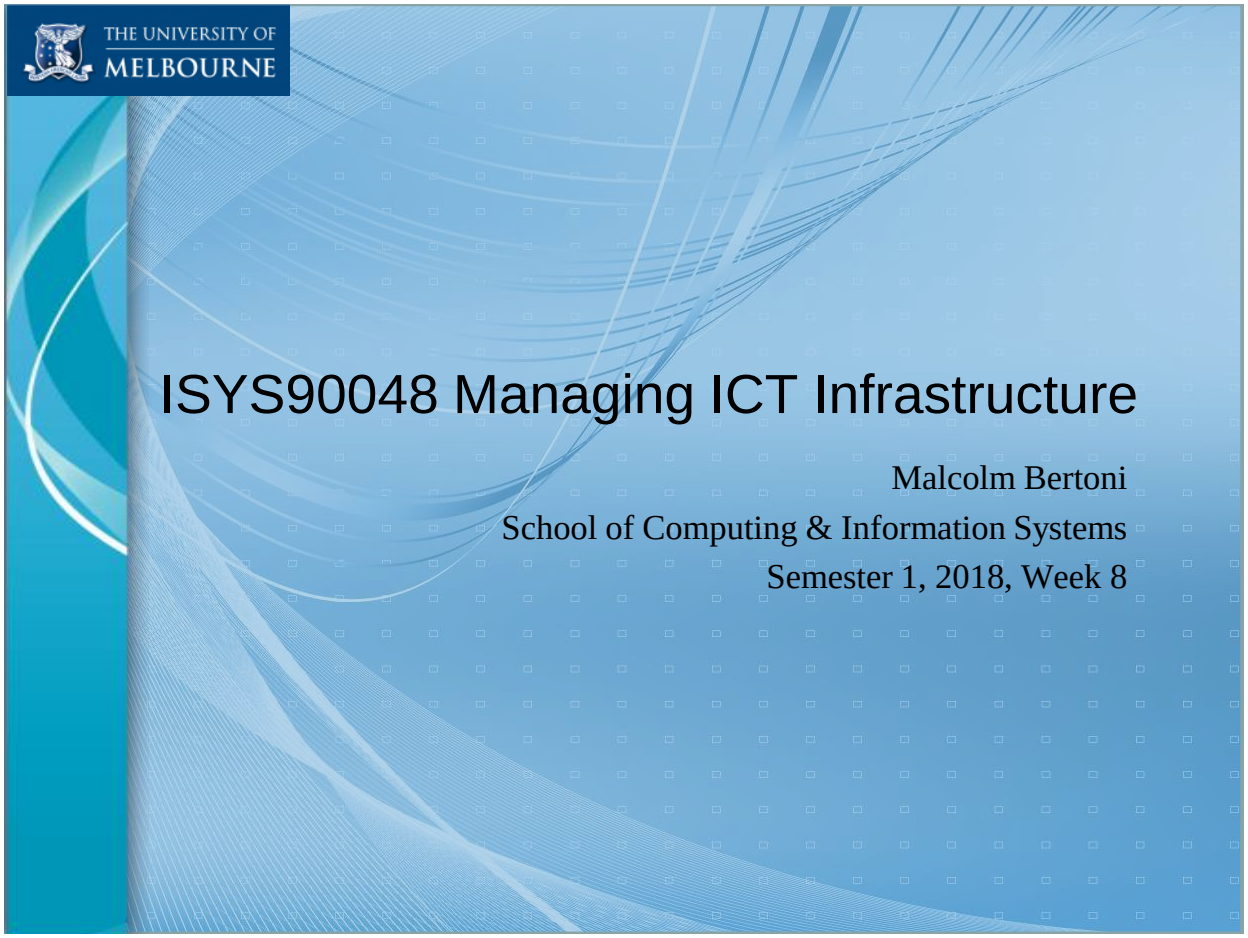

ISYS90048 Managing ICT Infrastructure

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School of Computing & Information Systems
Semester 1, 2018, Week 8

