

Integration in A Service-Oriented World: The Big Picture

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Information Technology

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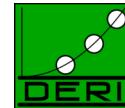
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Gartner

bea



IONA Making Software Work Together™



A New Era of Computing ...

❑ Trends

- Growth
- Competition: Google effect
- Social computing
- Globalization

❑ Disruptions

- Service-Oriented Architecture: to address integration
 - Core technology
 - Software creation
 - Solution delivery
- Web/Internet
- Virtualization
- Open Source
- Security
- Convergence

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Integration: The Big Picture

❑ Fundamental Change for Integration: X ↔ Y

- Pre-SOA: outside, after development
- Post-SOA: inside, integral part of development / computational model

❑ Consequences

- How should integration be done?
- Innovation and experimentation
- Competition, expansion, consolidation

❑ Conclusions

- Opportunity: Re-thinking integration
- Basic research
- Near-term chaos
- SOA + ecosystem time line: 2008 - 2012

❑ Evidence

- IDC Directions 2006 (3/2/06): SOA important but not understood or deployed as claimed
- Gartner (2/15/06): "Globally, organizations placing minor emphasis on understanding the role of data integration in SOA and creation of data services at the foundation of their architectures"

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The History of Integration

❑ 1950 – 2006: Integration = develop then integrate

- 1950s-1970s: Simple, manual integration
- 1970s-1980s: Distributed Computing
 - Applications (interoperation)
 - Databases (integrate)
- 1990s: Business Driven Integration – concepts, technologies, and tools – increased automation, internet-based computing
 - Concepts: Workflows, Processes, Web,
 - Integration solutions blossom & diverge: ETL, EAI, BPM, ...
- 2000: SOA Emerges
 - 2000: Web services
 - 2003: Integration solution evolution accelerates, vendor chaos ensues
 - 2005: Growth in all integration categories

❑ 2006-2012: Integration = dominant programming model

- 2001-2010: Wrapping
- 2005-2010: Re-Engineering
- 2007-2008: Consolidation
- 2010-2012: Emergence of SOA Platforms and Solutions
- 2006-2012: Problem Solving Era: IT/integration relegated to low level function

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The SOA Vision

❑ SOA ≠ a computing environment where a service can invoke any (remote) service

❑ No “A” in SOA

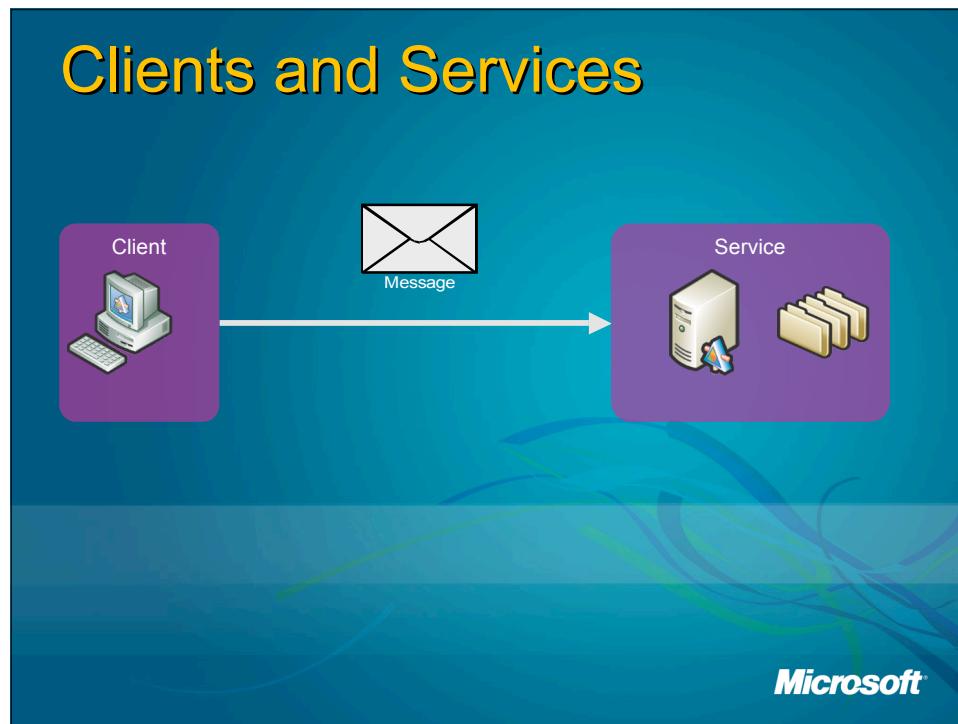
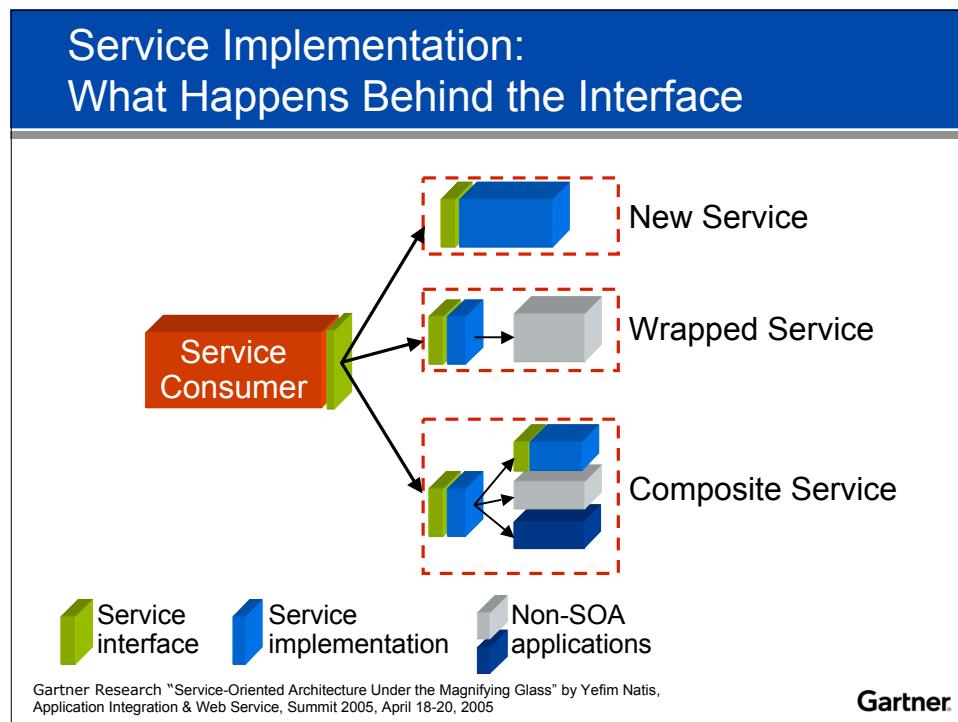
❑ Services

