Location Commerce, At a Glance

By
Muhammad Waseem Arfi
(Undergraduate)

National University of Computing and Emerging Sciences
(NUCES)

Postal Address: 295 A-One Township, Lahore.
Email Address: waseem@waseemarfi.com

Abstract

Predicting future is always a risky enterprise! Technology advances are leading resulting organizational and institutional changes, which will have a profound impact on the "positioning professions", as well as on the community in general. Location commerce or "L-Commerce" has become the latest buzzword to circulate among telecommunications industry watchers tracking new trends in the wireless arena. L-Commerce will help connect businesses with their most qualified customers, quickly direct individuals to the services they desire, and even increase the efficiency of emergency services. L-Commerce has combined the technologies of mobile computing/wireless communication with Global Positioning System (GPS), to provide a wide range of location-dependent services to the general public (such as roadside assistance, concierge services, location-sensitive advertising). By using the location services, people would be experiencing the world really as a 'Global Village'. [2]

Introduction

The convergence of multiple technologies including geographic information systems (GIS), Internet, wireless communications, location determination, and portable devices has given rise to exciting new types of information utilities that may be referred to simply as location services. Also called mobile location services, wireless location services, or location-based services, these systems are making a major impact on how we navigate our world and how business is done. Knowing where a person or object is at any time presents a powerful new dimension to the kinds of information services that can be offered. Location services deliver geographic information between mobile and/or static users via the Internet and/or wireless network. [5]

What are Location Services?

All businesses are in pursuit of *just-in-time actionable information* - just the right information, at the right time, ***at the right location***, on any device - from which they can make effective decisions and take immediate action." This observation applies equally to individuals in our daily lives. At some points in our lives, we have all found a need to know, for example, where the closest Pizza Palace is and how to get to it from wherever we happen to be at the moment, with a car full of hungry kids!

Within the mobile wireless network community, there are two distinct aspects of Location Services:

- *Location Services* (also called Mobile Positioning or Mobile Position Determination technology combined with M-Commerce known as L-Commerce) deliver specific information about the geographic location (i.e., position) of mobile terminals such as mobile telephones, PDA(s), and other devices attached to other moveable items such as people, packages and vehicles.

- *Location Application Services* (also called Location-based Services) deliver end-user applications, normally based on knowing the position of a user with their mobile terminal. These services can be delivered through a wide range of devices, including wireless phones, in-vehicle tracking modules and other types of mobile terminals. Location Application Services also support operations throughout a location-enabled enterprise, including such applications as customer relationship management, accounting, network planning, inventory management, field service, network management, inside/outside plant, and so on.

From a user's perspective the distinction between Location Services and Location Application Services may not be important. For simplicity, we use the general term *Location Services* to describe the infrastructure and services that deliver location-based information to users and are available across fixed and mobile networks, such that they can be used by anyone, anywhere at any time and on any device. Location Services become integral to the enterprise (and to the way individuals behave) when they are ubiquitous, efficient and easy to use. [3]

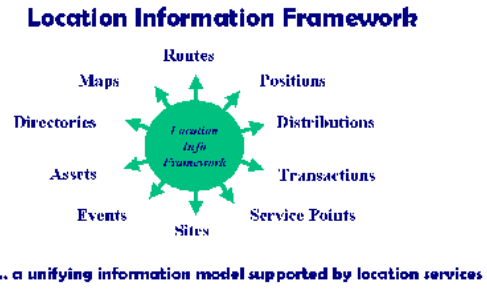
Why is Location So Useful?

Location is central to how people organize and relate to their world. As an information-based society, we value systems and services that can tell us about the location of people, objects, and phenomena. Our existing information systems reflect this, as most of the contents in databases today are linked to location or geographic components. Location services leveraging communications and computing technologies can provide ready access to this information in a broad array of applications for the business, consumer and government market sectors.

