Distributed and interoperable spatial database systems

Proliferation of spatial information technology

Spatially-extended databases

Distributed GIS

Unbundled spatial data processing and analysis functions into autonomous services

Spatial data processing characteristics

Standalone mainframe-, minicomputer- and workstation-based GIS

Desktop mapping and GIS

Embedded GIS components

Web mapping

Spatial Web services

Advancing mainstream information technologies

1970s 1980s   1995   2000   2005

Time

Table 12-1. Types and characteristics of mobile computers

Type	Characteristics
Laptop Computers	○ "Toughened" for field use. ○ Wireless communications capability. ○ Built-in global positioning system (GPS) device. ○ Screen designed for outdoor viewing and touch-screen navigation.
Personal Digital Assistants (PDAs)	○ Palm-held size. ○ Word processing, spreadsheet and Web browsing capabilities. ○ Connection to and communication with PCs. ○ GUI for navigation and data input using a pen-like stylus.
Hand-held Computers	○ Similar to PDAs in size but with larger screen and a keyboard. ○ Connection to and communication with mobile phones, GPS receivers, laser rangers and spatial database on a PC or workstation.
Tablet PCs	○ A scaled down PC using a full-featured Operating System (OS). ○ Large and high-resolution screen, external keyboard, and hand writing and voice recognition capabilities. ○ Built-in GPS receiver for position fixing.

Table 12-2. Mobile software products of major spatial database software vendors

Vendor	Mobile Software Products	Brief Description
Autodesk	OnSite Enterprise	A client/server solution that includes (i) Autodesk GIS Design Server using a Java servlet to deliver interactive vector maps and design information to mobile devices, and (ii) OnSite Viewer, which is a user interface on the client PDA or Tablet PC used in the field.
ESRI	ArcPad	A customisable mobile application that uses and processes spatial data, in shapefile and several popular raster formats, that is served up over the Internet using ArcIMS.
	ArcPad Application Builder	A development tool for customised mobile applications within the desktop environment for deployment on ArcPad devices in the field.
	Mobile ArcGIS Desktop System	The ArcGIS Engine customised for field tasks that require GIS analysis and decision making, typically performed on high-end Tablet PCs leveraging features such as pen-based computing and digital ink technology.
MapInfo	MapX Mobile	A specialised version of the regular MapInfo MapX Active X Control used for creating map-based applications for mobile computing devices.
	MapXtend	A development environment for creating wireless spatial applications using J2EE (Java 2 Enterprise Edition) and J2ME (Java2 Micro Edition) technology.
Intergraph	IntelliWhere	IntelliWhere provides an open and scaleable environment that leverages Intergraph's GeoMedia technology, using the industry-standard WAP and Microsoft's COM architecture to serve map images and accompanying location-based information.

