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1. Overall Purpose of Syllabus

The purpose of this syllabus is to provide a clear statement of the knowledge and skills required by a professional cloud solution architect. This syllabus informs both candidates and the designers and deliverers of learning materials of the objectives that must be met in order to fulfill the role of cloud architect. Furthermore, the contents of the syllabus will be used as the basis of the examination set by the Cloud Credential Council.

2. Structure of the Syllabus

The structure of this syllabus is layered as follows:

The role itself is briefly described in relation to the background context of cloud computing.

Each module has a clearly stated purpose and introductory synopsis followed by key topics and the specific learning objectives that must be met in order to achieve the required standard.

The flow of the learning modules is designed to build both understanding of the topics and practice in applying that knowledge to the architect role.

Each module also contains details of external reference materials and suggested case studies and scenarios to illustrate and enhance understanding of the topic.

Specific case studies and vendor links are provided for the complete role, testing the scope of learning objectives, issues and learning scenarios.

3. The Role of the Professional Cloud Solution Architect

Cloud computing has been around for a few years now and continues to be built on the foundations of Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). Public and private cloud implementations are now mainstream options that solution architects need to understand and consider in their role. There are a range of capabilities and issues that need to be successfully navigated to support the adoption, development and performance optimization of cloud solutions and services in the enterprise and the wider marketplace and IT ecosystem.

This syllabus examines these major issues and modern cloud-enabled systems and services and their impact on business models, software, hardware and devices. It looks at the following emerging new trends and leading architecture solutions:

- Tablets and other smart devices and platforms and their important role today in modern internet-based service ecosystems.
- The development of private cloud solutions and hybrid cloud solutions that are complementary and alternative to public clouds and their role in business and IT portfolio management and service hosting and delivery models.
- How social enterprise and business processes are converting into new online end user experience systems, mash-ups and services.
- Cloud computing is also creating new development, test and delivery models that are spreading across on-premise and off-premise hosting and deployment channel models.
Solution architects need to consider how existing systems and new solution practices driven by on-demand cloud computing are impacting on consumers, provider private- and public-enabled systems and the integrated hybrid categories of IT and business that are now part of today’s technology landscape.

4. Learning Level of the Syllabus

The modern version of Bloom’s taxonomy of learning is a widely used classification framework for course syllabi and assessments for certification. The taxonomy classifies learning into six ascending levels.

- **Level 1** – the Knowing Level: Exhibit memory of previously learned materials by recalling facts, terms, basic concepts and answers
- **Level 2** – the Comprehension level: Demonstrative understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions, and stating main ideas
- **Level 3** – the Application level: Using new knowledge. Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.
- **Level 4**: the Analysis level: Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations.
- **Level 5**: the Evaluate level: Present and defend opinions by making judgments about information, validity of ideas or quality of work based on a set of criteria
- **Level 6**: the Creation level: Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions

The level of this advanced course for the Professional Cloud Solution Architect role is level 3-4 (Apply, Analyze).

5. Syllabus – Core Skills

Unit 1. History of Computing and Cloud Computing

Module Purpose and Overview

The aim of this module is to give the candidate an understanding of the history of the shift from computing to cloud computing so that the candidate takes into account the impact of the historical context on cloud architecture design.

The evolution of computing has undergone another quantum leap; this time into an era of cloud computing that sees the convergence of existing and new technologies in a new business and technology paradigm. This introduction establishes the context of the trends that cloud computing represents in terms of technical, business and marketplace and governmental impact and legislation.

Key Topics

- From Virtualization to Cloud
- Utility computing, Grid Computing and Cloud Computing
- Impact of the internet, sustainability, energy consumption
- On-premise, Off-premise IT and Business service models
- Tablets, smart devices, services and marketplaces
• Search, subscript and consume lifecycles
• Provider, aggregator, broker and orchestrator lifecycles
• New Monetization strategies and service models
• SOA (Service oriented Architecture) and Enterprise Architecture
• Monetization and charging mechanisms

Learning Objectives

• (L2) Explains the pros and cons of utility computing, grid computing and cloud computing and decide on the best option for a particular set of circumstances.
• (L3) Relates the impact of the shift from virtualization to cloud and factors such as the Internet, sustainability, energy awareness and the emergence of tablets and smart devices on business.
• (L4) Analyzes cloud-related monetization strategies, charging mechanisms and service models, including SOA (Service oriented Architecture) and enterprise architecture

