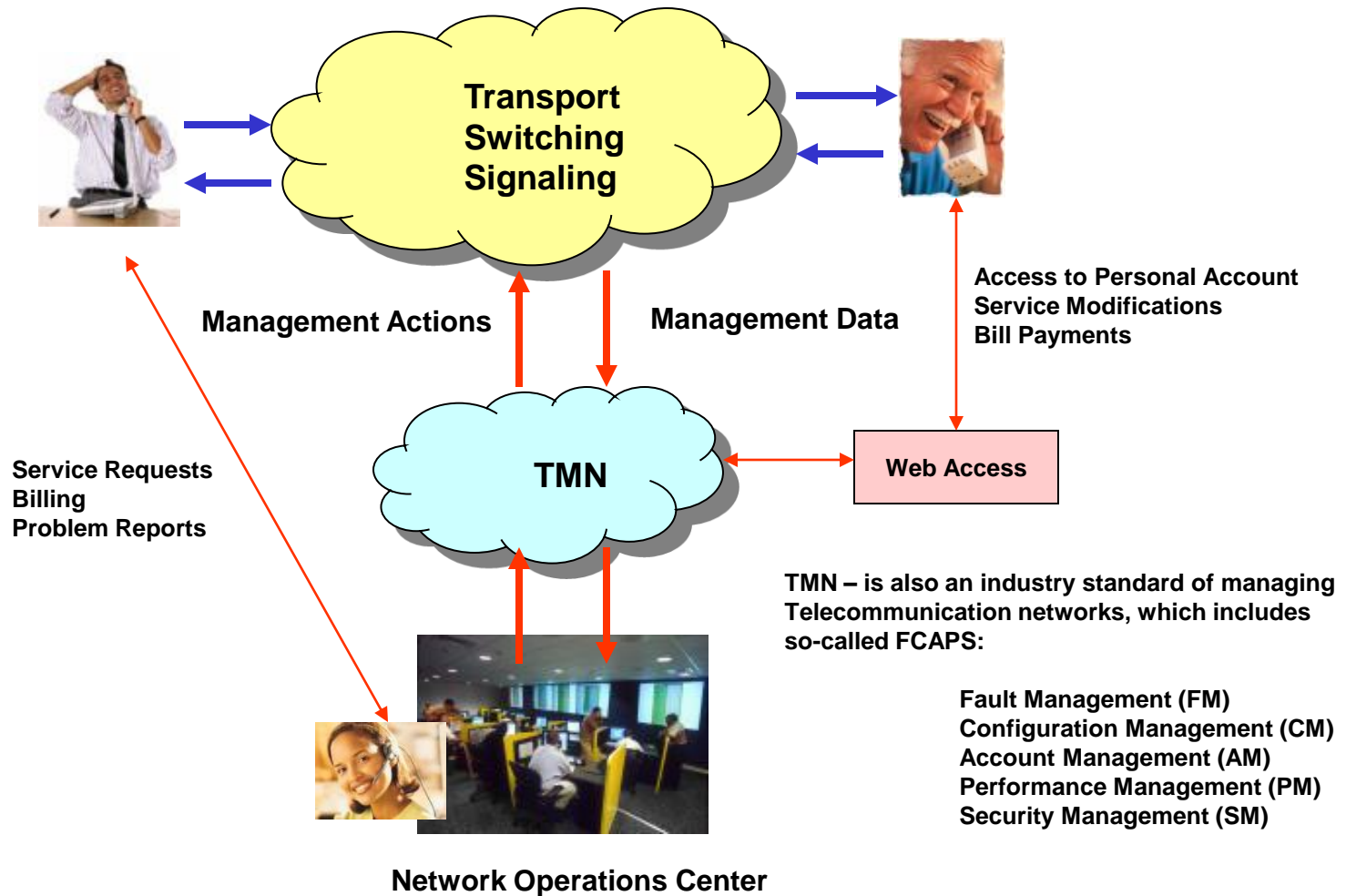
# Instead of Introduction

- **How our understanding of “network” has changed**
- **Next slide:**
  - **The year is 1995**
  - **The place is World Telecom Forum**
  - **The talk is about intelligent (knowledge based) network management**