Sources of information: Technical brochures of software products and Web sites of Autodesk (www.autodesk.com), ESRI (www.esri.com), MapInfo (www.mapinfo.com) and Intergraph (www.intergraph.com/gis).
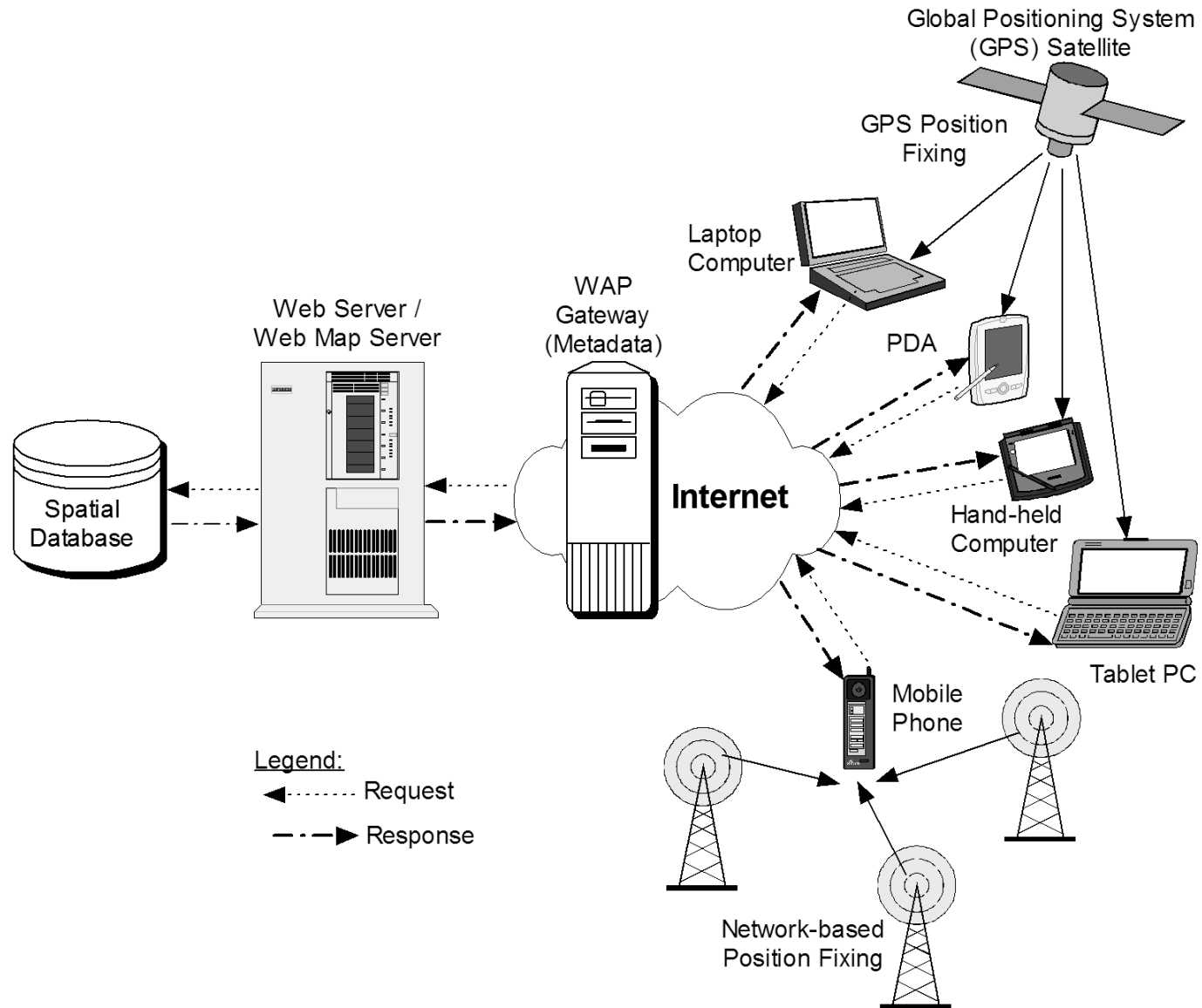
Spatial Database Applications

Domain-specific GIS / Spatial Database
- Land Management
- Resource Planning
- Healthcare
- Law Enforcement
- Transportation

Location-based Services (LBS)
- Enterprise Mobile Resource Management (EMRM)
- Consumer Information Portal Services (CIPS)
- Safety Service (E-911)
- Enterprise Location Software and Services (ELSS)
- Location-aware Transaction Services (LATS)

Spatially-enabled Information Infrastructure

- Database Access / Communications / Integration
- Database / Application Development Environment
- Information Policies and Standards
- Database Management Systems
- Data Stores