References

Links to content and books

• Before there was Cloud Computing there was SOA, Forbes, Sept 2012http://www.forbes.com/sites/joemckendrick/2012/09/18/before-there-was-cloud-computing-there-was-soa/
• Examples of cloud pioneers http://www.informationweek.com/cloud-computing/infrastructure/10-cloud-computing-pioneers/240142397

Unit 2. Impact of Cloud Computing

Module Purpose and Overview

The aim of this module is to establish the business, social, legal and commercial impacts of cloud computing so that the candidate can apply that understanding to cloud architecture design.

Cloud computing is a business model as well as a technology model that influences the way individuals, companies, marketplaces and whole governments need to think in terms of how to address its opportunities and challenges. This situation has also seen the rise of new collaboration models such as open source and new types of emerging on-demand cloud-enabled sourcing and digital stores and on-line marketplaces. There is also a wider context to these changes including the impact on security, privacy, intellectual property, legality, marketplace access and trading relationships. This can be taken from a number of viewpoints including those of consumers, providers, intermediaries and audit and policy governance.
Key Topics

- Disruption and innovation
- Risk, security and legal issues
- Technical standards and business compliance and certification
- Open source and cloud
- New business models and economics of the cloud
- New business case and value propositions of cloud
- Innovation, crowdsourcing, crowd funding
- Understand the key architecture issues in a cloud computing solution.
- Business requirements and does the cloud fit?
- The NIST definitions: on-demand self-service; broad network access; resource pooling; rapid elasticity; measured service.
- Transparency, tractability and auditability
- Building critical mass for B/E (Break Even) use of the solution and service
- How to define and use charging mechanisms, e.g. basis and methods of upload and download and other methods
- TCO (Total Cost of Ownership), life cycle and operational costs and benefits
- Connectivity, e.g. interfaces and networks
- Understanding the business processes and how cloud computing can support shared, dedicated or federated and remote business services
- Types of solutions e.g. mobile, social network, Big data, cloud computing hosting and other types of solutions that can use cloud computing
- Types of Services e.g. IaaS, PaaS, SaaS
- Make vs. buy costs and capabilities comparison
- What are the key components when using SOA (Service Oriented Architect for Cloud) Computing
- Understanding where to draw the boundaries in a service and cloud computing
- Modularity, code and reuse

An example of the difference in Architecture - The Apartment vs. Dormitory vs. Family analogy

- Scenario 1 - Single user
  Example

- Scenario 2 - Multi-User
  Can either apply to an application, e.g. Microsoft 365
  It can also apply to services that are not entire applications themselves but help other apps or services to work, e.g. Twitter API, Pdf creator API, Database services
  Another example is a network carrier VPN, users apply the service.
  It's all one "building" but the inhabitants think of themselves as separate entities so are separate users. These are Multi-user solutions (not Multi-tenant)

- Scenario 3 - Multi-Tenant
  Example of using Software Portal Solution
  Build a XaaS service to provide Multi Solutions
  More PaaS and SaaS

Learning Objectives

- (L2) Explains examples of the knowledge of innovative models and new forms of sourcing in creating cloud solutions.
- (L3) Relates the key risk, security and legal issues inherent in applying cloud solutions.
• (L4) Outlines the correct variant architecture solutions in case study scenarios.

References
Links to content and books

• Crowd funding [http://crowdfunding.pbworks.com/w/page/10402176/Crowdfunding](http://crowdfunding.pbworks.com/w/page/10402176/Crowdfunding)
• Cloud Computing Issues and Impacts, Ernst and Young, April 2011
• CSA Cloud Security Alliance. Guidelines and Matrix controls [https://cloudsecurityalliance.org/](https://cloudsecurityalliance.org/)
• NIST SP 800-144 - Computer Security Resource Center – 2011

Unit 3. Technology Engineering of Cloud Computing

Module Purpose and Overview

The aim of this module is to explain the implications of operating “as a service” so that the candidate can factor in the relevant key engineering concepts to their architectures.

