Chapter 11 Real-time Info Sys for Urban Environment & Risks Monitoring

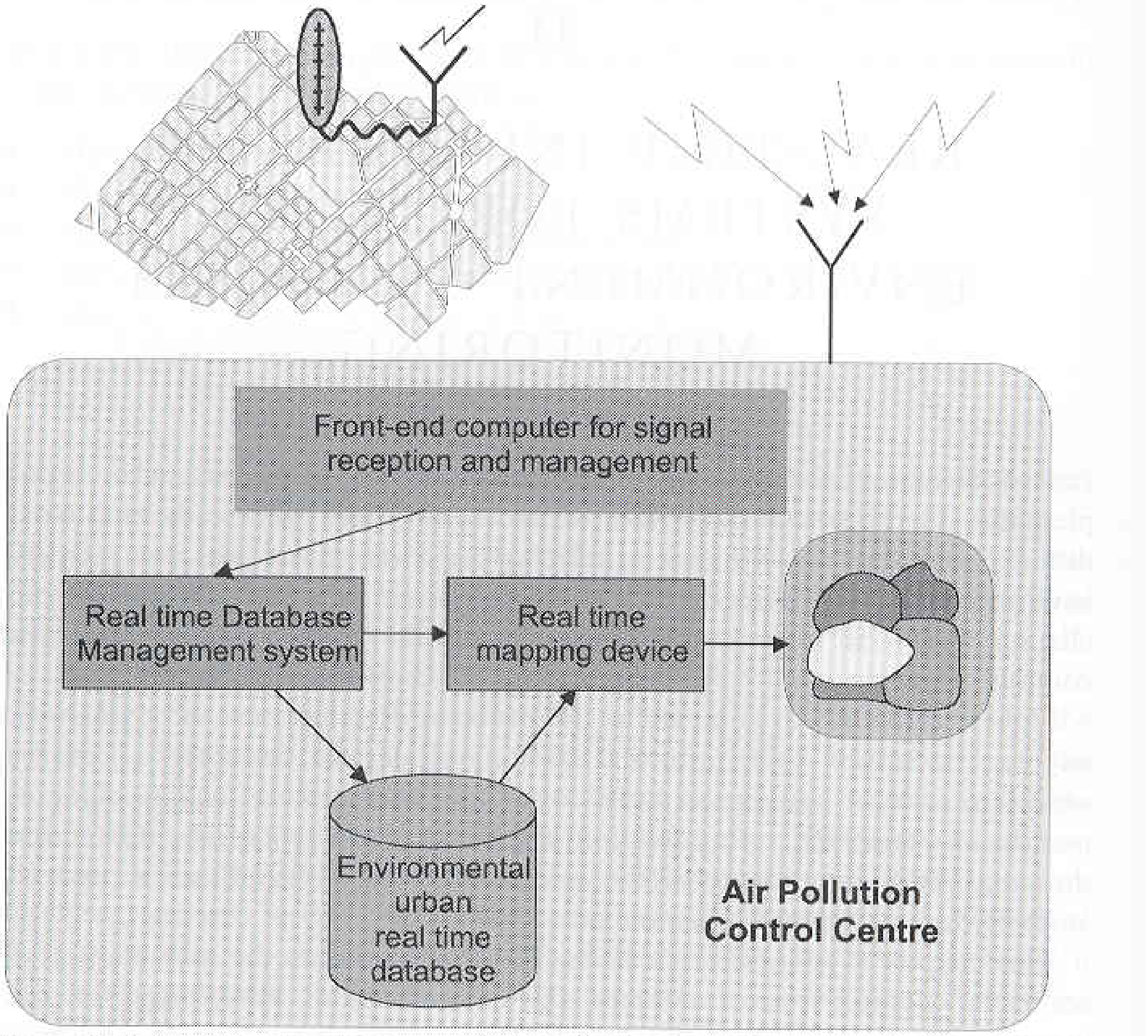

Figure 11.1 Functional architecture of a real-time information system for air pollution control.

11.1 Real-time sys for environmental monitoring

- real-time sys : env monitoring, traffic control, urban risks...
- example of air pollution control

  various sensors, communication sys, mapping device

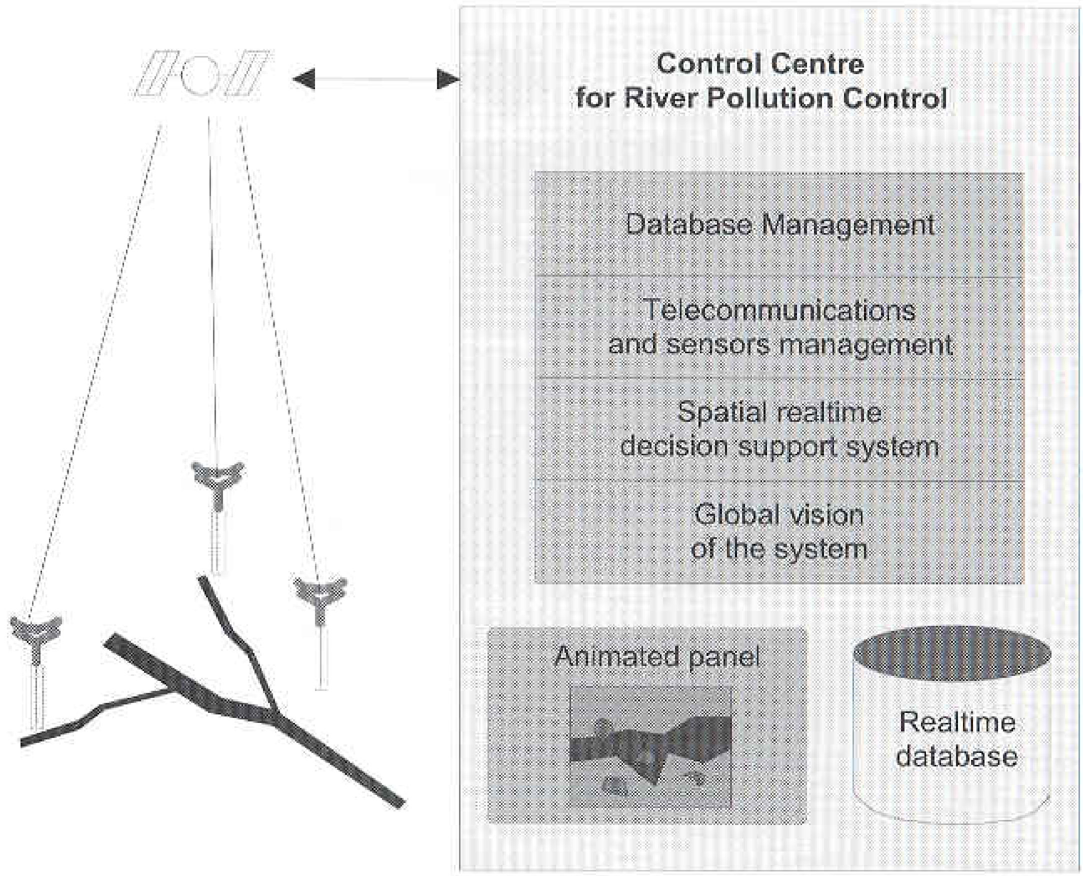

Figure 11.2 Sketch of a computer system for river pollution monitoring.