For example, customer relationship management (CRM) systems integrated with GIS can enable organizations to close the information gap between service providers and their customers or constituencies. By tying ubiquitous geographic location information with all aspects of business activity, service agents, marketers, planners, analysts, and managers can detect patterns and trends in the data that may otherwise have been missed. Think of personnel in the field, away from their office desks, utilizing wireless devices to access their corporate database, and linking to information relevant to their current location. This scenario can deliver extremely powerful results. Instant access to remote databases, coupled with the power to manipulate and query that data with a GIS will not only make mobile workers more efficient, it enables service providers to interact with their customers in ways that were never possible before. [5]

How is Location Used?

Location most certainly takes us one step closer to modeling the reality of our business (not to mention organizing our personal life!).



How so? Let's assume that a business has valuable information that is now buried in files, folders, documents and tables scattered around the enterprise and they want to get at this information more easily. Now let's say that much of these information have some form of location content, be they messages, asset maps, documents, customer databases, delivery routes, transaction reports, or whatever. Now let's add a location application server to the warehouse. The location application server keys on the location properties of warehouse holdings and organizes and provides location-based access to these data, accordingly. Likewise, the location application server makes it easy to exploit business information holdings, keying on location properties to generate reports and maps with actionable business information. [4]

How does GIS provide Value?

Simply knowing where you are, or how far you are from someone or something, is typically not valuable by itself. Relating location to other pertinent information gives it meaning and value. For example, knowing that you are one mile from a particular facility may give some small comfort that you are getting closer, but obtaining a travel path to that point adds value. Obtaining a valid or reliable route adds even more value. Access to information about other features, such as stores or customers located along that route, may enhance the value even further. Having the power to modify the route to avoid delays due to construction or traffic incident adds yet another level of value.

To derive this type of value, two types of elements are required: spatial data and tools to manipulate spatial data. GIS is central to both of these elements. GIS has for many years provided the tools to generate, manipulate, and manage spatial data. Government agencies and commercial data vendors use GIS extensively to create and maintain the map data used by location services. Vendors such as Geographic Data Technology, Inc. (GDT), Tele Atlas, and NavTech provide street centerline data sets that include address and street name, which are essential to geo-coding and routing applications. [5]

Location services that incorporate GIS tools enable a wide range of spatial transactions that can be delivered in meaningful ways. Data base management systems (DBMSs) now have some spatial data management capabilities providing limited support to location services, but they are not competitive in terms of performance, flexibility, and scalability without direct access to a robust GIS at their foundation.

The New Information Economy

Is the new information economy about taking risks? Sure. But what risks do you take by not participating or at least planning to participate? What will your opportunity losses be if you don't participate?

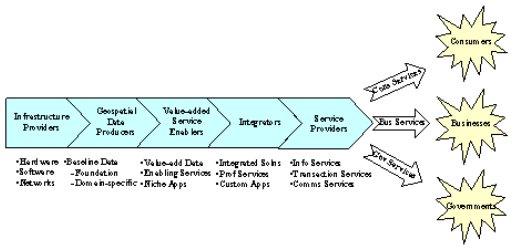
Opportunity abounds in the new information economy for industries with strong IT orientations, like the geospatial industry. The world is going digital, and the geospatial industry holds the key to the Digital Earth. The Digital Earth concept has powerful implications for the geospatial industry. The marketplace is searching for "Net coherence": getting around faster, finding what you need faster, and being able to put to immediate use any information you gather.

Better information modeling techniques (Digital Earth) will bring greater coherence to the Net. The Digital Earth will no doubt be considered a foundational information modeling paradigm for the Net. Many people in the geospatial industry understand this as an inevitable future outcome. All that remains is that the industry demonstrates the Digital Earth, not just as a concept, but as the reality of the industry's efforts to standardize, to build the global geospatial infrastructure and to join the IT mainstream.

Geospatial Information Value Chain

We list below five categories of geospatial industry players who work together to meet the needs of end users over the Net. All these players have a stake in a robust "GeoJava" infrastructure for distributed geoprocessing, if location information and services are to accompany Java as it expands the Global Information Infrastructure. We speak of this set of categories as a value chain, but in fact it is a complex network of relationships supporting information flows and transactions of many kinds.