The scope of technology that is involved in Cloud Computing includes devices, networks, computing, storage, databases as well as the applications, data and other components. Operating “as a service” can involve engineering management systems that enable secure federated security and identity, policy management, template configuration management, automated provisioning, tenancy and multi-tenancy management, subscription, pricing engines, metering, billing, self-service, catalog management and marketplace management, synchronization and API management and related technical standards. Understanding the technology concepts and reference component architectures in SaaS, PaaS, IaaS and the various deployment models: Private Cloud, Public Cloud, Community Cloud and Hybrid cloud is important in the design and control of effective Cloud Computing Solution Architectures.

Key Topics

• Secure federated security and identity
• Policy management
• Template configuration management
• Automated provisioning
• Tenancy and multi-tenancy management
• Resource pooling and load balancing
• Subscription
• Pricing engines
• Metering
• Billing
• Self-service
• Catalog management
Learning Objectives

- (L2) Distinguish the relevant paradigm shifts and reference architectures and standards.
- (L3) Demonstrates an understanding of the practical difference between resource pooling and load balancing.
- (L4) Analyze the appropriate deployment model and service type in a given scenario.
- (L4) Outline the pros and cons of the differing cloud solution architectures and their features.

References

Links to content and books


Unit 4. Cloud Computing Solution Architectures

Module Purpose and Overview

The aim of this module is to discuss the consumer and provider perspectives that have undergone radical changes as a result of cloud computing so that the candidate can use new cloud-enabled business models.

Cloud computing has resulted in new and shifting non-traditional consumer and provider perspectives thanks to the “art of the possible” by which cloud technologies have enabled new business models. A big shift is in the phenomenon of interchanging roles along that consumer-provider axis. Small to medium size enterprises and start-ups have new possibilities with cloud computing. Larger enterprises are greatly impacted by migration, transition and the potential transformations that cloud computing can bring to their organization and the wider marketplaces.

Key Topics

- Consumer viewpoints
- Consumer – Provider
- Search, subscription and consumer models
- User experience and social networks
- Mobile cloud and BYOD
- Big Data and data analytics
- Composite services and mash-ups
- Provider viewpoints
- Hosting, reselling, cloud managed services
- SLA and pricing models
- Metering and billing
- Open source: open stack, cloud stack and others
- Cloud brokerage
Learning Objectives

- (L3) Shows the impact and influence of new cloud enabled solution models (examples: composite mash-up web apps, mobile, BYOD, Big Data)
- (L3) Compare the different deployment channel models (hosting, reselling, management cloud) on architecting cloud solutions.
- (L4) Outlines appropriate architecture options for different sized businesses based on a range of impact factors.

References

Links to content and books

- Subscriptions, The New Software Pricing Model
  http://knowledge.wharton.upenn.edu/article.cfm?articleid=2872
- GovCloud II: Implementation and Cloud Brokerage Services

Unit 5. Cloud Service Life Cycle

Module Purpose and Overview

The aim of this module is to establish the relevant organizational and service paradigms so that the candidate can address situations in which the control and management of the architecture may be federated and/or involve multiple parties and technologies using new cloud-enabled business models.

Cloud computing affects software development life cycles and hardware management models. New concepts of cloud computing life cycles that involve new template-based techniques and standardization as well as rapid agile provisioning and development need to be understood to maximize elasticity, scalability, responsiveness and cost. Hardware and software component requirements and design need to consider cloud computing characteristics in XaaS design and deployment models.

Key Topics

- SLA and OLA Management and Choices (Service Level Agreements, Operating Level Agreements)
- Contract and contract-less services
- SLA and pricing mechanisms in cloud computing
- Service performance, security and reliability
- Commodity standardization vs. custom solutions
- Search, discovery and consumption
- Publish, subscription and product management
- Product lines, certification, syndication
- SOEs (Standard Operating Environments)
- Virtual containers and tenancy
- Templates, standardization, and catalogs
- Contract or contract-less
- Service Oriented Architecture (SOA) and the cloud
• Software development life cycle for cloud computing
• Requirements management and cloud computing

**Learning Objectives**

• (L2) Summarizes the different control and management issues in different cloud deployment solutions (defined in the previous section).
• (L3) Shows and apply the different cloud life cycles in a given scenario.
• (L4) Differentiates appropriate cloud solution characteristics for different deployment solution models.

