

# Spatial Technology Trends in Security and Public Safety

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URISA BC - GIS in Health and Public Safety Conference

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## Abstract For Today's Presentation

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### Spatial Technology Trends in Security and Public Safety:

- In recent years, our society has been increasingly focused on Security and Public Safety. This increased attention has been driven by a number of (natural and man-made) actual events as well as by the increasing recognition of the increasing potential for various types of events. Fortunately, advanced technologies are allowing us to address security and public safety needs more effectively than in the past.
- This presentation will take a look at the **evolving role that spatial technology is and will be playing in addressing society's needs for increased security and public safety**. The presentation will include some actual case studies that employ spatial technology.

## Some Points of Discussion

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- Security and Public Safety – who and what are we talking about?
- What is “Spatial”?
- Sensors and the SensorNet Project
- Tons of Imagery & DEM’s!
- Video, Alarms and Access devices
- Other enabling technologies
- Some issues/requirements of First Responders, Emergency Operations Centres (EOC’s) and Security Operation Centres (SOC’s)
- A spatially-enabled, Command and Control centric solution architecture
- Concluding Remarks

# Security and Public Safety – Who and what are we talking about?

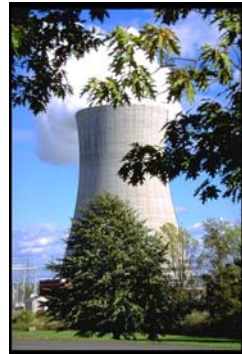


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# Security and Public Safety



**Emergency Operation Centers**



**Nuclear Plants**



**Chemical Plants**



**Military Bases**



**Government Buildings**



**Oil Pipelines & Facilities**



**First Responders**



**Schools**



**Tunnels, Dams & Bridges**



**Buses**



**Utilities**



**Transit**



**Ports**

# Typical Public Safety Practitioners



**Washington, DC  
Police**



**State of Victoria incl.  
Melbourne, Australia**



**RAC Motoring Services,  
United Kingdom**



**Chicago O'Hare  
International Airport**



**New Zealand Fire &  
Police**



**Bavarian State Police /  
German Federal Police**



**Belgian Federal Police  
(ASTRID)**



**Toronto Police &  
Fire Services**

# Typical Security Practitioners



"Quarterdeck of the Navy"

Naval District Washington



*Science in the National Interest*



Privacy & Legal Notice



Department of Energy  
University of California

**Lawrence Livermore**  
**National Laboratory**

Lawrence Livermore National Laboratory ensures national security and applies science and technology to important problems of our time.

# Airport Security



Chicago O'Hare



San Francisco



Pittsburg  
Raleigh Durham

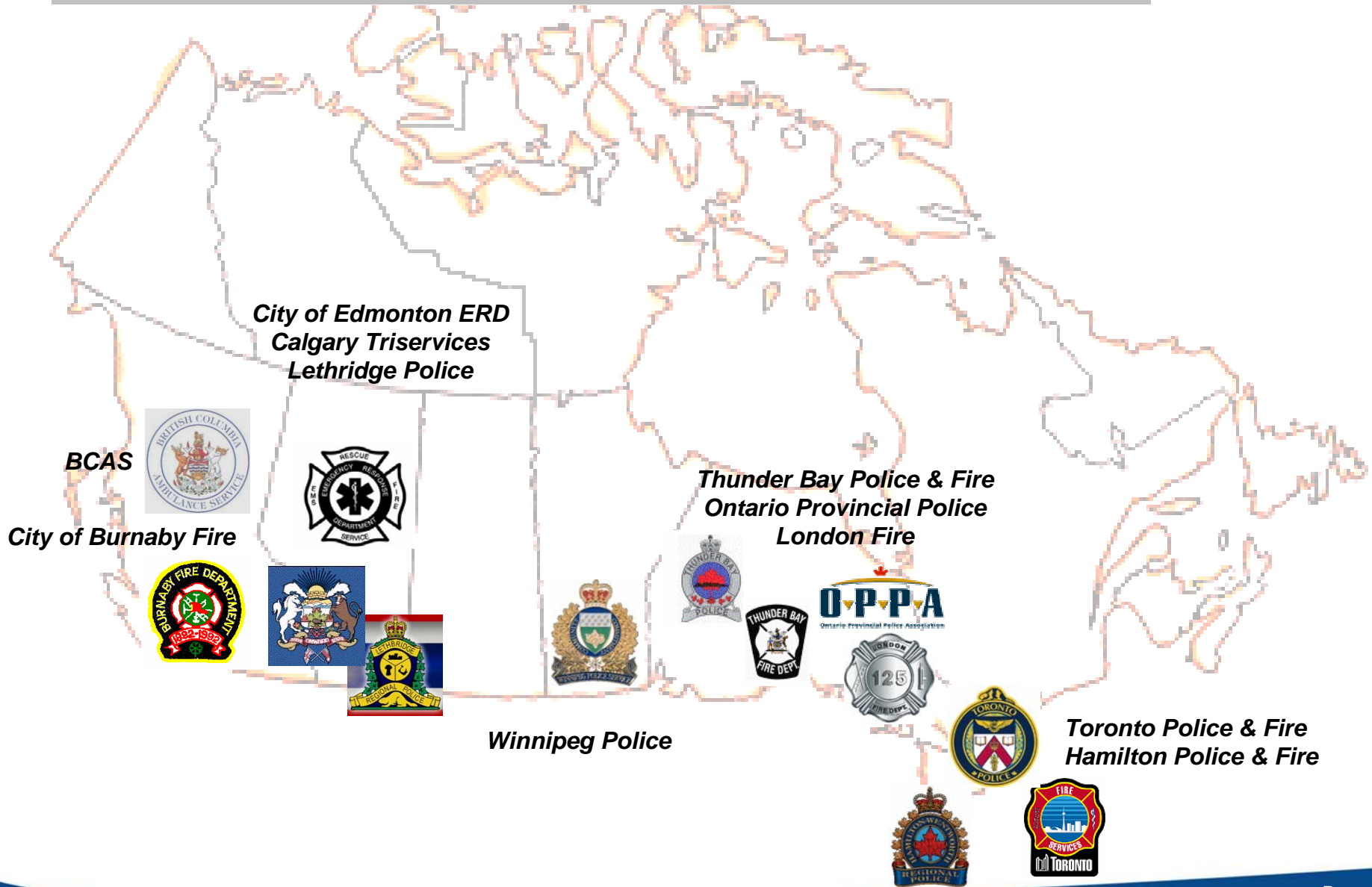


Midway





# Some Canadian Public Safety Practitioners



What is “Spatial”?



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## What is “Spatial”?

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- Spatial refers to “location aware” data coupled with location-processing functionality;
- Spatial Content:
  - Coordinate data representing things like road centrelines, utility distribution networks, ownership parcels, sensor locations, asset locations, etc.
  - Location can be static or dynamic;
  - Location data is ideally maintained within workflows for processes that create or modify the data (such as digital survey submissions and integrations or as-built plan submissions);
  - Location data can be stored locally and/or accessed through a service depending upon need, usage, access privilege, etc.;
- Spatial Functionality:
  - Typical functionality includes locate, zoom, pan, buffer, overlay, display, etc.

