Chapter 4. The enterprise cloud computing paradigm

- Enterprise cloud computing
  * The alignment of a cloud computing model with an organization’s business objectives (profit, return on investment, reduction of operations costs) and processes

(a) Background

- NIST: five characteristics of cloud computing
  → On-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service
  * How these characteristics manifest in an enterprise context vary according to the deployment model employed

- Deployment models for enterprise cloud computing
  * Public cloud: managed by cloud providers for general public
  * Private cloud: managed by an organization for internal use only
  * Community cloud: shared by several organizations and support a specific community
    # May be managed by the organizations or a third party
    # May exist on premise or off premise
  * Hybrid cloud: composition of two or more clouds (private, community, or public)

- Critical questions for selecting enterprise cloud computing strategies:
* Will an enterprise cloud strategy increase overall business value?
* Are the effort and risks associated with transitioning to an enterprise cloud strategy worth it?
* Which areas of business and IT capability should be considered for the enterprise cloud?
* How can the process of transitioning to an enterprise cloud strategy be piloted and systematically executed?

- The above questions are addressed from two perspectives: adoption and consumption

* Adoption strategies: an organization makes a decision to adopt a cloud computing model based on fundamental drivers–scalability, availability, cost, and convenience
  # Scalability-driven strategy
    - Objective: support increasing workloads without investment and expenses exceeding returns
    - Effort, costs (CAPEX and OPEX), and time invested on the cloud should be less than hardware and software procurement and licensing process
  # Availability-driven strategy
    - Assure IT capabilities and functions are accessible, usable, and acceptable by the standards of users
  # Market-driven strategy
    - Identify and acquire the “best deals” for IT capabilities as demand and supply change
    - Enable ongoing reductions in CAPEX and OPEX
    - More suitable for small, agile organizations that do not have massive investments in IT
  # Convenience-driven strategy
- Reduce the load and need for dedicated system administrations and make easier user access to IT capabilities, regardless of their location

* Consumption strategies: an organization makes decision about how to best deploy its data and software using its internal resources and those of the selected cloud data center (CDC)

# Software provision

→ Use CDC’s software (SaaS) but maintain data internally

- Choose this strategy when
* the elasticity requirement is high for software and low for data
* the controllability concerns are low for software and high for data
* the cost reduction concerns are high for software and low for data (i.e., data are highly sensitive)

- Needs
  * software in CDC to access internal data
  * to change some firewall properties for secure data access (e.g., VPN, proxy, or gateway)

# Storage provision
→ Rely on CDC’s storage
- Choose this strategy when
  * the elasticity requirement is high for data and low for software
  * the controllability concerns are high for software and low for data
  * the cost reduction concerns are high for data and low for software

- Other advantages
  * Sharing data between organizations is easy
  * Storage provision is fast
  * Management of storage utilization is easy

# Solution provision
→ Rely on the CDC for both software and software data; i.e., placing the entire IT solution (software and data) in the domain of the CDC
- Choose this strategy when
  * the elasticity and cost reduction requirements are high both for software and data
* the controllability requirements can be entrusted to the CDC

# Redundancy services
→ The organization switches between traditional, software, storage, or solution management based on changes in its operational conditions and business demands
- Software, storage, or solution services can be implemented using redundancy: a hybrid strategy
- Users can redirect to the CDC for maintaining functionality availability, performance, or response time
- Usually, the CDC is used for disaster recovery, fail-over, and load-balancing
- Business continuity is the main concern to prevent massive losses due downtime and degradation of QoS

(b) **Issues for enterprise applications on the cloud**

- Enterprise resources planning (ERP)
  * Purposes of ERP:
    # Equip enterprises with a tool to optimize their business processes with a seamless, integrated information flow from suppliers through to manufacturing and distribution
    # Provide the ability to effectively plan and control all resources necessary in the face of growing consumer demands, globalization, and competition
  * Transition to the cloud ERP
    # Requires a balance of strategic and operational steps guided by socio-technical considerations, continuous evaluation, and tracking mechanisms
# Involves a complex transition from legacy information systems and business processes to an integrated IT infrastructure and common business process throughout the organization
* Research showed that enterprises are willing to migrate both their production loads and the test and development workloads to the cloud

