E-Business
Technologies for the Future

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Overview

- The Technologies
  - Objects
  - Directories
  - Messaging
  - Global Positioning
- The Goals
  - Ubiquitous Computing
  - Mobile Computing
  - Netcentric Computing
- Component transaction monitors
  - Agents
  - Dynamic Composition

Objects

- Modern computing languages are based on objects
    - Objects allows for inheritance
    - Objects provide a level of encapsulation
    - Objects encourage code reuse
    - Objects provide a natural way to think about interfaces
- Objects consist of:
    - Private data stores
    - Public methods to access and manipulate the stores
- Objects allow for "component" design -- the Unified Modeling Language exploits this.

The Value of Objects

- Microsoft has made extensive use of objects.
    - A spreadsheet or graphic in a document is made possible by and object oriented approach
    - The Component Object Model (COM) allows this on one machine
    - Distributed COM (DCOM) is the extension of COM to networks
- For objects to be really useful, there must be some way of identifying them

URLs, URNs, and URIs

- Uniform Resource Locators (URLs) were one of the more significant developments to come out of the World Wide Web.
- A URL is simply one form of Uniform Resource Identifier (URI) and its goal is to provide a means for locating resources
- A Uniform Resource Name (URN) is another form of URI and it is meant to provide a persistent reference to a resource.
- In order to make URNs work it is necessary to have some mechanism for looking them up. These mechanisms are directories.

URN Criteria

- The functional requirements for URNs include:
  - Global scope: A URN is a name with global scope.
  - Globally unique: A URN is isomorphic to a resource.
  - Persistence: the lifetime of a URN is permanent.
  - Scalability: URNs can be assigned to any resource
  - Legacy support: Supports existing legacy naming systems – e.g. ISBN, ISO public ids, UPC, etc.
  - Extensibility: A scheme must permit future extensions.
  - Independence: The name issuing authority determines the conditions under which it will issue a name.
  - Resolution: Resolvable to corresponding URLs.

Object Identifiers

- A Digital Object Identifier (DOI) uniquely and persistently identify objects:
  - Each object is identified by a distributed ID where part one ids the authority and part two the object
  - If an object is moved, the owner simply needs to update the location value of the DOI entry.
- Because the DOI has two parts, software will know where to go to resolve a DOI
- Once DOI's are widely (universally) used, they can be built into software systems to manage enterprise wide transactions

Directories (1)

- A directory is a tool by which objects may be defined.
- There are two directory systems with which many users are familiar
  - The "registry" is a structure used by Windows operating systems to associate objects of given types with programs that act on them
  - The Domain Name System(DNS) is a distributed directory system that maps domain names (spring.sis.pitt.edu) to specific machines at specific locations
- The Common Object Request Broker Architecture (CORBA) defines Object Request Brokers (ORBs) that would provide similar functionality in a heterogeneous environment – i.e. not just Windows

Directories (2)

- As a part of its work on text messaging, the CCITT defined the X.500 Directory Service.
  - A distributed system (like DNS)
  - Capable of describing objects of any sort
- The Lightweight Directory Access Protocol (LDAP) provides a similar capability:
  - Client server design
  - Distributed authorities
  - Extensible to a variety of objects
    - Persistent identifiers
    - Authentication controls
    - Roaming Netscape preferences

Messaging (1)

- E-mail is messaging intended for human consumption
- Programs have been designed for mail notes
  - "vacation" is a program used by people to automatically handling e-mail messages while they are away
  - Bulletin boards and list servers also automate in simple ways the processing of messages
- Client server computing is based on the exchange of well defined messages between computer programs.