## What is “Spatial”?

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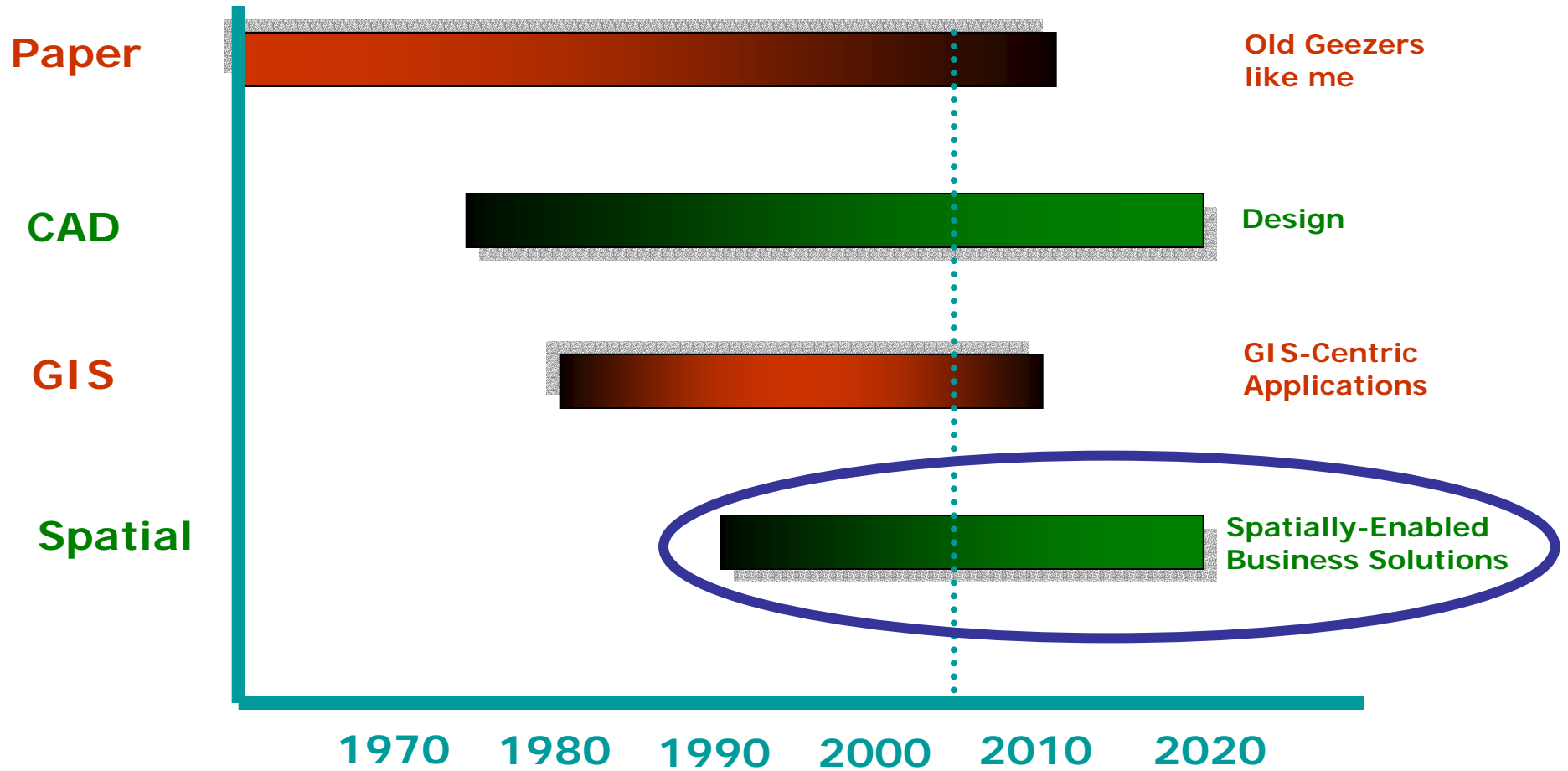
- Spatial data and spatial functionality can be incorporated with everyday process work-flows to make them more efficient;
- Integrated analysis of multiple disparate business systems is possible through the use of spatial technology (saying: “*Geography – The Information Integrator*”);
- For example:
  - Massive amounts of data generated by independent, disparate security systems (such as alarms, access control systems, sensors, cameras, etc.) can be “integrated” into a spatial “common operating picture” to make better sense of it;
- Radical Statement:
  - “GIS” as a distinct discipline is disappearing as spatial data and spatial functionality become imbedded inside core business processes...

## Some Views on the Spatial Industry



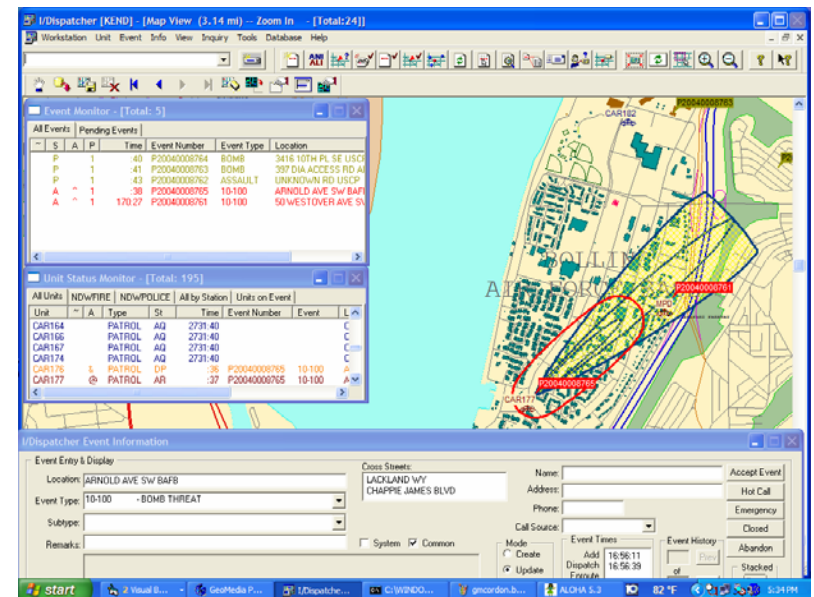
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# Gariepy's View of Things...



# Spatially-Enabled Public Safety Command and Control

- Public Safety systems used extensively by Canadian Police forces were one of the first core business applications to be truly “spatially-enabled”;
- Spatial data and functionality are used to ensure effective command and control - a simplified operational picture of the locations of events and assets enabling the ability to recommend optimal mobile assets for dispatch;
- Maps were highly simplified to ensure optimal performance and ease of interpretation;
- Increased processing power and use of industry standards is now making it feasible to incorporate other types of spatial data (imagery, parcels, plumes, alarms, sensors) and functionality (event triggers, response execution, notification, etc.);



# Some Spatial Data Types Required for Security and Public Safety



- Intelligent road network;
- Planimetric (roads, railways, building outlines, etc.);
- Topographic (rivers, lakes, etc.);
- Parcels;
- Utility/Infrastructure/Storage (water, wastewater, gas, electric, wells, pipelines, chemicals, etc.);
- Digital Elevation Model (DEM);
- Imagery (satellite, air photography, ortho, etc.);
- Special site layouts (malls, exhibition areas, parks, universities, etc.);
- Special event sites (inaugurations, sports events, concerts, etc.)
- Building layouts;
- Mobile assets;
- Sensor data (will be explained further)



## Sensors and the SensorNet Project



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## The “Sensor Explosion”

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- In recent years, there has been a proliferation of fixed and/or mobile sensors that are capable of detecting, measuring and reporting on all manner of phenomena including:
  - Chemical, Biological, Radiological, Nuclear, Explosive (“CBRNE”);
  - Meteorological;
  - Traffic and road conditions;
  - Video and others
- Coupled with spatial and other technologies, these sensors can contribute to extremely effective, near-real-time, public safety and security solutions;
- The problem is, this proliferation has resulted in:
  - “Stove piped sensor networks and systems”;
  - Non-standard and proprietary interfaces;
  - Lack of near-real-time utilization;
  - Lack of consistent and common data;
  - Need for interoperability;
  - Sound familiar?

## The SensorNet Initiative

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- There are many types of sensors and many applications for them;
- SensorNet is an initiative by a group of public and private sector partners lead by:
  - the Oak Ridge National Laboratory (“ORNL”) in collaboration with;
  - the Open Geospatial Consortium (OGC);
  - the National Institute for Standards and Technology (“NIST”); and,
  - the IEEE;
- The purpose of SensorNet is to **develop and implement interoperability standards for ubiquitous, cost-effective and secure sensor networks**;
- SensorNet is Web-Services based – employing IEEE1451 and OGC GML, WFS and other existing and developing standards;
- Interestingly, everything (Sensors, Nodes and Observation & Measurement data) is **treated as geographic or spatial features**;
- Users (EOC’s, SOC’s Public Safety Organizations, Special Events Organizations, others) will be able to query as well as receive automated sensor alerts;
- SensorNet makes it possible to network sensors with intelligent decision-support platforms (like Security Operations Centres and Emergency Operations Centres) – in real time.

## A Scenario...

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- Delivery tanker truck has overturned in an urban area and is leaking a chemical gas;
- 911 calls start arriving from the scene;
- Dispatcher sends police to the scene – chemical sensors verify abnormal levels of chemical detection;
- “Significant event” created by police officer at the scene
- Event is elevated to Incident Commander
- ALOHA plume modeling is undertaken based on current weather conditions and plume area is designated
- Cordon is created around toxic release area
- Emergency evacuation modeling is undertaken and routes are designated;
- Reverse 911 is activated, for evacuations
- Roads and intersections are closed by police

# Incident Management: Public Safety Dispatch Display



- Dispatcher responds to 911 calls and sends police to the scene

The screenshot shows the GeoMedia Professional interface with a map of Fort Meade, British Columbia. Several event markers are visible on the map, each with a red arrow pointing to it. The markers are labeled with event numbers: P20040008763, P20040008762, P20040008761, P20040008765, and P20040008764. A table titled 'I/Dispatch Events' is open in the bottom right corner, displaying a list of events with their details. The table has columns for 'P', 'S', 'Event Number', 'Event Type', and 'Location'. The 'Units' table in the bottom left corner shows a list of units with columns for 'Unit', 'A', 'Type', 'ST', 'Event Number', and 'Location'. The Windows taskbar at the bottom shows the start button, several open applications, and the system tray with the time 5:09 PM and temperature 81 °F.

