



IBM Software Group

# Information Integration

Underpinning On Demand Computing

**DB2** Information Management Software

**Nelson Mattos**  
Distinguished Engineer and Director, Information Integration

@business on demand software

# Agenda

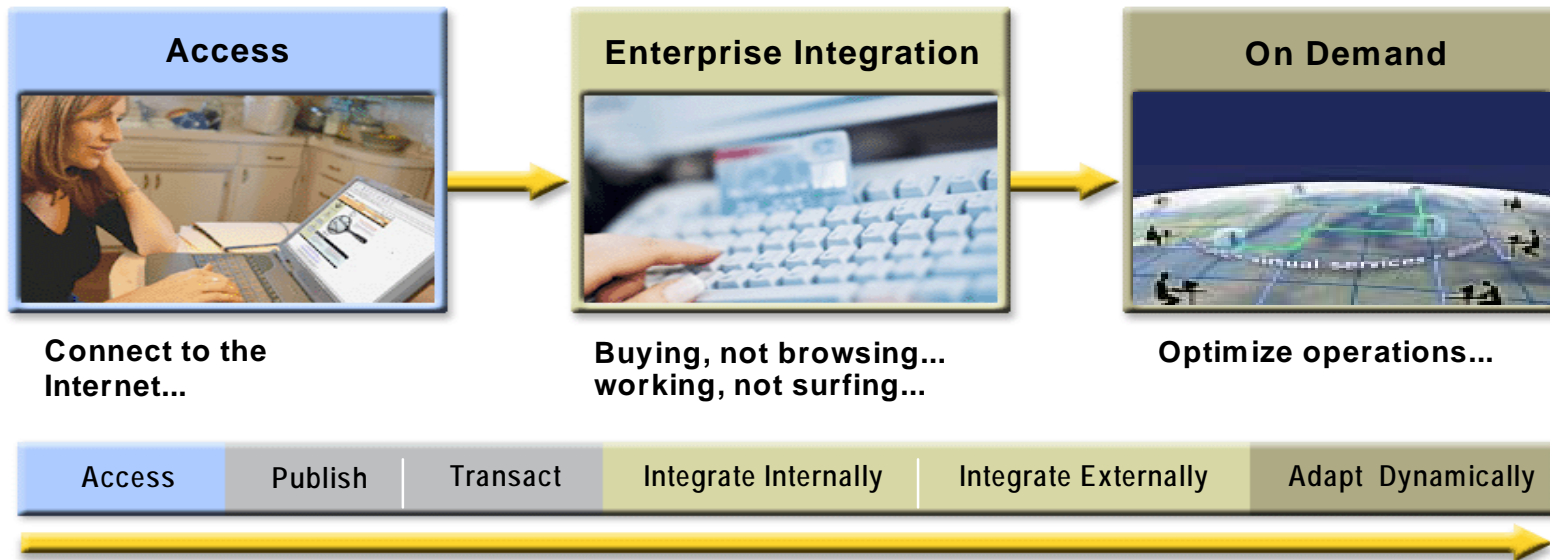
## It's here now

The next generation of  
data integration software

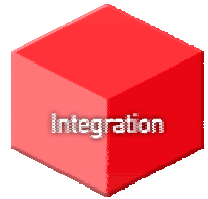


- On Demand Computing
- DB2 Information Integrator 8.1 Overview
- Scenarios and Customers
- Market Response and Momentum
- Summary

# Stages of e-business Adoption



*An on demand business is an enterprise whose business processes – **integrated end-to-end across the company and with key partners, suppliers and customers** – can respond with speed to any customer demand, market opportunity or external threat.*

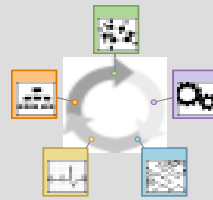


# Defining Business Integration

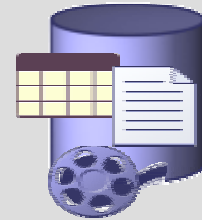
The efficient and flexible combination of resources to optimize operations across and beyond the enterprise



People



Processes



Information

Portal – personalized information  
 Collaboration technology  
 Adaptable workplace  
 Consistent rule-based experience across devices

Workflow management  
 B2B connectivity  
 Messaging infrastructure (EAI)  
 e-Business transactions  
 Service-oriented architecture

Federation & data placement (replication, ETL, caching)  
 XML (store, query, webservice)  
 Meta-data management  
 Text Search and analytics

Can I create business value from my existing IT systems?



**People, Process, Information**

Can users react in real-time to the most recent information?



**People, Information**

Are business operations fully integrated for optimal efficiency?



**Process, Information**



# Data Challenges

## *Variety, Velocity, and Volume*

- New composite applications need data from multiple sources
  - ▶ Consumers expect holistic, personalized, and value-added content
  - ▶ Relational, XML, packaged applications, content repositories, file systems all contain critical business information
- Increasing emphasis on current data
  - ▶ Real-time analytics
  - ▶ Business activity monitoring
- Petabytes will be the measure of available online data
  - ▶ All client interactions are important ( e.g., instant messages, audio records, web traffic,...)
  - ▶ Internet and intranet content

*The world produces  
250MB of  
information every  
year for every man,  
woman and child  
on earth.*

*85% of  
digitized  
information  
unstructured.*



# What is Enterprise Information Integration?

**Enterprise Information Integration refers to a category of middleware which lets applications access diverse and distributed data as if it were a single source, whether or not it is.**

It enables the integration of structured and unstructured data

- ▶ to provide real-time read and write access,
- ▶ to transform data for business analysis and data interchange, and
- ▶ to manage data placement for performance, currency, and availability.



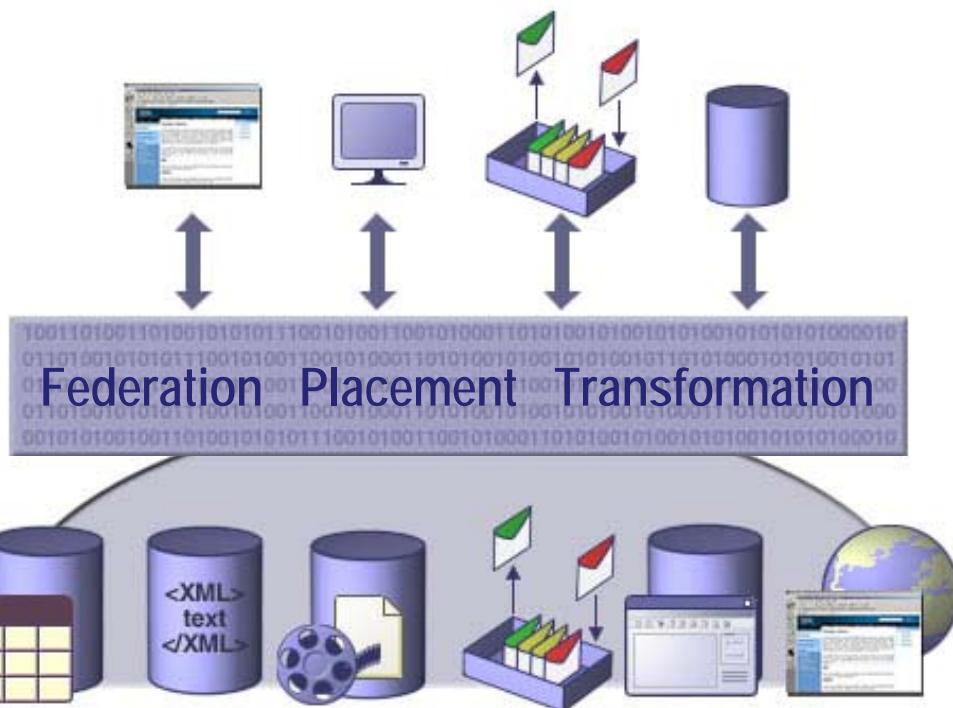
# Complementary Information Integration Approaches

- Consolidate data for local access
  - ▶ Access performance or availability requirements demand centralized data.
  - ▶ Currency requirements demand point-in-time consistency, e.g. close of business
  - ▶ Complex transformation is required to achieve semantically consistent data
  - ▶ Production applications, data warehouses, operational data stores
  - ▶ Typically managed by ETL (Extract, Transform, and Load) or replication technologies
  