Spatial Data Sources

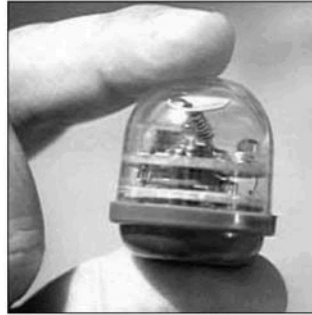- INTERNET / Sensor Web
- Business transactions
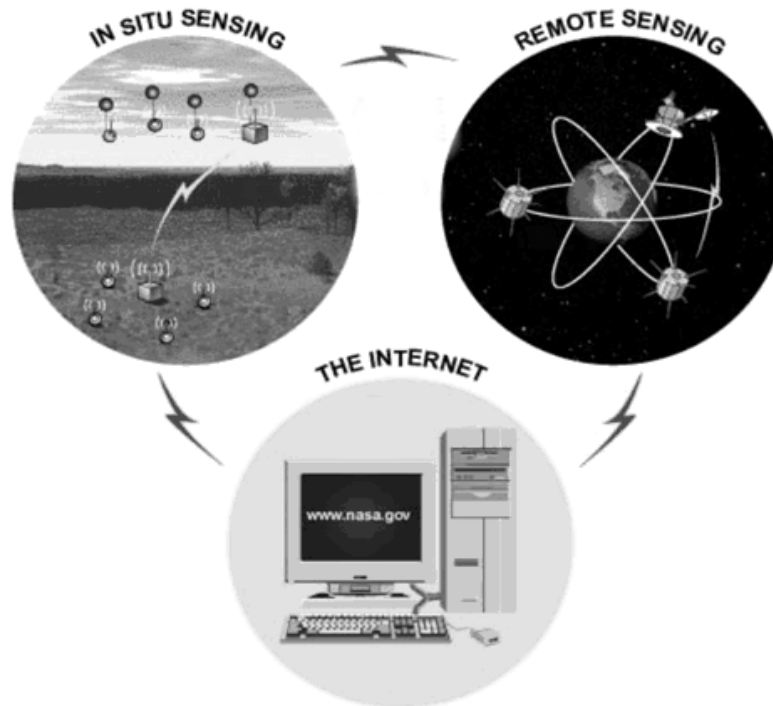- Field data collection
- Existing maps and images
- External non-spatial database systems

(a) A Sensor Web pod (Source: NASA, no date)