**References**

Links to content and books

• What is XaaS? [http://searchcloudcomputing.techtarget.com/definition/XaaS-anything-as-a-service](http://searchcloudcomputing.techtarget.com/definition/XaaS-anything-as-a-service)
• What is SaaS? [http://searchcloudcomputing.techtarget.com/definition/Software-as-a-Service](http://searchcloudcomputing.techtarget.com/definition/Software-as-a-Service)
• What is PaaS? [http://searchcloudcomputing.techtarget.com/definition/Platform-as-a-Service-PaaS](http://searchcloudcomputing.techtarget.com/definition/Platform-as-a-Service-PaaS)
• What is IaaS? [http://searchcloudcomputing.techtarget.com/definition/Infrastructure-as-a-Service-IaaS](http://searchcloudcomputing.techtarget.com/definition/Infrastructure-as-a-Service-IaaS)
• What is a SOE (Standard Operating Environment) [http://www.techopedia.com/definition/4544/standard-operating-environment-soe](http://www.techopedia.com/definition/4544/standard-operating-environment-soe)
• Operating system vs. hypervisor-based virtualization, a comparison between containers and virtual machines [http://www.servernest.com/container-virtual-machine.html](http://www.servernest.com/container-virtual-machine.html)

**Unit 6. Service Transition and Service Transformation**

**Module Purpose and Overview**

The aim of this module is to focus on the issues involved in moving from non-cloud to cloud solutions so that the candidate can effectively advise and guide a successful transition.

Much of the perceived benefit of cloud computing can be attributed to the rapid search, discovery, selection and use of services. The SLA performance and running of services have different viewpoints from the consumer and provider perspectives.

How to “run your business in the cloud” and how to “run IT as a business” are two key consequences of this. Which factors need to be addressed and what changes are involved when moving away from a traditional hosting model are addressed in this module.

**Key Topics**

• Public vs. Private Cloud Environment characteristics
• Barriers and enablers to Cloud Computing adoption
• “Running your business in the Cloud”
• Consumer perspectives
• Provider perspectives
• Intermediary perspectives
• Certification and accreditation of a cloud
• Different types of certification: security, staff skills, vendor/technology, legal compliance)
• An app to run in a cloud
• A custom developed app to run in a cloud PaaS
• Infrastructure certification of IaaS
• A cloud environment and provider certification
• License Tracking and Asset Usage Control in Cloud Computing
• ITIL and Service Management Life Cycle Impact of Cloud Computing
• COBIT and Impact of Cloud Computing
• Service Lines and Service Desk Management
• Support Engineering Services

Learning Objectives

• (L2) Summarizes the key features and issues of “running your business in the cloud” and “running IT as a business”.
• (L3) Shows the main issues involved in certification and accreditation of a cloud solution.
• (L4) Compares different strategies to maximize the enablers and minimize the barriers of adopting cloud computing as a business option.

References

Links to content and books
• Cloud Computing and SLAs
  http://www.computerworld.com/s/article/9221644/Cloud_Computing_and_the_Truth_About_SLAs
• ITIL and Cloud Computing
  http://www.itilnews.com/ITIL_and_Cloud_Computing_by_Sumit_Kumar_Jha.html
• COBIT and Cloud Computing
• Apps Stores and Cloud Computing
  http://www.partnerpedia.com/blog/cloud-computing-accelerating-enterprise-app-store-trend/
• Enterprise Apps Stores
  http://www.partnerpedia.com/enterprise_app_store.html
• Mobile Apps Stores
  http://www.partnerpedia.com/enterprise_app_store.html
• Big Data Analytics as a Service
• Data as a Service
  http://searchcloudapplications.techtarget.com/definition/data-as-a-service
• Storage as a Service
  http://searchcloudapplications.techtarget.com/definition/data-as-a-service

Unit 7. Consumer Perspective on Setting Up Cloud Environments

Module Purpose and Overview

The aim of this module is to explore the perspective of the cloud consumer so that the candidate can take it into account when architecting a cloud environment.
This module covers the consumer side of defining a cloud environment, including the IaaS, PaaS and SaaS models and different deployment options.