- Integrated access to distributed sources
  - ▶ Access performance and load on source systems can be traded for overall lower cost implementation
  - ▶ Currency requirements demand a fresh copy of the data
  - ▶ Data security, licensing restrictions, or industry regulations restrict data movement
  - ▶ Combining mixed format data, e.g. customer ODS with related contract documents or images
  - ▶ Query requires real-time data, e.g. stock quote, on-hand inventory
  - ▶ Represents an emerging category of technology – Enterprise Information Integration (EII)
  
- Major Benefits come when both approaches are combined



# EII Components

*Integrating diverse business information  
across and beyond the enterprise*



- Data federation
  - ▶ Standard programming models
    - SQL, XQuery, Search
  - ▶ Read/write access across diverse data and content sources
  - ▶ Extensible access
  
- Data placement
  - ▶ Caching and replication over heterogeneous information
  
- Data transformation
  - ▶ Leveraging SQL and XML standards
  - ▶ Advanced search and mining
  - ▶ Metadata management and interchange



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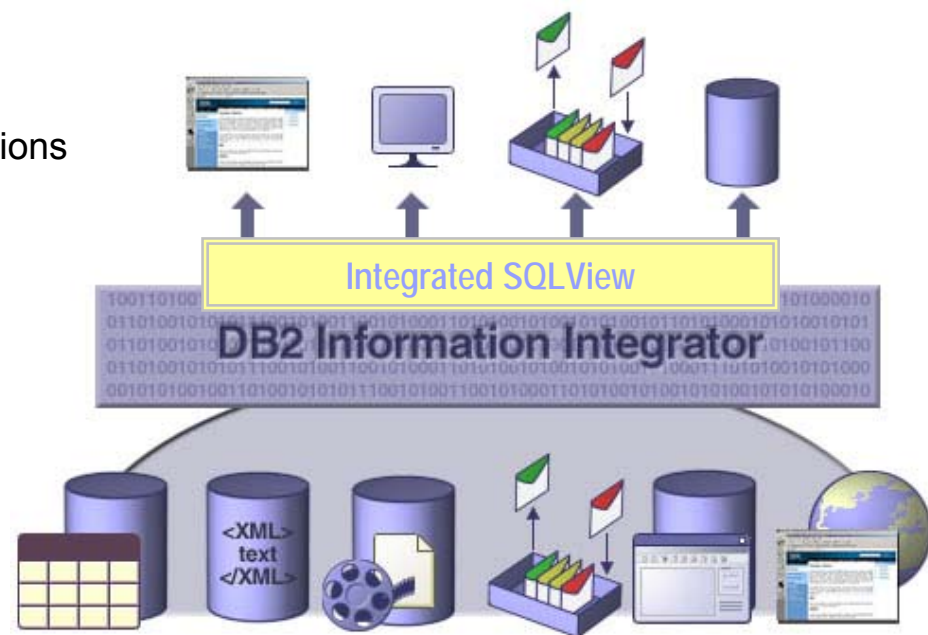


- On Demand Computing
- *DB2 Information Integrator 8.1 Overview*
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# DB2 Information Integrator 8.1

## *A Federated Data Server – Query distributed data as if it were a single source*

- Define integrated view across diverse and distributed data
  - ▶ Wide range of data and content sources
  - ▶ Extensible to virtually any data source
- Query as if a single source
  - ▶ Use standard SQL query and SQL expressions
  - ▶ Include text semantics in the search
  - ▶ Surface specialized functions into SQL
  - ▶ Leverage query optimization and caching
- Compose XML documents
  - ▶ Combine diverse sources
  - ▶ Validate against DTDs or schema
- Publish results to a message queue
  - ▶ Familiar DB programming model
- Single source, relational updates

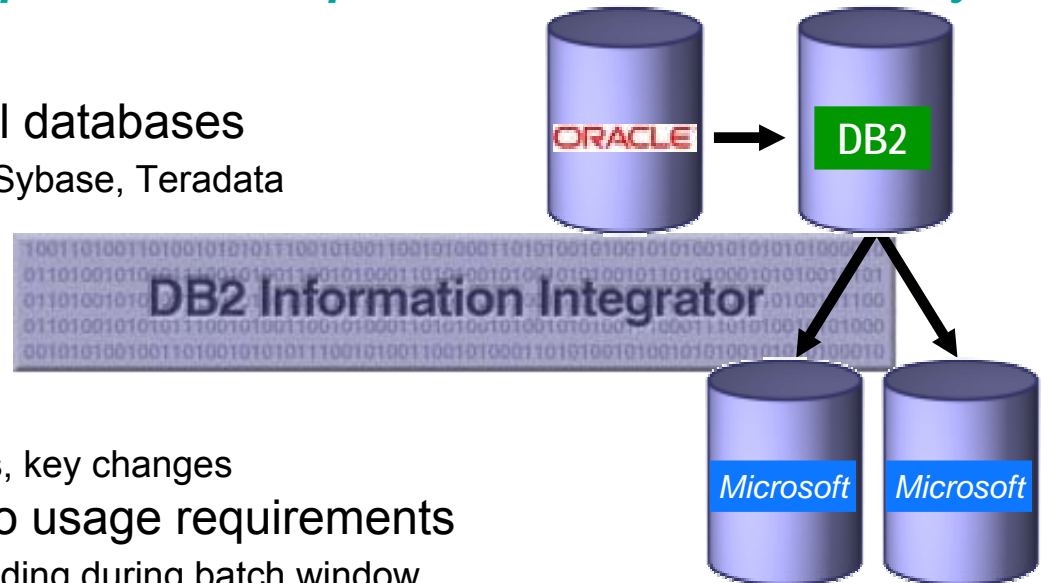


DB2, Informix, Oracle, SQL Server, Sybase, Teradata, OLE DB, ODBC, Excel, XML, message queues, Web services, flat files, document repositories, content repositories, LDAP directories, WWW, email databases, and more.

# DB2 Information Integrator 8.1

## *A Replication Server – Manage placement for performance and availability*

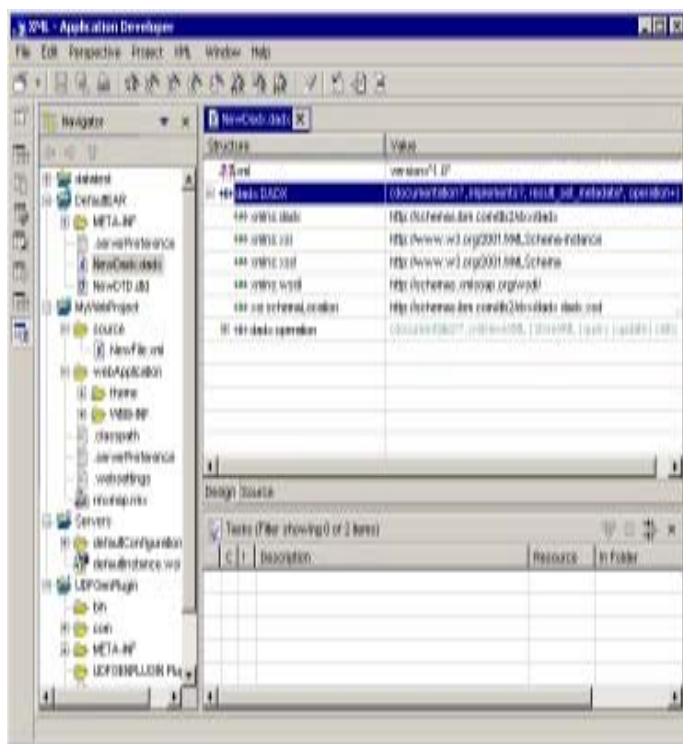
- Distribute data among relational databases
  - ▶ DB2, Informix, Microsoft, Oracle, Sybase, Teradata
- Support flexible topologies
  - ▶ Distribution: One to many
  - ▶ Consolidation: Many to one
  - ▶ Column and row subsetting
  - ▶ Multiple flavors, e.g. history tables, key changes
- Match data movement modes to usage requirements
  - ▶ Table-at-a-time for warehouse loading during batch window
  - ▶ Transaction-consistent for online data
- Choose latency characteristics
  - ▶ Scheduled, interval-based, event-driven, continuous
- Apply transformations in-line
  - ▶ Standard SQL expressions or stored procedure execution.