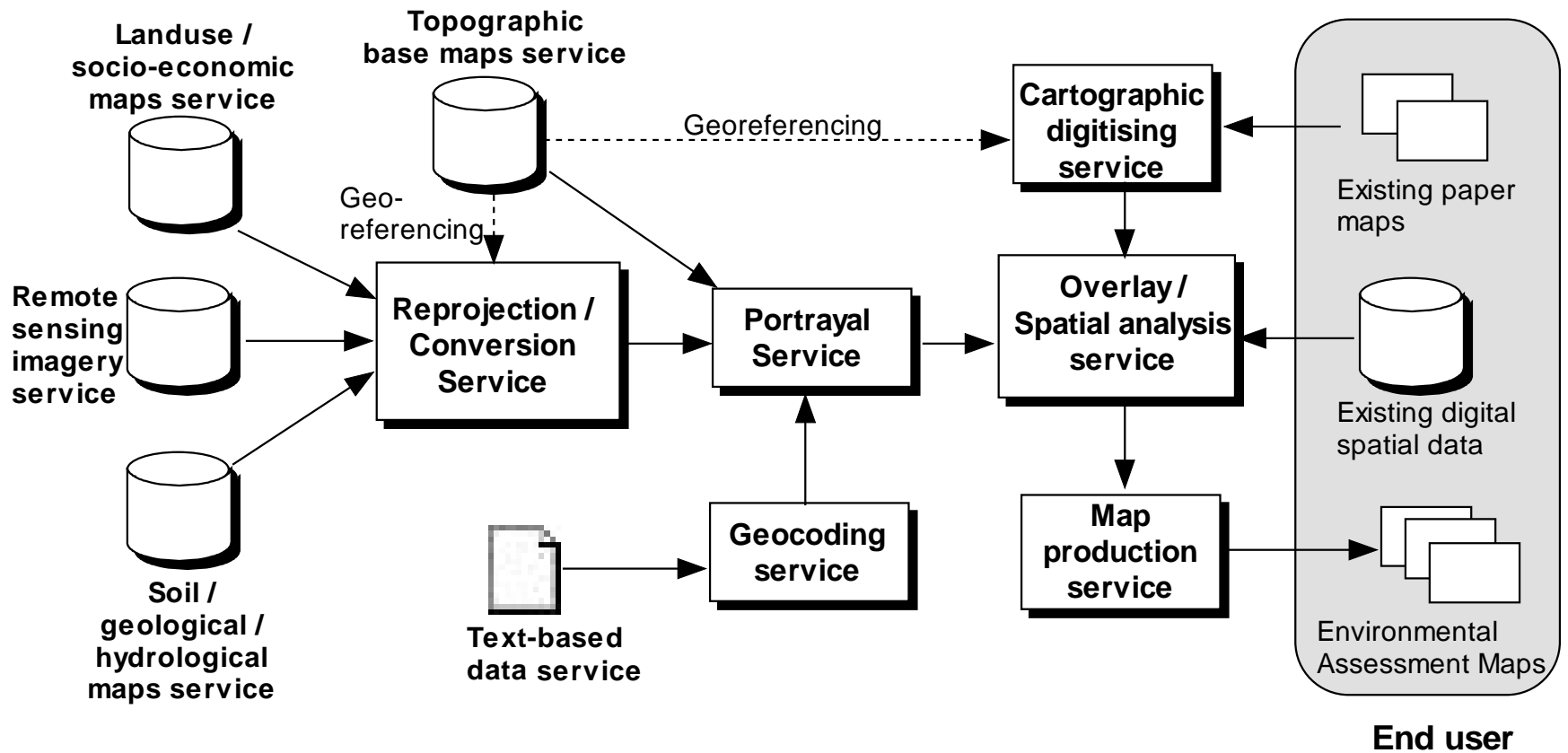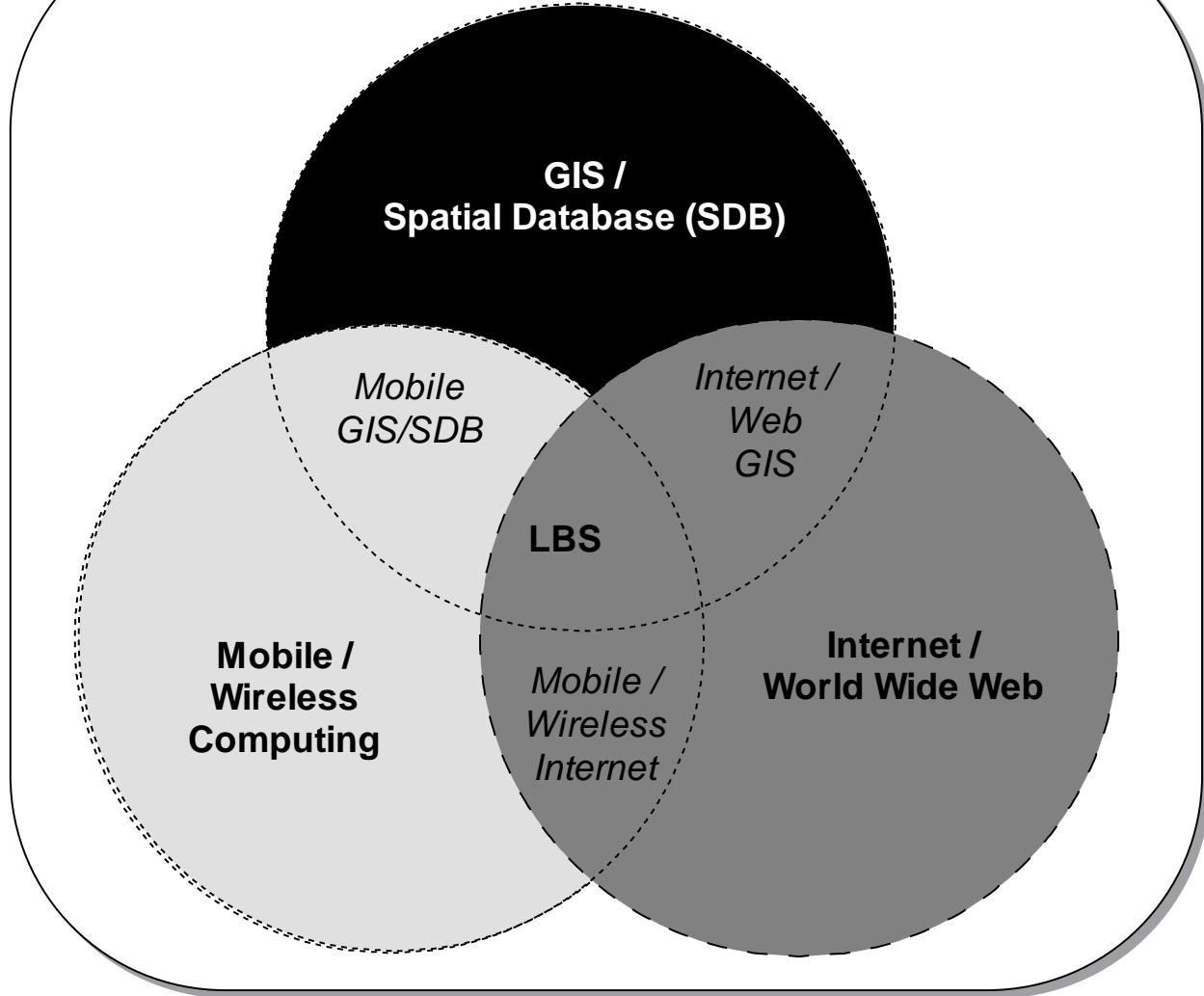