- example : river flood & pollution control

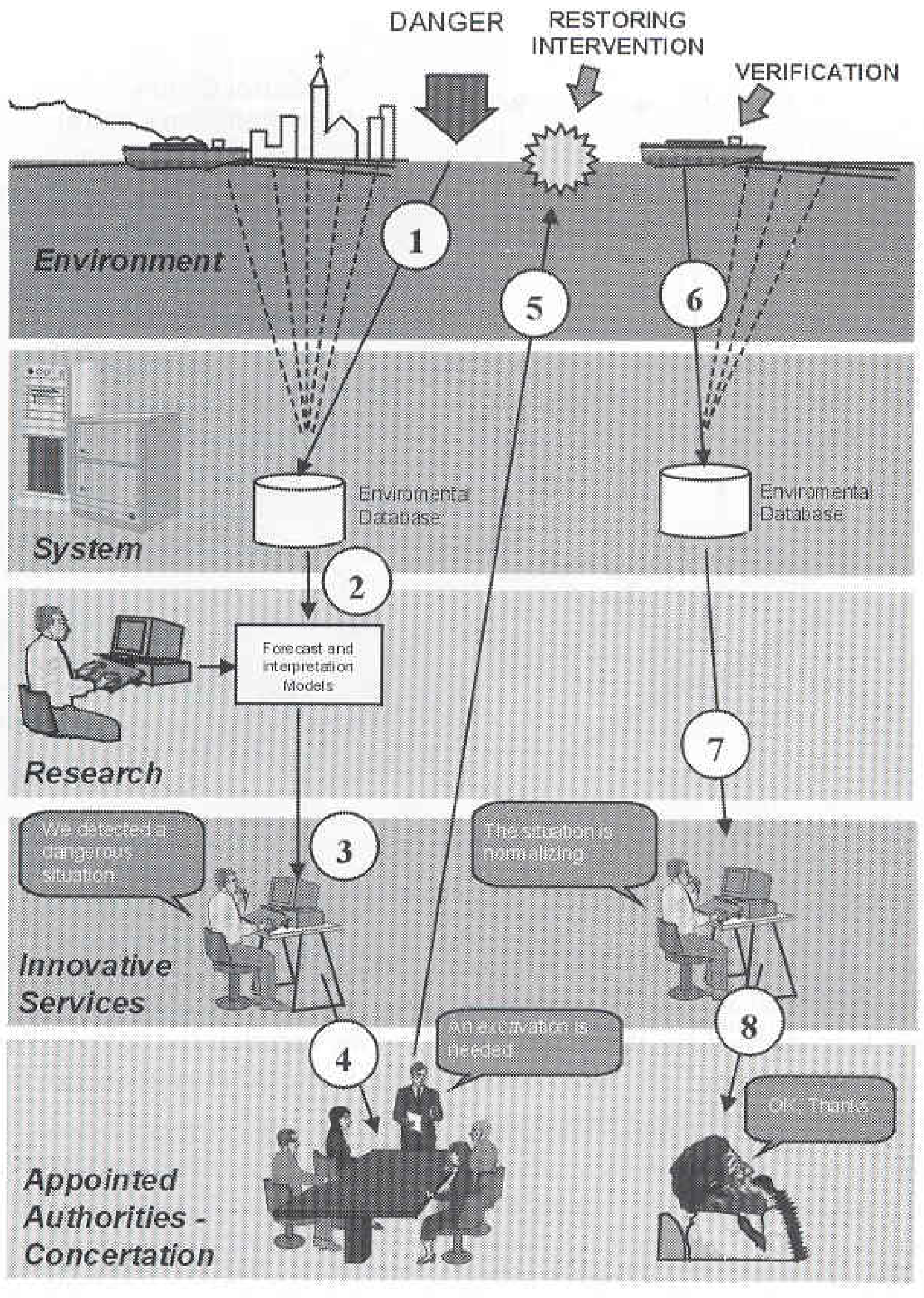

Figure 11.3 Description of the system for the monitoring of the Venetian lagoon (Cambruzzi *et al.* 1999).

- example : mobile sytems

  sensor moves

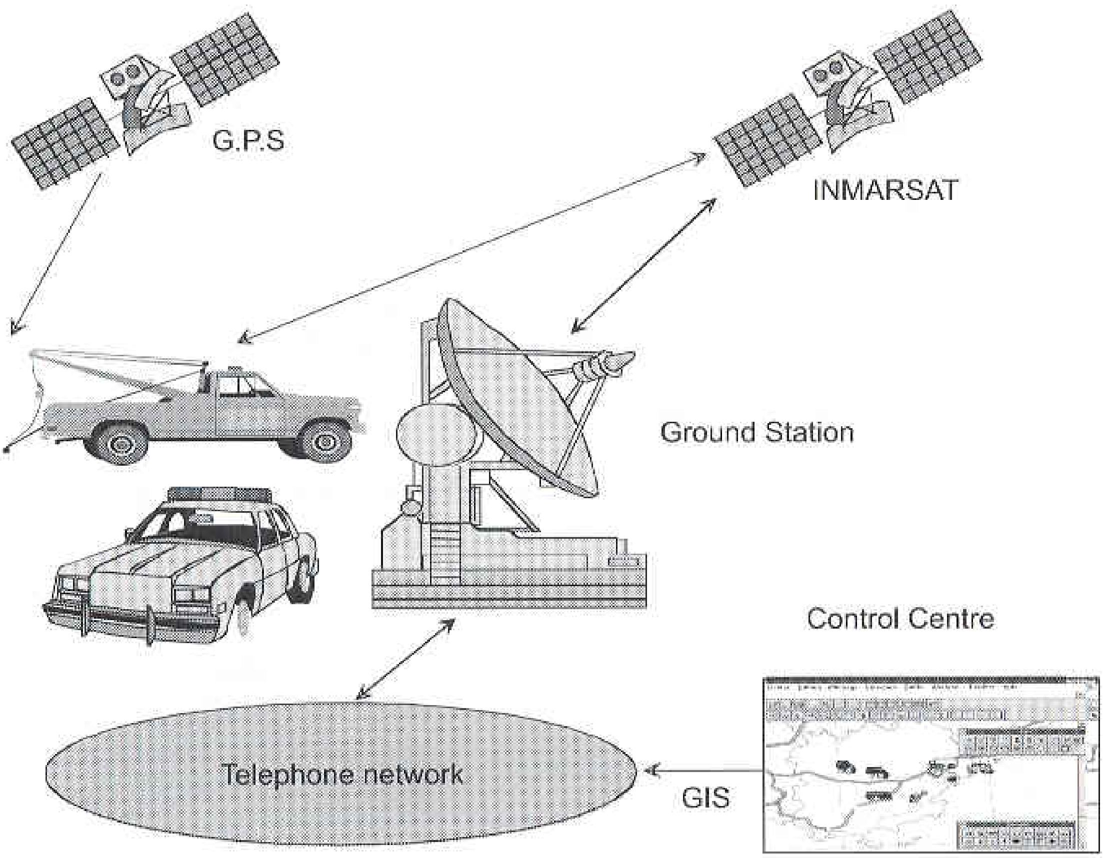

Figure 11.4 Schema of a system for the monitoring of toll motorway traffic (Tanzi *et al.* 1998, Laurini 1999).