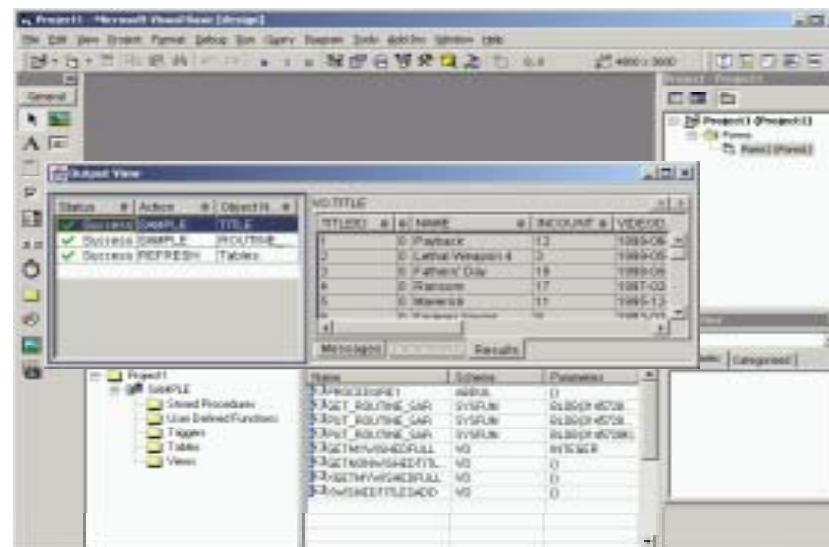
# Enable Application Development

*Developer productivity for both worlds: Java and .NET*

WebSphere Studio



Microsoft Visual Studio



- Reduce hand coding 40%-65%
- Maintain performance

# IBM In House Experiment

- Understand trade-offs of building Web components spanning multiple data sources
  - ▶ Build servlets, session EJBs, CMP entity EJBs
    - With DB2 Information Integrator for data access
    - With hand-coded direct data access
- Application scenario
  - ▶ Corporate merger of multiple distributors
  - ▶ Access to 2 RDBMSs (DB2, Oracle), 1 non-RDBMS (Excel)
  - ▶ Multiple queries (some derived from TPC-W, TPC-H)
    - Catalog search
    - Post-merger analysis
- **DB2 II simplified server-side Java development**
  - ▶ **Reduced coding efforts by 40 - 65%**
  - ▶ **Reduced skills requirement**
    - **No need to manually decompose queries**
    - **No need to manage multiple connections**
    - **No need to worry about different APIs, data types**
  - ▶ **Maintained reasonable performance**



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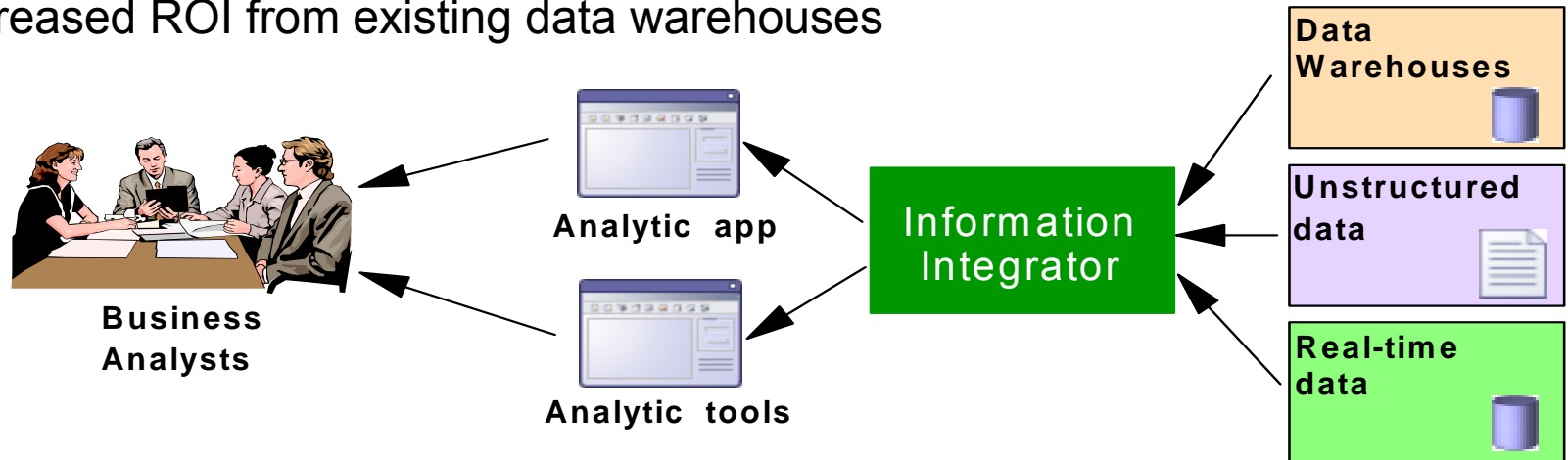
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# Beta Program Summary

- Customers
  - ▶ 80+ customers and 40+ partners in 21 countries WW
  - ▶ Industries – financial services, manufacturing, insurance, retail, life sciences health care, telecommunications, education, transportation, government
- Scenarios
  - ▶ Extending the warehouse
  - ▶ Operational reporting
  - ▶ Help desk support
  - ▶ Database migration
  - ▶ Inventory management
  - ▶ Pharmaceutical research and collaboration
- Value
  - ▶ Innovative discovery
  - ▶ Cost savings vs maintaining redundant data
  - ▶ Simple and fast application development
  - ▶ Extend tool access to additional sources

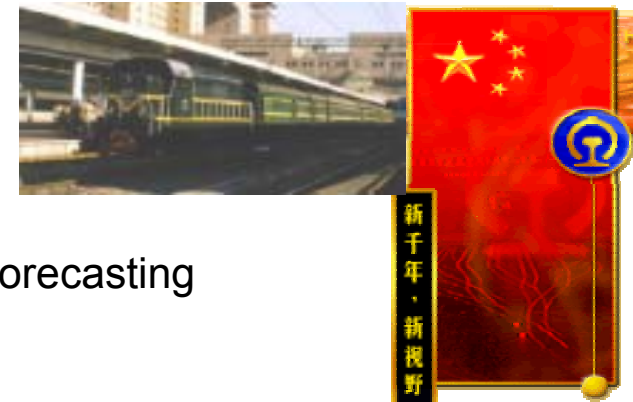
# Extending the Data Warehouse

- Better decisions from more comprehensive and more up to date information
- More responsive to business needs
- Increased ROI from existing data warehouses



## Ministry of Railways (China)

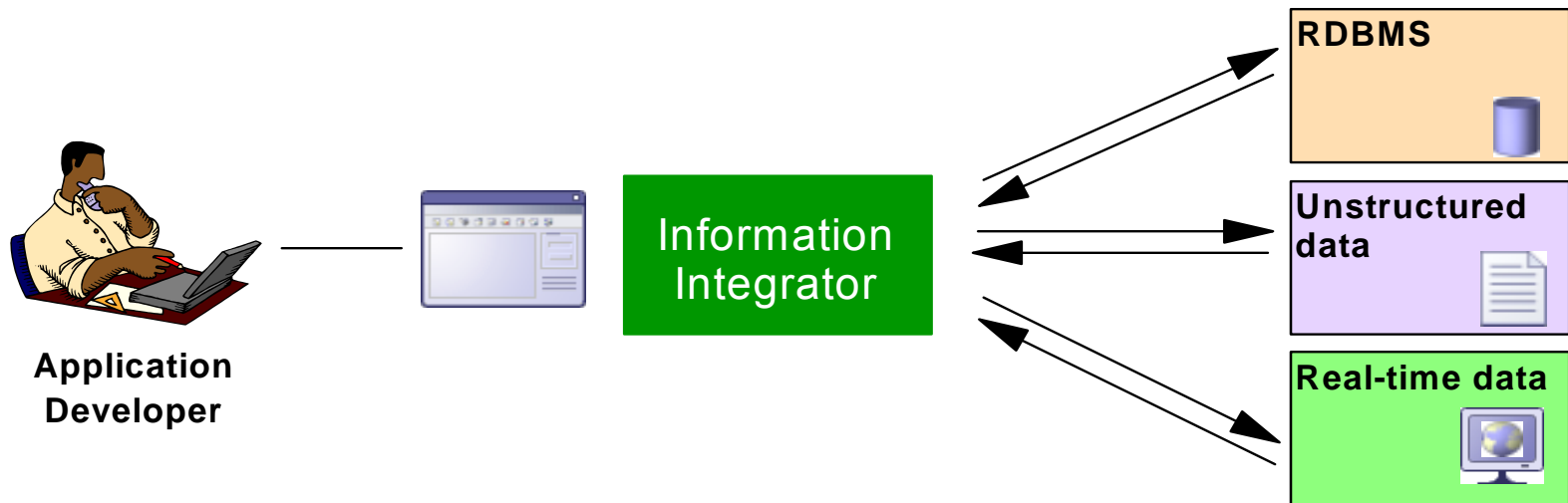
- Improve the quality of railway transportation management
- Respond more quickly to market demand by improving freight forecasting
- Optimize carrying resource assignment