- Transactional capabilities
  * Transactional type of applications:
    # Systems that manage transaction-oriented applications → mission-critical functions
    # Typically using relational databases
    # Also called On-Line Transaction Processing (OLTP) applications
    # Rely on strong **atomicity, consistency, isolation, and durability (ACID)** properties
    # Write-update intensive
    # For examples: sales and distributions (SD), banking and financials, customer relationship management (CRM), and supply chain management (SCM)
  * Challenges to deploy in the cloud:
    # Classical transactional systems use a shared-everything architecture; whereas cloud platforms mostly consist of shared-nothing commodity hardware
    # ACID properties are difficult to guarantee for current cloud-based data management and storage systems
    # Opportunities: highly complex enterprise applications are decomposed into simpler functional components, e.g.:
      - salesforce.com focuses on CRM-related applications
- taleo.com offers on-demand Human Relationship (HR) applications
  # Now leading software providers are offering tailored business suite solutions, e.g., SAP Business ByDesign

- Analytical capabilities
  * Analytical type of applications
    # Provide business reporting, marketing, budgeting, and forecasting (Business Intelligence, BI)
    # Also called On-Line Analytical Processing (OLAP)
    # Efficiently answer multi-dimensional queries for analysis, reporting, and decision support
    # Systems tend to be read-most or read-only, and ACID are not required
    # Better suited to run in a cloud
    # Analytics as a Service (or Agile Analytics): service providers offer on-demand BI and analytic services
      - Data sources can be processed using elastic computing resources on-demand, accessible via APIs, web services, SQL, BI, and data mining tools
      - E.g.: SAP BusinessObjects BI OnDemand, IBM Cognos Now!

(c) Challenges of ERP Transition
- Challenges of ERP transition
  → Can be classified in 5 categories, i.e., the 5 aspects of enterprise cloud stages: build, develop, migrate, run, and consume
* Understanding the state of the enterprise’s IT
  # Which IT is already, can, and cannot be transited
  # IaaS is most popular and easiest, but are there opportunities for PaaS and SaaS?
  # *Unplanned cloud* spreads throughout the organization (small cloud islands): what’s the company-wide cloud approach?

* Migrating the existing (legacy) applications to the cloud
  # Average lifetime of an ERP product is about 15 years
    → Sooner or later, the company needs to evolve toward the new IT paradigm
  # Planning, negotiation, and testing are required just as those for the classical software
  # Migration to the cloud depends on the concept of decoupling of processes: work needs to be organized using a process (or service) centric mode, rather than the standard “silo” mode
commonly used in IT (server, network, storage, database, …)

* Applications may need reengineering
  # Redeveloping applications involves completely different concepts: governance, reliability, security/trust, data management, and control/predictability
  # Future enterprise application development frameworks will need to enable the separation of data management from ownership

* Operation challenges
  # Running the enterprise cloud
  - IT operations will be different from what they are now: update and upgrade of IT department’s components
  # Running applications on the enterprise cloud
    - Interoperability between in-house infrastructure and service and the CDC

* Consuming the cloud
  # Two pricing models: allocation based and usage based
    - Allocation based: allocating resources for a fixed amount of time
    - Usage based: no reservations, resources are allocated as a per need basis
  # Challenge: finding the right combination of billing and consumption model for every services

(d) **Enterprise cloud technology and market evolution**

- Technology drivers for enterprise cloud computing evolution
  * Open interoperable standards
# Eliminate vendor lock-in, e.g., barriers of proprietary interface, formats, and protocols
# Standardization initiatives: OGF OCCI for compute clouds, SNIA CDMI for storage and data management, DMTF Virtualization Management (VMAN), DMTF Cloud Incubator, …
# Main cloud providers (Google, Amazon, IBM, Microsoft, …) currently do not actively participate in these efforts