**Key Topics**

Walkthrough of Example Steps to Development and Appreciation of Key Issues

- Setup active directories, sign-on SSO policies and controls
- Administration management, provisioning and domain management
- Security controls on endpoints, e.g. personal mobile device controls and cloud storage
- Access environment policies and SLA usage threshold limits
- Setup service management, account management and reporting controls
- Setup tablets, smart devices, end points controls, connectivity and services
- Portals and browser services
- Setup provisioning automation and self-service controls
- Setup storefront and usage controls

Key Solution Architecture Business Features:

- Self-service provisioning of additional resources
- Costs and billing based upon metered resource usage (utility)
- Search, access and consume
- Portability and movement of personal data to cloud, mobile devices
- OpEx cost vs. CapEx investment
- Shorter-term commitments (hourly-daily-weekly-monthly)
- Simple contracting process (e.g. credit card)
- Portability of services across hosting providers

**Learning Objectives**

- (L2) Summarizes the key business features of a consumer cloud solution architecture.
- (L3) Prepares and plans a specific consumer cloud environment for a given scenario.
- (L4) Identifies the key steps in setting up a consumer cloud environment.

**References**

Links to content and books

Unit 8. Provider Perspective on Setting Up Cloud Environments

Module Purpose and Overview

The aim of this module is to explore the perspective of the cloud provider so that the candidate can take it into account when architecting a cloud environment.

This module covers the provider side of defining a cloud environment, including the IaaS, PaaS and SaaS models and different deployment options.

Key Topics

Walkthrough of Example Steps to development and Appreciation of Key Issues

- What is a cloud environment
- Features and characteristics
- Types of XaaS
- Reference models - the layers that matter
- Security in cloud
- Trust, isolation, domains, tenancy, multi-tenancy
- Cloud XaaS continuum
- SaaS, PaaS, IaaS
- Private, public, hybrid, community
- Requirements
- Self service
- Custom requirement
- Sourcing
- Options and methods (marketplace)
- Dynamic sourcing using spot cloud marketplace
- Provision
- Self service
- Request build
- Launch cloud environment
- Publish new catalog service
- Portfolio Management
- Deployment strategies
- Private cloud / public cloud
- Hybrid cloud
- Multi-cloud providers
- Existing legacy environment with the cloud
- Metering / billing
- Performance
- Service management
- SLA
- Reporting
- Automation
- Elasticity features
- Tools, policy management
- Marketplace
- Multi-CSP (Cloud Service Provider) environments
Key Solution Architecture Application Features

- Remediated and abstracted, virtualized applications (e.g. resource hard-coding)
- Templated granular virtual server roles (auto-scaling of capacity)
- A strong understanding of automation logic (errors, conditions, events, responses)
- Solid approaches to managing state across virtualized infrastructure
- Robust security engineering at the application layer (Jericho, Bastion models)
- Operate on x86 hardware platform

Key Solution Architecture Infrastructure Features

- Adequately available capacity of compute, network and storage resources (vs. theoretically infinite)
- Monitoring of user demand and scaling of infrastructure resources to meet required capacity
- Highly-available, redundant infrastructure components
- Secure segmentation and partitioning of users and services throughout all layers of the virtualized infrastructure
- Metered usage & consumption of compute resources
- API and web service interaction models (vs. GUI tooling/management)
- Programmatic control and workflow of key tasks (e.g. provisioning, configuration settings, de-provisioning)
- Interoperable with standards (immature) to avoid lock-in challenge

Learning Objectives

- (L2) Summarizes the key business features of a provider cloud solution architecture.
- (L3) Prepares and plans a specific cloud provider environment for a given scenario.
- (L4) Identifies the key steps in setting up a provider cloud environment.

References

Links to content and books

- [http://www.ictknowledgebase.org.uk/cloudproviderquestions](http://www.ictknowledgebase.org.uk/cloudproviderquestions)
- Vendor Example Definition [http://gnax.net/](http://gnax.net/)

Unit 9. Cloud Ecosystem

Module Purpose and Overview

The aim of this module is to cover the interconnected nature of the different elements of the cloud ecosystem so that the candidate can take into account the bigger picture and consider how providers and consumers and intermediaries can play different roles in this landscape.

The cloud environment can involve many solutions and components. Beyond this the choice and variety of cloud access endpoints and the diversity of marketplaces and services means that often providers and
consumers are able to offer or leverage a variety of products and services. This represents the emergent ecosystems of cloud products, services and devices that occur inside and outside an organization.