11.2 Toward telegeomonitoring

- a child of GIS & telecommunications
- characterized by positioning sys, cartography, exchange of info, real-time spatial decision-making
- applications: traffic monitoring, fleet management, env planning, transportation of hazardous materials, surveillance

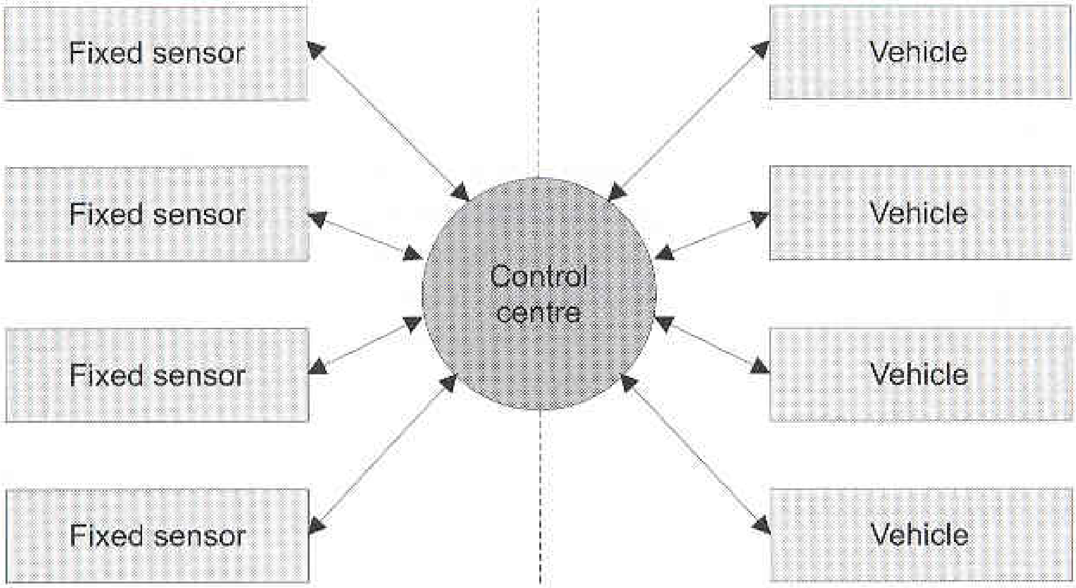

Figure 11.5 Centralised telegeomonitoring architecture.

11.3 Computer architectures

Models of architecture

- 3 models: centralized, cooperative, federated architectures

- centralized architecture

  a control center, mobile vehicles, fixed sensors

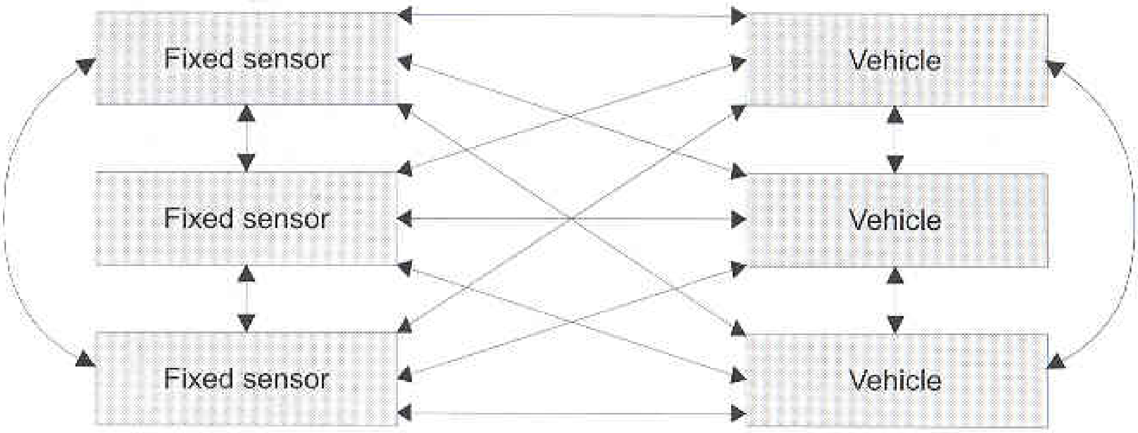

Figure 11.6 Co-operative architecture for telegeomonitoring.

- cooperative architecture

  fixed & mobile components exchange info without any central site

  all sites have a global vision of the context

  robust to crashes than the centralized architecture

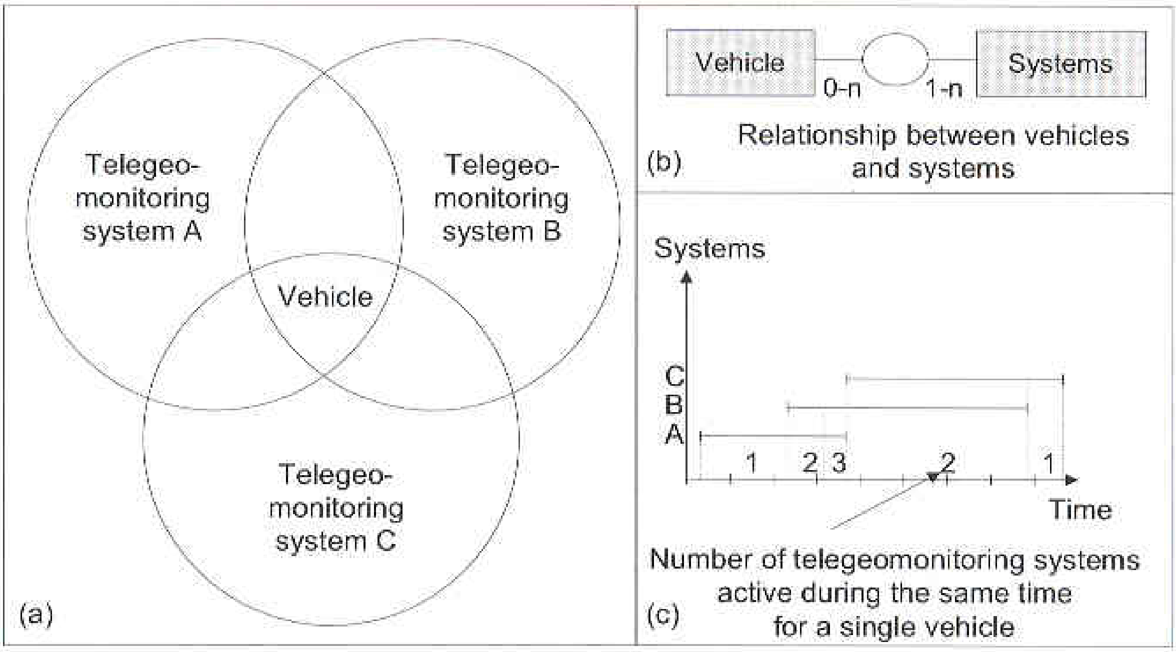

Figure 11.7 A single vehicle can belong to several telegeomonitoring systems. (a) Ownership diagram. (b) Relationship between vehicles and telegeomonitoring systems. (c) Temporal sequence.

- federated architecture

  vehicles connected to several telegeomonitoring control centers

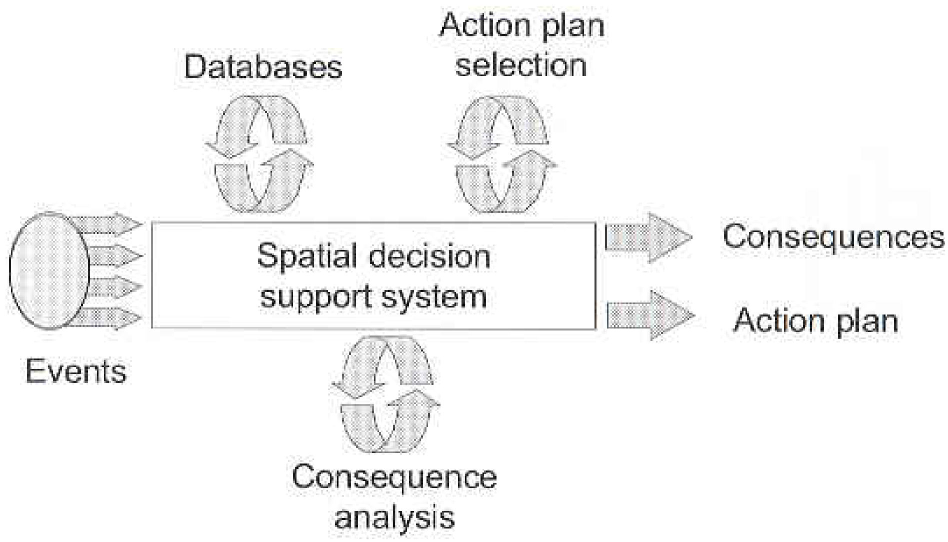

Figure 11.8 Environment of a real-time decision support system (Tanzi *et al.* 1998).