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Teaching Session 08

- Understanding Cloud Computing and its services:
  - Software as a Service (SaaS
  - Platform as a Service (PaaS)
  - Infrastructure as a Service (IaaS)
- The essential Cloud characteristics
- Cloud deployment models
- Cloud components
- Cloud security
- Cloud governance
- Cloud computing and SOA

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Cloud Computing

- Cloud computing is ICT-based services delivered over a network using a configuration of virtualised resources
- It is based on three component architectures:
  - Infrastructure-as-a-Service (IaaS)
  - Platform-as-a-Service (PaaS)
  - Software-as-a-Service (SaaS)
- Definition: Cloud computing is a model for enabling on-demand network access to a shared pool of configurable computing resources (eg, networks, servers, storage, applications, and services) that can be rapidly provided with minimal management effort or service provider interaction
  - A cloud model promotes availability & is composed of five essential characteristics, three service models & four deployment models
  - Valued at US$260 billion in 2017 – project to grow to US400 billion by 2020 (Gartner, October, 2017)

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Cloud Computing

- From a customer perspective, the cloud offers a way to gain new capabilities on demand without investing in new hardware or software
  - Instead, customers pay their cloud provider a subscription fee and only pays for the resources they use
  - Simply by filling in web forms, users can set up accounts
  - More users or computing resources can be added on the fly – the latter in real time as workloads demand those resources thanks to a feature known as auto-scaling

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The Five Essential Cloud Characteristics

1. On-demand self-service
   - Get computing capabilities as needed automatically
2. Broad network access
   - Services available over the net using desktop, laptop, PDA, mobile phone, etc
3. Resource pooling
   - Location independence
   - Provider resources pooled to server multiple clients
4. Rapid elasticity and flexibility
   - Ability to quickly scale in/out service
5. Measured service
   - Controlled, optimised services based on metering
     - "Pay as much as used and needed" type of utility computing and the "always on, anywhere & any place" type of network-based computing
     - Cloud are transparent to users and they can be built in multiple ways

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Advantages/Disadvantages of Cloud Computing

Advantages

- Improved performance
- Reduced software costs
- Instant software updates
- Improved document format compatibility
- Unlimited storage capacity
- Increased data reliability
- Universal document access
- Latest version availability
- Easier group collaboration
- Device independence
- Elasticity/flexibility
- On-demand self-service
- Measured service
  - Pay as you go
- Massive scale

Disadvantages/Issues

- Requires a constant Internet connection
  - Does not work well with low-speed connections
- Features might be limited
- Can be slow
- Stored data might not be secure, ie security issues
  - Stored data can be lost
- Compatibility with cloud's data bases/data centres, etc
- Standards
- Robust network access required

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The Four Cloud Deployment Models

1. Private cloud
   - Single organisation only
   - Managed by the organisation or a 3rd party
   - On or off premise
2. Community cloud
   - Shared infrastructure for specific community
   - Several organisations that have shared concerns
   - Managed by organisation or a 3rd party
3. Public cloud
   - Available to the general public
4. Hybrid cloud
   - Composition of two or more clouds
   - Bound by standard or proprietary technology

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Cloud Security

- Cloud Security is a major issue
  - General Security Advantages
    - Shifting public data to a external cloud reduces the exposure of the internal sensitive data
    - Cloud homogeneity makes security auditing/testing simpler
    - Clouds enable automated security management
    - Redundancy / Disaster Recovery
  - General Security Challenges
    - Trusting vendor's security model
    - Customer inability to respond to audit findings
    - Obtaining support for investigations
    - Indirect administrator accountability
    - Proprietary implementations can't be examined
    - Loss of physical control

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Cloud Governance

- Cloud services governance is a general term for applying specific policies or principles to the use of cloud computing services
- The goal of cloud services governance is to secure applications and data when they are located remotely
- This ensures all enterprise expenditures related to the cloud are aligned with the business objectives and matches the enterprise's own ICT governance
- It recognises that cloud computing increases the pervasive nature of ICT
- Cloud service providers can use similar frameworks such as ITIL, COBIT, etc
- It is essential that the cloud provider's governance is as robust as the customers
- Ideally, cloud services governance complements or is integrated into existing governance processes