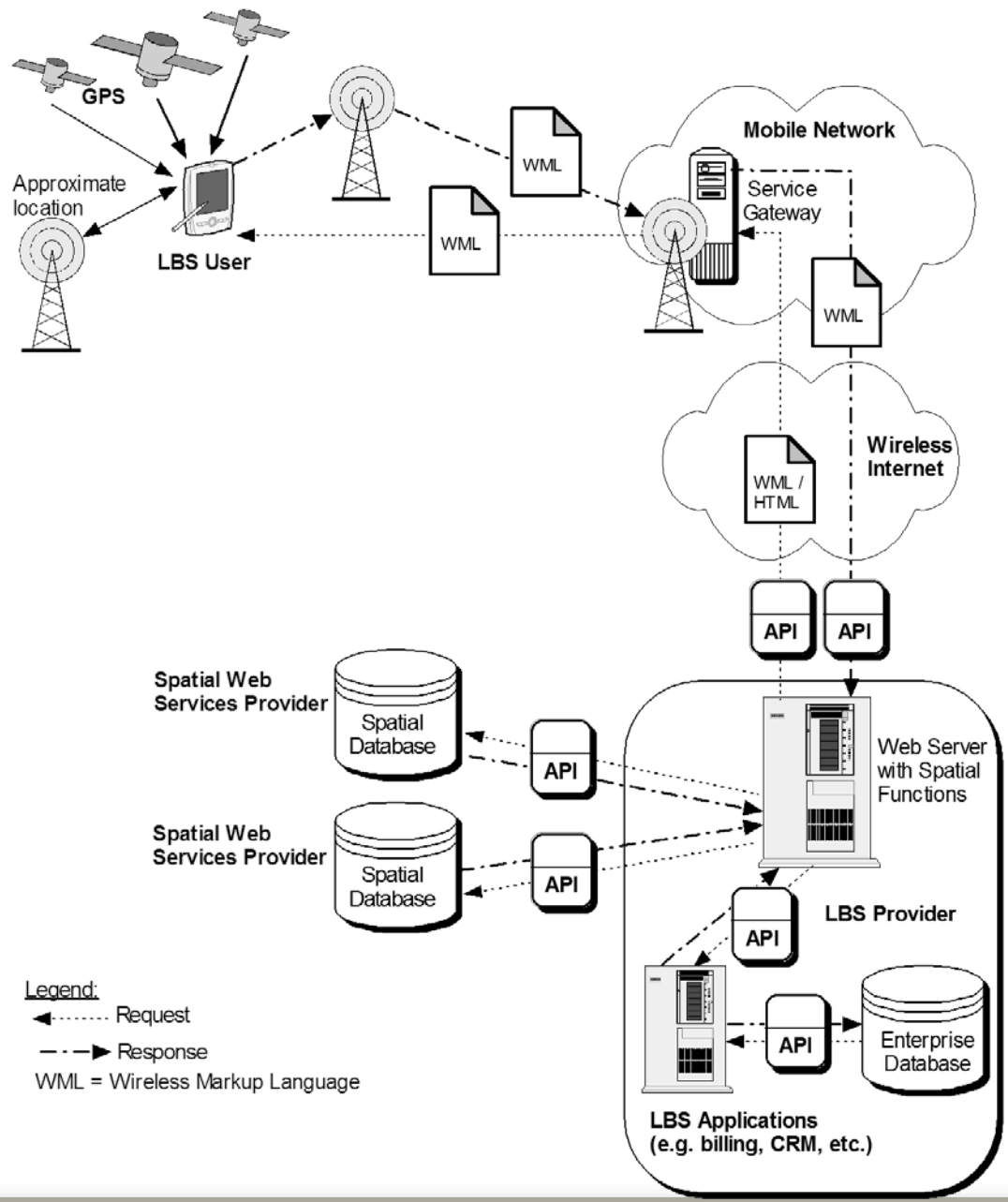(b) Components of a Sensor Web (Source: NASA, no date)