Functional aspects

- real time info sys can be seen as real time spatial decision support sys

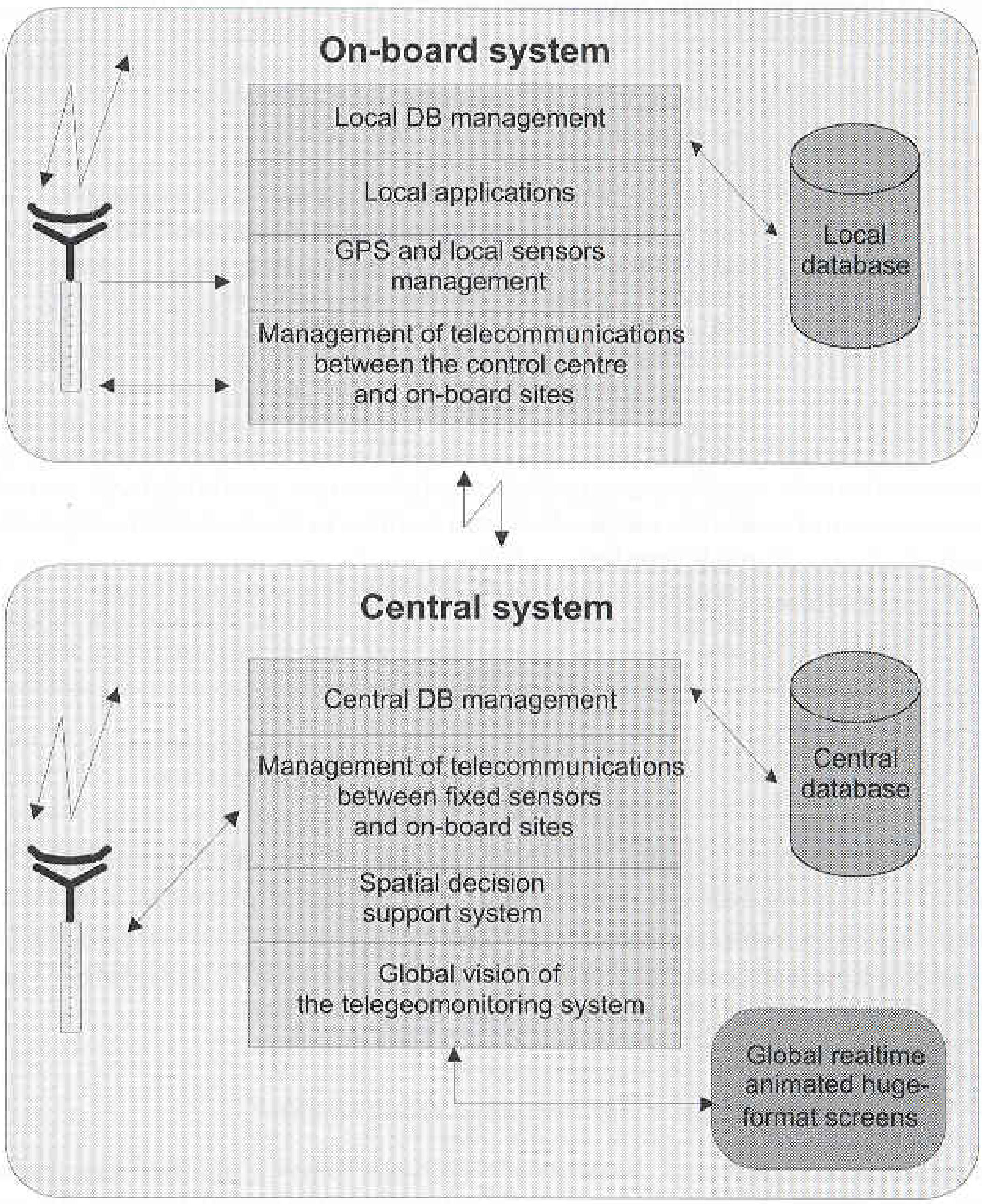

Figure 11.9 Functional details for central and on-board systems.

Table 11.1 Common characteristics of some classes of telegeomonitoring systems

Activities		Examples of applications				
		Motorway traffic management	Fleet management	Hazmat transportation	River pollution monitoring	Risk monitoring
Computer architecture	Use of GPS	Yes, on some vehicles	Yes, on all vehicles	Yes, on all vehicles	Possibly for some sensors	Possibly for some sensors
	Fixed sensors	Yes	Possibly	Possibly	Yes	Yes
	On-board components	Yes	Yes	Yes	Generally no	Generally no
	Real-time DB	Yes	Yes	Yes	Yes	Yes
	Data exchange	Yes, between vehicles, sensors and control centre	Yes, between vehicles, sensors and control centre	Yes, between vehicles, sensors and control centre	Yes, between all components	Yes, between all components
	Control centre	Yes	Yes	Yes	Yes	Yes
Functional architecture	Real-time decision support system	Yes	Yes	Yes	Yes	Yes
	Anticipation by simulation	Yes	Yes	Yes	Yes	Yes
	Animated cartography	Yes	Yes	Yes	Yes	Yes

Table 11.2 Phases for disaster management systems in cities (FEMA 1998)

Mitigation	Mitigation is the process of taking sustained actions to reduce or eliminate long-term risk to people and property from hazards and their effects.
Preparedness	Provide the leadership, policy, financial and technical assistance, training, readiness, and exercise support to strengthen (a) community readiness through preparedness and (b) the professional infrastructure of trained and tested emergency workers, community leaders, and public citizens who can prepare for disasters, mitigate against disasters, respond to a community's needs after a disaster, and launch an effective recovery effort.
Response	Response is the process of conducting emergency operations to save lives and property by positioning emergency equipment and supplies, evacuating potential victims, providing food, water, shelter, and medical care to those in need, and restoring critical public services.
Recovery	Recovery is the process of rebuilding communities so individuals, businesses, and governments can function on their own, return to normal life, and protect against future hazards.

11.4 Urban major risk management

<u>Main action phases</u>

- disaster management sys is characterized by info to support decision making in all chronological phases of a disaster
  : mitigation, preparedness, response, recovery

Table 11.3 Information resources for decision making for urban risks. From Cochran and Power (1999) with modifications

Base data	Topography; political boundaries; public land survey system; geographic names; demography; land ownership/use; critical facilities; etc.
Scientific data	Hydrography/hydrology (surface and subsurface flows and levels), major and flash floods, glaciers; ocean levels and tides; soils geology: rock types/ages/properties/structure, landslides, underground caves; meteorology and climatology; archaeology; seismology: active faults, seismicity, seismic wave propagation, ground motion; volcanology; disasters: earthquakes, hurricanes, tornadoes, drought, storms, snow, fires, falling meteorites, etc.
Engineering data	Control structures: locks, dams, levees, huge retaining walls; pump stations; building inventories/codes; transportation (cars, metros, trains, boats, etc.), bridges, tunnels, airports, cable cars; utility infrastructure, petrol pipelines, power lines, gas pipes, electricity cables; hazardous plants: chemical plants; nuclear plants, gas stations, etc.; hazardous storage: ammunition and weapon storage; petrol storage depot, etc.; hazardous transportation; critical facilities: huge sport grounds, huge theatres, etc.; communication systems; computer crashes; etc.
Environmental data	Hazardous sites; water quality; critical facilities, etc; wars, terrorism attacks, huge demonstrations (sometimes), etc.
Economic data	Demography; employment and services locations; epidemiology, transmissible illness, etc.
Response data	Evacuation routes; management plans; aircraft routes; personnel deployment; equipment deployment; warning system; hospitals; shelters, etc.