Geoprocessing Value Chain for the Net



Infrastructure Providers

Infrastructure providers are responsible of providing networks, hardware and software. Geospatial infrastructure providers must evolve towards a more mainstream model in order to realize ubiquitous location services. And in order for the geospatial industry to realize its full potential, the geoprocessing infrastructure must be congruent with the communications and distributed computing architecture of the Net. Looking in this respect the most suitable technology seems to be Java for that matter.

Geospatial Data Providers

Geospatial data providers need to apply geospatial e-commerce to data sales over the Net. Their businesses have focused on selling "scenes" or large data sets that usually contain much more data than the buyer needs. These providers need ways to gain the same or greater revenues by charging less for a greater number of smaller transactions that give users only what they need.

Value added service enablers

We will see a proliferation of market niches for value added information product producers who convert location data into information products that are packaged for particular market segments or individual users.

Integrators

Open GIS Consortium(GIS) is defining geoprocessing service interfaces that integrators need to build interoperable, extensible, maintainable, forward-compatible component-based systems for their clients. Java has considerable mind share among integrators, who appreciate its benefits of developer productivity, easy maintenance, architectural options, platform independence, etc. While integrators are using Java more and more, they are just beginning to learn how location services can benefit their clients. They respond favorably to standards that define the basic approach to Java geoprocessing.

Service Providers

In the Internet market, service providers provide information services (information that has come through an information provider), business transactions (e-commerce, or in general, e-business), communications, online tools, or some other direct or indirect service. What location service providers offer will sometimes be mainly geospatial in nature, but more often, their offering will be a hybrid, with location information or service representing only a portion of the total value of the service.

End Customers

End-customer satisfaction will depend heavily on cooperation among providers in the geoprocessing value chain. There is a danger: The lack of standards-based approaches to location service provision is growing very fast on the Web browser side, even as organizations such as the Open GIS Consortium (OGC) work Web mapping specifications. The Web's advance is predictably creating a "swarm" of network-resident geospatial data and geoprocessing services. Currently there are many Web-based mapping sites, but few interoperate. Products available today for Web-mapping whet peoples' appetites for what will be possible with open-standard conformant servers and browser-visiting applets.

The Technology Picture

The "Wireless Web" is the technology mantra of the day. The integration of the Internet and wireless worlds paves the way for a host of new value-add IP services for mobile subscribers. But, if we believe that only wireless technology and the Internet form the backbone of location services for mobile subscribers, we overlook another key technology GIS (GIS is well integrated with the Web and enterprise systems today. Wireless location services need GIS too! That is, to get the most value out of location services, we must have GIS technology. Some of these services may include only simple uses of GIS technology, but the GIS underpinnings are there nonetheless.)

Location Services = f (GIS + Internet + Wireless)

We often read these days about the wonders of the wireless Web, with much of the emphasis being placed on emerging wireless technologies, like 3G and next generation mobile terminals, and emerging Internet technologies, like XML and RDF/S (the building blocks of the Semantic Web). Fine. We certainly need wireless-IP platforms to deliver digital services any time, anywhere, and on any device. There is clear value in having these platforms. But, what we don't hear enough about are the application content and services that will deliver the substantive information to subscribers that causes them to buy services in the first place. This is where GIS comes into play!

With regard to location services, another important topic of the day in the wireless world concerns the various technologies for determining the position of mobile terminals, like GPS and GPRS. There is great value to having a service provider know where a mobile terminal is located. For starters, wireless operators in the U.S. must comply with the FCC mandate for E911. But, the full value of knowing the position of a mobile terminal won't be realized until operators are able to apply this to the wide variety of location services that will exploit this capability. Again, this is where GIS comes into play! [6]