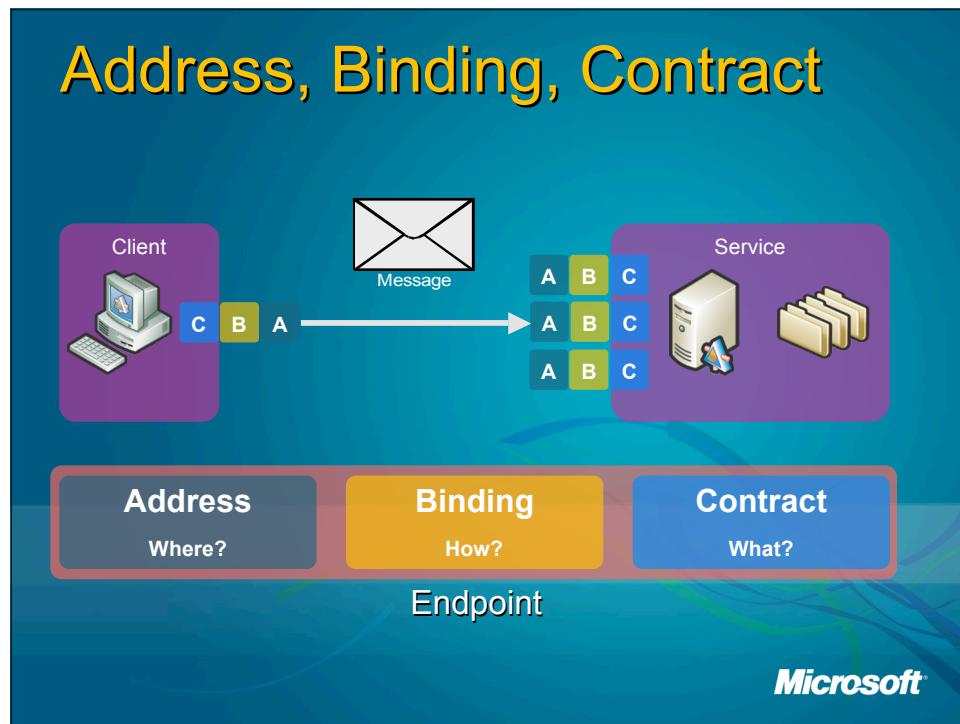
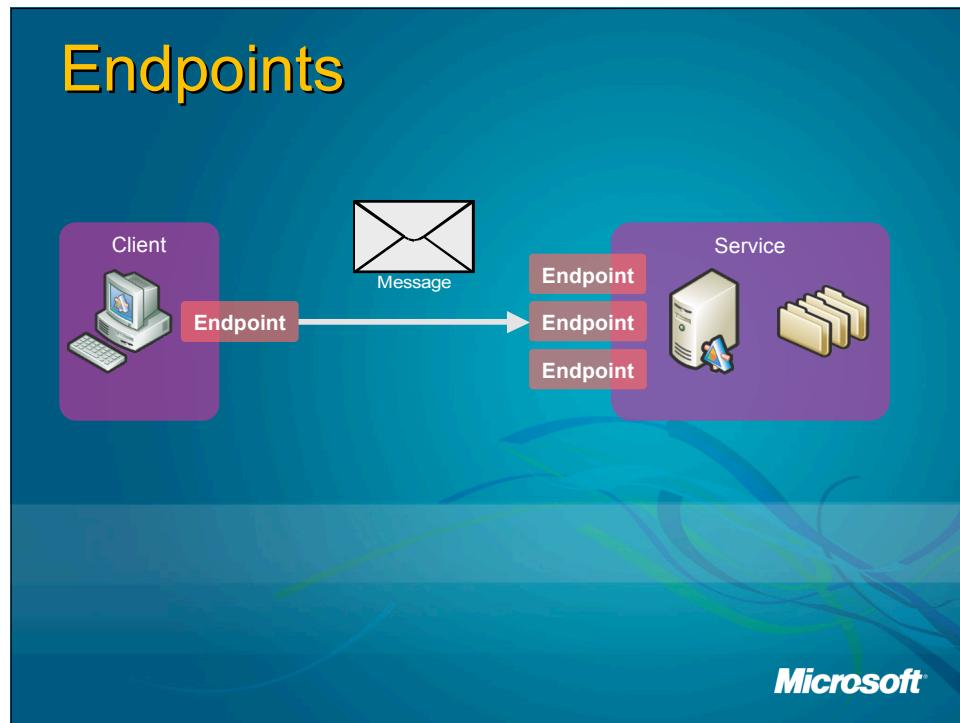
- Many types
 - Business service
 - Data service
 - Infrastructure service
- Service = method library