**Key Topics**

- Exploring the Business and IT Context
- Internet of Things, Internet of Everything
- Ubiquitous Systems, Pervasive Computing
- Actors and Roles
- Services and Domains
- Cloud Brokerage models
- Portfolio Management, Governance and Policy Impact of Cloud Computing

**Learning Objectives**

- (L2) Summarizes the impact of wider concepts such as the Internet of Things and the Internet of Everything on the process of architecting cloud solutions.
- (L3) Discovers and prioritizes the different macro and micro drivers of business and technology ecosystems and how Cloud Computing may change these for different stakeholders and investors
- (L4) Identifies the roles of consumer, provider and intermediary in the context of broader governance and policy.

**References**

Links to content and books

**Internet of Things**

- [http://www.theinternetofthings.eu/](http://www.theinternetofthings.eu/)

**Ubiquitous Computing**

- [http://www.rcet.org/ubicomp/what.htm](http://www.rcet.org/ubicomp/what.htm)

**Cloud Brokerage**

- [http://www.businesscloud9.com/content/cloud-brokers-rise-definitions-remain-blurred/12172](http://www.businesscloud9.com/content/cloud-brokers-rise-definitions-remain-blurred/12172)

**Unit 10. Types of XaaS Solutions**

**Module Purpose and Overview**

The aim of this module is to explore both the existing and new generation of workloads that exist in today’s cloud enabled digital ecosystem so that the candidate can utilize the full range of architecture and business model solutions.

The emergence of IaaS, PaaS and SaaS as mainstream on-demand services has led the way to the evolution of new cloud supporting services including Big Data analytics, mobility, social enterprise,
embedded devices, multi-channel stores resulting in a cultural and market shift. Issues such as cloud service broker (CSB), user experience (UX), open source cloud and the new integration of hybrid cloud environments are also evolving fast as part of the range of cloud ecosystems.

DaaS (desktop as a service) has evolved from virtual desktop integration (VDI) into a multi-channel customer user experience, BYOD (bring your own device) and converged network and business services. Personal cloud and personal cloud storage and services are also evident particularly in individual and small to medium size businesses in the new cloud consumer usage models. NaaS (network as a service) and ECS (embedded cloud services) have resulted in new cloud-enabled services and the Internet of Things (IoT) that is seeing even more types of devices being connected. Over 7 billion devices were connected in 2008, this is predicted to pass 50 billion by 2020.

Enterprise architecture and solutions architectures have been developed to align with this new range of service types and deployment model options (collectively known as XaaS). The critical issue is the analysis of horizontal and vertical workload requirements that determine the criteria used to select and fit XaaS type solutions.

**Key Topics**

**Vision of cloud ecosystem – scope and scale of XaaS**
- The technological history of cloud computing resources and services
- Enterprise application stores, platform marketplaces
- Examples of common cloud management services, security, metering, billing, governance, reporting, audit, provisioning, catalog
- Big Data analytics, mobility, social enterprise, embedded devices, multi-channel stores and cloud computing (Gartner Nexus, IDC the 3rd Platform)

**Analysis of cloud ecosystem requirements**
- How to conduct horizontal, vertical and diagonal (stores, marketplaces, appliances) workload requirements analysis
- Cloud interactive ecosystem language – modeling the cloud ecosystem: devices, networks, services, contents, security and domains
- Layers of the cloud ecosystem
  - strategic architecture – drivers, domains, resources, roles and rules
  - internet of things – ubiquitous presence devices, meshes and services
  - capability architecture - system to system
  - functional architecture

**Make, Buy, Subscribe, Reuse options analysis**
- “as a service”, products and services, commodities versus custom
- Private versus public sourcing options
- Balance sheet CAPEX versus cash-flow working capital OPEX Investment and payment options, assets versus subscription
- Dedicated versus specialist workloads - high performance computing, grid versus cloud computing and virtualization clusters.

**XaaS solutions**
- IaaS (infrastructure as a service)
- PaaS (platform as a service)
- SaaS (software as a service)
- BPaaS (business process as a service)
- Personal cloud and personal cloud storage
• Big Data analytics and data as a service
• UX (user experience as a service) and mashups
• DaaS (desktop as a service) and VDI (virtual desktop integration)
• ECS (embedded cloud devices), ubiquitous computing and presence
• Naas (network as a service)
• CaaS (carrier as a service), (communication as a service)
• CaaS (compliance as a service)
• SecaaS (security as a service)
• CSB (cloud service broker) and Integration-aaS (integration as a service)
• Browser device services (The development of tablet, application store and data content store service marketplaces effectively represents yet another "as a service" category for consumption and device-centric services enabling front end device interaction and back end cloud marketplace and service delivery models for device-related application, content, commerce and collaboration style services.)