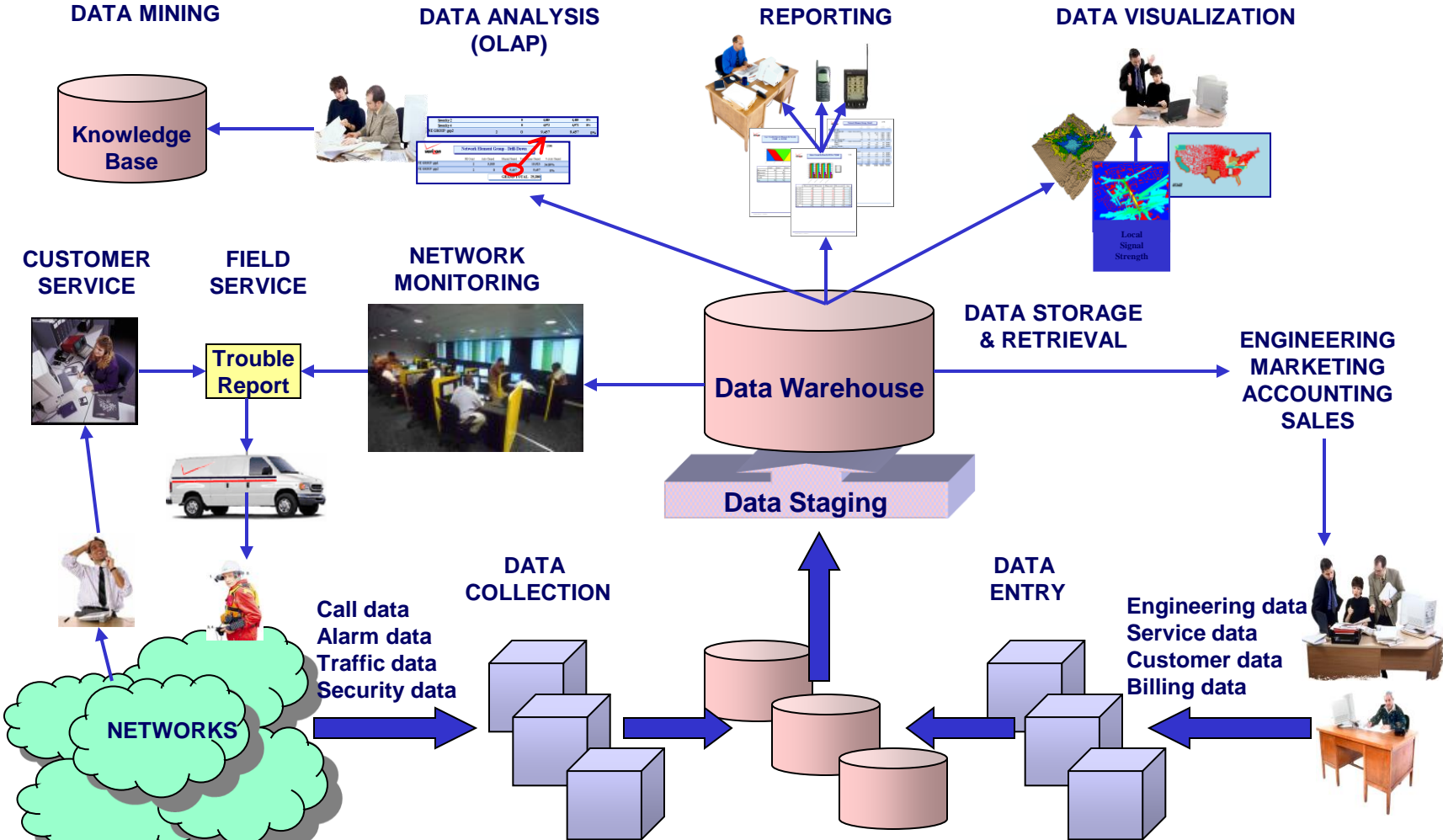
# 1995 WIRELESS TELECOMMUNICATIONS NETWORK