Landuse / socio-economic maps service

Topographic base maps service

Georeferencing

Cartographic digitising service

Existing paper maps

Geo-referencing

Reprojection / Conversion Service

Portrayal Service

Overlay / Spatial analysis service

Existing digital spatial data

Remote sensing imagery service

Soil / geological / hydrological maps service

Text-based data service

Geocoding service

Map production service

Environmental Assessment Maps

End user

Table 12-3. Spatial web service software products from major vendors

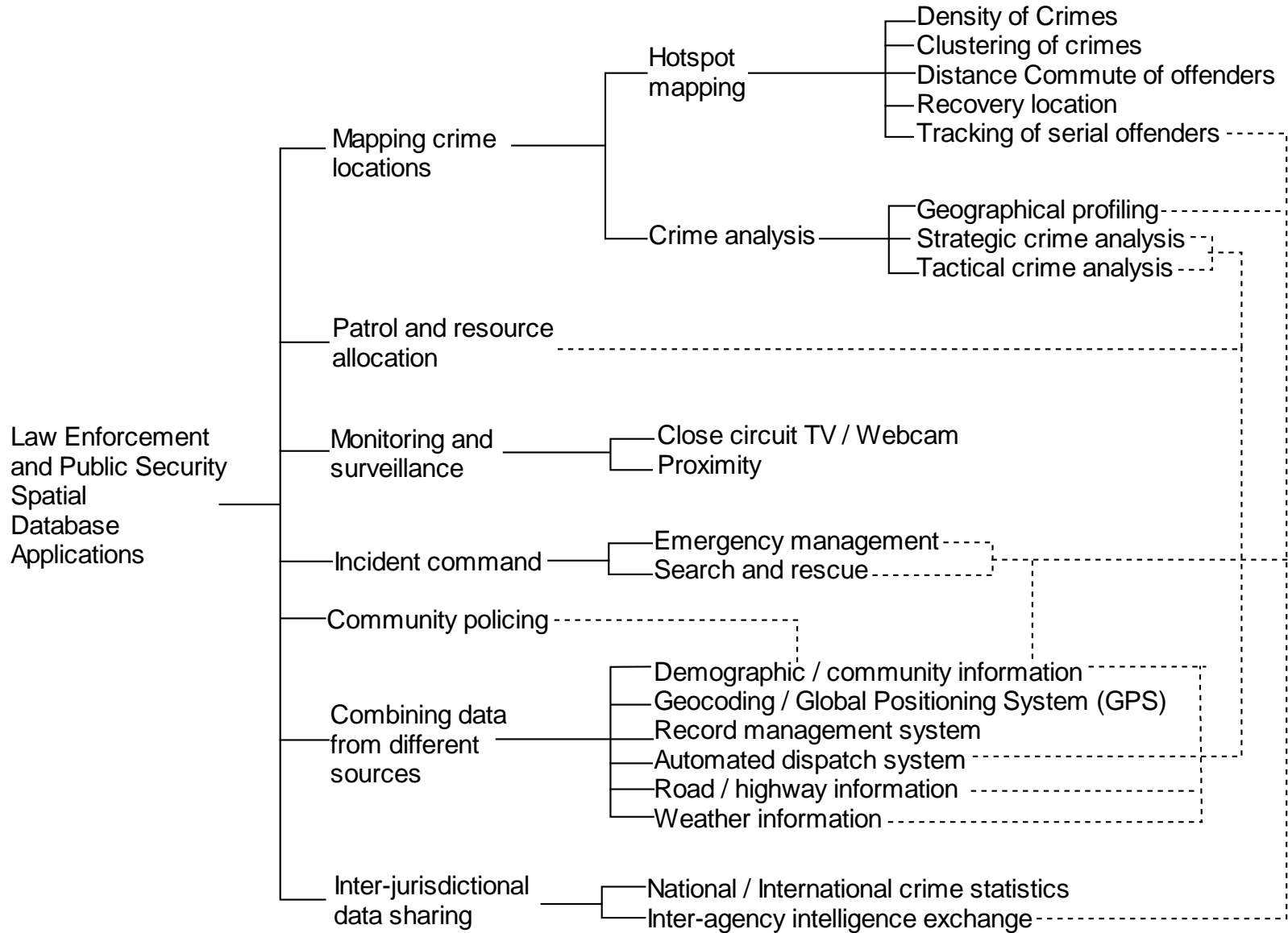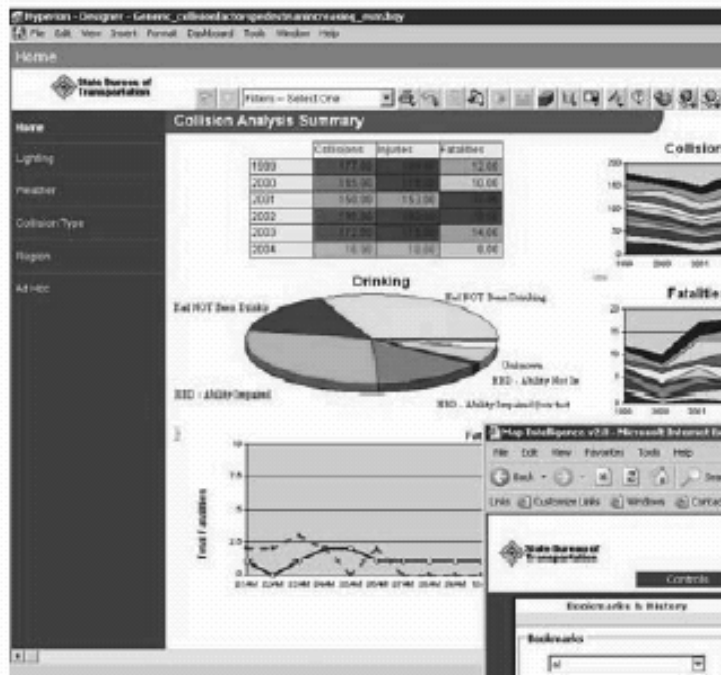| Vendor	Spatial Web service Products	Brief descriptions
Autodesk	MapGuide Commerce, OnSite and LocationLogic.	These three products are designed for delivering spatial technology through the application service provider model, in a traditional WAN architecture as well as a wireless network
ESRI	ArcWeb Services	A collection of spatial data and capabilities that is available to users on demand when needed, accessible directly using ArcGIS or used to build unique Web-based applications. It can also be used to extend users' Web mapping and GIS capabilities by integrating them into their ArcIMS implementation
GE Smallworld	Internet Application Server (IAS)	This product is designed to enable existing GE Smallworld desktop products such as Model It to be deployed to a variety of users and Internet applications through an application service provider