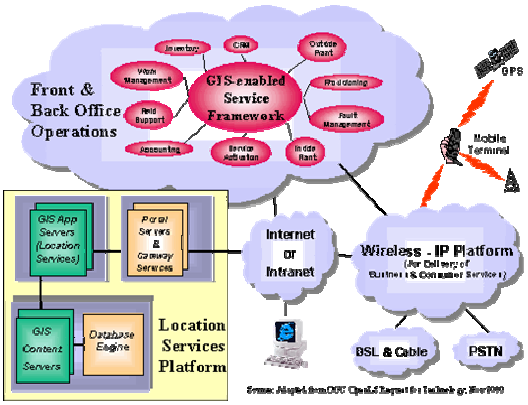
Putting things together

One company, ESRI, of Redlands, California, is putting together an impressive array of GIS and Location Services capabilities (i.e., the underlying platform technology, as well as innovative value-add services) for both the wired and the wireless Web. This GIS leader has been quite busy the last two years adapting their

technology for the Internet and the wireless world. This has not happened at the expense of their proven solutions for the enterprise. On the contrary, ESRI plainly sees that desktop-server solutions are not going to vanish from the enterprise scene. As discussed earlier, there is a clear symbiotic relationship between these approaches.

ESRI is attacking the problem on multiple fronts. First, they produced their ArcIMS product, with a flexible, adaptive service model for providing location services over the Web ('GeoServices'). ArcIMS is expected to grow rather dramatically as ESRI's clients, both in the private sector and in government (hundreds of thousands strong), turn their attention increasingly towards the Web. ArcIMS also has WAP-enabled APIs to provide location services for the wireless world and ESRI is adding support for the other emerging standards for the wireless market. Next, they completely revamped their core product line, producing ArcGIS 8. This product family forms the underpinnings of their location services solution suite (the fruits of years of effort in developing and perfecting GIS art and science). ESRI also produced ArcPad, which takes their GIS technology repertoire to a small-form factor Windows CE palm-size computer. Perfect for field operations, ArcPad supports a variety of location data that can be updated in the field and then uploaded to a master database back at the office. With its optional GPS receiver, ArcPad turns into a location-sensitive device, giving field users their instantaneous position on a map. Finally, ESRI produced what might be the most exciting of all their latest offerings, Geography Network (http://www.jlocationservices.com/company/ImageMatters/valueinlocationservices.html#). The Geography Network provides the framework for a global network of users and providers of location content and services. The Geography Network could well be the information and service framework that comprises the first major layer of the Semantic Web. As discussed earlier, the role of geography in this context is compelling. When the Geography Network goes wireless in 2001, the first bastions of the location-based Semantic Web will reach mobile subscribers with a rich array of location services. [6]

And so, GIS is now available for the wireless world and the Web! GIS software components that have been perfected through years of refinement have been adapted for IP service frameworks. As integral parts of these frameworks, the value of GIS is available at the right service delivery points, in the right application context, where and when needed. The figure below illustrates how GIS capabilities that serve internal customers of the enterprise with a host of location-based applications and services, also serve external customers through a location services platform that is integrated with enterprise service frameworks and wireless-IP platforms.



The following table of GIS-powered location services illustrates how businesses, governments and consumers are benefiting now, and will continue to benefit, by having location information available on demand, on the Internet device at hand.

	Location Services		
Types of Location Information	**Consumer**	**Business**	**Government**
Positions	•Where am I? (map, address, place)	•Contact nearest field service personnel.	•Location-sensitive reporting.
	•Where is? (person, business, place,..)	•Where is this business located?	•What's your 20?
Events	•Car broken down… need help.	•Local training announcements.	•Local public announcements.
	•Medical alert!	•Traffic alert!	•Accident alert!
	•Nearest theatre playing the movie I want to see?	•Job fair promotions.	•Traffic re-routing for major events.
Distributions	•House hunting in low-density area.	•High growth trend?	•Growth patterns?
	•Want to vacation near highest concentration of….	•Sales patterns?	•Per capita green space?