XaaS solutions and the architecture landscape
• Example criteria for key functional and non-functional attributes of XaaS types
• Strategic architecture and XaaS solutions
• Capability architecture and types of cloud solutions
• Functional architecture and XaaS solutions

Learning Objectives
• (L2) Relates the historical development of cloud computing and its future path to new cloud ecosystem solutions.
• (L3) Identifies the types of XaaS solutions and service options and how functional and non-functional criteria can be determined.
• (L4) Contrasts the different options available in XaaS that can be combined in strategic, capability and functional architectures, giving examples by technology and vertical industry exemplars.

References
• http://www.zdnet.com/blog/service-oriented/nist-definition-of-cloud-computing-doesnt-go-far-enough/8634
• XaaS http://searchcloudcomputing.techtarget.com/definition/XaaS-anything-as-a-service
• IaaS http://searchcloudcomputing.techtarget.com/definition/Infrastructure-as-a-Service-IaaS
• PaaS http://searchcloudcomputing.techtarget.com/definition/Platform-as-a-Service-PaaS
• SaaS http://searchcloudcomputing.techtarget.com/definition/Software-as-a-Service
• BPaaS http://www.dummies.com/how-to/content/what-is-business-process-as-a-service-bpaaS-inclio.html
• Big Data http://www.gartner.com/it-glossary/big-data/
• Big Data Analytics as a Service vendor example http://www.emc.co.uk/collateral/.../h10839-big-data-as-a-service-persp.pdf
• Data as a Service http://searchcloudapplications.techtarget.com/definition/data-as-a-service
• Monitoring as a Service Maas http://www.thefreedictionary.com/monitoring+service
• http://www.westglobal.com/til
• Messaging as a service Maas Vendor example http://www.capgemini.com/services-and-solutions/technology/emc/solutions/messaging-as-a-service/
• Network as a Service http://www.telecom-cloud.net/network-as-a-service/
• Network as a Service NaaS  http://www.networksfirst.com/category/network-as-a-service-naas/
• Carrier as a Service CaaS  Vendor example http://www.xo.com/services/carrier/Pages/overview.aspx
• http://searchenterprisewan.techtarget.com/resources/Telecommunications-Carrier-Services
• Enterprise Mobility management http://en.wikipedia.org/wiki/Enterprise_mobility_management
• Enterprise Mobility as a Service Vendor view http://www.verizonenterprise.com/products/mobility/enterprise-mobility-service/?__ct_return=1
• Compliance as a Service CaaS vendor example http://controlcase.com/CaaS-Compliance-as-a-Service.htm
• Internet of Things http://lexicon.ft.com/Term?term=the-internet-of-things
• Big Data http://blogs.forrester.com/mike_gualtieri/12-12-05-the_pragmatic_definition_of_big_data
• Personal Cloud http://www.pcmag.com/encyclopedia_term/0,1237,t=personal+cloud&i=62784,00.asp
• Personal Cloud Services http://www.gartner.com/newsroom/id/1942015
• Personal Cloud Storage http://searchcloudstorage.techtarget.com/definition/personal-cloud-storage
• BYOD Bring your own device http://whatis.techtarget.com/definition/BYOD-bring-your-own-device
• http://searchconsumerization.techtarget.com/definition/BYOD-policy
• Social Enterprise http://en.wikipedia.org/wiki/Social Enterprise
• UXD User Experience Design http://en.wikipedia.org/wiki/User_experience_design
• TOGAF Architecture Landscape http://pubs.opengroup.org/architecture/togaf9-doc/arch/chap41.html
• SecaaS Security as a Service  http://searchsecurity.techtarget.com/definition/Security-as-a-Service
• SecaaS https://cloudsecurityalliance.org/research/secaas/

Unit 11. Targeting the Right Solution Architecture

Module Purpose and Overview

The aim of this module is to consider the role of the solution architect so that the candidate can balance the perspectives of provider, consumer and intermediary.