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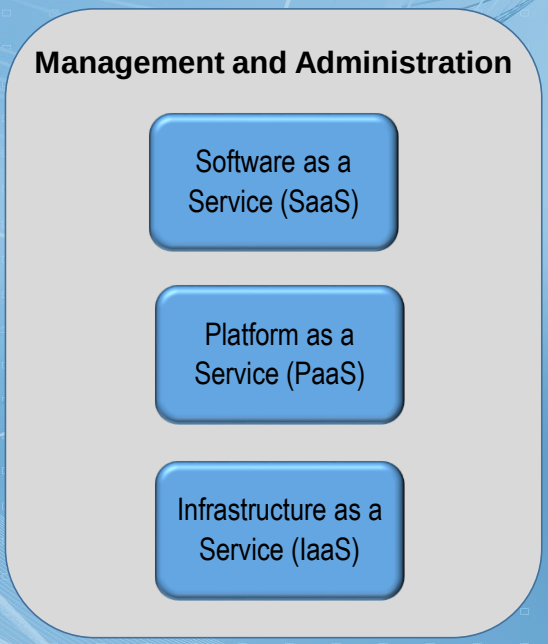
Cloud Governance

- Organisations that use cloud-based services usually do so through an SOA architecture
  - The SOA integration platform plays a key role in integrating existing applications into cloud services and between clouds
  - Cloud-based systems must be built on SOA and modern Enterprise Architecture principles if they are to be effective
  - In many ways, cloud services governance can be viewed as an extension of SOA governance
    - Thus both of them are considered as a subset of ICT governance

The Three Cloud Services Delivery Models



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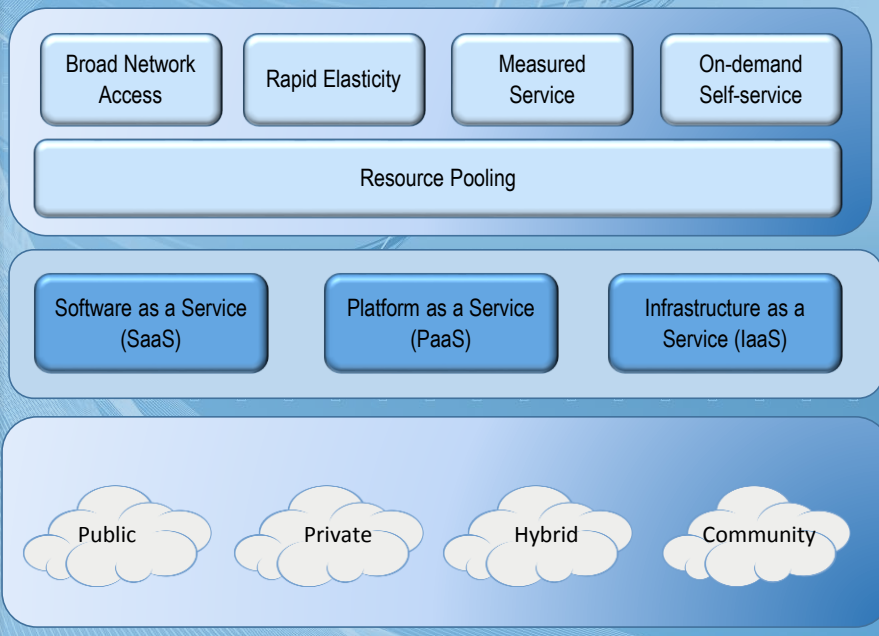
Cloud Components



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1. Cloud Software as a Service (SaaS)

- At the highest layer, SaaS offers applications as services, running on the provider's infrastructure and serving multiple client organisations
  - For example, Google Docs, SalesForce, MS Office 365, MS OneDrive, IBM, Adobe
  - Use provider's applications over a network
    - Interface is often via a browser
- User doesn't manage or control the network, servers, OS, storage or applications
- Most common service provided by the cloud
- No upfront investment for the customer
- Valued at US$40 billion in 2016
  - 20% annual growth