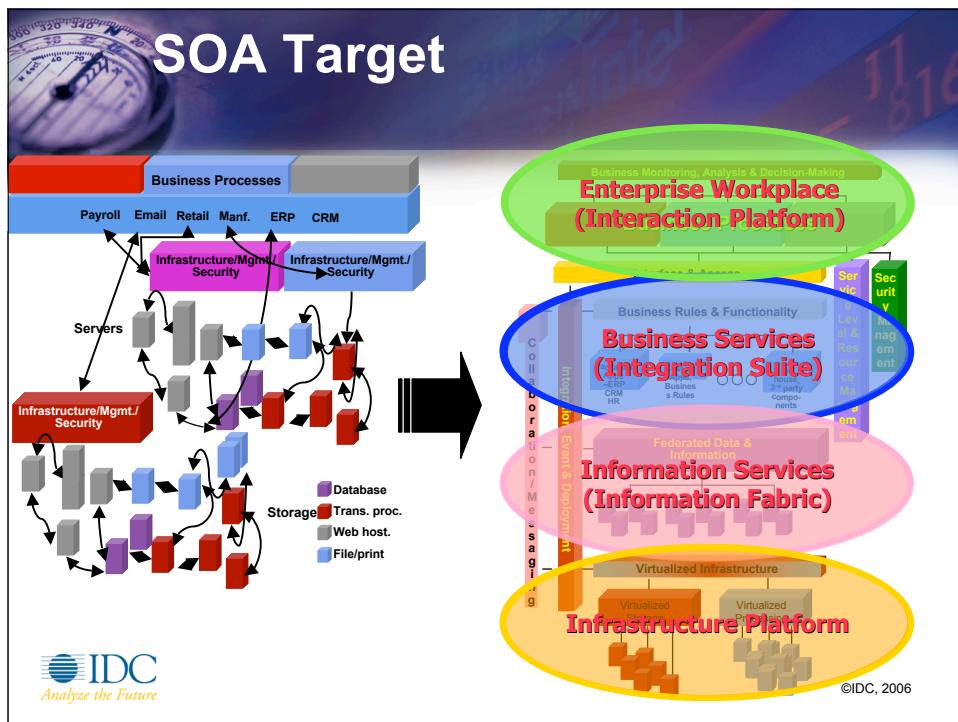
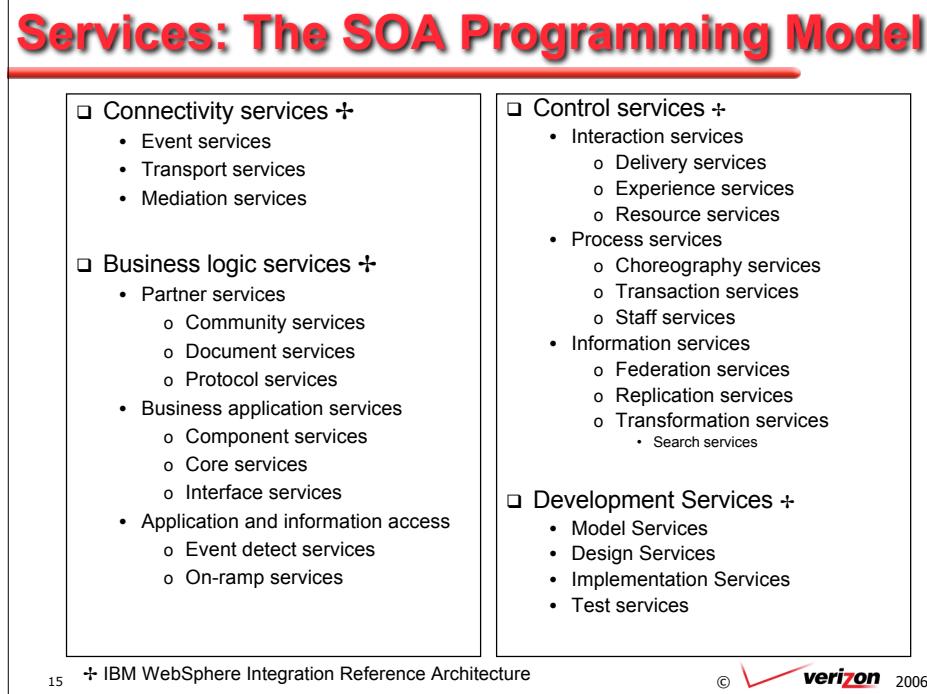
❑ What is a service?

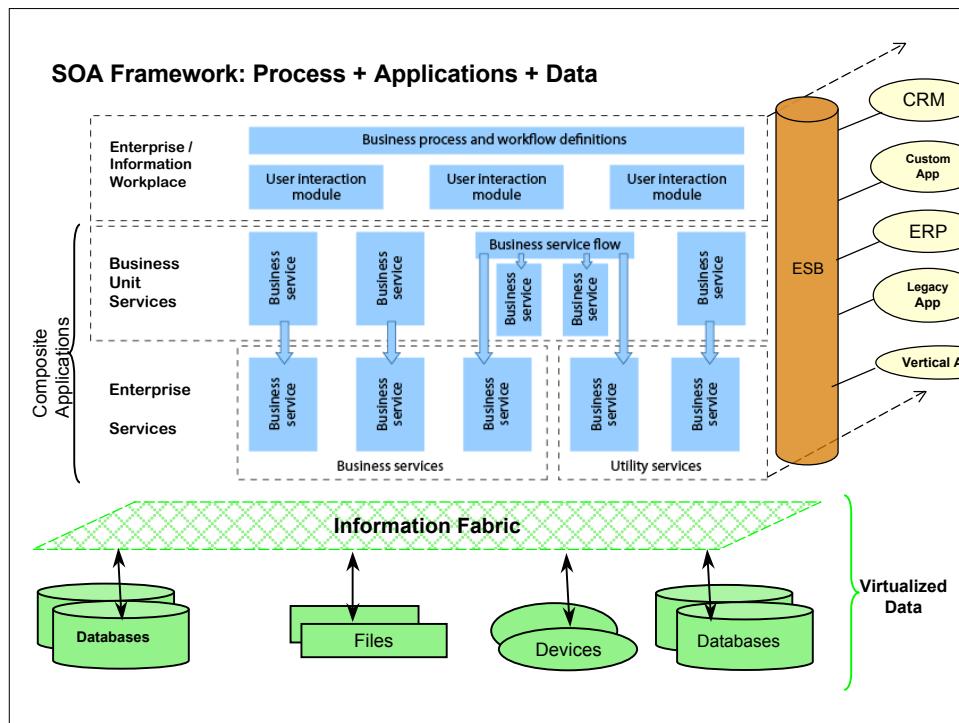
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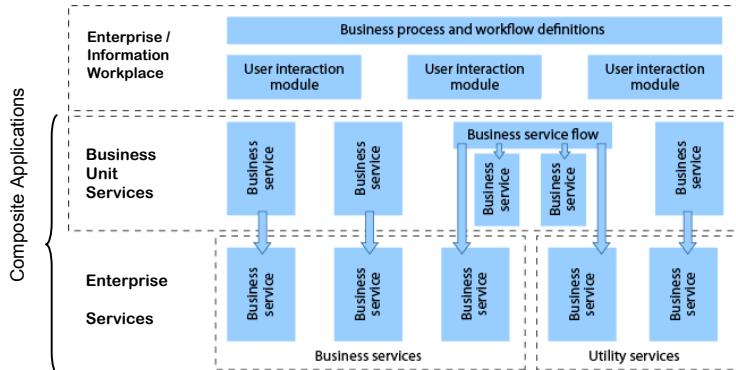




Deep SOA Integration Requirement

❑ Composite Application: Fundamental SOA Concept

- Integration pattern: defines a new application, service, or process from existing elements that automatically supports change to
 - Composite: process behavior, user interaction, ...
 - Component services: add, delete, modify
 - Meta-data, business rules, policies, events, ...