# How the Network Management Looked in 1995 using TMN – TELECOMMUNICATION MANAGEMENT NETWORK FRAMEWORK



# INFORMATION TECHNOLOGIES FOR NETWORK MANAGEMENT



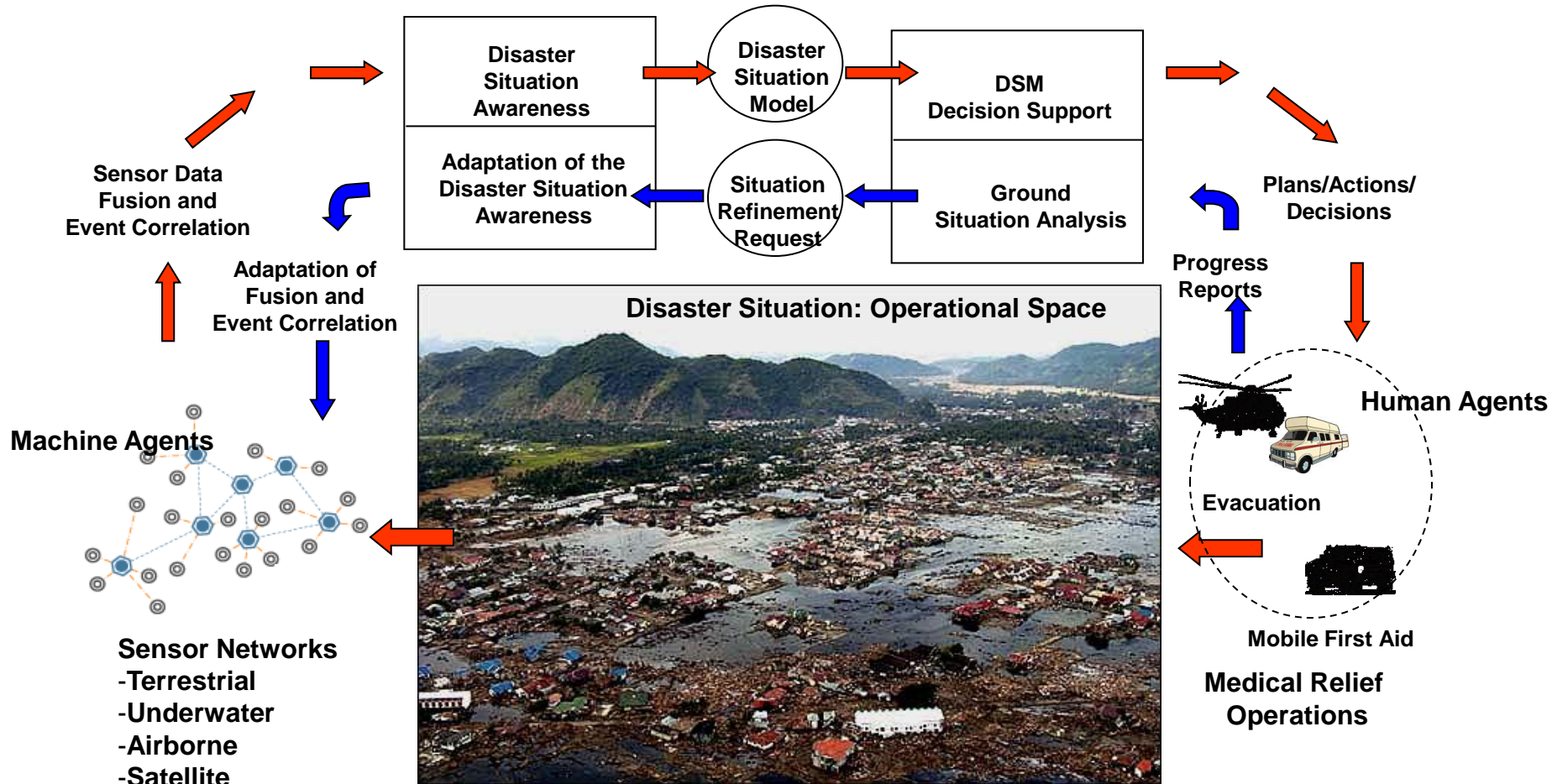
# What is the Moral from the Previous Slides?