<u>Info requirements</u>

- data requirement to build a disaster info sys

  : base data, scientific data, engineering data, env data, economic data, response data

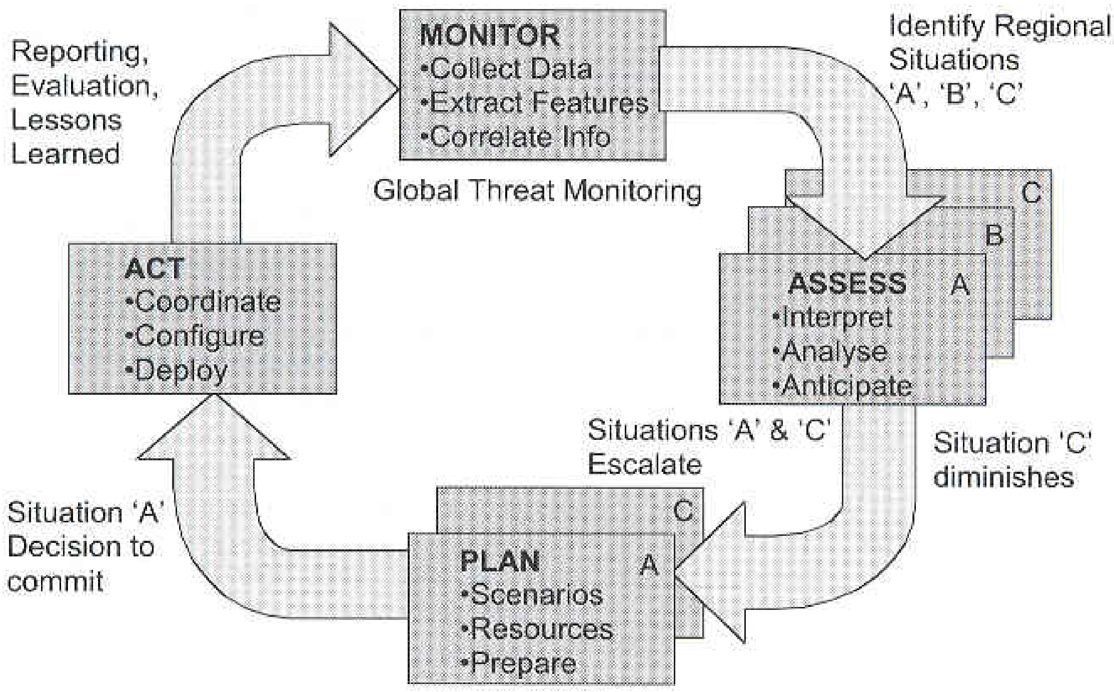

Figure 11.10 The operational concepts of an urban risk system. After Cochran and Power 1999, published with permission.

<u>Structuring the system</u>

- concepts for structuring the system

  : monitor, assess, plan, act

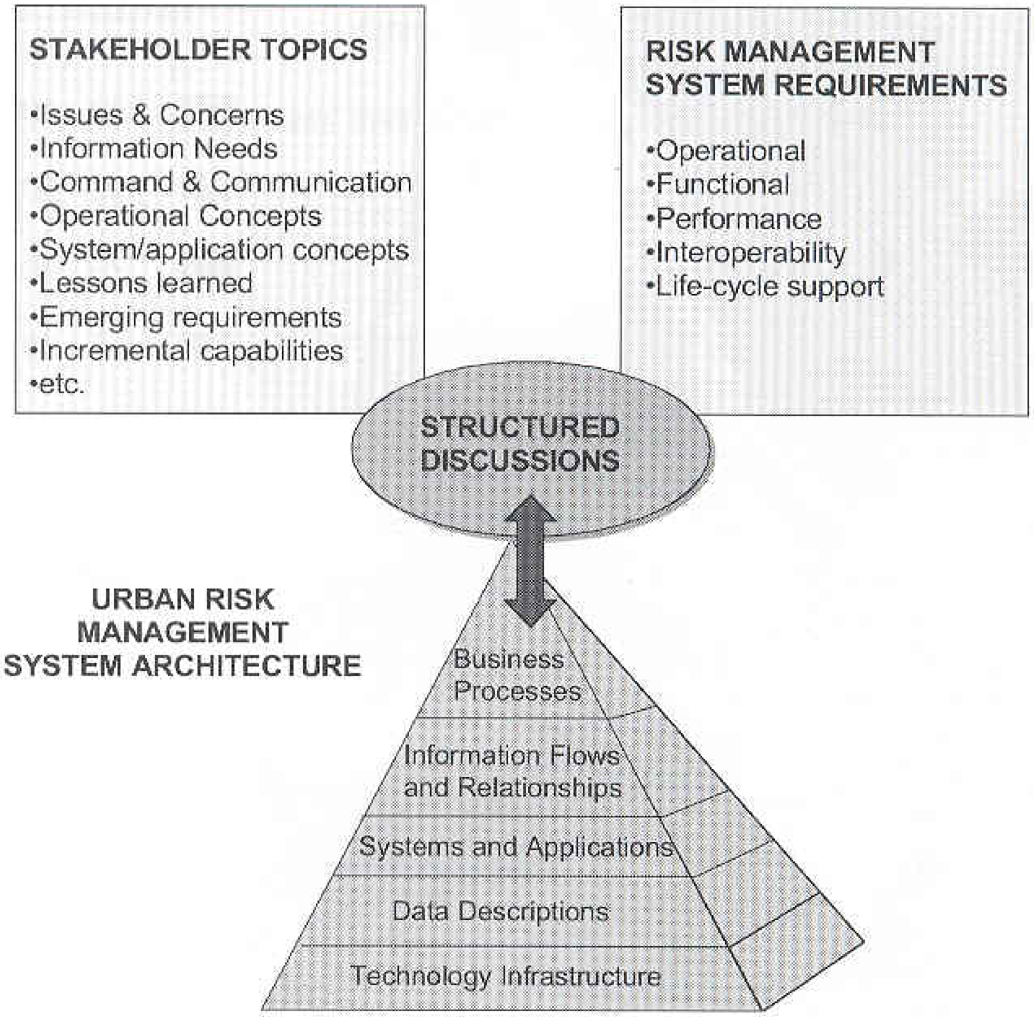

Figure 11.11 Relationships between stakeholders, requirements and system architecture via structure discussions.
After Cochran and Power, 1999, published with permission.