SOA: A Ten Year Evolution

- ❑ Myriad of integration solutions
- ❑ Consolidation
 - Process
 - Application
 - Data
- ❑ Deeper issues
 - Core technology
 - SOA
 - DBMS
 - Push integration from business logic to infrastructure
 - Automation and dynamic aspects via semantics

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Outline

- ❑ Integration
 - What is integration?
 - Requirements, Challenges, Trends
- ❑ Integration Solutions (Pre-SOA)
 - Taxonomy
 - Data and Information
 - Applications
 - Process
 - Challenges and Opportunities
- ❑ Integration in Service Oriented Architectures
 - SOA Integration Categories
- ❑ Research and Future Directions



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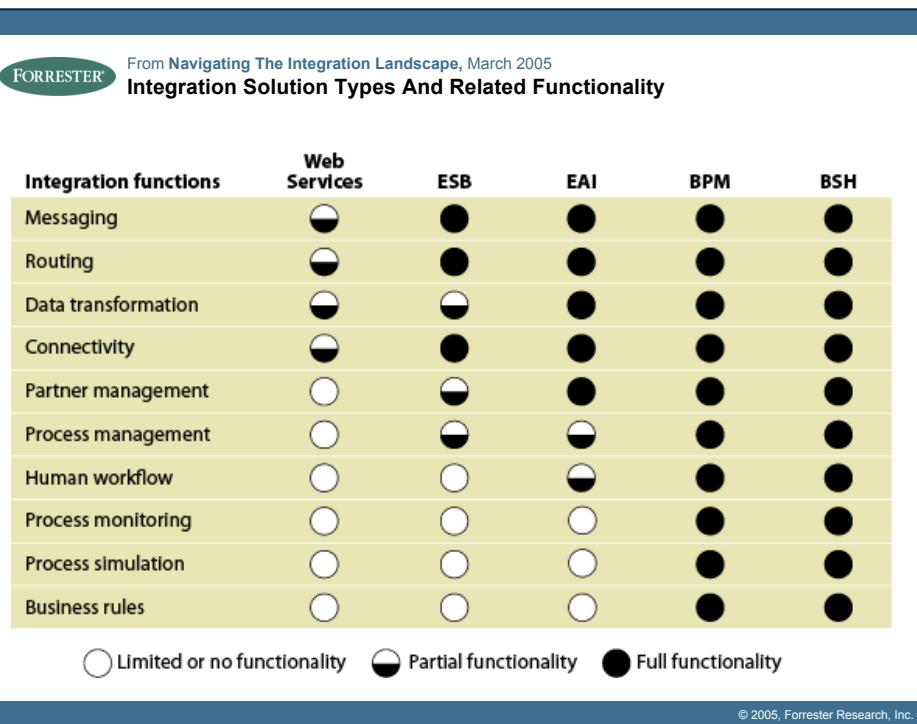
What Is Integration?

- Objects combine, transform, or interact → meaningful result object
 - Core - mappings or transformations of information and/or actions
- Integration Types

<i>Integration Type</i>	<i>Result</i>
Data	Integrated data: global, federated database
Application	Composite application
Process	Complex or orchestrated process/workflow
Presentation	Presentation
Protocol	Protocol
Messaging	Message
Routing	Routing
Connectivity	Connection
Business rules	Business rules
Policies	Policies
Web pages	Mash up, ...
Content	Content

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Why is Integration Hard?

❑ Myriad of Divergent

- Enterprise
 - Resources: process flows, applications, databases, ...
 - Possible solutions
 - Integration types
 - Complex, conflicting requirements
 - No simple guidance - best practice
- Vendor
 - Tools / products: rapid evolution

❑ Technical

- Proof that solution meets requirements takes months or years
- Preserving meaning: semantics
- Complexity: Static vs. dynamic, ...
- Legacy
 - Lack of meta-data, mappings, ...
 - Identify and extract re-usable entities from databases and applications

⇒ Revolution

- Business drivers requires more ...
- SOA changing everything
 - Integration becomes fundamental
 - Schisms: data vs. process-orientation

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Previously Avoided Problems

❑ Community / Managerial

- Standards based on community consensus
- Governance
- Managerial support for enterprise and industry solutions, e.g., Meta-data

❑ Architectural

- Product-specific integration architectures
- Plus: workbench, libraries, repositories, ...

❑ Technical

- Declarative mappings
 - Languages
 - Generators
- Semantics

⇒ Legacy

- Lack of meta-data, modularization
- Mappings hard to extract
- Integration breaks when parts change
- Legacy thinking, e.g., ETL = batch processing

⇒ Composite Application

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Why Is Integration Important?

Challenges

- Top CIO concern 10+ years
- Integration **cost** dominate development
 - 35-50% of all systems development since early 1990's
 - 50% of system enhancement since late-1990's (internet, process-orientation, re-use, ...)
- Legacy systems: inflexible, erroneous
- Regulatory compliance: Sarbanes-Oxley
- Growth
 - Automation
 - Data volumes
 - Business transactions
- Mergers, acquisitions, re-organization, globalization, partnering

Opportunities

- Strategic
 - Re-Use: Derive value from existing processes, applications, data
- Competitive
 - Real-time
 - Process improvement
 - Integrated functions: billing, ordering, shipping, ...
 - Agility
- Technical: Service-Oriented Architecture, etc.