		•Parts inventory for field service locations?	
Assets	•Where is my car?	•Where are my dispatched repair trucks?	•Where are the snowplows?
	•Lowest insurance rates?	•Status of utility field devices?	•Road maintenance.
	•Where's my cell phone?		•Parking situation?
Service Points	•Tell me when I'm near where I'm going.	•Where are my customers, given target profile?	•Economic development areas?
	•Where are the sales?	•Field service logistics.	•New zoning.
Routes	•How do I get there? (address, place)	•Best delivery route given shipping manifest, traffic and weather?	•Traffic volume & patterns?
	•Fastest route (given traffic situation)?	•Taxi dispatch.	•Emergency dispatch.
	•Best travel times and routes?	•Best distribution network?	•Priority road maintenance?
Context (Overview)	•Nearest visible landmark?	•What's near the hotel?	•Collaborative economic planning.
	•Show me the nearest___ (business, place,..)	•Show me car rentals near the airport.	•Local commerce.
Directories	•Looking for nearest___ (specialist,..)	•Best supplier within next two hours?	•Public services.
	•Where can I buy? (product, service)	•Nearest repair services?	•Outsourcing?
Transactions	•Lowest shipping rates?	•Location-sensitive billing.	•Tax revenues.
	•Must purchase in specific location.	•Low cost distribution services?	•Location-sensitive tolls.

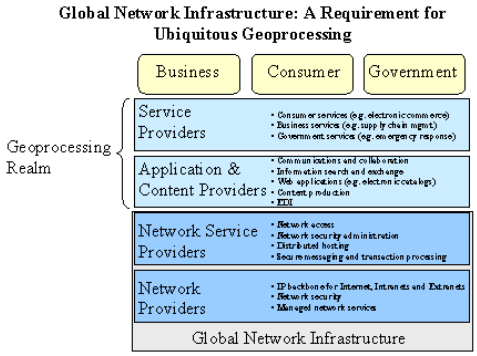
		•Location-sensitive quick dial.	
Sites	•Candidate properties to build my house.	•Candidate store sites?	•New schools?
	•Tourist attractions to visit?	•Optimum cell tower locations?	•Environmental monitoring stations?

The Global Network Infrastructure

The Global Network Infrastructure (GNI) is the vision for an open, information-oriented society where people around the globe share information via an infrastructure of interconnected computers, information services and information repositories. The GNI, otherwise called the "Net," is comprised of a global IP network with network computers and core network services. The Net provides essential communications and distributed computing capabilities upon which the Global Information Infrastructure and ubiquitous geospatial data and geoprocessing depends.

The Net encompasses the Internet and enterprise-oriented intranets and extranets. The Internet forms the backbone for interconnectivity and communications between a global network of distributed computers and network appliances. Intranets and extranets extend the reach of the Net and fulfill specialized communications and distributed computing needs for enterprises and enterprise clusters (e.g. a supply chain), and through gateways, provide enterprises access to the Internet. [7]

The Global Network Infrastructure is rapidly evolving to meet the increasing demands of a rapidly growing population of users, with expanding needs for more sophisticated applications, like geoprocessing.



The Net is rapidly expanding to meet anticipated demand. Communications providers have made the expansion of the global IP network a top priority in their growth plans. Internet Service Providers (ISPs) are enabling widespread access to the Net and are providing consumers and businesses with basic applications like email, Web hosting and other core network services.

A multitude of service providers, integrators, application and content (data) providers are dependent on the Net. They are building and providing the services and applications to support communications, information exchange, transaction processing and other crucial services and applications to consumers, businesses and governments. Notable among these are the innovative, rapidly expanding "portals" to the Net, which are primarily oriented towards consumer services, but are rapidly expanding into the small business arena.

We discussed Geoprocessing Value Chain for the Net in the above. The above figures shows it clearly that is required that is purely meant for internet. And for that matter Java is the best language that we can opt for to implement this architecture. Let us see how java helps in the growth of the geospatial industry.

How Java Supports Growth of the Geospatial Industry

The following table describes how Java™ (i.e., Java Language, Java Platform and Jini) supports growth of the geospatial industry in the new information economy.