* Cloud resources and services perform according to the business requirements
  # Reducing underperforming resources or service disruptions
  # Services with primitive SLAs or non-existing SLA is bound to change
  # Sophisticated monitoring and reporting capabilities: allow customers to comprehend and analyze the operations of the cloud resources and services
  # Allow even third-party independent vendors to measure the performance and health of cloud resources and services

* Divergence from the traditional RDBMS based data store backend
  # Traditional relational data models are no longer the mainstream in the cloud
  # Alternative data storage technologies: Amazon Dynamo, Facebook Cassandra, Google BigTable, NoSQL movement, …

- Market trends of the cloud services stacks
  * SaaS market trends
    # Has he most growth potential
    # Currently, most SaaS solutions are edge applications like supplier management, talent management, performance management, …
# Desperately need integration between SaaS offered by different cloud providers

* PaaS market trends
  # PaaS is predominantly used for developing situational applications to exploit the rapid development cycles
  # Especially for projects with tight timeframe to bring to the solutions to the market
  # Focusing on innovation aspects and gaining competitive edge
  # PaaS market will consolidate into a smaller number of service providers

* IaaS market trends
  # Attractive for small companies or startups that don’t have enough capital and human resources to afford internal infrastructures
  # Enterprise and large organizations are also experimenting IaaS services

- Cloud service brokerages
  * Cloud services would eventually become complex to be handled directly by the consumers
  * Meta-services or cloud brokerage services will emerge
  * Brokerage would use several types of brokers and platforms to enhance cloud service
  * Foreseeable Cloud service brokerages (CSB):
    # Cloud service intermediation: directly enhance a given cloud service
    # Aggregation: combines multiple services into one or more new services
    # Cloud service arbitrage: provide flexibility and opportunistic choices for the service aggregator
(e) Business drivers toward a marketplace for enterprise cloud computing

- Porter’s five forces model
  * To understand the forces, offering and consuming players, and the motivations of the players in the cloud
  * Actors, products, and business models are clarified and structured

* The adjusted model for the cloud market:
  # Rivalry: amount of companies dealing with cloud and virtualization technology is quite high → the rivalry is high
  # Substitute: products and offers are quite various → there are many niche products
  # New entrants: cloud-virtualization market is booming → fight for customers and market
share is intense

# Suppliers: initial cost for huge data centers are enormous
# Buyers: low switching cost increases competition

Adjusted model for the cloud market
**The cloud supply chain**

- Cloud supply chain (C-SC) and cloud supply chain management (C-SCM)
  - Supply chain: two or more parties linked by a flow of goods, information, and funds
  - Cloud supply chain: two or more parties linked by the provision of cloud services, related information, and funds
  - Concept of C-SC:
# Two categories of products:
- Functional products:
  * Favor competition and lead to low profit margins
  * Low inventory costs, low product variety, low stockout costs, and low obsolescence
- Innovative products:
  * Unpredictable, variable demand
  * High uncertainties, difficult to forecast
  * Short product life cycles (typically 3 months to 1 year)

- Comparison of traditional and emerging ICT supply chain

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<th>Emerging ICT Concept</th>
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<td>Responsive SC</td>
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<td>Supply demand at the lowest level</td>
<td>Respond quickly to</td>
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<td><strong>Product design strategy</strong></td>
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<td>Maximize performance at the</td>
<td>Create modularity</td>
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<td>minimum product cost</td>
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<td><strong>Pricing strategy</strong></td>
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<td><strong>Manufacturing strategy</strong></td>
<td>Lower costs through high utilization</td>
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<td><strong>Inventory strategy</strong></td>
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<td><strong>Lead time strategy</strong></td>
<td>Reduce but not at the expense of costs</td>
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