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Integration Requirements

First Class Citizen

- Flexible = continuously add / delete / modify integrated
 - Processes
 - Applications
 - Information

Scalable

Real-time (right time)

Federation (distribution) Vs. "Integration"

Data Quality

- Master Data Management

Meaningful Integration

- Enterprise Information Management

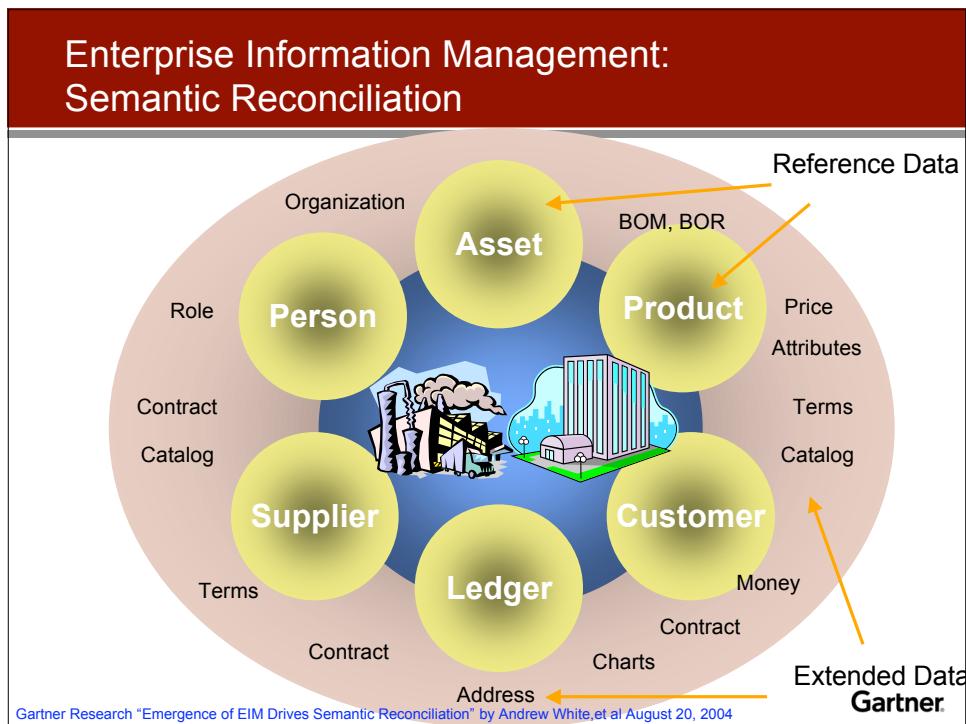
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Master Data Management (MDM)

- **Goal**
 - Consistent management of enterprise entities for compliance, operational efficiency, and competitive differentiation
 - Single version of the truth
- **Master Data** = consistent and uniform set of identifiers and extended attributes that describe the **core entities of the enterprise** — and are used across multiple business processes [Gartner]
- **Supported by**
 - **Processes:** harmonize, cleanse, publish, and protect common information assets
 - **Technology:** ensure consistent master information across transactional and analytical systems in real-time using **modeling, mapping, meta-data, governance**, etc.
- **Status**
 - MDM products: IBM, SAP, Oracle, ...
 - Entity hubs emerging in shared service environments
 - Gartner predicts 70% of Fortune 1000 will apply by 2010

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Enterprise Information Management

- ❑ **Example:** millions of retail product suppliers and vendors deal with the same products, e.g., P&G + 1,000s suppliers + 10,000s vendors
- ❑ **EIM** = a strategy for improving the integrity, efficiency, relevance and accessibility of all information assets (structured and unstructured content) across the enterprise [Gartner]
- ❑ **EIM Strategy / Process**
 - Architectures
 - Governance
 - Technologies: XML, SOA, ...
 - Functions: semantic reconciliation
- ❑ **International Initiatives**
 - Product / Product Information Management (PIM): Global Data Synchronization Ecosystem
 - Customer: Customer Data Integration (CDI)
 - People: underway

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- ❑ **Integration Solutions (Pre-SOA)**
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- ❑ **Integration in Service Oriented Architectures**
 - SOA Integration Categories
- ❑ **Research and Future Directions**



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Integration Solution Taxonomy*

- Data and Information Integration
 - ETL
 - EII – federated databases
- Application Integration: Information and Processes
 - EAI
 - B2B Gateway
 - ESB
- Process Integration
 - Business process management (BPM)
 - Business-to-business integration (B2Bi)
- Processes, Applications, and Information Integration
 - Application Servers
 - Application Server Platforms
 - Application Platform Suites
- Infrastructure + Applications
 - ▷ Application and infrastructure platforms (e.g., Oracle, SAP) - aplistructure - Forrester
- Enterprise Workplace

* Partial: Many areas not considered, e.g., integration appliances

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ETL: Extract, Transform, and Load

- ETL = process
 - Extract data from 1+ sources
 - Transform & integrate (syntax, semantics) to target requirements
 - Load result into 1+ target data repository
- Characteristics
 - Use: Data Warehouse, Business Intelligence (BI)
 - Large volumes of data moved from source
 - Data mappings
 - Not: on-demand, real-time, low-latency
 - Issues: data quality, performance, ...
- Vendors
 - IBM: Websphere ETL: WebSphere DataStage product family
 - DataStage for ETL
 - ProfileStage data profiling
 - QualityStage for data cleansing
 - MetaStage for metadata management
 - DataStage TX for heavy transformation requirements (ex-Mercator offering)
 - Microsoft: SQL Server Integration Services (SSIS)
 - Ab Initio Software
 - Business Objects
 - Informatica
 - iWay Software
 - Oracle
 - Pervasive Software
 - SAS Institute
 - Sunopsis

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EII: Enterprise Information Integration

- **EII** = data federation = virtual database + distributed queries
 - Create views of multiple data sources for real-time read & write access for applications

□ Characteristics

- Use: applications, query and reporting tools, ...
- Provides access, data not moved, small return sets
- Issues: latency when multiple sources involved, meta-data management
- Caching for optimization => distributed cache management

□ Vendors

- | | |
|--|---|
| <ul style="list-style-type: none">• CONNX Solutions• Metamatrix• IBM WebSphere Information Integrator• Oracle Data Hub• BEA Liquid Data• Composite Software• Virtuoso Universal Server | <ul style="list-style-type: none">• Avaki/Sybase• Ipedo• Denodo Virtual DataPort• Enterprise Information Integrator, Software AG• Actuate Information Objects• Attunity Connect from Attunity• WebFOCUS, Information Builders |
|--|---|

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EAI: Enterprise Application Integration

- **EAI** = architecture + tools + methods that integrates in real-time a set of applications including their processes and databases

□ Characteristics

- Use: application, process, and database integration
- All applications can access each other
- Reduce point-to-point (M:N) [45] connections to 1:N [10] via intermediate models
- Platform permits: a virtual development environment - enterprise policies, rules, etc.
- Integration: application via adapters, connectors + other technologies, e.g., BPM
- Transforms: proprietary and 3rd party adapters, transform generators, ...
- Issues: growing complexity, massive libraries of adapters, adapter management, replicating other solutions - real-time, transactions, ...