Factor/Trend	How Java Helps
Towards a consistent, coherent information model for the Net	Java supports the notion that everything can be an object with well-defined interfaces. Java™/Jini™ provide the means to distribute objects over the Net. This makes it easier to model the earth in a distributed fashion, while maintaining a consistent, coherent model through appropriate geospatial standards – OGC.
"Coopetition" (cooperation between competitors)	Java's broad industry acceptance as a preferred core technology for the Net makes it a good candidate for the global geospatial standards framework. Furthermore, Java's benefits in software productivity, interoperability with mainstream IT technologies, cross-platform independence, etc., make it ideally suited for the geospatial industry to broadly leverage itself and more quickly reach its goal of ubiquitous geoprocessing.
Rapid product cycle times	The Java Platform moves us away from centralized design to design by many, thus distributing development workloads more effectively. The breadth and robustness of the core Java Foundation Classes allows developers to get their applications developed more quickly. JavaBeans and Enterprise JavaBeans provide an unlimited extensibility framework for sharing reusable components across the geospatial industry.
Convergence of TV, PC and the telephone	Jini environments treat all digital devices the same, as intelligent objects, capable of using one another's services. Such a universal standard for distributed device interoperability will bring GeoJava object intelligence to all devices in the home, home office, automobile, hotel room,

	etc.
Emergence of virtual communities	Virtual communities share. They share everything and anything. Java objects can be anything. GeoJava objects will find their way into thousands of virtual communities, for myriad location-based information services. The broad availability of Java Platforms, coupled with Java's object portability and interoperability, will facilitate ease of use of GeoJava objects, leading to broad user acceptance.
Increased data mining	The Java Platform facilitates data mining applications through JavaBeans that integrate legacy systems and databases. The JavaBean component model will make it easy to build data mining applications that must deal with a wide variety of data sources and algorithms for fusing and analyzing these data. Additionally, Java-enabled data mining "agents" will be dispatched around the Net on a vast number of missions to search, filter, package, and return valuable information. Standardized GeoJava objects will add geo-intelligence to the standard portfolio of data miners. Increasingly, new GeoJava decision aids will emerge and be readily disseminated and assimilated into the management, planning and operations environments of enterprises.
Commoditization; Falling prices	Java moves us closer to a Net&Object-Centric world. The Net offers greater accessibility to everyone. Java objects provide convenient packaging and distribution. As the global geospatial infrastructure grows, more geospatial objects will enter the realm of the Net. The result: deflation.
Customer loyalty and churn	Java technology will improve geospatial products and services, lessening customer churn. The industry will also be able to respond more quickly to market needs and easily add new geo-intelligent services to their portfolios.
Emergence of intelligent devices	Java/Jini provide support for embedded device (object) intelligence and distributed devices (objects). Jini's spontaneous nature allows intelligent devices to easily join a network and be instantly recognized and exploited, or exploit the services of other devices (objects) on the network. Jini also supports intelligent agent portability, the way to easily extend the reach of an intelligent device. GeoJava objects will play an important role in embedded systems by spatially-enabling them for a variety of applications. Of particular interest are the applications of GeoJava in mobile consumer and business devices.
Rise of Net portals	Net portals attract the majority of the consumers and small businesses. They are crucial distribution channels to the future of ubiquitous geoprocessing. The portal companies are very Net-savvy and often change their business models, underlying technology, and offerings on the fly, as necessary to accommodate market changes. Java is a core technology for these companies. Java-compatibility will be crucial for easily introducing new services and products offered by the geospatial industry into these lucrative environments.

Rise of distributed, portable, modular and extensible information system architectures	Java/Jini have inherent, pseudo-organic qualities that make them particularly well suited for this new architecture paradigm for the new information economy. You might say, in a nutshell, that this is exactly what Java/Jini are about.
Rise of e-commerce	Countless businesses are entering the e-commerce realm. The progressive, new technologies of e-commerce are built with the best available core technologies today, including Java and Java Platform. GeoJava resources will become standard tools in this expanding market, offering location-based information to shoppers, supporting geo-intelligent targeted advertising, or giving smart shoppers geo-intelligent agents to discover what local providers offer.
The dynamic enterprise	Changing business models in a rapidly changing environment require flexible business processes and infrastructure. Java supports highly scalable business systems that can grow and adapt as a business shifts its emphasis and needs. Enterprise JavaBeans provide the ultimate in flexibility, making it easy to assimilate new business functions (objects). GeoJava objects can easily migrate into the enterprise and be used throughout the enterprise. Jini's native features support environments of constant change, with autonomous GeoJava devices (objects) coming and going, spontaneously joining and disjoining the network.