P	S	Event Number	Event Type	Location
7	1	P20040008762	ASSAULT	UNKNOWN RD USCP
7	1	P20040008763	BOMB	397 DIA ACCESS RD ANA: @397
7	1	P20040008764	BOMB	3416 10TH PL SE USCP
8	1	P20040008761	10-100	50 WESTOVER AVE SW BAFB: @50
8	1	P20040008765	10-100	ARNOLD AVE SW BAFB

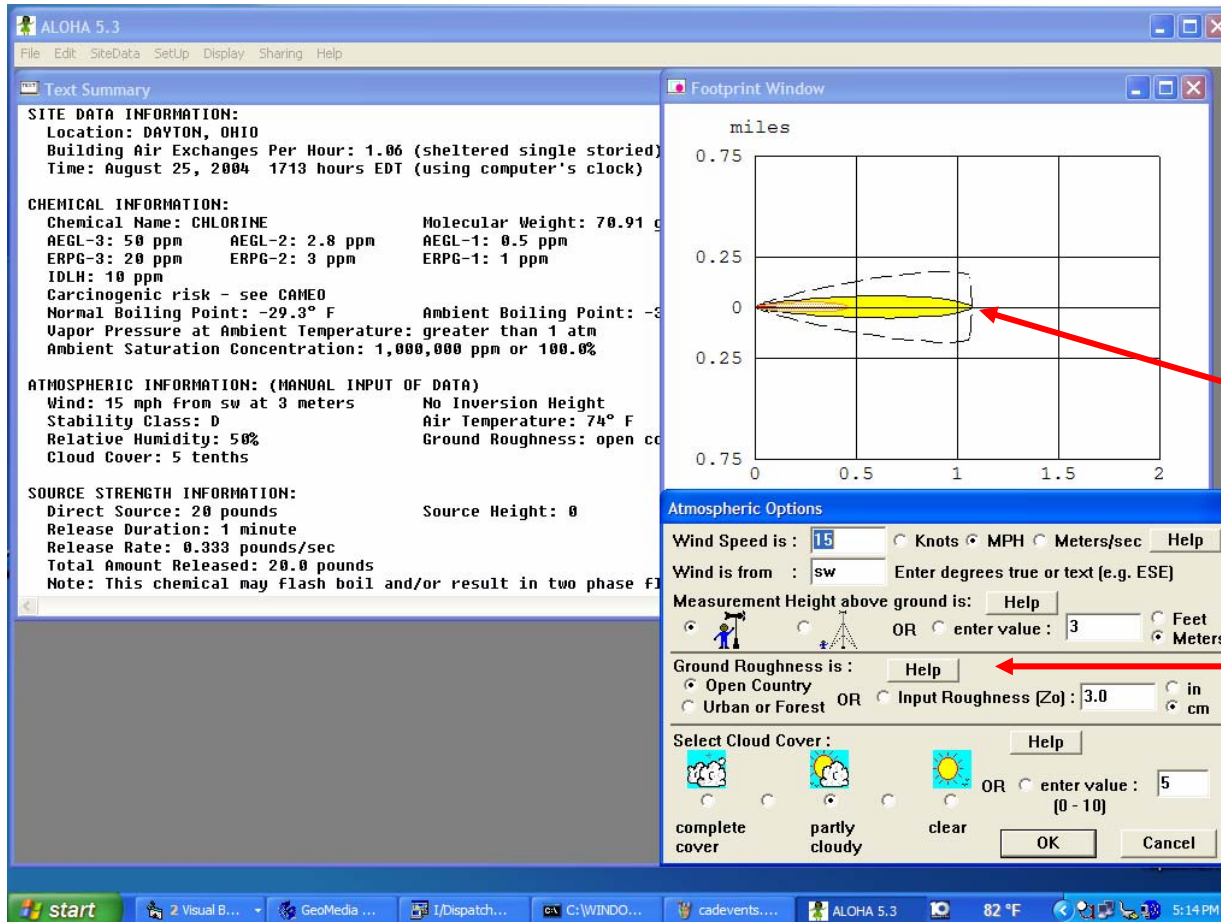
Unit	A	Type	ST	Event Number	Location
1-0	0				FTMD: @4230
1-1	0				FORT MEADE
1-2	0				FORT MEADE
1-3	0				FORT MEADE
1-4	0				FORT MEADE
1-5	0				FORT MEADE

Event

Units

# ALOHA Plume Modeling

- Incident Commander creates plume model in ALOHA

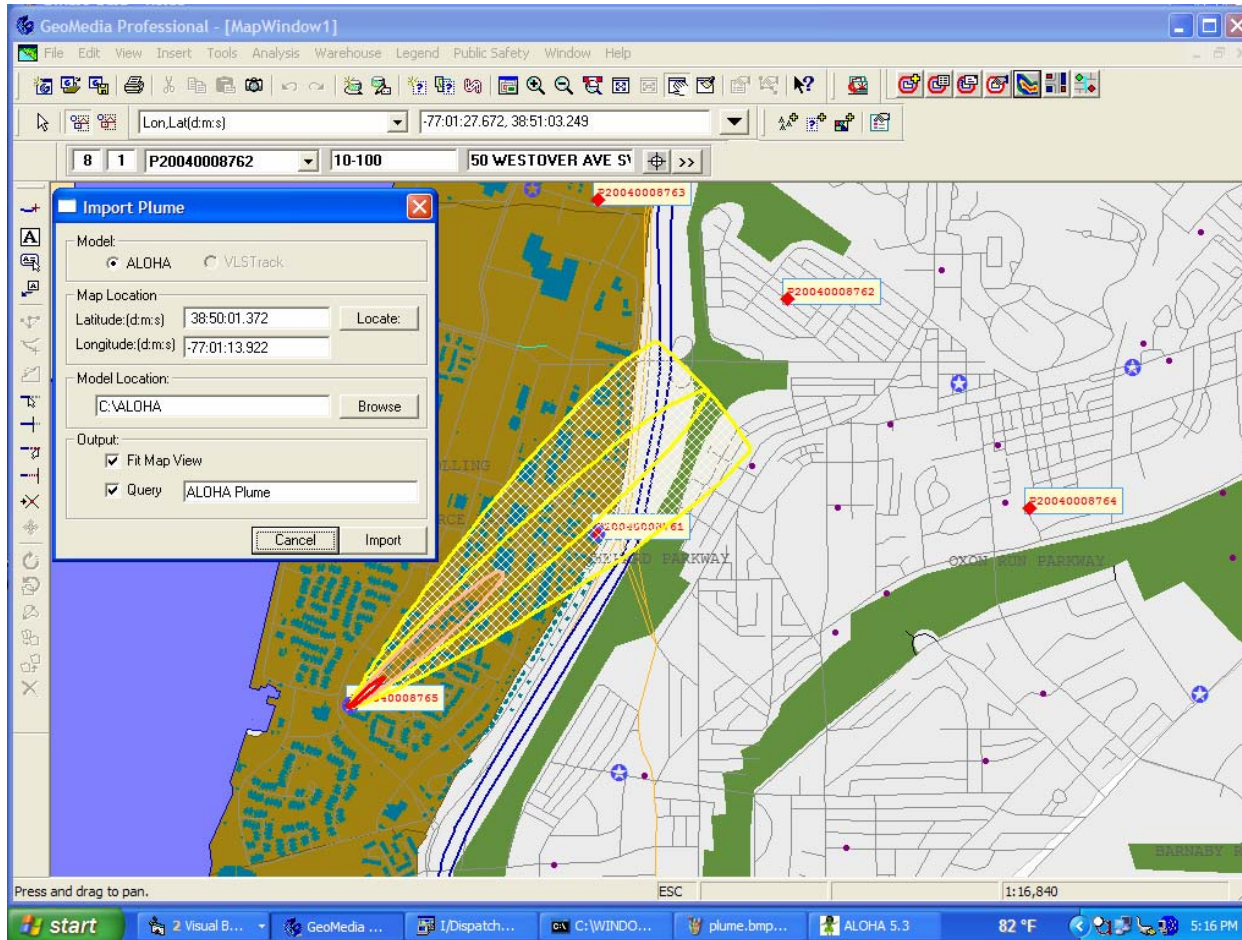


- ALOHA is a First Responder tool for airborne chemical release.
- Plume release model initially has no spatial context for situational awareness
- Atmospheric conditions from various sensors

