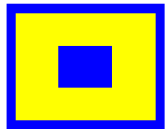


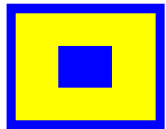
Application Service Provider Model: Perspectives and Challenges

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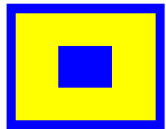
Contents

- ◆ ASP as service-based computing model
- ◆ Advantages of ASP computing
- ◆ ASP challenges
- ◆ ASP supporting technologies
- ◆ ASP challenges
- ◆ ASP as first step towards network-centric computing and networked economy



Two Industry Commercial Models

- ◆ An ***application*** consumes ***resources*** to provide ***services***
- ◆ The end-users only care about services
- ◆ Two major commercial models:
 - Service-based
 - Resource/application based

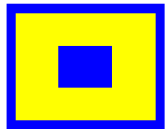


Two Industry Commercial Models ...

- ◆ Service-based industries use comprehensive resource/service delivery network and application hosting; no expertise is needed from end-users
- ◆ Resource/application based model sells resources (generators) and applications, and end-users need expertise to turn resources and applications to services

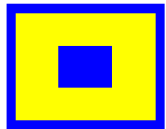
Resource/Application Based Model

- ◆ Computer industry mainly sell
 - hardware: resource generator
 - software licenses
- ◆ Users need to
 - maintain infrastructure
 - install and maintain applications
- ◆ The model lacks
 - resource sharing
 - expertise pooling



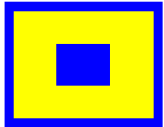
Service Based Model

- ◆ The model is based on standardization
- ◆ End-users don't need expertise in turning resources to services
- ◆ Telecommunications sell resources and services
 - Network bandwidth
 - Value-added services
 - Caller-ID, directory service, ...
- ◆ Utility industries mainly sell resources



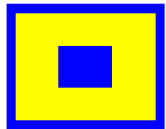
Service Based Model ...

- ◆ The model enjoys
 - Resource sharing
 - Amortization of infrastructure cost
 - Expertise pooling
 - Value-added services
 - Service quality control
 - Rich cost models
 - Standardization of resources and main services



Internet Enables Service-Based Computing Industry

- ◆ Internet is becoming global service delivery network
- ◆ Web browsers become universal GUI
- ◆ Internet makes global distributed system integration possible
- ◆ Component technologies become key to control the complexities of distributed applications

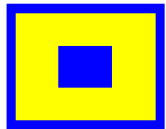


Application Service Provider Model

- ◆ Most ISPs have become application service providers
- ◆ E-Commerce web sites are also examples of ASP
- ◆ ASP is based on
 - Application hosting
 - Thin client and component technologies
 - Comprehensive service/data delivery network

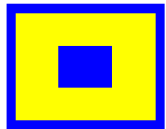
ASP Model ...

- ◆ ASP represents the beginning of commercially delivering computing as services
- ◆ The ASP market is projected to grow rapidly over the next 3-5 years, from a very small base to over \$20 billion in 2003, yielding a compound annual growth in excess of 80%
- ◆ ASP is still young, it needs significant breakthroughs in
 - network infrastructure
 - Computing technologies
 - Rental-based cost models and financial services



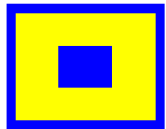
Benefits of ASP

- ◆ To service providers
 - No distribution costs
 - No user installation
 - Fewer illicit copying
 - Instant upgrades
 - Consistent user base
 - Usage monitoring
 - Potential constant revenue stream



Benefits of ASP ...

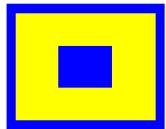
- ◆ To users
 - Limitless choices
 - No installation hassle
 - No compatibility issues
 - No support overhead
 - Reduced downtime



Benefits of ASP ... Benefits of ASP

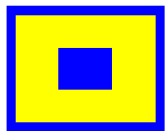
◆ To investors

- A high percentage of predictable, recurring revenue through competitive ASP operations
- Leverage generated from a one-to-many solution model
- Ability to sell high-margin, value-added services into the customer base



Major Difficulties of ASP

- ◆ Difficulty in securing client data
- ◆ Limited performance due to limited bandwidth of the Internet
- ◆ Lack of standardization of services