# Speeding Application (or Reporting) Deployment

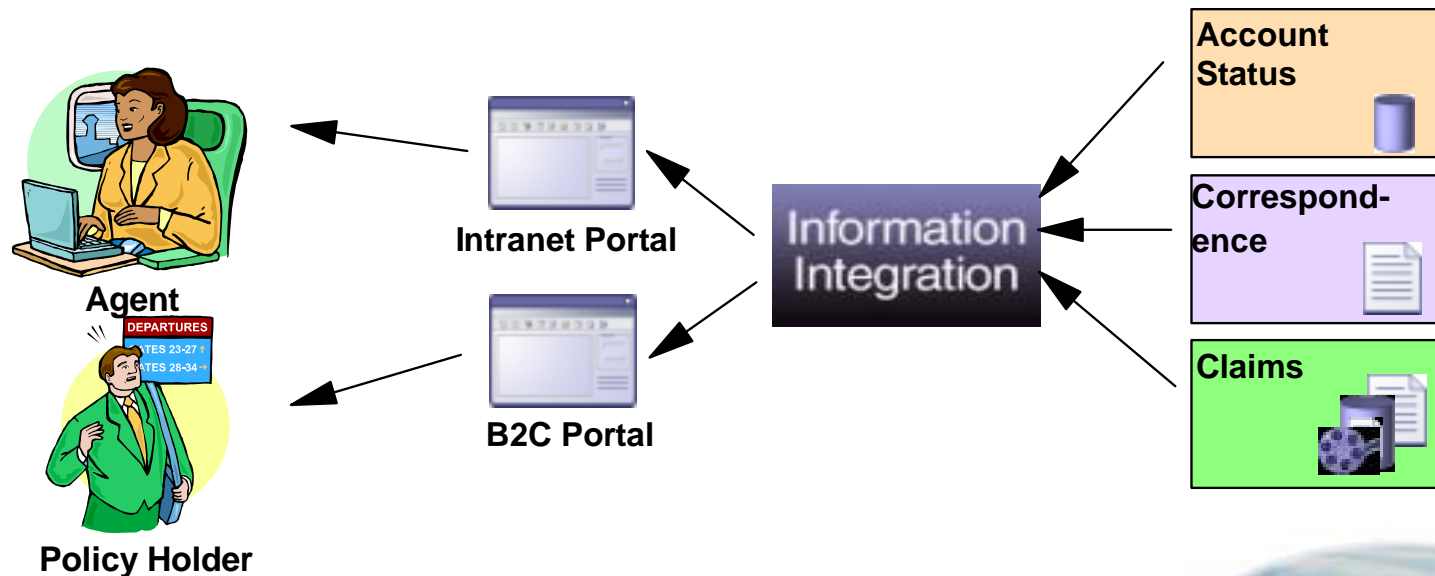
- Integrate data with higher developer productivity and improved application efficiency
- Give applications access to all the relevant data sources
- Reduce application maintenance costs
- Deploy existing skills over wider ranging integration projects



- Provides transparent, globally optimized access to heterogeneous, distributed data.
- Accesses the distributed data as if it were a single database.
- Response time improvement of up to 98% seen in house.

# Call Center

- Improved response times through single query access to all customer records
- More accurate delivery of customer information -- complete profile
- Extended access directly to customers for self-service via the web



- Broke its all-time record for new business
- Boosted premiums at each agency by an average of 35 percent.
- Process 98% of new applications in 24 hours, vs. 60 days for competition

# Merger and Acquisition

- Gain complete cross-fund portfolio view by customer
- Incorporate content of analysts' stock reports and syndicated information into a single view
- Information platform with unified access to comprehensive account and securities information

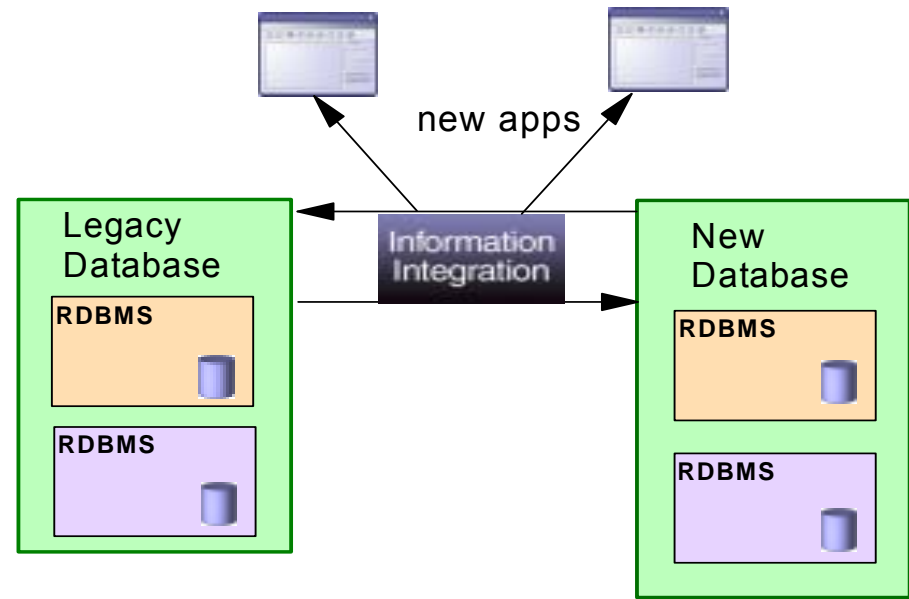


- Improve customer services without extensive changes to their existing infrastructure.
- Simplify asset management and comparison between target/actual inventory.



# Database Migration

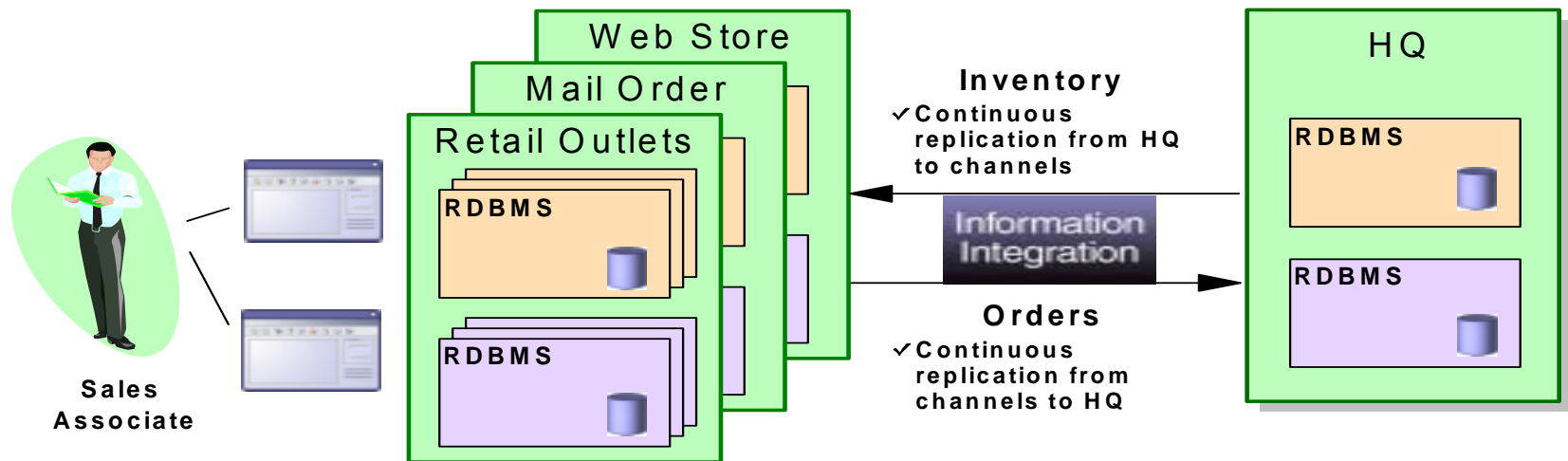
- Reduced migration cost by managing data placement without impacting applications
- Immediate data availability to new applications throughout the migration process
- Managed replication environment