- actors & sys interacts to solve the problem of risk management

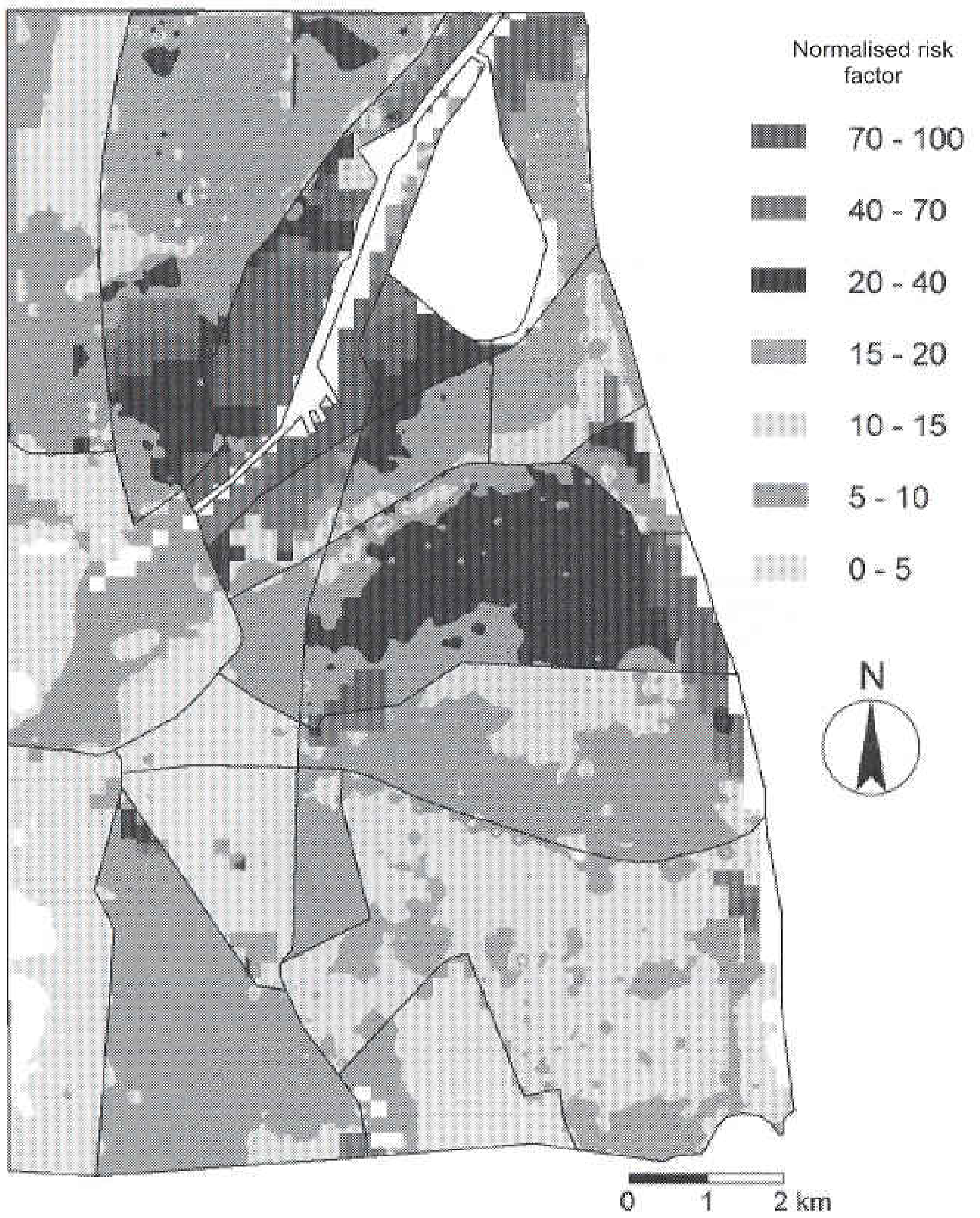

Figure 11.12 Risk map of the City of Ravenna, Italy for 2100, with the pessimistic scenario and a 10-year event.
Source: http://cenas.dmsa.unipd.it/results/littoral/fig30.html. 'CENAS: Coastline Evolution of the Upper Adriatic Sea due to Sea Level Rise and Natural and Anthropgenic Land Subsidence' G. Gambolati (ed.) p. 342 © 1998 by Kluwer Academic Publishers. Reproduced with kind permission from Kluwer Academic Publishers.

Urban risk mapping & GIS

- mapping urban risk: show risky zones, risk factors, establish priority
- example of City of Ravenna

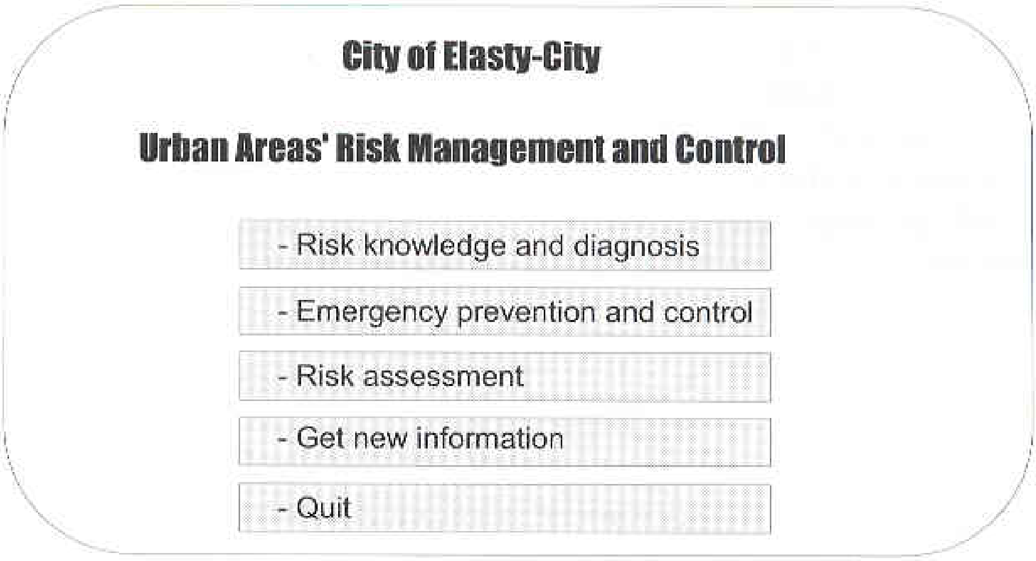

Figure 11.13 Home page of an extranet system for information to citizens for urban areas' risk management and control.

Info to citizens concerning risks

- one solution of risk management is to describe everything thru the web
- structure of an internet site targeted at citizens
  : example of elasty city

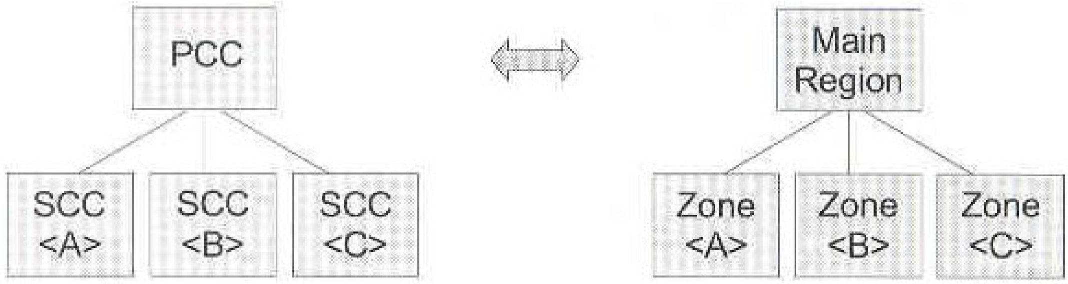

Figure 11.14 Zones and controllers hierarchy.

11.5 Example of telegeomonitoring sys for hazmat transportation planniing

Architecture

- 2 fundamental control types

  : primary control center(PCC), secondary control center(SCC)