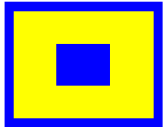


ASP Supporting Technologies

- ◆ ASP generalizes distributed computing to distributed system integration
- ◆ ASP enabling technologies turn existing client/server applications to ASP ones with minimal investment and inferior performance
 - Windows 2000 Terminal Services (WTS)
 - Citrix
- ◆ Component technologies are main tools to control complexities of ASP applications

Objects vs Components

- ◆ Object reuse based on inheritance implies the availability of application module source code
- ◆ Object reuse implies language dependency
- ◆ Most companies don't like to release source code
- ◆ A component is a binary module supporting a set a special properties for binary system integration

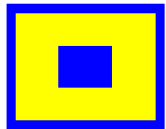


A Reference Model for Distributed Components

- ◆ Binary code integration
- ◆ Universal reference
- ◆ Network interoperability
- ◆ Introspection
- ◆ Customizability
- ◆ Toolability

Component Support System

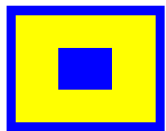
- ◆ Naming
- ◆ Trading
- ◆ Life cycle
- ◆ Persistence
- ◆ Event
- ◆ Transaction
- ◆



Major Component Technologies

◆ CORBA

- Supported by industry consortium OMG representing over 800 companies
- Supports heterogeneous platforms
- Supports all of our component properties except customizability and toolability
- All Netscape web browsers have a built-in ORB support
- Easy to support legacy code
- Significant progress in service standardization
- Ultimate goal is distributed system integration



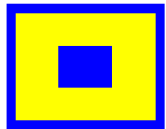
Major Component Technologies ...

- ◆ Enterprise JavaBean (EJB)
 - Non-visual Java components running on servers
 - Supports most properties of our ref. Model
 - Only supports Java component integration
 - CORBA has become implementation technique of EJB RMI. EJB provides Java with friendlier user interface
 - Integration with CORBA makes EJB interoperable with components implemented in various languages on various platforms

Major Component Technologies ...

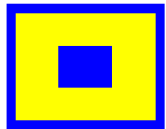
◆ Microsoft DNA

- Based on proprietary technology COM+ instead of open standard
- COM+ = COM/DCOM + MTS
- Based on mature technologies for Windows applications
- Close integration with Windows applications and IDEs
- Mainly for Windows platform only
- Limited scalability



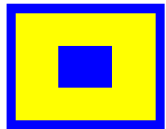
ASP Challenges

- ◆ Scalability of ASP servers
 - Huge number of concurrent connections with states, unpredictable server workload
 - Existing solutions
 - RAID disk array
 - Server clusters
 - Extensive caching
 - Non-preemptive scheduling
 - Our strategy
 - Formalism of scalability
 - Preemptive scheduling
 - State data management



ASP Challenges ...

- ◆ Internet infrastructure
 - Replace 32-bit IP addresses (IPv4) with 128-bit IP addresses (IPv6)
 - With bandwidth 10^{12} b/s for optical fiber, communication delay is determined by router delays
 - Electromechanical based mirror routing
 - Wormhole routing



ASP Challenges ...

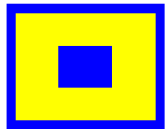
◆ Micropayment

- Credit card is not practical for very small or very large transactions
- Current approaches under investigation include electronic money, virtual money, digital money, and smart cards
- To support distributed system integration, standards are needed to collect usage statistics, thus support microaccounting

ASP Challenges ...

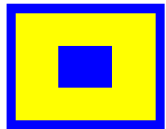
◆ Security

- Current solutions
 - virtual private network (VPN)
 - Encryption
 - Server firewalls
- Main difficulty is with careless or malicious acts of server center employees
- Keep sensitive data on client site



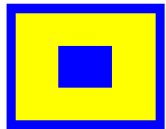
ASP Challenges ...

- ◆ Dynamic configuration
 - Multiple clients may need different application configurations
 - Neither conventional client/server applications nor next-generation e-commerce application architectures currently support dynamic configuration



ASP in Perspectives

- ◆ Breaking ASP monopolies
 - Public standardization of data formats of major applications
 - Public standardization of user interfaces of major applications
 - OMG has provided successful examples



ASP in Perspectives ...

- ◆ Network-centric computing
 - Essence of distributed computing is to use networks to promote cooperative computing and specialized computing
 - Internet is becoming new platform of global computing characterized by
 - Component-based finer granularity
 - Global cooperation and specialization
 - Multimedia data
 - Binary integration
 - Mobil computing
 - Omnipresence in electrical/electronic devices
 - Networked economy characterized by integration of services