ALOHA® 5.3 Developed jointly by NOAA and EPA

# Spatial Display of ALOHA Plume Model

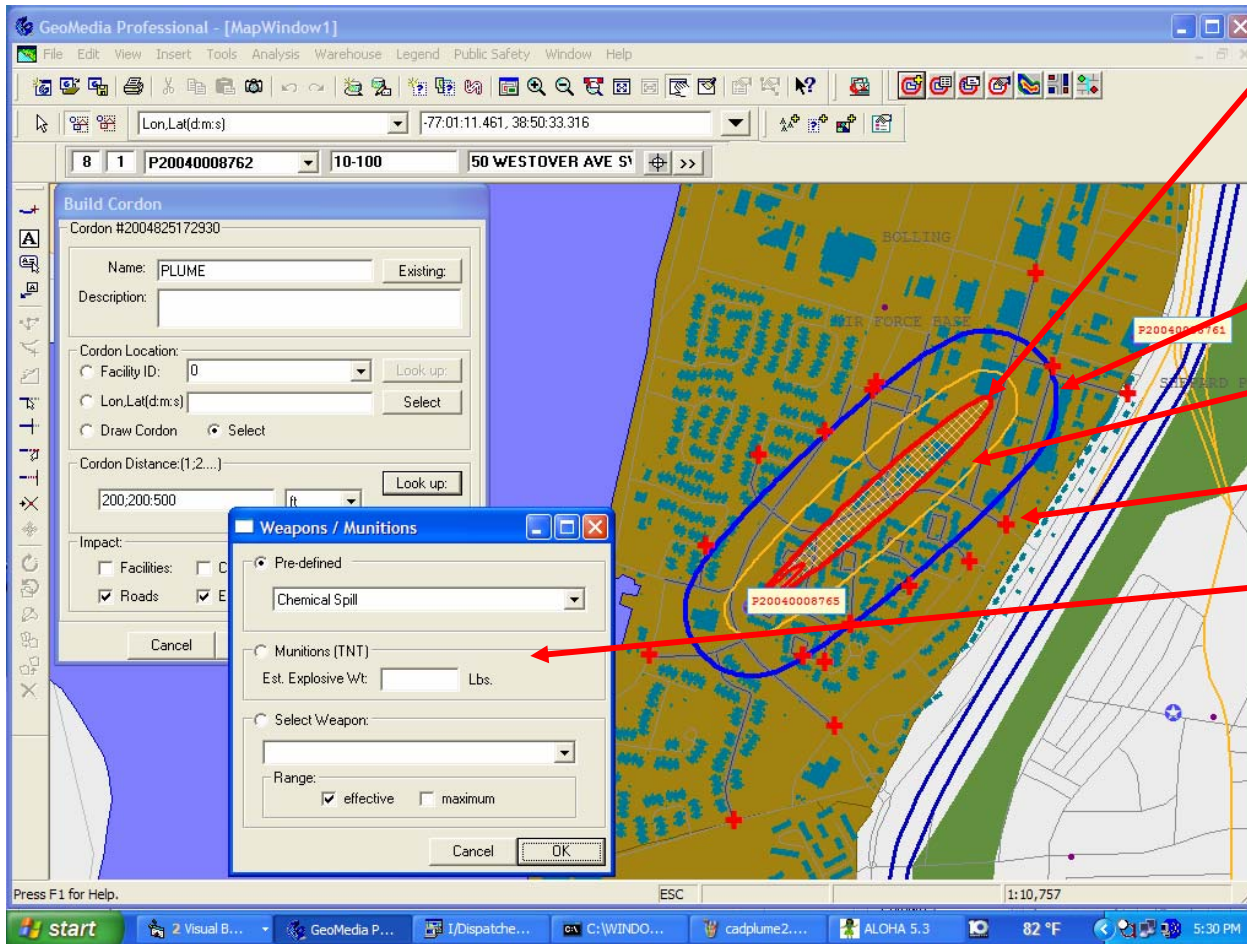
- Incident Commander evaluates event using spatial technology



- 911 event location designated as chemical release point
- Plume release model now has a spatial context illustrating complete situational awareness

# Spatially-Enabled Incident Management

- Incident Commander employs spatial technology to help manage the incident



**Restricted Area of Plume:**  
general population will experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

**Cordon Area**

**Hot Zone**

**Road Blocks**

**Build Cordon:**

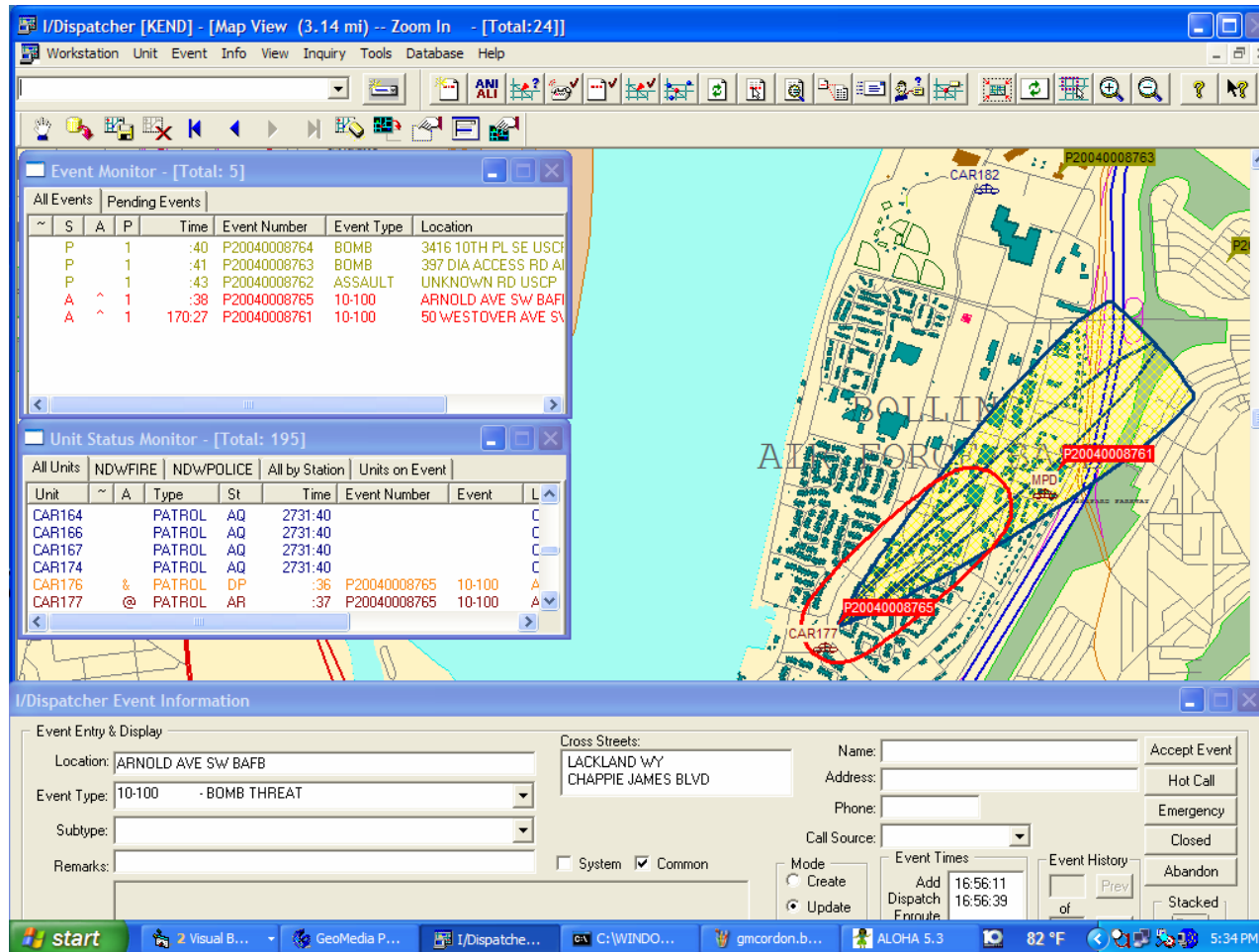
- Location
- Distance - lookup
- Impacts





# Spatially-Enabled Incident Management

- Incident Commander decides what data to send to dispatcher



The screenshot displays the I/Dispatcher software interface. The main window shows a map view with several incident locations marked by red circles and labeled with event numbers (e.g., P20040008763, P20040008761). The interface includes several panels:

- Event Monitor - [Total: 5]**: A table listing all events and pending events.
- Unit Status Monitor - [Total: 195]**: A table listing units, their status, and assigned events.
- I/Dispatcher Event Information**: A form for entering and displaying event details.