  PCC: main node that centralizes the event's trackability

  SCC: distributed agents for the supervision of hazardous material transportation

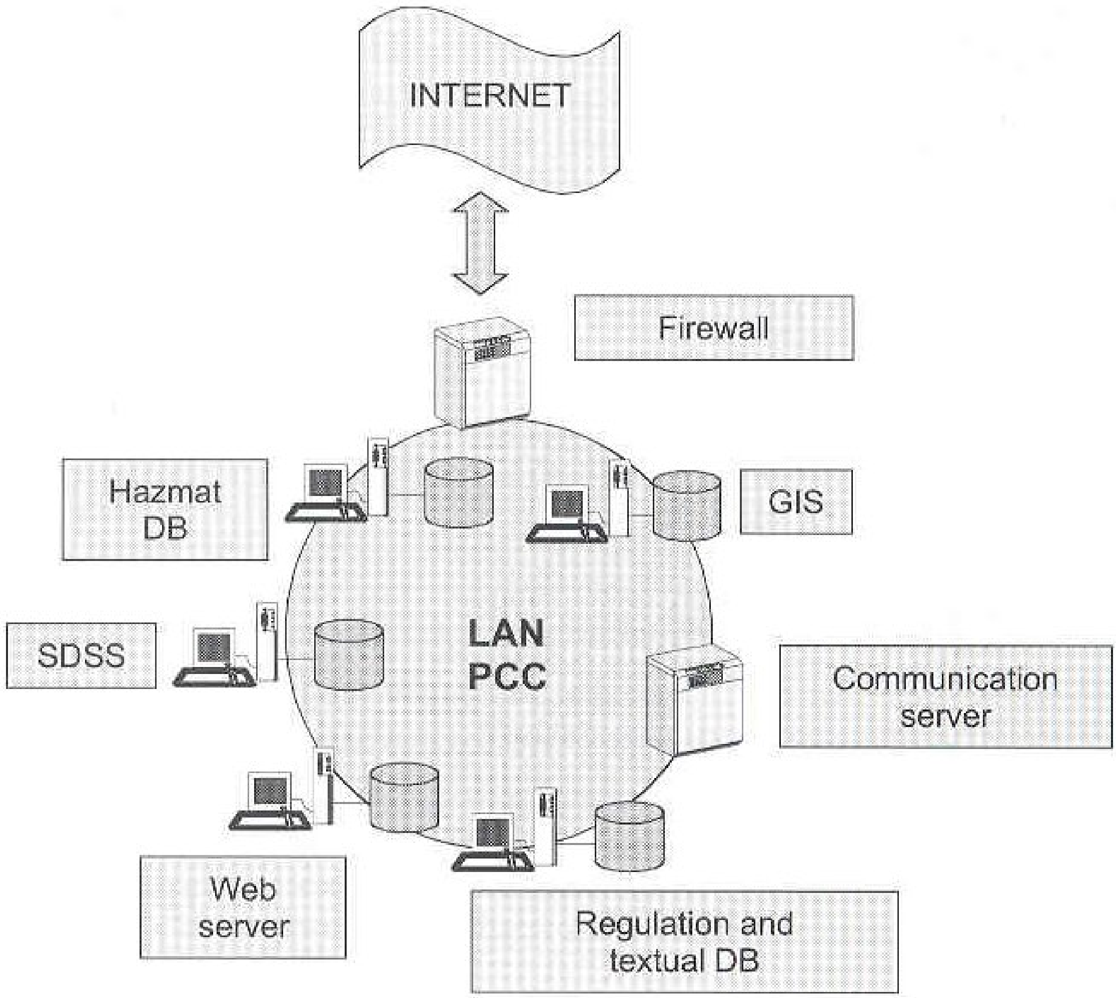

Figure 11.15 Global architecture of hazmat monitoring system: primary control centre viewpoint.

- intranet protected network & opened toward the internet

- components

  GIS: materialize the geographical facet of the DSS

  two relational DBs: multimedia DB of hazardous materials

  regulation/textual DB

  SDSS: tools for SDS & spatial analysis

  communication server: feed SDSS, archives of PCC itineraries

  web server: offer JAVA applets allowing access to node resources

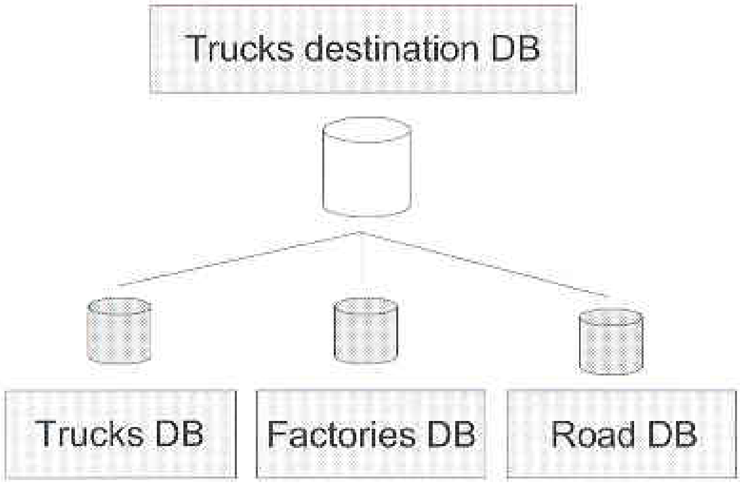

Figure 11.16 Databases hierarchy.

- primary controller unifies the global image of the network
- itinerary DB at the primary controller level displays 3 DBs

  : factories, trucks, road info

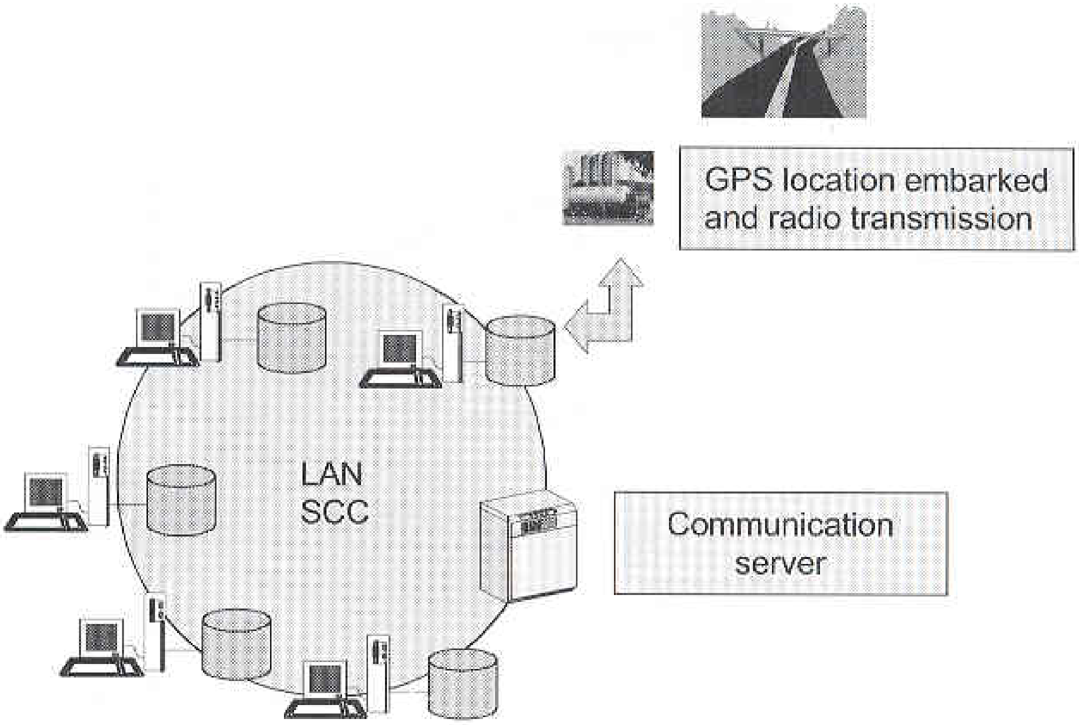

Figure 11.17 Technical network infrastructure: secondary control centre viewpoint.