- Provided transparent access to Sybase and DB2 databases for migrating applications using DB2 Information Integrator
- Enable incremental application migration
- Works seamlessly with established PowerBuilder tools
- Anticipated strategic value in accessing heterogeneous data environment

# Multi-channel Retailing

- Early detection and prevention of out of stock and overstock situations
- Increase revenue through sales and inventory allocations optimized across channels
- Managed replication environment

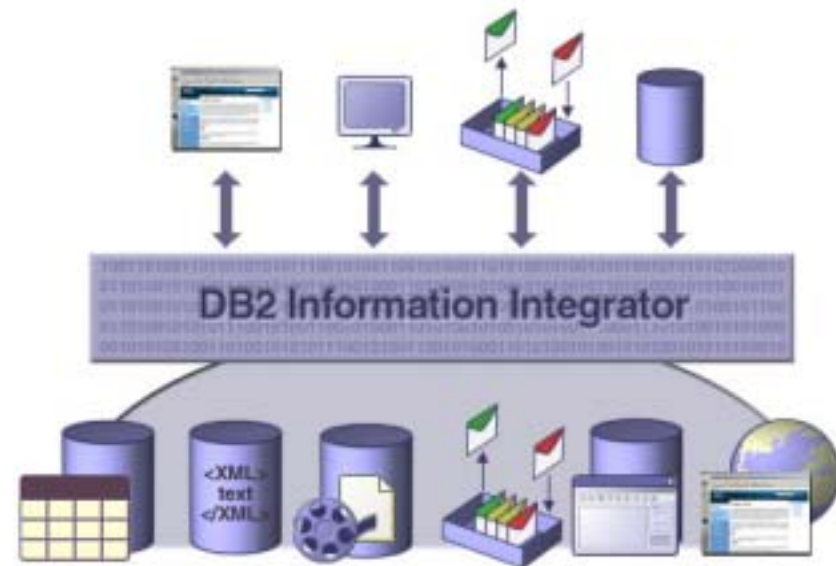


- Near-real-time inventory data to sales personnel on showroom floor and continuous product and sales information for remote order-entry and management information system
- Projected sales increase of over \$9M
- Improved order accuracy and customer satisfaction
- Reduced order processing costs and delays

**s.Oliver<sup>®</sup>**

# Home Land Security Scenario – US Gov. Agency

- Environment
  - ▶ Oracle - suspect and witness database
  - ▶ Sybase - phone tap database
  - ▶ Tamino - agents database
  - ▶ Documentum - case files
  - ▶ Filenet - mugshots, crime scenes, fingerprints
  - ▶ DB2 CM - field incident reports
- DB2 Information Integrator provides real-time search across all sources:
  - ▶ tip with a phone number for a certain case
    - join across data sources to do discovery
    - result is analyzed and content is then studied
- Applications
  - ▶ public crime stoppers website
  - ▶ prosecution support system
  - ▶ investigation support system
  - ▶ reporting system



# Federated Scenarios



## Chinese Ministry of Railways



- Business Intelligence
  - ▶ Extend reporting with real-time data, unstructured content, or cross-warehouse views
- Research and Development
  - ▶ Complex query over diverse and distributed data
- Business Activity Management
  - ▶ Access and integrate KPIs, planned targets, historical trends, and current values
- Asset Management
  - ▶ Develop a consolidated view of asset information and inventory control systems which were fragmented across various structured and unstructured data sources.

# Federated Scenarios



## ITERGO



- Portal Development
  - ▶ Access and integrated diverse sources for Web deployment
  
- Customer Data Integration
  - ▶ Integrate customer operational data stores or registries with related detail
  
- Mergers and Acquisitions
  - ▶ Create integrated views across business units
  
- Migrations
  - ▶ Create single system view for migrating applications





# Replication scenarios

- Data Consistency

- ▶ Auto dealer replicates DB2 UDB based sales and inventory information to dealer portal database on Microsoft SQL server
- ▶ Airline company replicates DB2 UDB based flight schedules to Sybase server



- Distribution / Consolidation

- ▶ Clothing manufacturer replicates order detail from DB2 UDB data to Oracle distribution warehouses and fulfillment detail from Oracle back to DB2 UDB
- ▶ Retailer consolidates Informix store data to corporate DB2 UDB headquarters ODS

- Warehouse Maintenance

- ▶ Retailer replicates POS transaction detail from DB2 UDB to Teradata warehouse
- ▶ Licensing agency replicates POS transaction detail from DB2 UDB to DB2, Oracle, or Microsoft SQL Server reporting databases



# Value to Clients

- **Extend current investments**
  - ▶ Work within your existing infrastructure
  - ▶ Consolidate data or access distributed data as if it were a single data source
  - ▶ Combine existing data and content assets in new ways
  - ▶ Use familiar SQL programming model and existing tools
  - ▶ Build on a standards-based, strategic integration platform
- **Speed time to value for composite applications**
  - ▶ Reduce hand-coding 40%-65%
  - ▶ Reduce skill requirements
  - ▶ Reduce development time by half
- **Control costs**
  - ▶ Reduce payroll costs
  - ▶ Reduce need to rip and replace
  - ▶ Reduce need to manage redundant data
- **Innovative Discovery**
  - ▶ Correlate and analyze data in new ways
  - ▶ Improved reporting and business analysis
  - ▶ Real-time



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# Business Press Placements



## IBM to Unveil New Database Software

May 19, 2003

The product, DB2 Information Integrator, is designed to make it easy to get various types of information without doing separate searches of many different computer systems.

## IBM to Start Selling New Data-Searching Software Tomorrow

May 19, 2003

The Bloomberg.com logo, with "Bloomberg.com" in a bold, orange, sans-serif font on a dark grey background.

Bloomberg - Information Integrator will "step up competition with rivals such as Oracle." Kaufman Brothers said "it is a significant advantage for IBM."

## IBM Shipping New, Data - Tapping Software

May 20, 2003



...the software makes it possible for a user to make a single query to get information from Oracle Corp. (ORCL.O) or IBM databases, images from Documentum Inc. (DCTM.O) applications, e-mail from Lotus Notes, or spreadsheets from Microsoft Corp.'s (MSFT.O) Excel.

# Industry Analyst Endorsement

- Redmonk

- ▶ James Governor, an analyst at RedMonk, calls **federated data management a "crucial technology"....** "Offering the ability to pull together far flung information in a centralized location and at manageable expense, this approach will become **a no-brainer for those in need of real-time access to real-time data,**" he said.

Dow Jones International News, May 21, 2003

THE BOTTOM LINE: Software Heralds The Utd States Of Data

- Aberdeen

- ▶ **IBM differentiates its EII offering especially by its open standards support, its scalability and performance, its range of data sources supported, and its "deployability"** due to IBM's services strength.