~	S	A	P	Time	Event Number	Event Type	Location
	P	1		:40	P20040008764	BOMB	3416 10TH PL SE USCP
	P	1		:41	P20040008763	BOMB	397 DIA ACCESS RD AI
	P	1		:43	P20040008762	ASSAULT	UNKNOWN RD USCP
	A	^	1	:38	P20040008765	10-100	ARNOLD AVE SW BAFB
	A	^	1	170:27	P20040008761	10-100	50 WESTOVER AVE SV

Unit	~	A	Type	St	Time	Event Number	Event	L
CAR164			PATROL	AQ	2731:40			C
CAR166			PATROL	AQ	2731:40			C
CAR167			PATROL	AQ	2731:40			C
CAR174			PATROL	AQ	2731:40			C
CAR176		&	PATROL	DP	:36	P20040008765	10-100	A
CAR177		@	PATROL	AR	:37	P20040008765	10-100	A

**I/Dispatcher Event Information**

Event Entry & Display

Location: ARNOLD AVE SW BAFB

Event Type: 10-100 - BOMB THREAT

Subtype:

Remarks:

Cross Streets:  
LACKLAND WY  
CHAPPIE JAMES BLVD

Name:

Address:

Phone:

Call Source:

Mode:  
 Create  
 Update

Event Times:  
Add 16:56:11  
Dispatch 16:56:39  
Enroute

Event History:  
of  
Prev

Buttons: Accept Event, Hot Call, Emergency, Closed, Abandon, Stacked

- Cordon Area
- Hot Zone
- Road Blocks
- Road Closures

## SensorNet – Fort Bragg Case Study

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- Fort Bragg North Carolina is a Military Base with a population of about 67,000 people stretching across 6 counties containing shopping malls, a medical centre, schools, churches, homes – it is like a City.
- The Fort Bragg Directorate of Emergency Services is conducting a test-bed for the SensorNet initiative;
- Intergraph is working with Fort Bragg to design, test and implement a “next generation Incident Management Command and Control Solution” that includes:
  - Computer automated dispatch;
  - Spatially-enabled incident management;
  - Sensor integration using SensorNet standards

# Tons of Imagery & DEM's!



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## Imagery & DEM's

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- In recent years, there has been a proliferation of:
  - Satellite imagery;
  - High Resolution airborne imagery;
  - Ortho mapping;
  - LIDAR
- These data products are in high demand due to their abundance of content and ease of interpretation – ideal for supporting Public Safety and Security initiatives;
- Product resolutions are increasing while production costs are decreasing;
- The result is a proliferation of Imagery and DEM data which is leading to data management and data access problems...

# Accuracy in Damage Assessment

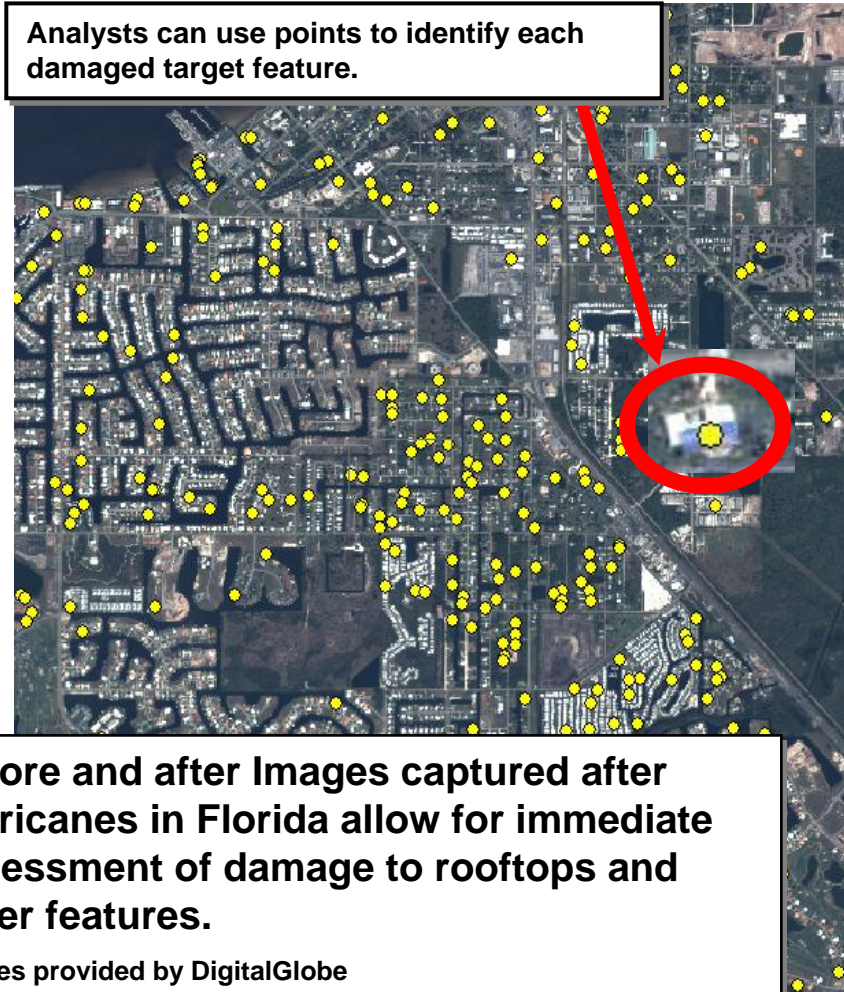
**Before**



**After**



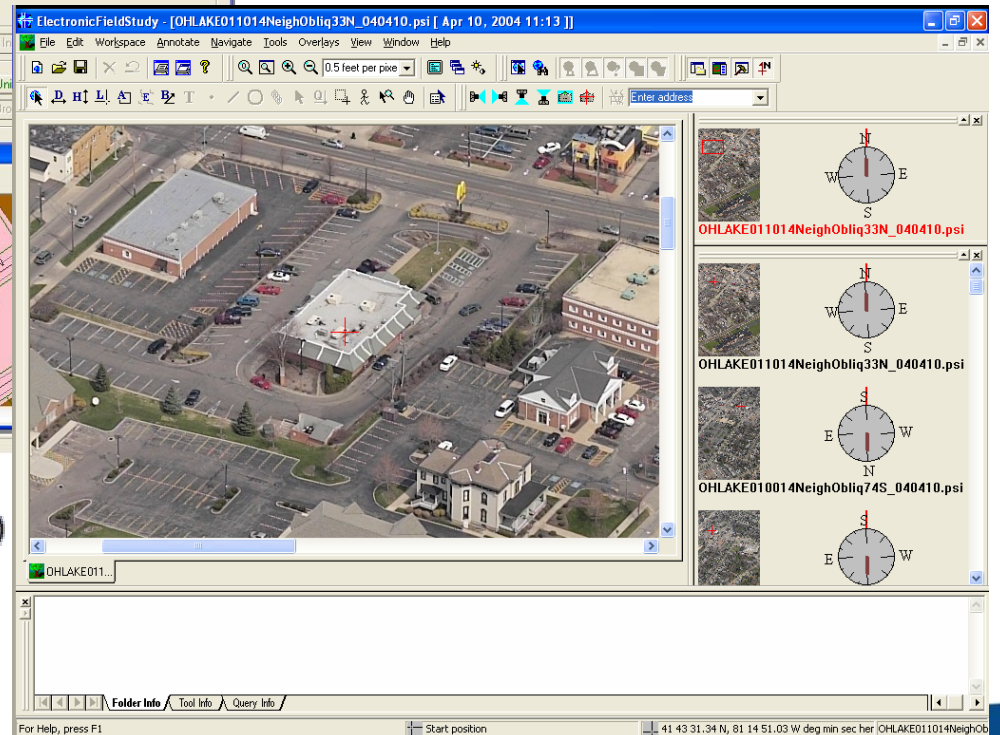
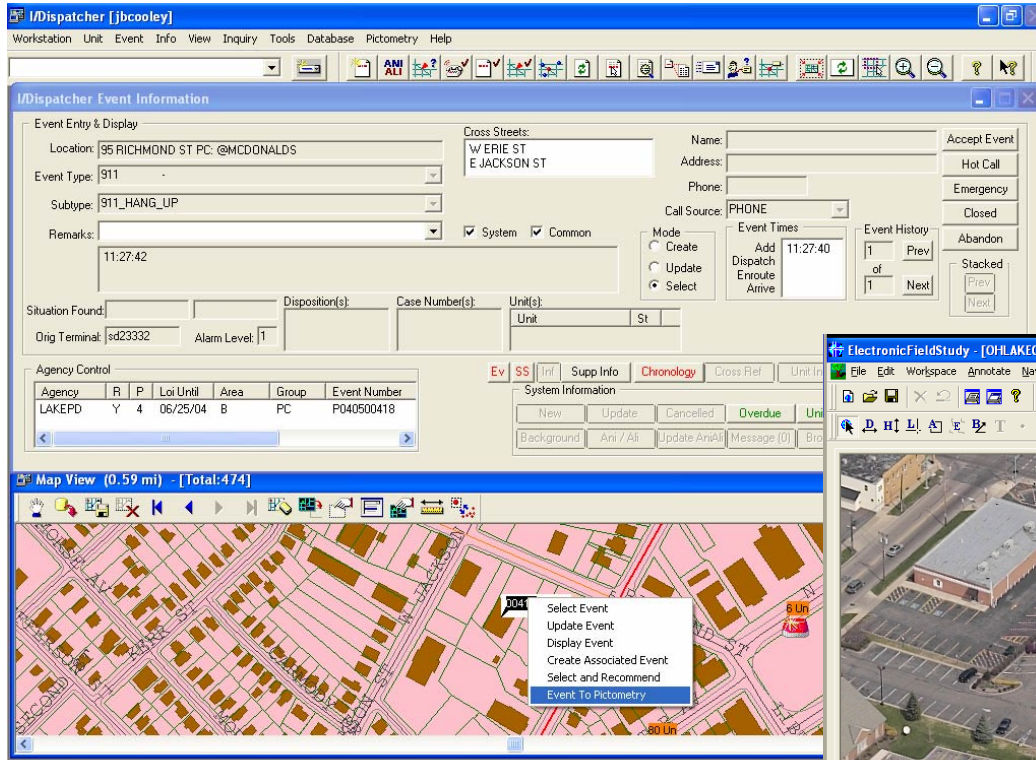
Analysts can use points to identify each damaged target feature.