□ Vendors

- | | |
|---|---|
| <ul style="list-style-type: none">• Adobe LiveCycle Workflow Server• BEA WebLogic Integration Server• Fiorano Business Integration• Fujitsu Interstage• webMethods• AT&T/Sterling Commerce Gentran Integration Suite | <ul style="list-style-type: none">• IBM WebSphere Process Server• Microsoft BizTalk• Oracle Integration and BPEL Process Manager• Sun/SeeBeyond Java Integration Suite• TIBCO Staffware and BusinessWorks |
|---|---|

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EAI+: B2B Gateway and ESB

□ B2B Gateway

- Centralized management of partner interactions - profiles, security, authorization, business rules, monitoring, regulatory reporting, ...
- Growth
 - Increased partnering complexity and requirements
 - Meet requirements and reduce costs
- Extensions: Business Activity Monitoring (BAM), ...
- Vendors: 30+ IBM (WBIC), TIBCO, SeeBeyond, webMethods, ...

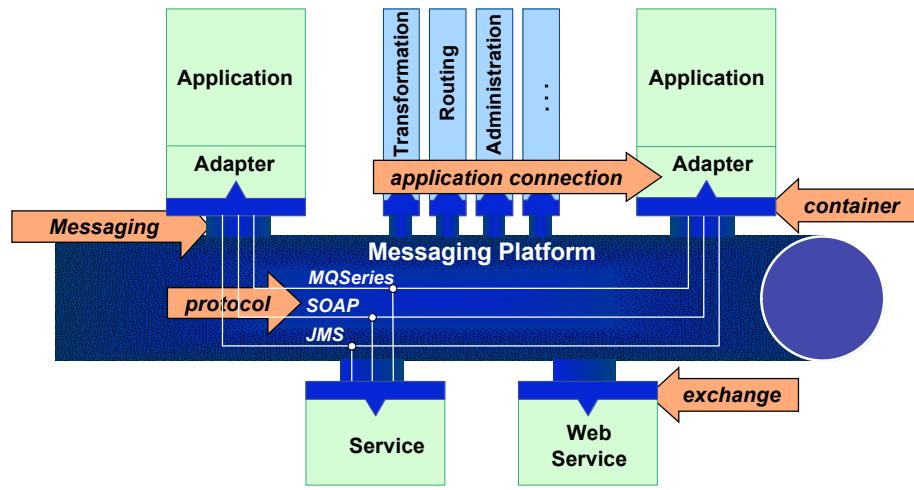
□ ESB = Enterprise Service Bus

- New technology: SOA generation EAI + MOM + ...
- Core SOA infrastructure for service-to-service communication, mediation, and other SOA / Web service functions
- All integration types including infrastructure
- Vendors: 20 and growing

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Evolving Integration Suite Features: An Enterprise Service Bus Core



Gartner

BPM: Business Process Management

- **BPM** = set of activities and technologies to design, execute, and monitor business processes in an enterprise often crossing organizational boundaries
- **B2Bi** = Business to Business Integration (BPM + B2B Gateway)
- **Characteristics**
 - Use: process definition, execution, monitoring, refinement, and optimization
 - History: growth of processes ↳ need for direct management, execution, and monitoring
 - Evolution: Business-IT interface: Business Activity Monitoring (BAM), Total Quality Management (TQM),
 - Issues
 - Process-orientation evolution ↳ product evolution; BPM being absorbed
 - Biggest barriers are human / political
- **Vendors (pure play)**
 - FileNet, Fuego, HandySoft, Intalio, Lombardi Software, Metastorm, Pegasystems, Savvion, Staffware, and Ultimus

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Integration Challenges

- **Failure to Embrace Solutions**
 - Technology: Meta-data, federation, distributed databases, frameworks, ...
 - Enterprise: architectures, schemas, business models, ...
- **Divergence & Growth in EVERY sector**
 - Enterprise solutions: growth of the legacy
 - Technologies: product categories, products, ...
 - Proprietary solutions, e.g., adapters, connectors, wrappers, ...
- **Requirements Growth**
 - Flexibility: inflexible EII, EAI, ETL solutions also impose performance costs
 - Performance: real-time response, asynchronous messaging
 - Data and transaction volumes: X2 every 3 years
 - Data protection, quality, security, and application integration

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Integration Opportunities

- ❑ Industry wide commitments
 - Master Data Management
 - Enterprise Information Management
- ❑ Business Trends
 - Process-orientation, business activity monitoring, ...
- ❑ Technology Opportunities
 - Service-Oriented Architecture (SOA) and Web services
 - Re-use
 - Programming = Composition
 - Policy driven
 - Meta-data
 - Patterns
 - Etc.
- ❑ Integration Consolidation

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Integration in SOA

- SOA motivation = Integration
- Integration in SOA is hard
 - SOA offers a framework Not a solution
 - SOA is in its infancy
 - Integration solutions are consolidating and evolving rapidly
 - Gartner, Dec 2005 survey
 - 7 leading Web Service / SOA approaches equally hard - 6 out of 10
 - Significant challenges using, integrating with non-SOA, etc.