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1. Cloud Software as a Service (SaaS) cont

Characteristics of SaaS software:

- The software application is a network resource that is licensed for use to clients via the network
  - No actual transfer of software or of software licences take place
- Software support, including hosting, capacity management, deployment, authorisation of use and upgrade is managed by the ISP and is online
- Software development, upgrade & re-configuration is managed by the ISP at the host end without the need for any action by the clients
- The software is typically highly re-entrant – many clients can be using the same software at the same time, with each client having a distinct interface
  - Much more sophisticated than just web-based applications

1. Cloud Software as a Service (SaaS) cont

Typical features of SaaS software:

- There is a strong focus on interoperability and modular reuse at the host end in order to facility rapid re-configuration and systems development
- The application typically interacts with databases, and other networked software resources, without the client's awareness, substantially reducing the cost and complexity of the systems integration for the client
- Low-cost addition of new features, since the total cost of new features is marginal
  - One client can request a new feature and that feature be made available to many clients at a small incremental cost to each client
- The focus on service delivery and the need to be competitive for many clients mean that the SaaS is driven to adopt best practice

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1. Cloud Software as a Service (SaaS) cont

Levels of Software-as-a-Service:

1. Ad-hoc: many clients have partially integrated services running on networked hosts
   - Each service is configured to meet the needs of its client(s)
2. Configurable: through the use of XML technology, common software platforms are established to serve multiple clients
3. Configurable & Re-entrant: each software application can serve many clients concurrently and is also configurable to meet the needs of each client
   - Clients can be using highly integrated and re-entrant service modules without their awareness
4. Configurable, Re-entrant & Scalable: all of the above, plus the ability to dynamically use a range of virtualised, networked resources to meet changing demand levels, while maintaining agreed levels of service delivery

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1. Cloud Software as a Service (SaaS) cont

Software-as-a-Service Advantages:

- Higher resource utilisation rates, through virtualisation and concentrating services on fewer shared resources
- Resource consolidation on few servers, with the potential for greater integration and shared resource usage
- Space, management and operational savings
- Disaster recovery/business continuity improvement through the need to manage fewer servers
- Enhanced management functionality through the use of centralised monitoring
- Increased focus on service delivery, rather than technology
- Greater agility in service development through a focus on interoperability and modular reuse
- SaaS is suitable for both SMEs and big business because it offer enterprise solutions to all levels of business

1. Cloud Software as a Service (SaaS) cont

Software-as-a-Service Disadvantages:

- Increased reliance on SaaS
- Increased dependence on service level agreements with SaaS
- Need to follow common development pathways
- Reduced freedom in migration to new systems
- Ongoing cost of service fees
- Potentially less differentiation from competitors with the same or similar SaaS
- Lack of standardisation of browsers, is a issue
- Development of Apps is not keeping pace with commercial requirements of SaaS deployment

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2. Platform as a Service (PaaS)

- At the middle layer PaaS encapsulates a virtual system that can be employed for development or production
  - For example, virtual Linux services offered by many ISPs
  - Users deploy their applications on a cloud
  - Users control their apps
  - Users don't manage servers, IS, storage
    - For example, Amazon, Google App Engine

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3. Cloud Infrastructure as a Service (IaaS)

- At the lowest layer IaaS provides the basic networking, storage, processing, including backup and recovery, typically through virtualisation technology
  - These resources may be shared across many physical processes, depending on load and geographic distribution of demand
  - It may also include the delivery of operating systems and virtualisation technology to manage the resources

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3. Cloud Infrastructure as a Service (IaaS) cont