Before and after Images captured after hurricanes in Florida allow for immediate assessment of damage to rooftops and other features.

Images provided by DigitalGlobe

# Oblique and Orthogonal Aerial Photography



## Hurricane Katrina Case Study Cont'd

- Jefferson Parish Emergency Response officials were displaced by Katrina and forced to set up in in the Baton Rouge Office of Emergency Preparedness (about 60 miles from New Orleans);
- Intergraph helped install and set up a GeoMedia Professional-based system that could leverage Jefferson's vector mapping data along with high resolution digital photography and numerous other forms of data covering the entire Louisiana disaster area;
- This system was used during the recovery by Plaquemines Parish, Orleans Parish, the American Red Cross and others.



## Hurricane Katrina Case Study Cont'd

- Intergraph worked with Louisiana State University (LSU) to quickly build a spatial data clearinghouse based upon TerraShare to store, manage, index and serve over 100GB of raster data
- The clearinghouse also used Oracle to store vector data and GeoMedia Web Map to provide access to all data;
- The clearinghouse became a defacto hub for GeoSpatial data used by FEMA and the State Office for Emergency Preparedness for disaster recover;
- Katrina lessons learned:
  - A real bottleneck is the massive amounts of imagery data that come in from data providers and the government — terabytes of data
  - Desperately needed, are the tools and the trained personnel to take data in, process it, and disseminate it to first responders in a simple and helpful way.





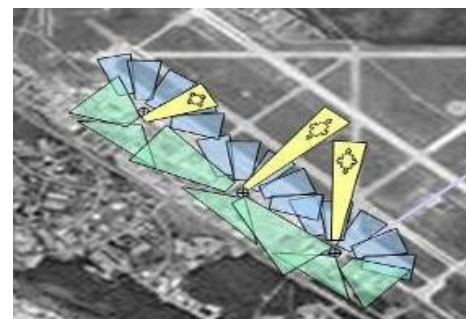
## Video, Alarms and Access Devices



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# Video, Alarms and Access Devices

- There is a proliferation of CCTV Cameras, Alarm devices and Access Control Devices in common use.
- Monitoring these systems and devices can become overwhelming – especially when an incident may be underway:
  - Is an alarm false or real – how is this verified?
  - How do you effectively monitor hundreds of CCTV displays?
  - Are the various devices integrated or independent?
  - Etc.
- Similar to sensors, imagery and other inputs, the proliferation of video, alarms and access devices is resulting in mountains of data;
- Systems integration is often required for fusion of sensors, videos, alarms and access devices to support effective incident management and command;
- Such systems integration should have a spatially-enabled command and control capability at its core.



Courtesy of  
**ObjectVideo**



## The Need for Video Integration



***The problem in London is that the cameras are provided by a multitude of vendors and are not integrated.***

***Police, Private Security, Transit all have their own and can't talk to one another.***

Charles Shoebridge, MSNBC Terror Analyst, 7/22/2005



## Other Enabling Technologies



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# Video Analysis Technology



Brighten and frame-average images.



Stabilize jittery video.



Demultiplex images from multiple cameras.

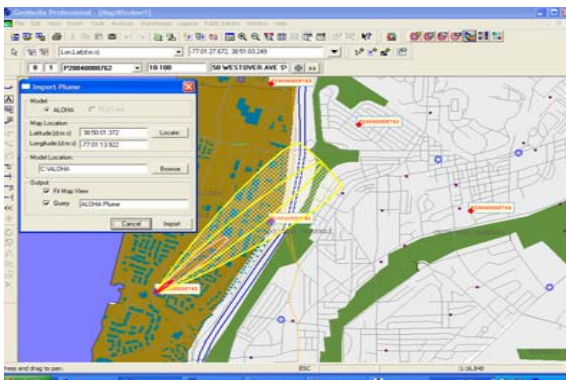


Deinterlace for image clarity.

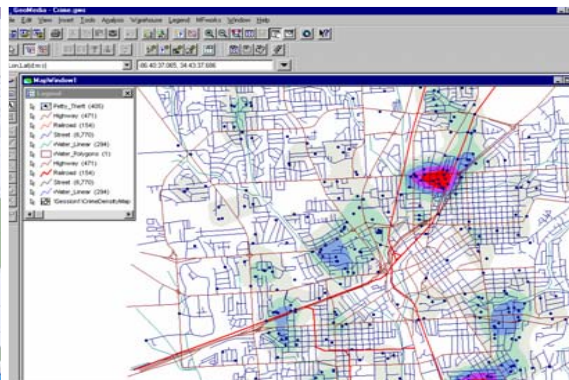
- Unique technology for video stabilization, registration and enhancement
- More than thirty enhancement tools that extend NASA's VISAR technology.
- Applications:
  - Crime forensics
  - Command and control

# Geospatial & Video Analysis Software

- Intelligent mapping software to manage critical resources & infrastructure, with a focus on emergency planning & response:
  - Predictive modeling analysis for events such as chemical & biological attacks as well as floods & fires
  - Data clustering for incident & infrastructure location analysis
- Forensic video analysis software for intelligence agencies:
  - Significantly enhances and edits nearly any type of video
  - Often provides critical evidence in intelligence briefings and criminal cases



**Predictive Modeling**



**Data Clustering**

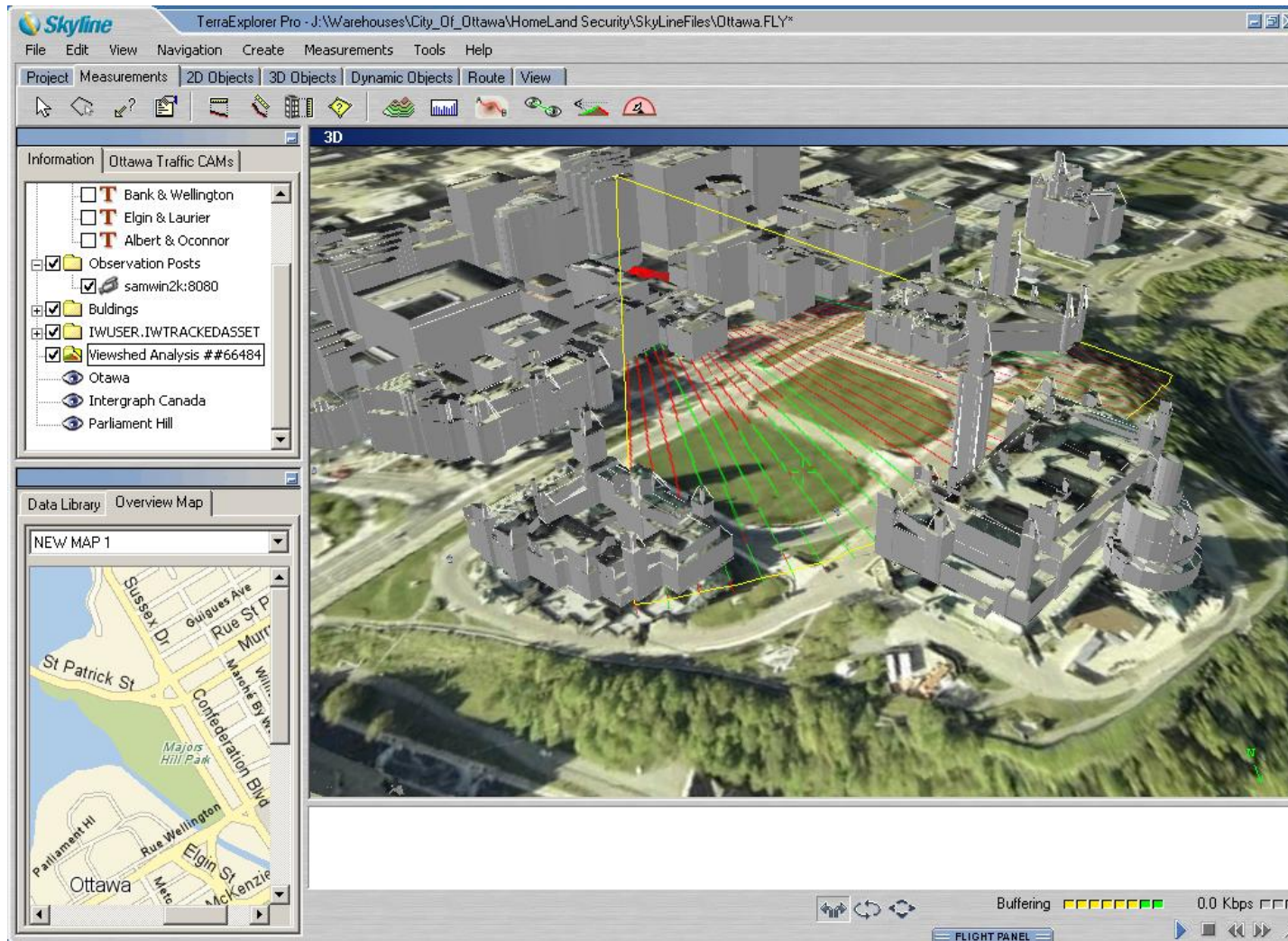


**Forensic Video Analysis**

# 3D Visualization



# View-Shed Analysis





# Mobile Resource Management



IntelliWhere TrackForce - Microsoft Internet Explorer provided by Intergraph

File Edit View Favorites Tools Help

Back Forward Stop Home Search Favorites Refresh Print Mail Stop Taskbar

Address http://itordemo/IntelliWhereWeb/TrackForce?mVisualization\_Click=true Go Links