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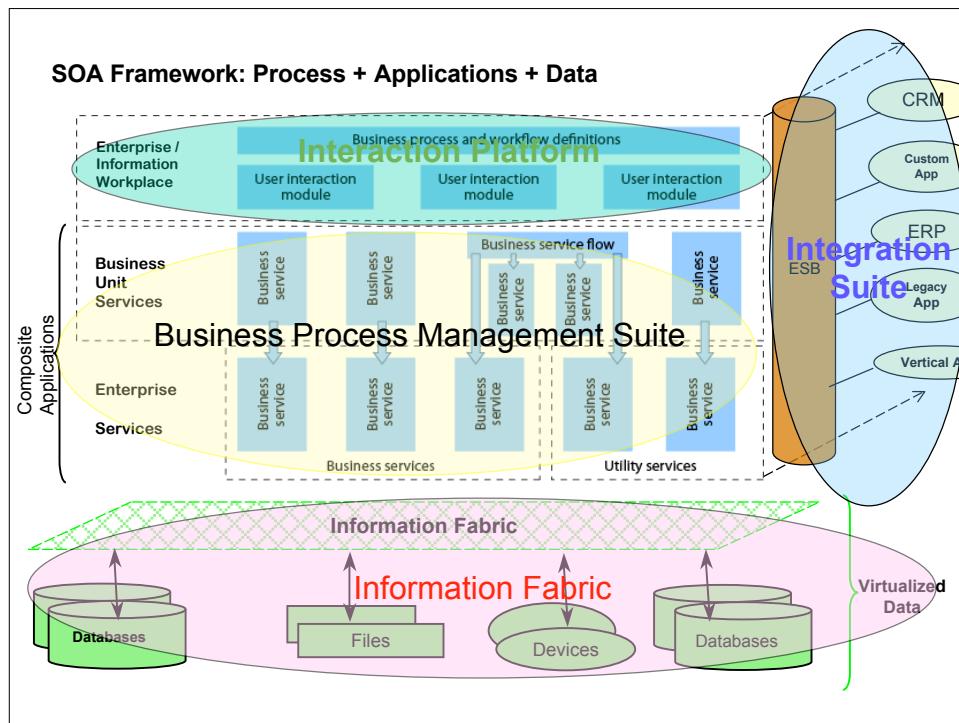
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Integration Consolidation in SOA

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- Processes, Applications, and Information Integration
 - Application Servers
 - Application Server Platforms
 - Application Platform Suites
- Infrastructure + Applications
 - ⇒ Application and infrastructure platforms (e.g., Oracle, SAP)
- Enterprise Workplace
 - ⇒ Interaction Platform
- ⇒ Information Fabric
- ⇒ Business Process Management Suite
 - Human-Centric
 - Integration-Centric
- ⇒ Integration Suite

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SOA Integration Taxonomy

❑ Consolidation

- Applications (EAI + BPM + B2B) ↳ **Integration Suite (Application Server Platform)**
- Processes (BPM) ↳ **Business Process Management Suite**
- Information (EII + ETL+) ↳ **Information Fabric**
- Infrastructure (MOM, EAI, ..) ↳ **Enterprise Service Bus**

❑ Trends

- Consolidation ↳ comprehensive platforms
↳ development + operational environments (application OS)
- Expand functionality: analysis, collaboration, reporting, events,
- Independents innovate and optimize, then generalists swallow
- Re-engineering to SOA, e.g., NetWeaver requirements
- Verticals: healthcare, financial services, Telcos, manufacturing, retail

Integration Suite (Application Platform Suite)

- Goal: Composite applications (50% cost savings)
- Components
 - Integration server: EAI, BPM, B2B, B2Bi
 - Application server
 - Portal server
- Extensions
 - Adapter / connector rationalization + semantics
 - Collaboration
 - Transactions
 - Analysis, reporting, ...
 - Development
 - B2B support: BAM, profiles, monitoring, contracts,
 - SOA standards: e.g., business process execution language (BPEL), business process modeling language (BPML)
 - Code generation
- Vendors
 - Leaders: TIBCO, webMethods, IBM, SeeBeyond, Oracle, SAP, GXS, Sterling Commerce, Microsoft, Axway
 - Strong: BEA, Sybase, Vitria

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Business Process Management Suite

- Goal: continuous process improvement
 - Complete process life cycle support: creation, testing, execution, monitoring, modification, reporting, analysis, ...
- BPM types
 - Human-centric - people intensive processes
 - Integration-centric: system intensive processes
- Extensions
 - Rules
 - Orchestration
 - Business Intelligence (BI)
 - Repositories: process artifacts - rules, models, services, ...
 - Simulation and optimization
 - Analysis and reporting: regulatory compliance
- Vendors
 - Adobe Systems, Appian, Axway, BEA Systems, Cordys, FileNet, Fuego, Fujitsu, Global 360, GXS, HandySoft, IBM, Inovis, Intersystems, Lombardi Software, Magic Software, Metastorm, Microsoft, Oracle, Pegasystems, SAP, Savvion, Sterling Commerce, Sun Microsystems, Sybase, TIBCO Software, Ultimus, Vitria Technologies, W4, webMethods