A Model for GeoJava Computing

Elements of the Internet Computing Model for Geoprocessing

The Internet Computing Model for Geoprocessing consists of the core technologies and standards for implementing distributed geoprocessing, which are woven into mainstream IT as an integral part of the global information economy. [8]

The key elements of the model are defined below:

Digital Earth – A virtual model of the earth, comprised of the total set of geospatial holdings on the Net. These holdings are bound together as a coherent, consistent and universal earth model by virtue of common standards for geospatial data and geoprocessing. The Digital Earth is part of the Global Information Infrastructure.

Geospatial Components – The plug-and-play building blocks for ubiquitous geoprocessing. Multipurpose components with standardized, easily composed interfaces and well-defined behaviors.

Geospatial Agents – Active (mobile on the Net), autonomous applications that have the means to search, discover, access, interact and assimilate geo-intelligence from remote services (e.g. geospatial servers and appliances). They are comprised of one or more geospatial components.

Net-enabled Geospatial Applications – Standalone geospatial applications that access other Net-based resources, including net-source geospatial servers, data, applets, agents and appliances. They are comprised of one or more geospatial components.

Net-source Geospatial Servers – Net-enabled servers that are capable of serving subsets of their geospatial data and/or geospatial applet holdings to remote clients that are requesting service. The clients may be geospatial applications, applets, appliances or other geospatial servers. They are comprised of one or more geospatial components.

Net-source Geospatial Data – Geospatial data that are packaged and transported over the Net.

Net-source Geospatial Applets – Plug-in geoprocessing applications that can operate through a Web browser. Comprised of one or more geospatial components. Geospatial applets can be easily transported over the Net.

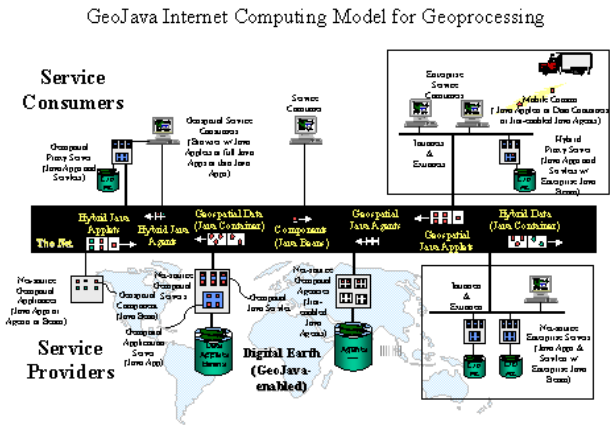
Net-source Geospatial Appliances – Spatially-enabled devices that are accessible on the Net. They are comprised of one or more geospatial components.

Geospatial-hybrids – Any applications, servers, data, applets, agents and appliances that make use of geospatial data and embedded geospatial components, but serve primarily a non-geospatial oriented purpose.

The Net – The Global Network Infrastructure that supports distributed communications and computing, including the physical network, network computers and core network services. *This infrastructure includes Java Platform and Jini; the core software technologies for enabling distributed geoprocessing.*

The "GeoJava" Internet Computing Model

This section briefly addresses how the Internet Computing Model for Geoprocessing can be implemented with Java to support ubiquitous geospatial data and geoprocessing.



The GeoJava Internet Computing Model is built upon the Global Network Infrastructure and provides an extended service infrastructure consisting of core geoprocessing services and application support services. This service infrastructure includes Java Platform and Jini, the foundation software technologies that enable distributed GeoJava applications and services.