- **“Networks” were pieces of hardware and software, sometimes buildings, power generators, cell towers, etc. added**
- **The management paradigm was mostly centralized (in the best case – client/server architecture), despite that the “distributed AI” concept has been around for a while**
- **The management policies were static and predefined**
- **Very clear border between managed networks (hardware/software) and management by humans**

# Let's Return Back to 2009 (almost 15 years later)

- **Next Slide**
- **It is also an “network”, but significantly different**
- **First of all, the nodes are not only routers and servers; they can be also humans; actually, they can be vehicles, satellites, troops, weapon systems, emergency teams, etc.**
- **The topology is not any more only “port x is connected by port y over an optical link; they can be any spatial, temporal, causal, social, financial, etc. links across many different domains;**
- **The management paradigm is moving from “client/server” to the framework of distributed autonomic mobile agents**
- **Cooperation, knowledge sharing, adaptation, self-organization are the principals of management**
- **Situation awareness, information fusion, knowledge and goal sharing, automatic reasoning are becoming the central pieces of behavior of the agents.**
- **Most importantly – humans are both as the agents of management as well the entities to be managed**

# Disaster Situation Management: Rescue and Recovery Operations



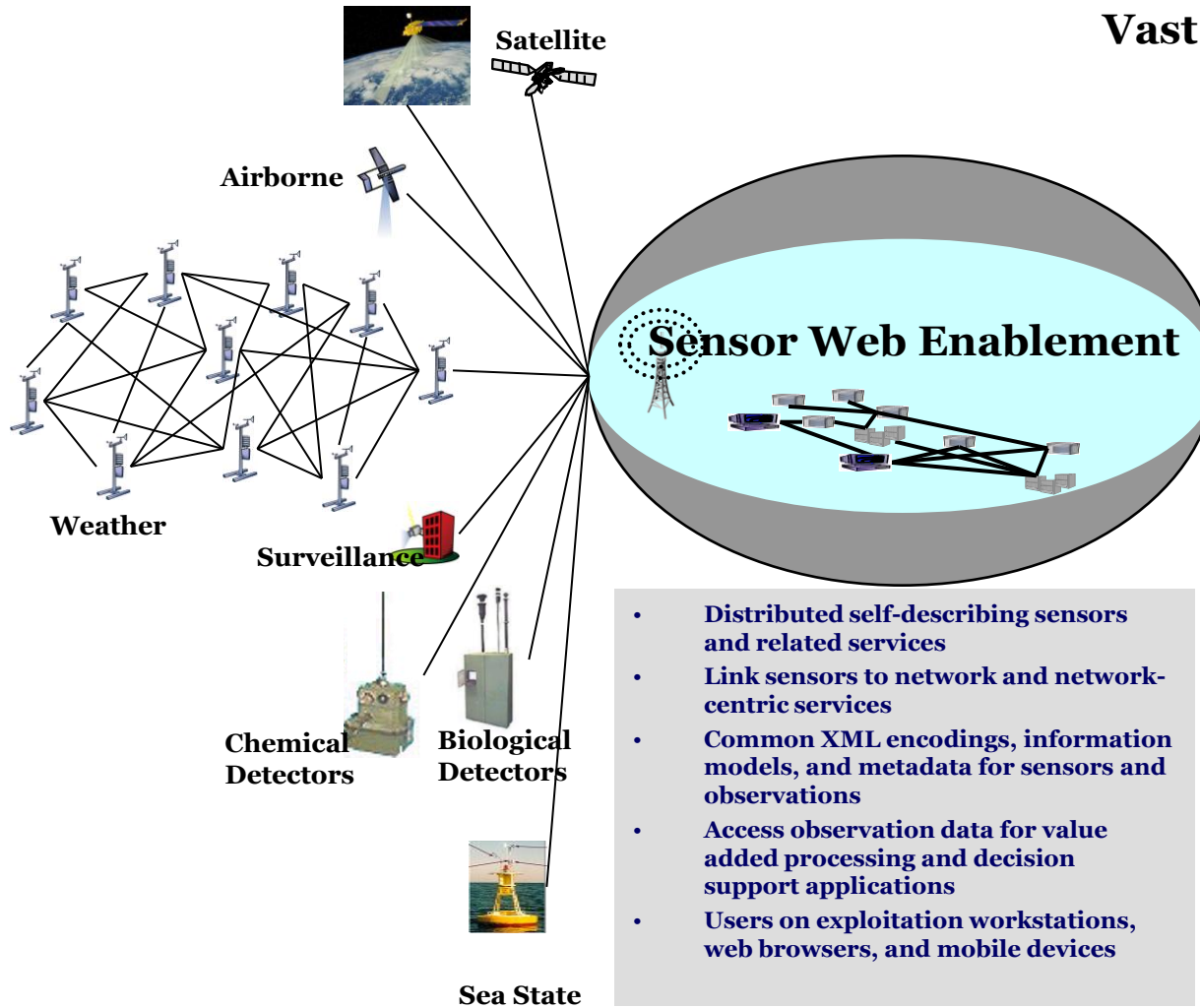
Gabriel Jakobson, "Situation Sensing, Fusion and Management for Collaborative Emergency Operations",  
Presentation at Pacific Telecommunication Conference PTC 2008, Honolulu, Hawaii, January 13-15, 2008.