- secondary controller is linked to the communication w/ trucks

- it has responsibility for communications processing in 2 directions

  : guidance of trucks by dynamic routing locally

  important events(accidents..) are reported to the primary controller

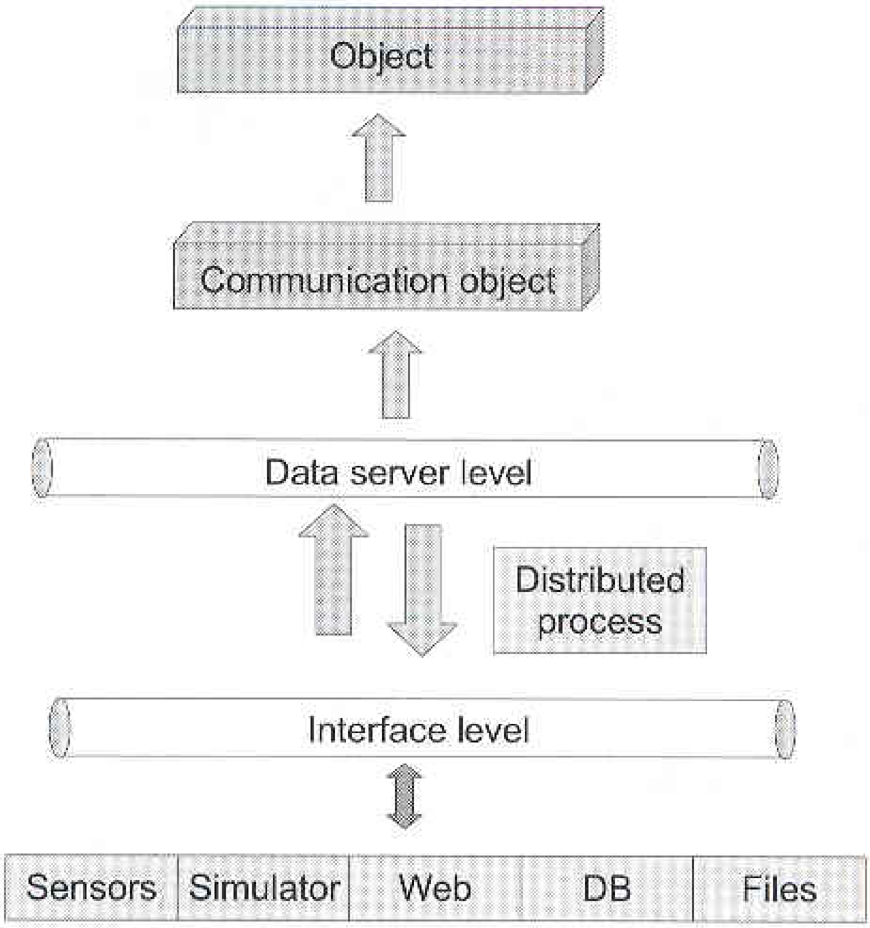

Figure 11.18 High-level description of data-collection process.

<u>Data collection process</u>

- client/server mechanism is used in telegeomonitoring context
  : server process on the side of data server
  several processes to the level of interfaces w/ data sources

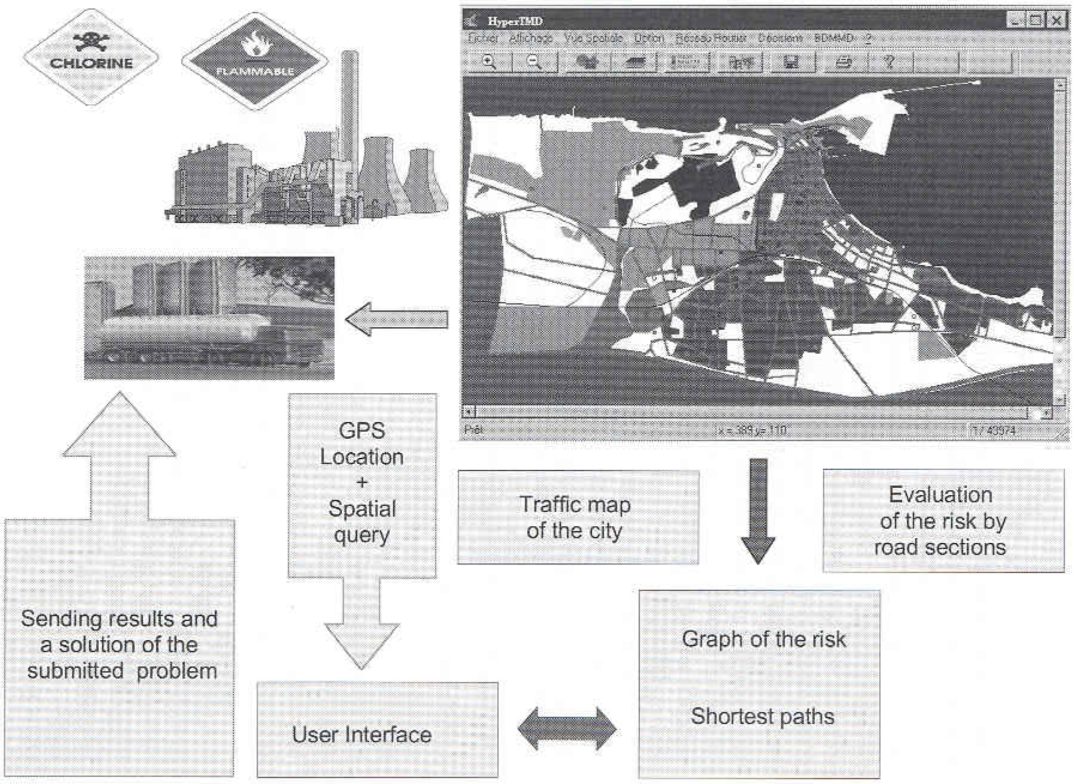

Figure 11.19 Basic scenario of the functioning of the spatial decision support system for hazmat transportation.

Risk modeling

- guide of the US-DOT

Risk = Accident probability × Accident consequence

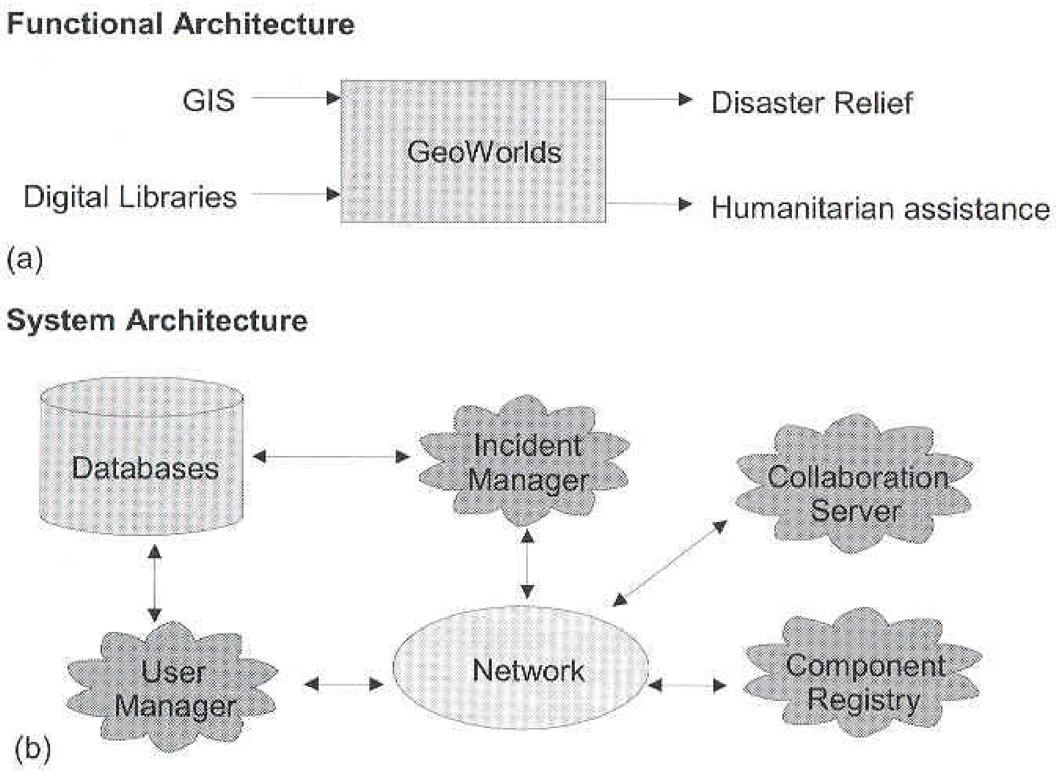

Figure 11.20 Architecture of GeoWorlds. (a) Functional architecture. (b) System Architecture.
From Kumar *et al.* (1999).

11.6 Example of humanitarian assistance in urban environment

- GeoWorld system
  experimental sys to assist humanitarian during disasters
  seeks synergy between 3 tech: digital library, GIS, telecommunications of remote sensor data
  component-based sys to support continuous increase of functionality
  effectively provide functional support to spatially distributed teams