Messaging (2)

- The Green project (SUN) provided an architecture for messaging between internet "appliances"
  – The Java Virtual Machine (JVM) was an environment that could be placed on any device and Java could then be used to write programs for the device.
  – The Java Naming and Directory Interface provided a system independent way of locating objects
  – JINI (not an acronym) is an architecture of local network automated discovery – Plug and Play for the network

- The current schemes all build in one way or another on ad hoc federations and messaging

Messaging(3)

- For messages to be understood, they must be readable and understandable
- EDI was an early effort to define the syntax and semantics for business transactions
- XML is becoming the de facto standard for exchanging structured business messages
  – The Resource Description Framework (RDF) is being positioned as the mechanism for defining message semantics
  – The Simple Object Access Protocol (SOAP) will likely play a role in distribution
  – The Universal Description Discovery and Integration (UDDI) protocol defines the nature of the dialog

Global Positioning

- Based on initial military applications, global positioning uses a set of low earth orbit satellites to fix the position of a device on the surface
- Current commercial applications allow positioning to within 10 meters but the resolutions continue to improve
- The increase in 911 calls made from cell phones has caused the FCC to mandate that cell phone companies be able to triangulate the position of cell phones
- Ultimately, any mobile device will be capable of knowing where it is as the cost of the GPS and other positioning systems come down

The Ideas

- Using objects, directories, messaging, and global positioning, the next generation web will allow for:
  - Ubiquitous computing – all electronic devices will be capable of some level of communications
  - Mobile computing – desktop computing capability at all times and places with locational awareness and intelligence
  - Net-centric services – a rich data repository will be maintained on the network for each user
  - Component transaction monitors – a form of distributed computing based on objects

Ubiquitous computing

- The reduced cost of chip technologies will enable almost all electronic devices to do some level of I/O, processing, communication, and actuation
  - Devices will be able to sense
    - Video cameras, microphones, and motion sensors
  - Devices will have programmable logic circuits
  - Devices will be able to sense other devices near them
  - Devices will be capable of acting in the real world
    - Speech synthesis
    - Micro and macro actuators

Examples of Ubiquitous Computing

- Current
  - Motion detectors in lights and doors
  - Smart microwaves, phones, cars, etc.
- Near Term
  - Smart kitchen and bathroom appliances and fixtures
  - Smart houses for heating, AC, lighting
- Long Term
  - Smart rooms will know what is being discussed
  - Smart cars will know where they are, and are going
  - Smart buildings will learn usage patterns

Mobile Computing

- Mobile computing is based on two converging technologies
    - Handheld devices with significant processing power
    - Cell phones with on demand connectivity
- At the current time, they operate very differently:
    - PDAs rely on periodic linking for update
    - Cell phones rely on modified content on demand
- The future will see everywhere connected devices with significant processing power

Net-centric Computing

- Next generation mobile computing enables net-centric computing
- Wireless access in broad geographic regions is provided either by wireless access protocols such as 802.11 or by 3rd generation phone technology
    - Local connectivity is provided by 802.15 or Bluetooth
    - Rich directory services that contain information pertinent to the user of the mobile device is provided by directory services (LDAP)
    - Data is provided through a ubiquitous standard for data interchange such as XML
    - Devices are made smarter by sensors that locate them and describe their environment

Component Transaction Monitors

- The web provides access to pages of information.
    - Through CGI back ends, these servers are increasingly providing services.
    - Plug-ins on the client side are increasingly capable of data manipulation and logic.
- The web is increasingly being used as a shell through which programs on both the client side and the server side communicate.
- The next generation web will need a system to optimize this activity. It is called a Component Transaction Monitor

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Component Transaction Monitors

- Major vendors are providing new approaches:
    - OMG's CORBA
    - HP's E'speak
    - Microsoft's .NET
    - SUN's JXTA
- Each of these technologies provides a variety of built in services:
    - Service finding through naming
    - Security features like authentication and encryption
    - Transaction management

CTM Applications

- Using CTMs, it is possible to imagine a semantic web of the future where
  - Services are dynamically located
  - Aggregate services are dynamically composed
  - Agents manipulate information stores on the network on behalf of users
  - Filters operate on information to prepare it for destination devices and users
  - Relationships between different data stores are understood and data is translated transparently