MapQuest Services	MapQuest Site Advantage	An XML interface that allows users to embed street-level maps and spatial search capability of North America, Latin America and Europe in their applications
Microsoft	MapPoint Web Service	A set of APIs that developers can incorporate into enterprise and customer-oriented applications to add address lookup, map rendering, reverse geocoding, and location-aware functionality
Microsoft	MapPoint Location Server	A companion service of MapPoint Web Service that allows its users to connect real-time location information from mobile operators with mapping and routing information

Sources of information: Technical brochures of software products and Web sites of Autodesk (www.autodesk.com), ESRI (www.ersi.com) and ESRI (2004b), GE Power (http://wwwgepower/prod_serv/products/gis_software/en/sias.htm) MapQuest (www.mapquest.com) and Microsoft (http://www.microsoft.com/mappoint/products/webservice/default.mspx).

GPS

Approximate location

LBS User

Mobile Network

WML

WML

Service Gateway

WML

Wireless Internet

WML / HTML

API   API

Spatial Web Services Provider

Spatial Database

API

Spatial Web Services Provider

Spatial Database

API

Web Server with Spatial Functions

LBS Provider

API

Legend:
◄······· Request
—·—► Response
WML = Wireless Markup Language

API

Enterprise Database

LBS Applications
(e.g. billing, CRM, etc.)

(a)

(b)

(c)