Google Search New! 1 blocked ABC Check AutoLink AutoFill Options

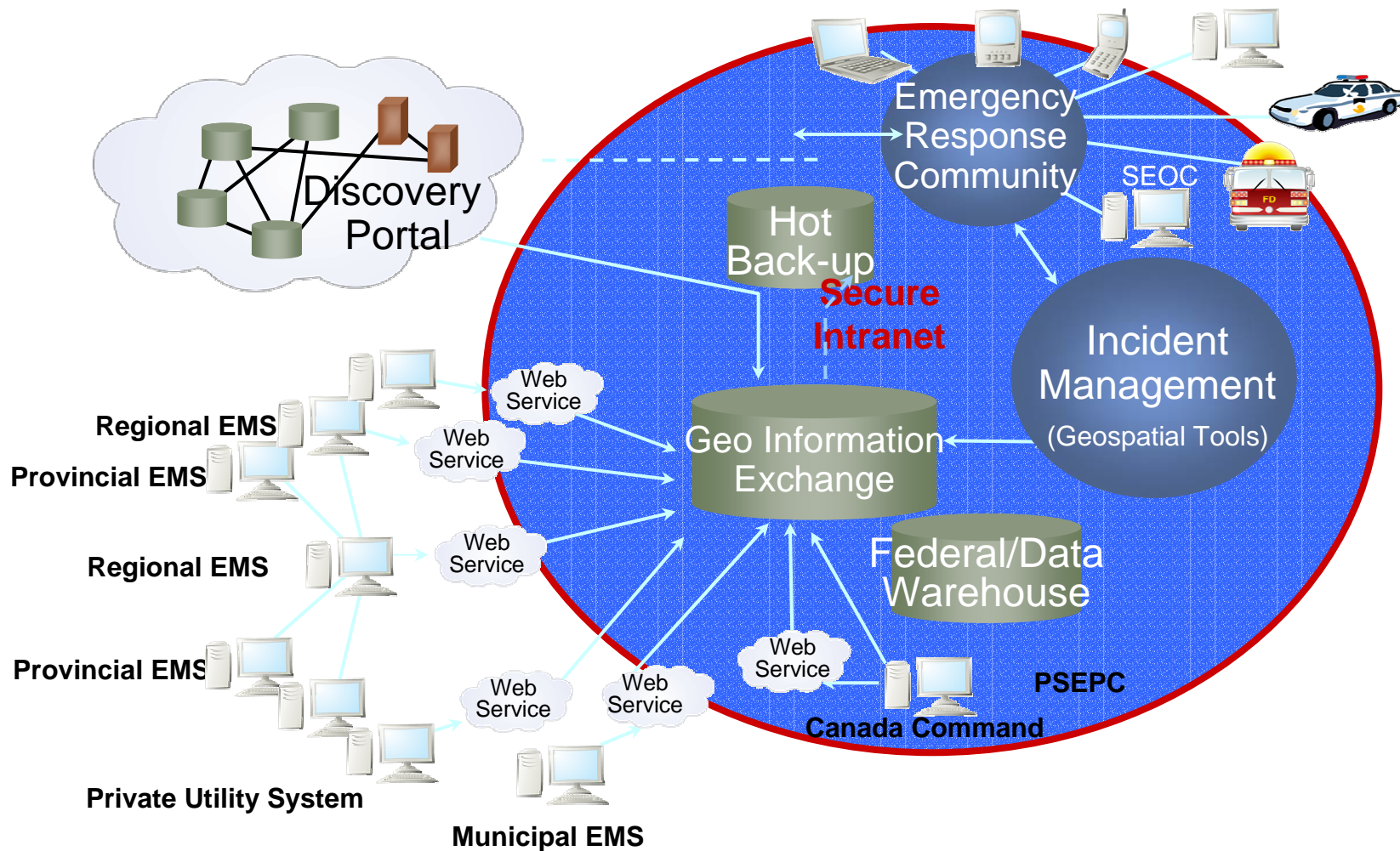
**IntelliWhere® TrackForce** **INTERGRAPH**

- Resource Management
- Group Management
- Class Management
- Job Management
- User Management
- Alarm Management
- Attribute Management
- Reports
  - Alarm Viewer
  - Job Viewer
  - Map Viewer
  - Replay
  - Logout
- Open Control Centre
- Preferences
- Help
- About

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Local intranet

# GeoConnections Public Safety and Security: National Information Exchange Concept



(Courtesy of GeoConnections - Modified from 2005 Morgan & Felton, Maryland Emergency Geographic Information Network)

# Issues and Requirements



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## Public Safety and Security Considerations

- With events like Katrina, the London Bombings and others, Public Safety and Security are receiving increased world-wide attention;
- Business drivers – protect the public, customers, staff, physical assets, protect business (maintain confidence), minimize staffing costs (security guards), comply with regulation, maintain law & order, be perceived to be doing something, etc.
- Governments are increasing funding;
- Proliferation of technologies is resulting in a LOT of data but not enough information – a need for “plug and play” components and general interoperability;



## Public Safety and Security Considerations Con't

- Human nature limitations - research reveals human concentration span is limited to 25 minutes
  - **Orienting Reflex**; the reflexive redirection of attention that orients you toward the unexpected stimulus. It unconsciously alerts you to direct your attention to the location of the new stimulus.
- More video surveillance devices don't necessarily reduce prevention
  - Post analysis forensics of both 9/11 and London bombings revealed video of all terrorists
- Need to maximize multi-agency / multi-level coordination and cooperation;



# A Solution Architecture

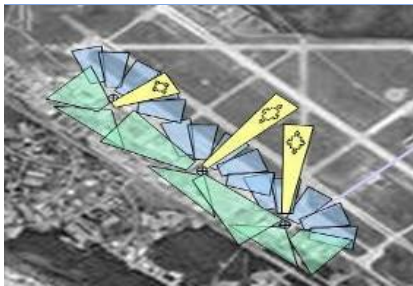


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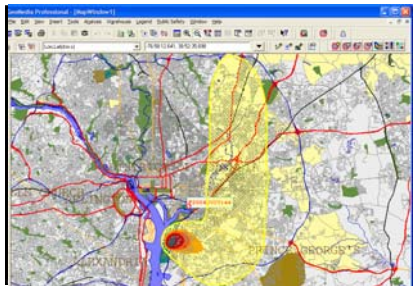
# Meeting the Challenge

- Requires systems to Capture, Analyze, Integrate, Visualize and Act upon the unorganized and complex data associated with emergencies – spatial technology helps this process
- Requires “**systems of systems**” that support a coordinated response while maintaining jurisdictional and agency autonomy

## GEOSPATIAL TECHNOLOGY



**Capture**



**Analyze**



**Respond**



**Coordinate**

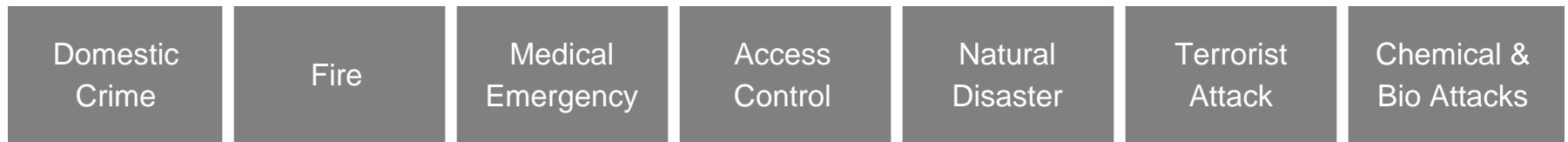
## DATA

Common User Defined Operational Picture

# What is required?

- An “Integrated Command & Control Solution” that:
  - Is standards-based and spatially-enabled;
  - Built from COTS components;
  - Integrates disparate security devices and systems;
  - Inter-operates with other systems;
  - Has Command and Control at its core