# **New Directions in Disaster Situation Management**

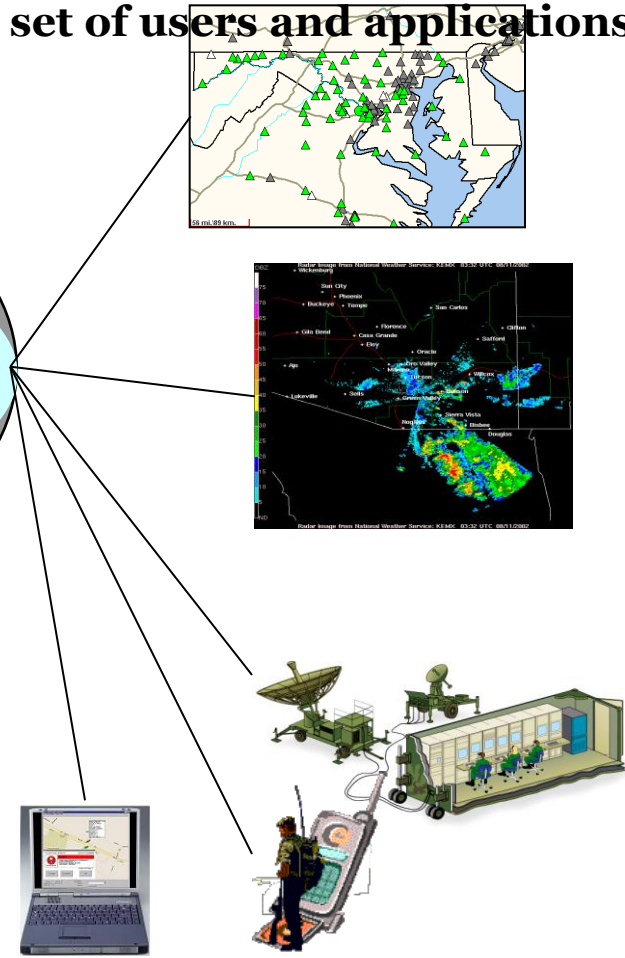
- **I recent years we can see a new generation of technologies that can potentially provide a new quality to disaster. This includes**
  - **Development and deployment of the technologies of smart sensing and sensor networks**
  - **Introduction on autonomic robotic land, aerial and under-sea vehicles**
  - **Application of Grid computing, distributed systems and agent technologies**
  - **The use of the methods of cognitive information processes**
  - **Significant advancement of the technologies of situational awareness, information fusion, command & control, and the use of adaptive, self-organizing and knowledge-based systems**