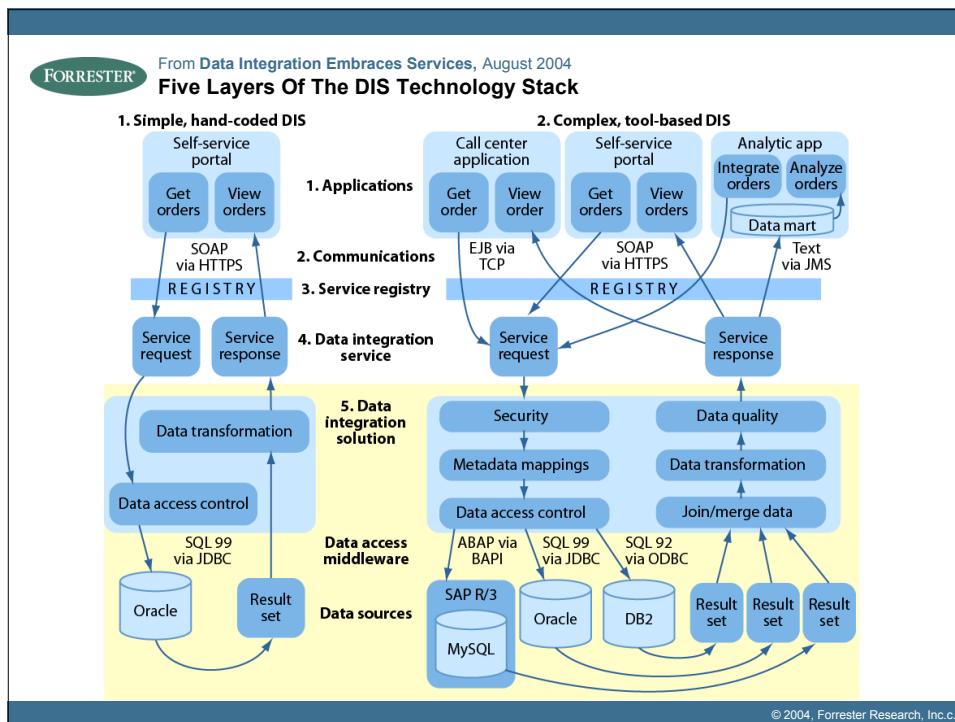
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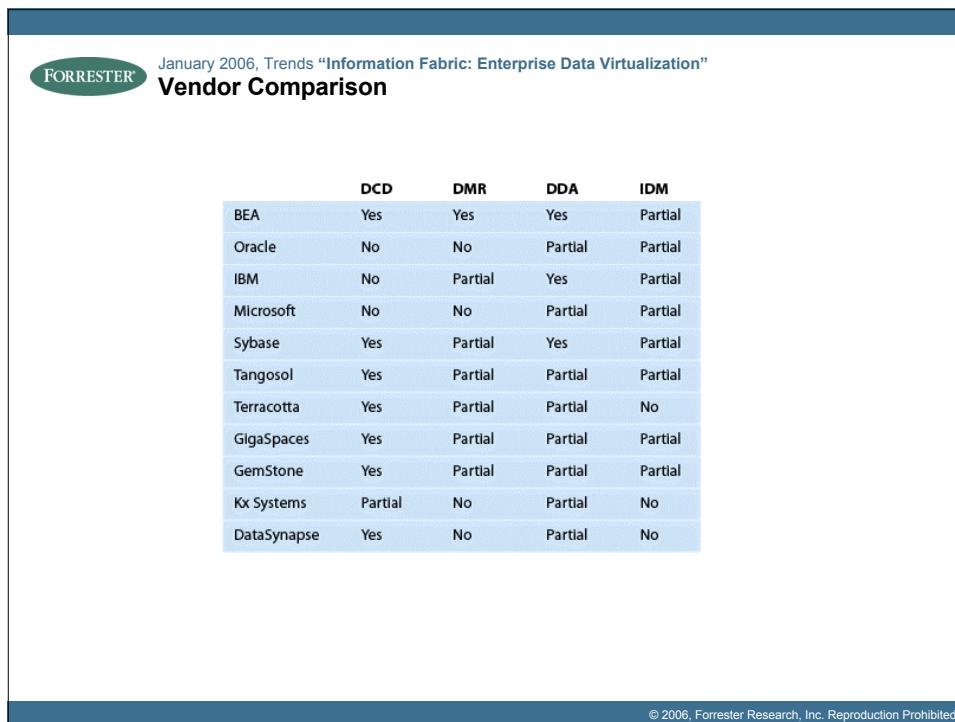
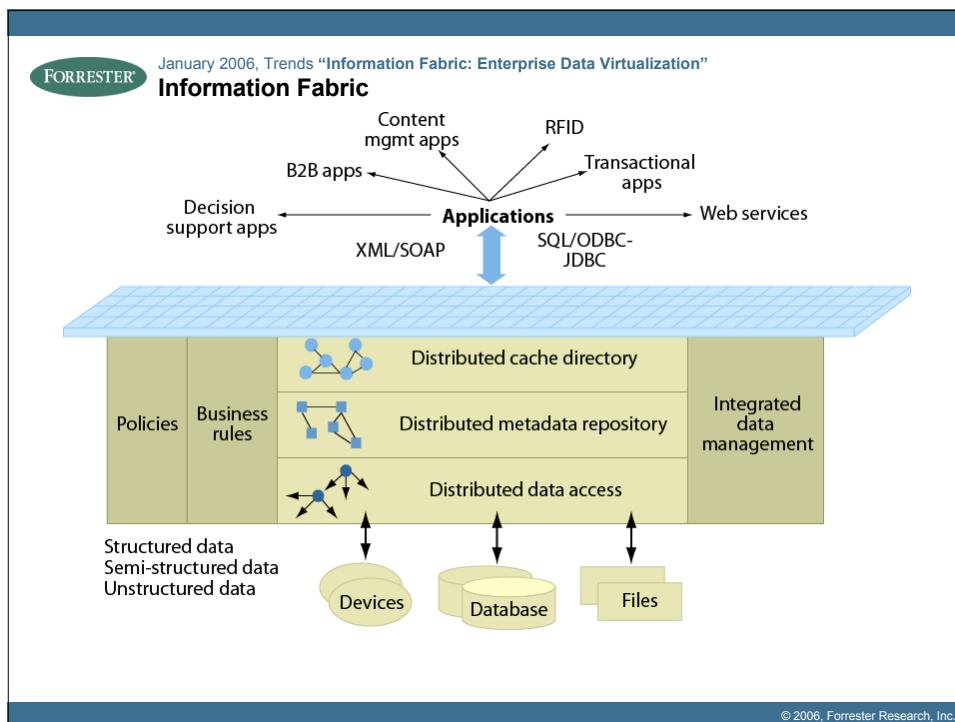
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Information Fabric (Data Services)

- Goals (a.k.a. Data Services, Information Virtualization)**
 - Holistic view of data: structured, unstructured, ... (Information Holy Grail)
- Components**
 - DBMS: distributed, federated- distributed query, stored procedures, ...
 - EII + ETL + replication
- Extensions**
 - Distributed Meta-data Repository (DMR)
 - Distributed Data Access (DDA)
 - Integrated Data Management (IDM)
 - Distributed Cache Directory (DCD)
 - Grid
 - MDM
- Vendors**
 - BEA, Oracle, Microsoft, IBM, Sybase, Tangosol, Terracotta, GigaSpaces, Gemstone, KX Systems, DataSynapse

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Fundamental Opportunities in SOA

- ❑ **Remove Integration from Business Logic**
 - Place in meta-data: schemas, policies, models, patterns, business rules, ...
- ❑ **Push Integration to the Infrastructure**
 - Orthogonal mapping solutions ⇒ SOA infrastructure (aspect-oriented computing)
- ❑ **Automation requires Meta-Data and Semantics**
 - Data-Orientation: Data semantics vs. process semantics
- ❑ **Model Management**
 - Platform + operators for mapping (integration)

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Service “Integration” and Semantics

- **Service Integration**
 - Steps (static or dynamic)
 - Discovery
 - Selection
 - Negotiation
 - Adaptation
 - Composition
 - Invocation
 - Monitoring
 - Processes: Mediation, orchestration, semantic adaptation, synchronization, ...
 - Types: protocol, data, process, ...

- **Issues**
 - Meta-data
 - Semantics: ontologies,
 - Data vs. process semantics

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