- Every web hosting company out there could almost be considered an IaaS provider
  - The key differentiator between a web hosting provider & an IaaS provider is how they charge for their services
    - A web hosting company charges by the system by the month An IaaS provider charges only for the compute power that is utilised (usually by CPU hours used by month)
    - The line between IaaS and PaaS is blurring as many IaaS providers have started offering database servers & application servers in addition to the OS
    - Amazon EC2 (elastic cloud compute), Google Compute Engine, IBM Cloud, Microsoft Azure

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Other Cloud Service

- Data Centre as a Service (DCaaS) – a growing trend
- Where the role of ICT and the data centre is to deliver the right service, at the right pace, from the right provider, at the right price
- Data Centres are moving to the cloud
  - Some or all of its data centre to the cloud provider
  - Requires a good connection and speed
  - Disruption is a the biggest concern
- Everything as a Service

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Cloud Computing and SOA

- Services are important for cloud computing from both an infrastructure and an application perspective
- Cloud providers build the cloud infrastructure on well-designed services with clearly defined interfaces
  - These services allow the cloud to scale
  - The cloud infrastructure itself is service oriented
- Companies build applications designed for the cloud as services & this makes it easier for customers & partners to use them
  - For example, Software as a Service providers need an ecosystem of partners that provides either complementary components or full applications that are important to sustaining and growing their businesses
    - A service oriented architecture is the only way partners can economically build on these platforms

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Cloud Computing and SOA cont

- Concepts like reusability and loose coupling that are central to SOA are also integral to the scalability of cloud services
- The use of reusable and loosely coupled components makes scalability and elasticity a reality for cloud service providers
- Companies benefit from SOA and the cloud because both of these approaches place a priority on understanding what the business needs, when it needs it, and how efficiently and cost effectively the business can be served
- SOA is an architectural approach, Cloud is a set of enabling technologies
- SOA and Cloud are complementary, not competitive
  - SOA supports Cloud Computing
    - Enabling easy migration of services to the Cloud
- Cloud computing does not replace SOA as an integration technology

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Cloud and SOA

- There are important overlaps between SOA and Cloud computing
- But they have a different emphasis, resulting from their original focus on different problem sets

Cloud Computing	Overlap	SOA with Web services
Software as a Service	Application layer Components./Services	System of Systems integration focus
Utility Computing	Network dependence	Driving consistency of integration
Storage on demand	Cloud/IP Wide Area Network supported services requests	Enterprise Application Integration
Data distributed in a Cloud	Leveraging distributed software assets	Reasonably mature implementation standards
Platform as a Service	Producer/Consumer model	
Standards evolving		

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Virtualization

- Virtualization is the creation of a virtual - rather than actual - version of something, such as an operating system, a server, a storage device or network resources
- Operating system virtualization is the use of software to allow a piece of hardware to run multiple operating system images at the same time
- A key use of virtualization technology is server virtualization, which uses a software layer called a hypervisor to emulate the underlying hardware
- Virtualization allows for greater flexibility, control and isolation by removing the dependency on a given hardware platform
- Used in six areas:
  - Networks
  - Storage
  - Servers
  - Data
  - Desktop
  - Application

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Summary

- Cloud computing allows use of diverse computing devices such as desktop, laptop, tablet, mobile phone
  - Always accessible
- Can be less expensive for businesses
  - Low/minimal up-front costs
  - Fixed operating costs (pay-per-use)
- Many Cloud providers
- Cloud is a service-delivery model
- A cloud user can combine the services offered by a cloud service provider with in-house services to create SOA-based composite applications
- Security risks (but risks are transferred to the Cloud provider)
- Requires robust Internet as volume of traffic increases

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- Cloud Computing Implementation Model (2014). © State of Queensland (Department of Science, Information Technology, Innovation and the Arts, 74 pp
- Foote, K. D. (2018). A Brief History of Cloud Computing. Viewed May 19, 2018, http://www.dataversity.net/author/keith-foote/page/3/

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Videos

- Cloud Computing IaaS, PaaS, SaaS (6.42 min) https://www.youtube.com/watch?v=36zducUX16w
- How Cloud Computing works (11.00 min) https://www.youtube.com/watch?v=DGDtujmOBKc