# Sensor Web Enablement

## Constellations of heterogeneous sensors



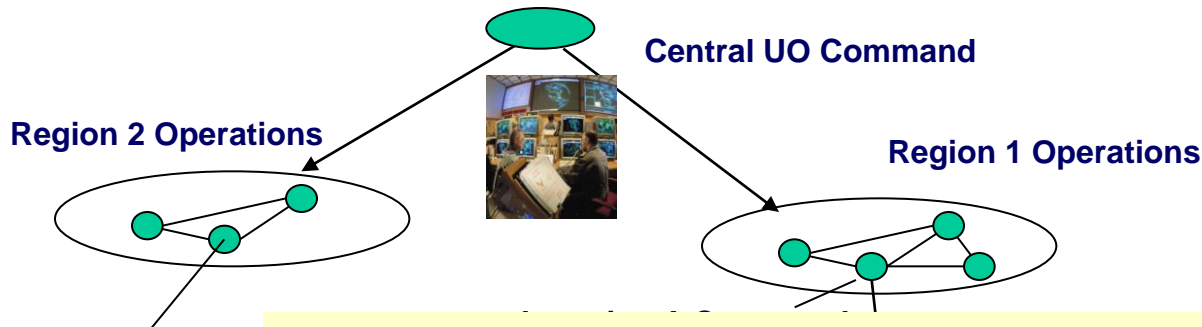
## Vast set of users and applications



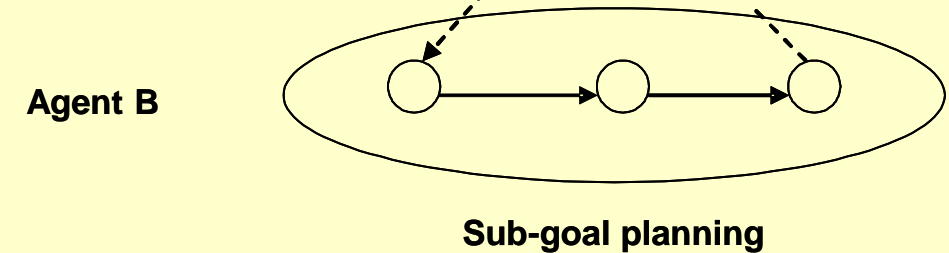
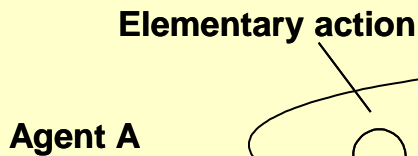
- Distributed self-describing sensors and related services
- Link sensors to network and network-centric services
- Common XML encodings, information models, and metadata for sensors and observations
- Access observation data for value added processing and decision support applications
- Users on exploitation workstations, web browsers, and mobile devices

From <http://www.opengeospatial.org/projects/groups/sensorweb>

# Example: Command Structure of a Tactical Urban Combat Operation



A federated architecture defines regions of local autonomy from a higher-level central command. The central command defines tasks (goals, plans, beliefs, knowledge, etc) and reporting structure, while execution of local task is left to a region. A federated architecture is the most promising for tactical UCO. It can also be adjusted dynamically during combat operations.