The GeoJava Internet Computing Model supports a variety of GeoJava-based elements that can be transported over the Net, namely: geospatial data in the form of **Java Data Containers**; simple geospatial components (objects) in the form of **JavaBeans**; intelligent geospatial components in the form of **Java Agents**; geospatial applications in the form of **Java Applets**; and hybrid versions of these four types of elements, where geospatial data and software are integrated, packaged and transported with non-geospatial data and software.

Within "service consumer" environments that implement the GeoJava Internet Computing Model, service consumers can invoke GeoJava applications on local workstations, via Web browsers with **Java Applets**, or through thick-client or thin-client **Java Applications**. Local service consumers can also gain access to **Java Applications** and **Java Servlets** on local proxy servers. In more complex enterprise settings, service consumers may also invoke extended enterprise functionality over intranets and extranets. These capabilities are implemented through component-based **Enterprise JavaBeans** and through hybrid **Java Applications** and **Java Servlets**, or they may exploit mobile computing services consisting of **Java Applets**, **Java Data Containers** or **Java Agents**.

"Service provider" environments that implement the GeoJava Internet Computing Model can offer a variety of net-source GeoJava services. These include: geospatial appliances that run **Java Applications**, **Java Agents** and/or **Java Beans**; geospatial servers that run **Java Servlets** and **Java Applications**, which access and serve up geospatial and/or hybrid data (e.g. "Digital Earth"), applets or beans; and specialized geospatial agencies that serve up intelligent **Java Agents**.

In summary, the GeoJava Internet Computing Model allows any geoprocessing or hybrid application in any service consumer or service provider environment to access any net-source GeoJava servers, data, applets, agents or appliances.

Conclusion

The future holds great promise for businesses that understand how to best exploit their vast information holdings. Businesses will discover along the way that one of the keys to achieving efficient and effective operations and growth lay in building well-organized frameworks of information and the corresponding service frameworks that will develop and exploit this information. Fully optimized, these frameworks will seamlessly reach out to all vital operations nodes and service points that an enterprise depends upon, including suppliers, partners,

internal operations, distributors, and customers. And, in a foundational role, as part of the lingua franca of business, will be ubiquitous location information and services, providing the means to organize, view, relate and analyze disparate business information. By keying on location as a common property of business information, business users will discover information patterns, trends and relationships previously hidden or unknown, and they will be able to leverage these advantages in every facet of their businesses. [9]

The ancient Greeks well understood the significance of location. Proper location description and knowledge impacted trade, the process of determining the sites of centers of commerce, military action, policy-making, and so forth. Aristotle wrote his thesis on planning as a study in location theory. Planning the location of a city required detailed knowledge of topography, access, lines of communication, conveyance of agricultural goods, and so forth. A well-known student of Aristotle, Alexander the Great, took these teachings to heart. He founded over 100 cities based upon these location tenets.

These ancient wisdoms have timeless meaning and relevance. With computers, we are able to build digital models of the earth. With the Internet we are building a Web of connected information … a much richer model of our world. And at the core of the Web is location, as a foundational, unifying semantic theme. I can't foresee a new economy business that won't exploit location.

References

[1] Cellular Telecommunications Industry Association Statistics and surveys, "Wireless 9-1-1 and Distress Calls" (http://ww.wow-com.com/statsurv/e911)

[2] Urban Models Energize the Coming Era of L-Commerce by Wolfang Walcher @ Vexcel

[3] Location is Everything, Teri Robinson @ Internet Week

[4] Introduction to Location Services and Location-Based Services (Introduction, Technologies, Delivery), John Davies @ AnyWhereYouGo.com

[5] What are Location Services? – From a GIS Perspective by Ian Koeppel, ESRI Location Services Industry Manager

[6] Where's the Value in Location Services by Harry Niedzwiadek, Image Matters LLC

[7] The Global Network Infrastructure at Java Location Services

[8] Assembling a GeoJava System for the Web by John Davidson at Open GIS Consortium

[9] Java Location Services: The New Standards for Location-enabled e-Business by Harry Niedzwiadek, Image Matters LLC