## Incidents

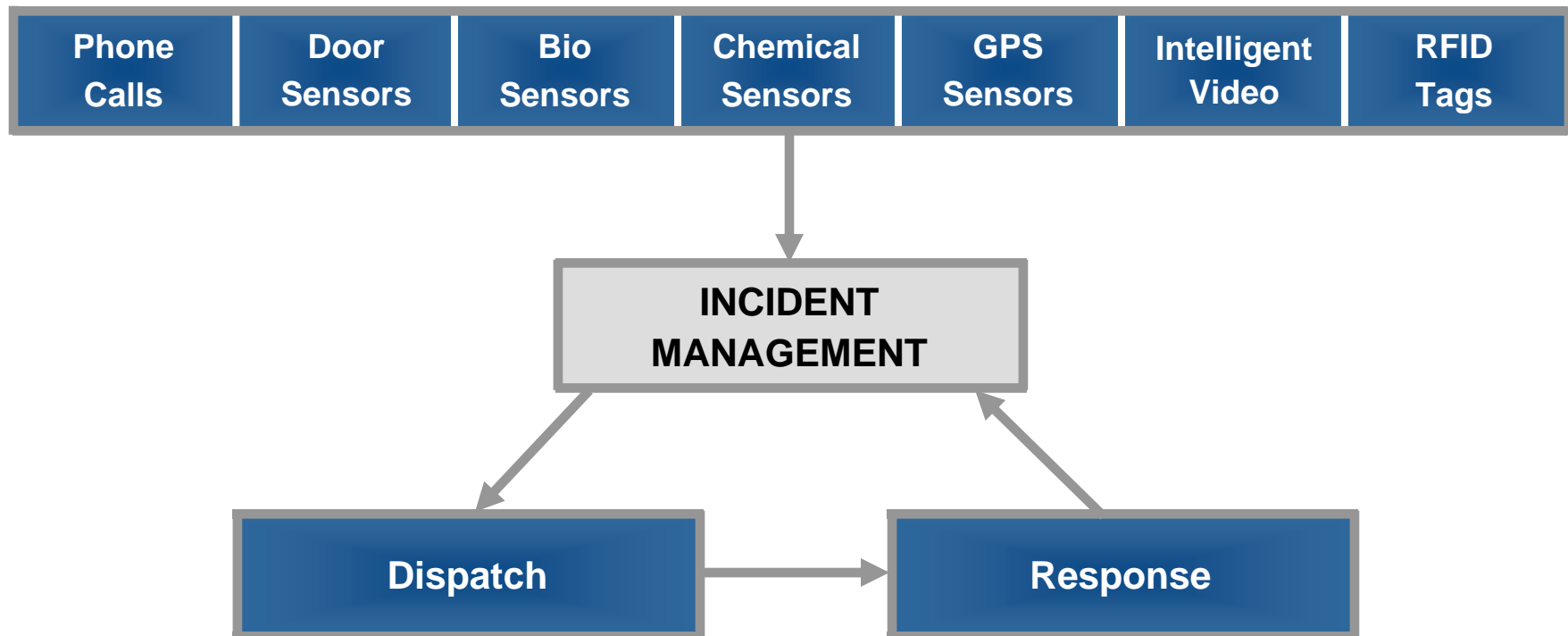


## Assets

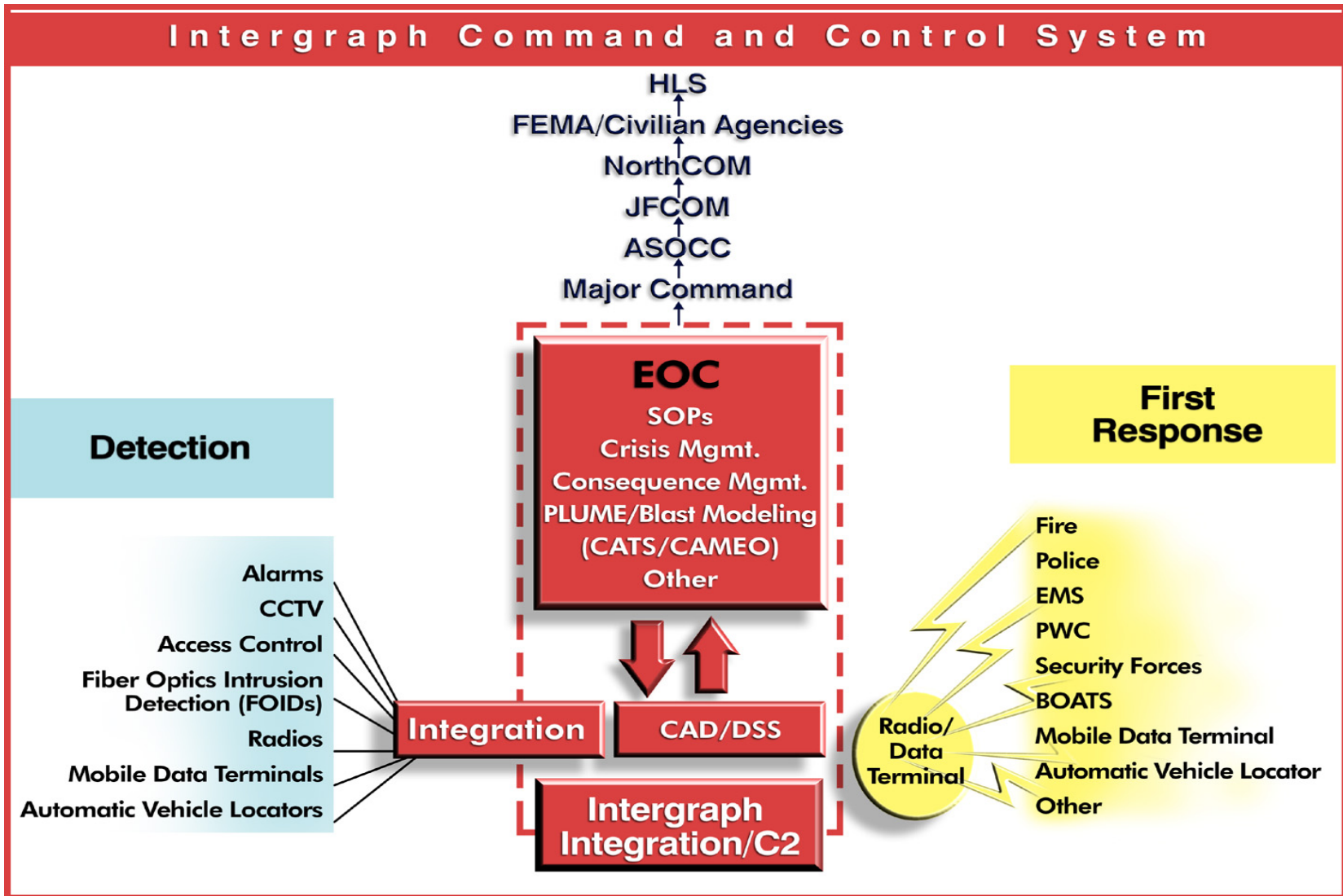


## Command & Control With Sensor & Spatial Fusion

- Command & Control software provides the foundational technology for leading-edge security systems
- Incident Management software captures & retains critical data from a range of sources & coordinates the correct response to any incident (emergency or non-emergency)



# Architecture of a Modern Public Safety and Security Command and Control Solution



# MTA - Integrated Command and Control Solution



- Multi Agency support
- Sensor Fusion
  - Standard 2 Way integration with Lenel
  - CCTV & Intelligent Video Integration
- Integrated security and dispatch management
- Dispatch, Event and Consequence Management
- Web based event visibility integrated with real time distributed Consequence Management
- Integrated Situational Awareness
- Common Operating Picture with Geospatial display and analysis
- High availability through full redundancy within and between each C3 center
- Publish and subscribe technology provides the robust architecture to support scalability and redundancy needs
- Interoperability between Dispatch Command and Control Systems based on XML standards

**Spatially-Enabled Security Solution**

## Concluding Remarks



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## Concluding Remarks

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- Increased demand for more effective public safety and security solutions;
- With the proliferation of technology including sensors, video, alarms, imagery, mapping, etc., First Responders, EOC's, SOC's and others are becoming overwhelmed with disparate systems and data;
- The nature of potential events dictates potential involvement by many different public and private organizations;
- Command and Control forms the heart of most large Public Safety and Security Solutions;
- There is no “one-size-fits-all” solution – open, interoperable, component-based solutions are required;

## Concluding Remarks Cont'd

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- Spatial technology and expertise are making significant contributions to Public Safety and Security in terms of:
  - Providing an effective integration framework tying together non-spatial components;
  - Contributing to use of open industry standards;
  - Increasing situational awareness and providing a Common Operational Picture;
  - Enabling better planning and decisions;
  - Maximizing cost-efficiency

## Concluding Remarks Cont'd

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- Technology is helping but the big issues are on the human side...
- Critical Infrastructure is mostly in private hands – this needs to be recognized by governments and the private sector;
- Security and Public Safety is not just a government responsibility. The private sector (infrastructure owners, technology providers, data providers, others) need to be more involved in the design, development, testing and implementation of modern, effective Security and Public Safety systems – **all possible knowledge, experience and resources need to be leveraged;**

## Concluding Remarks Cont'd

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- The Security and Public Safety industry represents a significant and growing user group for spatial data and spatial functionality. There are significant opportunities for collaboration. This is good for the spatial industry!



# Thanks!

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