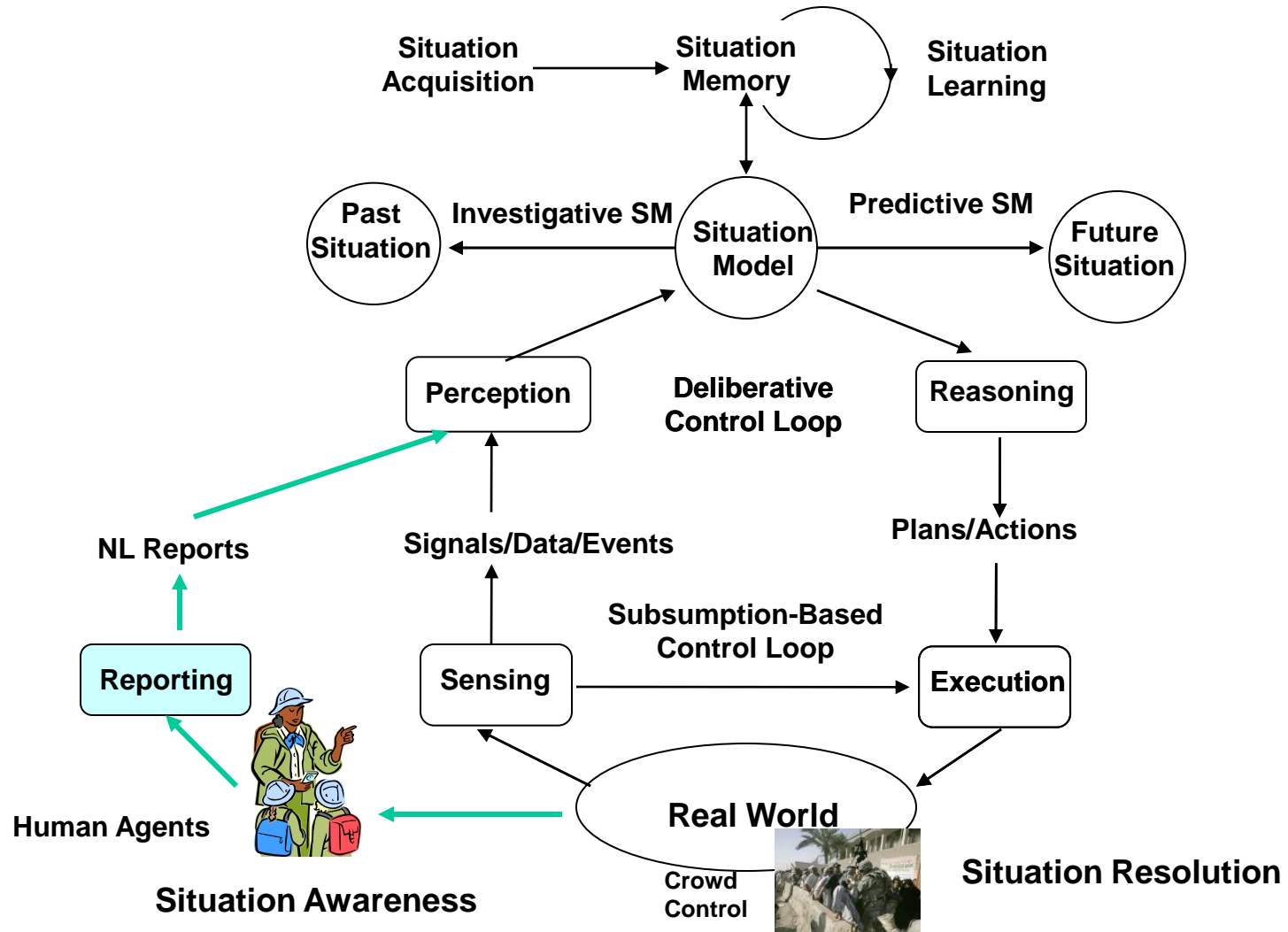


L. Lewis, G. Jakobson, J. Buford, "Inferring Threats in Urban Environments with Uncertain and Approximate Data: An Agent-Based Approach," *Applied Intelligence*, 2008.

# Introductory Definition of Situation Management

- **Situation Management is a synergistic goal-directed process of (a) sensing and information collection, (b) perceiving and recognizing situations, (c) analyzing past situations and predicting future ones, and (d) reasoning, planning and acting so that desired goal situations are reached within required quality, resource and time constraints**
- **Informally, situations are aggregated time-dependent states of a dynamic systems, while events are changes in the system's situations. Sensor readings, intelligence reports, event messages, etc. are external manifestations of events. Actions are external or system internal forces affecting the system's situation transitions. A sequence of situation transitions defines the system's behavior.**
- **Complexity of the situations may range from a single attribute value of an object, to a single relation between to objects, to an aggregated state of complex collections of objects interlinked by various class, structural, spatial, temporal, causal, and other (domain-specific) relations**