Wayne Kernochen, May 21, 2003

DB2 Information Integrator: Scope, Power, Services



# Industry Analyst Endorsement ...

- Bloor Research

- ▶ Microsoft notionally embraces the concept but it has done little to implement it, while Oracle's approach runs directly counter to federalism, with the company espousing consolidation (centralization) instead. Thus IBM has to market federation on its own. That shouldn't stop it: **the idea nicely aligns with its On-Demand Computing concept and it will make sense to a lot of users (as well as me).**

Phil Howard, May 21, 2003

IT-Director.com: Information Integrator Goes Live

- Gartner Group

- ▶ Ted Friedman, a principal analyst at Gartner, agrees. **"The potential impact of this technology could be very large, especially given the size of the vendors involved,"** he said....Friedman said the federated approach will be most relevant where there are a limited number of data sources, few users and when real-time data are needed.

Dow Jones International News, May 21, 2003

THE BOTTOM LINE: Software Heralds The Utd States Of Data

# Industry Analyst Endorsement ...

- Robert Francis Group

- ▶ RFG believes IT executives who apply EII technologies effectively and appropriately will gain a new ability to **produce substantive results more quickly, with lower costs and less training and difficulty than required by alternate approaches.**

Evan Bauer, June 17, 2003

Enterprise Information Integration – An Idea Whose Time May Have Finally Come  
(Part 1)

- Meta Group

- ▶ With DB2 Information Integrator, **IBM is currently leading the RDBMS vendor race in integration of information across structured, unstructured, and heterogeneous data sources.**

Aaron Zornes, July 17, 2003

Master Data Management: A Model for Choosing Among Overlapping Middleware  
(EAI vs. ETL vs. EII)



# World-Class Partner Ecosystem

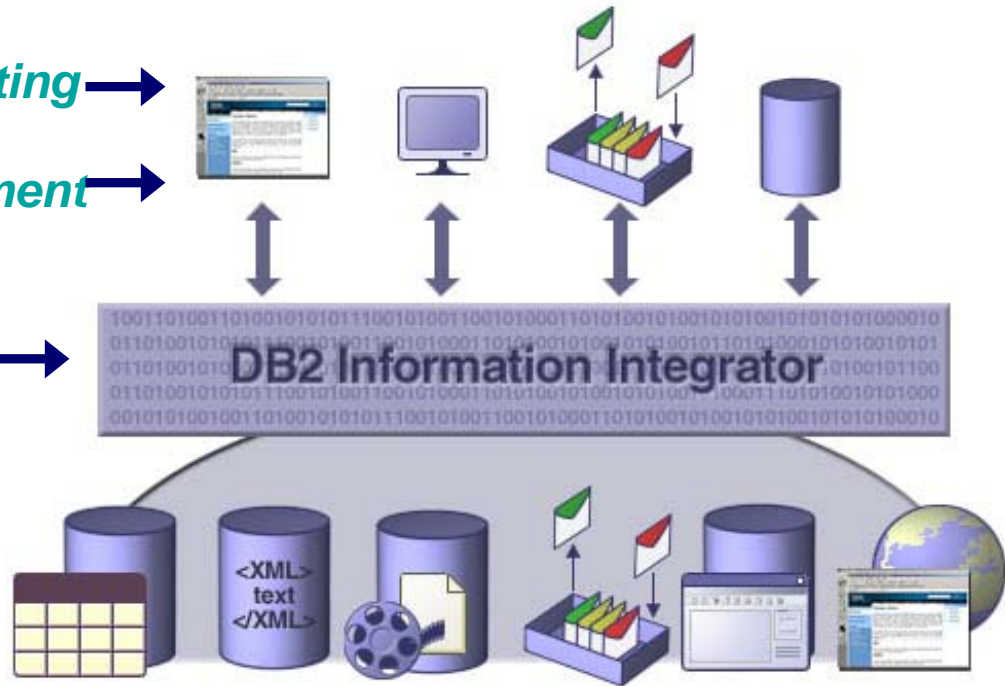
*Enhance analysis and reporting* →

*Enable application development* →

*Enrich function* →

*Extend reach* →

*Expedite deployment* ←→





# World-Class Partner Ecosystem

*“..exceptionally fast and efficient federated querying”*

*“..completely transparent..”*

*“..opens new opportunities..”*

*“..allows users access to important data that was often forgotten or used infrequently..”*

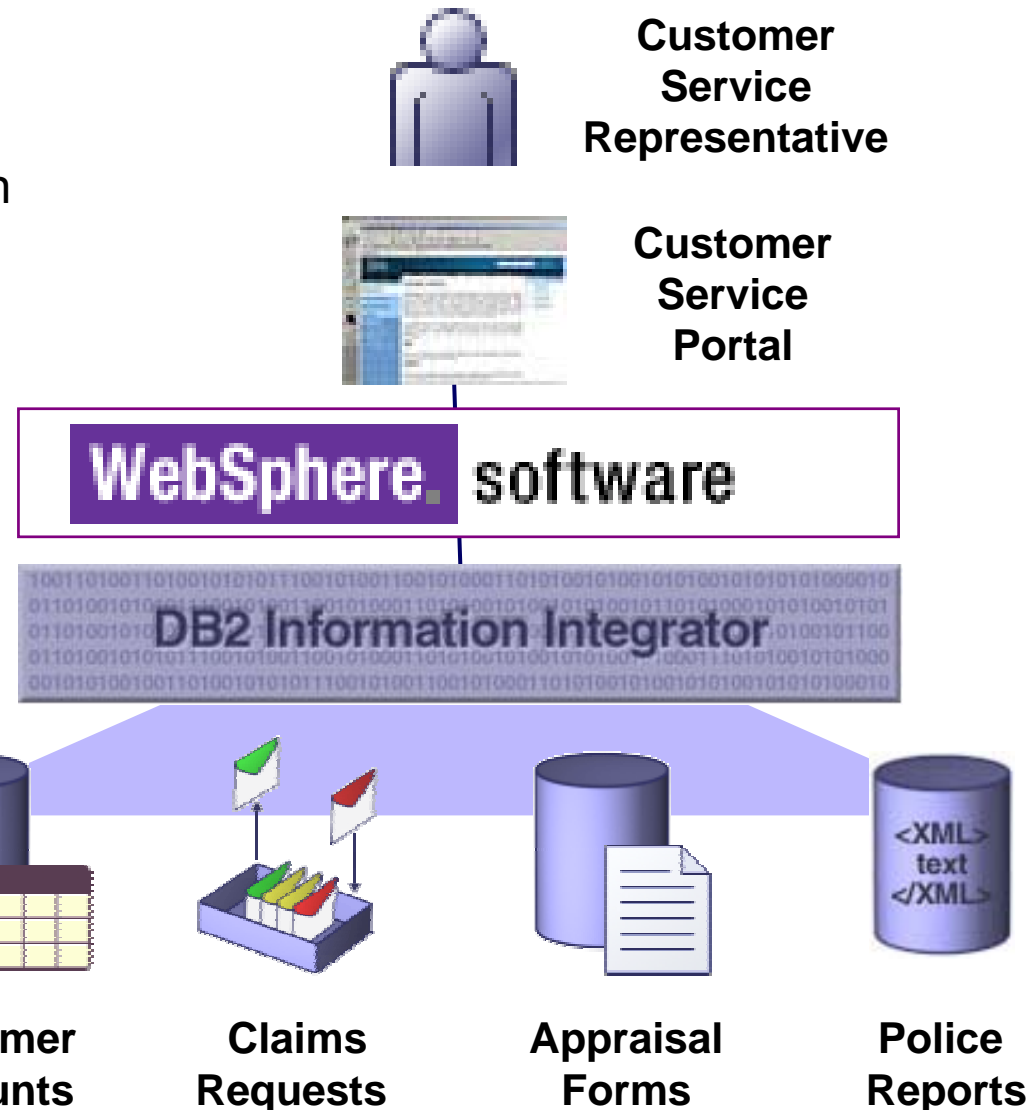
*“..providing integrated on-demand analysis and execution..”*

*“..an open, extensible, and consistent information integration framework..”*



# Portal Deployment for Insurance

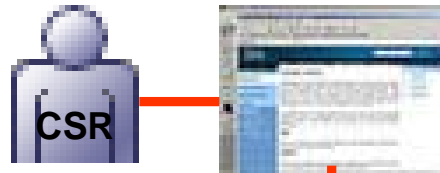
- Give service personnel integrated access to relevant claims information
  - ▶ Find claims with no incident report
  - ▶ Find policy information from name
  - ▶ Find customer record plus related claims and incident reports
  - ▶ Retrieve full claims documents
  - ▶ Open new claims
- Explore integration of WebSphere and DB2 Information Integrator