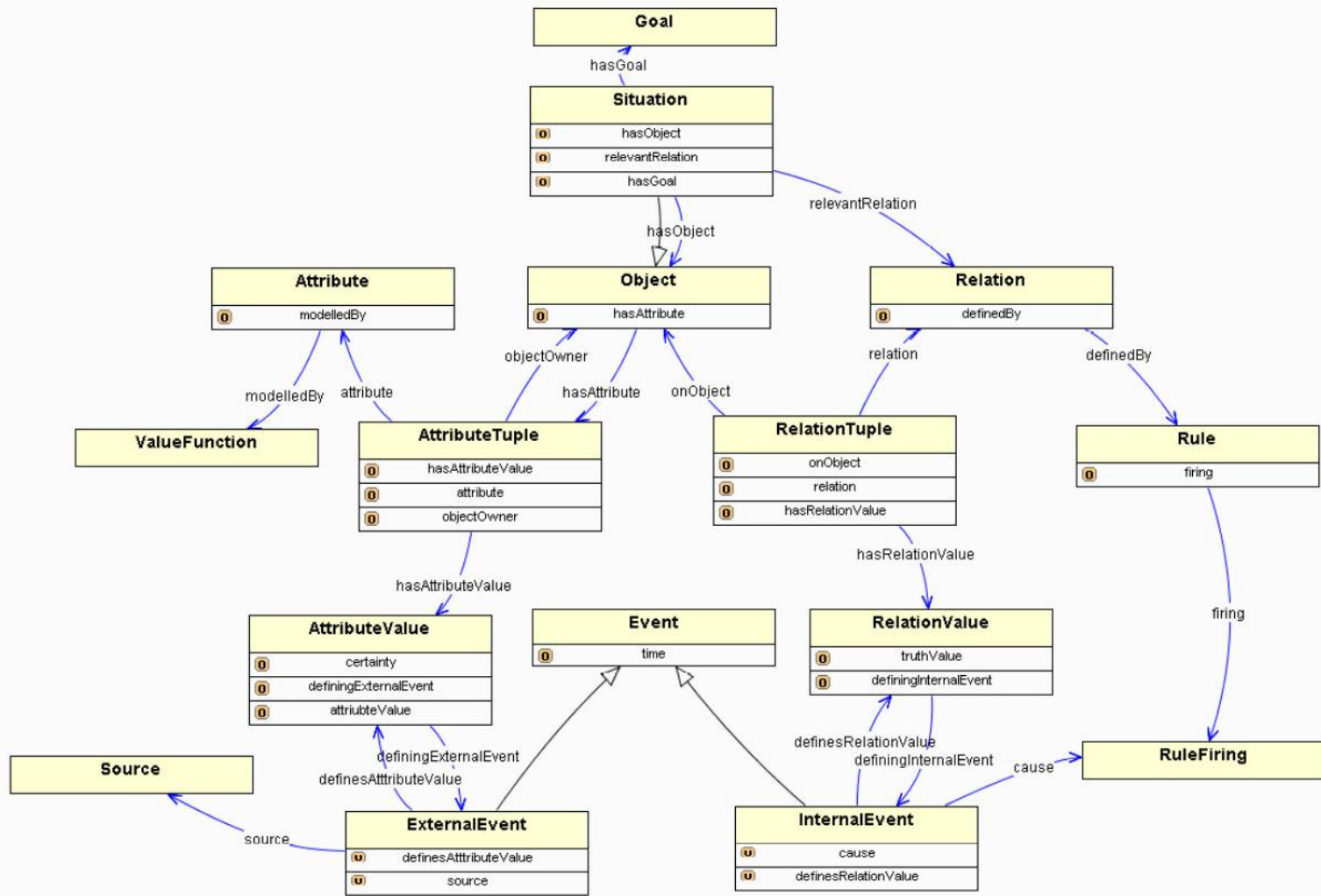
# High-Level View on Situation Management: Soft Situation Management



# Towards Soft Situation Management

- **Human Terrain**
- **People Tracking, terrorist organizations, crowd control**
- **Human networking**
- **Humans in the loop, both as decision-makers and objects of management**
- **Focus on natural (and/or structured) natural language intelligence reports**
- **AI and NL processing methods of extraction of spatio-temporal relations**
- **Cultural, ethnical, social, religious situation awareness**
- **Decision-making algorithms in highly uncertain and incomplete**

# Situation Awareness Ontology



From C. Matheus, et al., An Application of Semantic Technologies to Situation Awareness



**Thanks for Your Attention!**