# Integration with WebSphere for Insurance Claim Processing

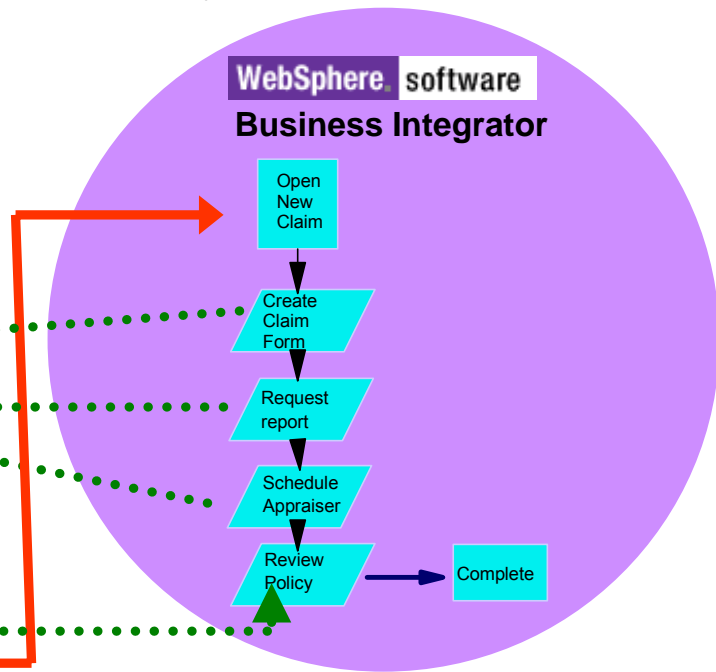
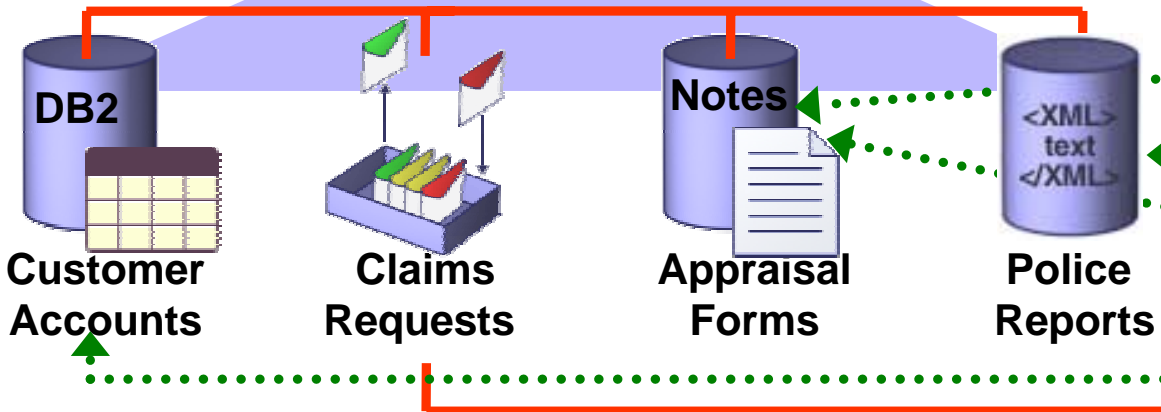
## Opening a new claim at customer request

- ▶ Information collected by CSR and submitted by application
  - MQ message written to queue
  - MQ message presence initiates a new collaboration
    - WBI process starts for new claims work flow
    - Data acquired and/or updated by collaboration steps
    - Same data access by portal via DB2 II

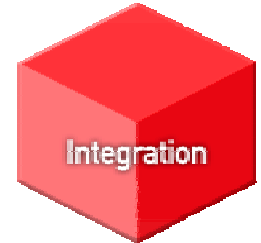


**WebSphere software**

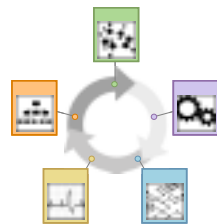
**DB2 Information Integrator**



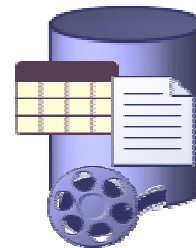
# Comparing Process and Information Integration



- Process Integration communicates events between applications
  - ▶ A new customer event must be shared across sales, marketing, and service application domains
  - ▶ A product sale must be shared across customer, finance, and inventory applications
- Information Integration is about capturing, integrating, and sharing the state of the business as embodied in its stored data
  - ▶ An enterprise balance sheet must consolidate financials across multiple divisions
  - ▶ A customer's portfolio must integrate banking accounts, brokerage accounts, stock holdings, and insurance policies across an enterprise.



Processes



Information

# IBM Competitive Advantage

## ■ More open

- ▶ *“Oracle has preferred to concentrate upon centralisation....whereas IBM has taken a more agnostic approach, supporting all sorts of relational databases within a federation. It is not hard to say, therefore, that IBM is the market leader in this space.”*

Phil Howard, The Register: What the Hell is IBM Information Integrator? , Feb 2003

## ■ More scalable

- ▶ *“Building on existing strengths, IBM is readying its EII offering for 1Q03 to counter BEA's Liquid Data (OEMed Enosys). We believe IBM's strong optimization will persuade technical buyers.”*

Doug Laney, Meta Group, Rising Demand for Distributed Data on Demand, Dec 2002

## ■ More function

- ▶ *“IBM will raise the bar on enterprise information integration. It has so much more to offer than small companies, and it has broadened the category to include unstructured data.”*

Philip Russom, Giga Information Group, CRN, IBM: Xperanto Rollout to Start In Early 2003, Jan 2003

## ■ More deployable

- ▶ Leverages wide-spread skills and tools infrastructure



# Project Masala

*Masala is a rich, flavorful mixture of spices used in Indian cooking*

- Symbolizes the harmony of the different technologies required in building an information management infrastructure as well as the diversity of data and content making up information assets throughout an enterprise.
  - ▶ Driving ROI
    - Expanding the flexibility, speed, and applicability of the infrastructure.
    - Enriching administrative capabilities
  - ▶ Expanding data reach
    - Package applications
    - Complex Web services
  - ▶ Free-form access
    - Highly relevant enterprise search
    - Easy administration



# Summary

- Information integration addresses a key pain point for customers
- IBM leads the industry in integrating information for on demand computing
- DB2 Information Integrator represents a distinct difference in approach between IBM and Oracle and Microsoft
  - ▶ Commitment to open architectures that protect, extend, and optimize current enterprise investments
  - ▶ Strategic vision for information on demand
- IBM is developing a world-class ecosystem of partners that enhance and exploit its capabilities
- Customers see real value in their deployments across diverse scenarios
  - ▶ Control costs
  - ▶ Speed time to value
  - ▶ Extend current investments
  - ▶ Innovative discovery



# Integration Middleware Market

It is generally estimated that for each \$1 spent for a packaged application, customers spend on average \$5 to \$9 on the labor for integration

Source: IBM - Study of service engagements, 2001, 2002

## Top IT Spending Priorities for CIOs

Source: CIO Magazine, The State of the CIO, IT Spending, March 2002

Business Integration is the **#1 priority for customers**, higher than e-Business and CRM.

Source: Morgan Stanley CIO survey, May 2001

40% of IT budgets are spent strictly on integration

Source: Gartner

Requirement for customized integration programming is growing

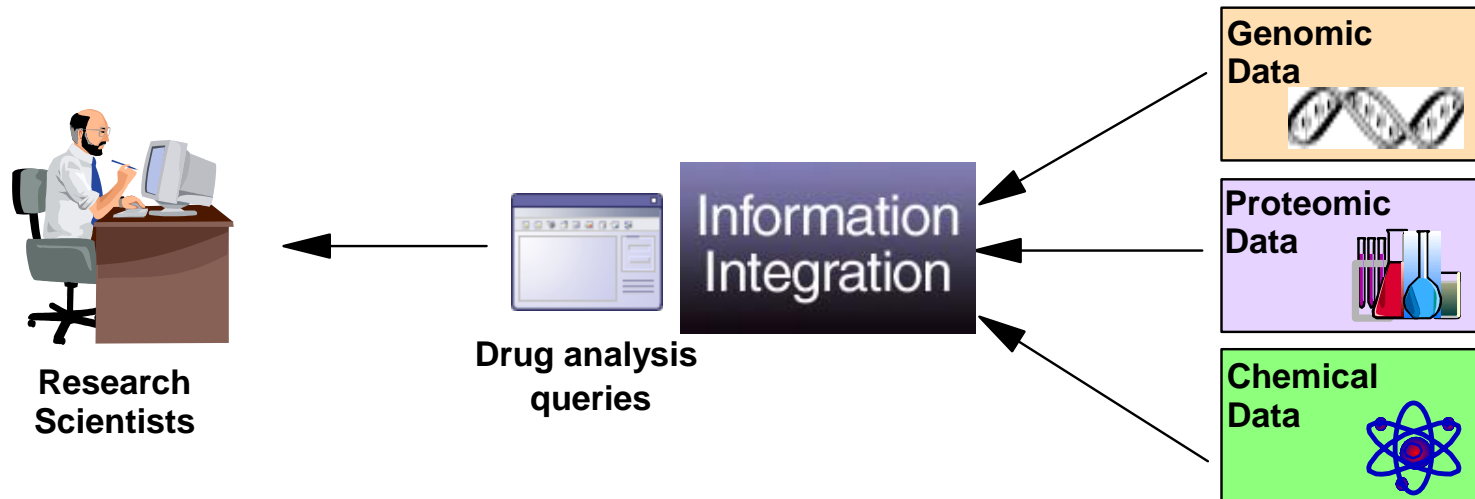
Source: IBM Customer Surveys, 2001, 2002





# Improve and Shorten Drug Discovery Process

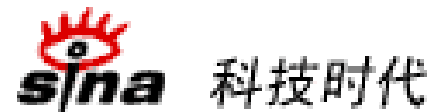
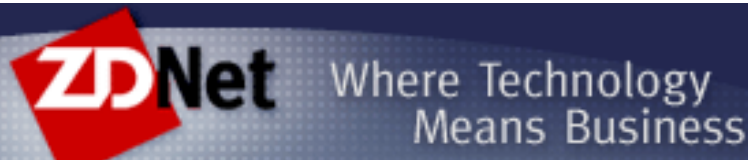
- Faster and more thorough analysis using single queries that span varied sources
- Effective analysis by identifying/rejecting candidates that will fail sooner in process
- Scalable to handle increasing data volumes and include more data sources quickly



- Increased research productivity leading to drug innovation and reduced time-to-market
- Provide researchers with transparent access to multiple data sources including internal and external life sciences data stores.



# 183 Articles Worldwide YTD



# DB2 Information Integrator Services Opportunities

- Consulting and solution design
  - ▶ Extending e-business applications with federation capability
    - E.g., real-time customer data integration for CRM
  - ▶ Integrating or re-purposing legacy application data
    - E.g., federation/replication over legacy host applications in a heterogeneous environment
  - ▶ Integration of structured and unstructured data
    - Mapping and metadata design
  - ▶ Assessing the inclusion of real time sources into a data warehouse environment
- Education
  - ▶ Designing a federated DBMS
  - ▶ Performance consideration in a federated system
- Integration and implementation
  - ▶ Including customized wrapper development
  - ▶ Migration services



# WebSphere Synergy

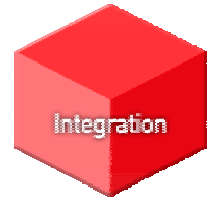
- Plug into a services oriented architecture
  - ▶ All the power of EII through Web service
  - ▶ Extend reach and transformation richness with Web services
- Improve developer productivity for composite applications
  - ▶ Reduce lines of code, development time, and skill needs
  - ▶ Give applications access to all the relevant data sources
- Reduce cost and complexity of complex business processes
  - ▶ Simplify development for composite business objects
  - ▶ Leverage set-base relational processing
- Enable business activity management
  - ▶ Correlate real-time and historical data
- Increase return on messaging system deployment
  - ▶ Analyze queue traffic with standard analytical tools
  - ▶ Make messaging infrastructure more easily accessible by DB community



# Customer Interest and Solution Delivery

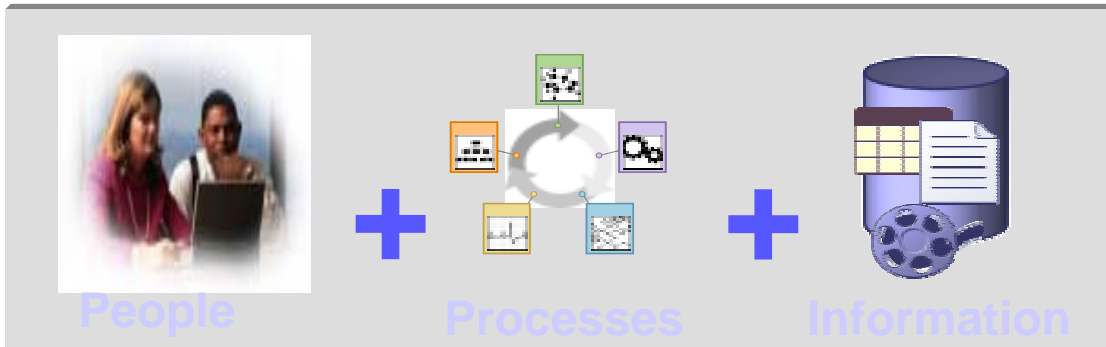
- Sales
  - ▶ Pipeline is 4X internal revenue target
  - ▶ 8% increase YTY in DataJoiner sales for 1H2003
  - ▶ Surprising interest in AP where DataJoiner sales have been limited
  
- Solutions
  - ▶ Centerpiece of On Demand Information Integration Offering
  - ▶ Included in On Demand Offering for Retail
  - ▶ Included in Grid offerings for various industries

# Information Integration is Key to Business Integration Solutions



“It is impossible in most cases to separate data integration from application or BP integration because all integration has a data component. For this reason the DBMS must play a large role in an overall integration solution.”

**Charles Garry, META Group, 2002**



Data federation is the only way customers will be able to integrate petabytes of information.

**Teri Palanca,  
Giga Information Group, 2002**

At least 30% of all new e-business applications face the problem of integrating multiple data sources.

**Giga Information Group, 2000**



## Ongoing Press Drumbeat



### **IBM database integrates diverse data**

February 10, 2003

DB2 Information Integrator ... lets users access structured and unstructured data, including XML documents, e-mail, multimedia files and even non-IBM databases, and creates a complete view of their information assets, says Nelson Mattos, director of information integration for IBM.



### **IBM to ship DB2 integration software; Software accesses multiple content types**

May 15, 2003

"We're very impressed with it," said Paul Bach, president of Striva, in Scotts Valley, Calif. "It's very powerful technology. It allows virtually all of the data within an organization to be accessed transparently, whether that data is relational or non-relational



### **IBM Digs Deeper for Data**

August 26, 2003

IBM has launched work on a research and development project that promises to extend the reach of its DB2 Information Integrator software until it can dig out data from every corner of an enterprise, whether inside or out of data warehouses ...Masala is being designed to push the limits of DB2 Information Integrator.

# Technology Roadmap



## *Masala*

### ■ Federation

- ▶ Wide range of data and content sources
- ▶ Extensible to virtually any data source
- ▶ Query as if a single source using standard SQL
- ▶ Web application support
- ▶ Up and running ease

### ■ Replication

- ▶ Heterogeneous support
- ▶ Ease of admin
- ▶ Monitoring

### ■ Low latency replication

- ▶ DB2 only

### ■ Performance, Scalability and Robustness

- ▶ Parallelism
- ▶ Fenced Wrapper Support

### ■ Administration

- ▶ Configuration deployment
- ▶ Monitoring
- ▶ Stats refresh
- ▶ Cache refresh

### ■ Packaged applications

- ▶ SAP, Peoplesoft, Siebel
- ▶ Free-form access

### ■ Metadata management infrastructure

### ■ Data placement advisor

### ■ Distributed transactions

- ▶ Federated 2PC

### ■ Identity management and security integration

### ■ Verticalization