This learning module covers the key skills in solution architecture to define specific cloud computing XaaS solutions and deployment models. The roles of architecture and solution architects are examined in the context of cloud computing and how enterprise architecture and solution architecture may work together to define a specification.

The solution architect needs to understand the perspective of their role and how it fits with a consumer, provider or intermediary perspective. It is possible to have all these roles in one organization being both a consumer and provider through consuming cloud and providing a cloud service.

Key Topics

• Roles of Architecture
• Enterprise Architecture:  Strategy, Portfolio, Selection, Catalog, Governance
• Solution Architecture: Requirements, Design, Build, Integrate, Management

What is your role?

• Different role perspectives
• Consumer? – finding a solution for my company to use
• Service Provider? – looking to build a cloud service to fill a need and go to market
• Broker/Integrator?

Frameworks and Design Choices
• The challenges?
• What is different for an architect for the cloud?
• What tools to use?
• What level of abstraction?
• Services
• Resources
• Interfaces
• Security considerations
• Channels
• Templates and SOEs, PODs
• Catalogs and self-service design
• Marketplace delivery methods
• Subscription and metering, billing models
• State management

Types of Solution Architectures in Cloud Computing
• XaaS Services Design
• Tablets and Smart Devices Service Solutions
• Stores and Marketplace Platform Solutions
• Standards and API management

Design principles for XaaS
• Elastic
• Scalable
• On-demand
• Self service
• Recovery
• Load balancing
• Yield distributed
• State/stateful

Defining Selection Criteria for XaaS
• Business and IT processes
• Information and security constraining
• Availability, mobility, access and performance constraints
• Contractual and legal constraining
• Outsourcing, ‘coLoc’, offshore, on-shore constraints
• Multi-user, multi-tenancy and hosting
• Cloud design and delivery methods
• Multi-CSP (Cloud Service Provider) scenarios

Portfolio Management and Controls

Project and Service Management

Analyzing the Demand, Supply and Channels
• Demand analysis: communities, individuals, enterprises
• Supply analysis: platforms, storefronts, API-centric, hosting-centric
• Channels analysis: device-centric, deployment-centric (Private, Public, Community, Hosting)

Analyzing Workload Analysis (for IaaS, PaaS and SaaS models)
• Horizontal workloads
• Vertical workloads
• Diagonal workloads
• Composite Rich Internet Application workloads

Analyzing Cloud Fit vs. Custom Solutions

Make versus Buy, Write vs. Rent decision criteria for cloud computing
• Request, design, publish and selection
• New development, test, deploy models

Open source and alternative models of use of cloud computing
• Marketplace services (apps, data, feeds)
• Crowdsourcing (collaborative)
• Composite Application Integration

Learning Objectives
• (L2) Prepares the key design principles of XaaS and types of deployment scenarios
• (L3) Prepares and illustrates the demand, supply and channel profiles and solution fit criteria in a given scenario
• (L4) Analyzes options comparing multiple solutions with inputs considering not only technology but also organizational and strategic implications
• (L4) Discriminates between key factors in solution selection, including Make vs. Buy, Write vs. Rent.

References
Links to content and books
• How to handle workloads in cloud computing http://www.dummies.com/how-to/content/how-to-handle-workloads-in-cloud-computing.html
• Monetization strategies for cloud computing http://cloudcomputing.sys-con.com/node/1645415
• Cloud Performance Metrics http://www.cio.com/article/595179/8_Ways_to_Measure_Cloud_ROI
• Types of Workloads: Cloud Computing for Business – The Open Group (Book) https://www2.opengroup.org/ogsys/jsp/publications/PublicationDetails.jsp?publicationid=12431
• Types of OSE (Online Sourcing Environments): Hand book of Outsourcing second Edition (Book)

6. Syllabus – Advanced Skills

The aim of this module is to identify the scope of the Cloud Architect role and activities in-depth so that the candidate can apply their skills to specific tasks and types of cloud solutions.

XaaS. The cloud computing ecosystem is increasingly expanding the possibilities of solution architecture and enterprise services that can include big data analytics, embedded services in smart devices, Network as a Service (NaaS) providing a range of communication and on demand services. The boundary of cloud environments and the ecosystem of devices, Wi-Fi, tablets, smart phones and different cloud enables services are redefining how business models, business processes and markets and social interactions and
services work in a modern economy. New Cloud services in encompassed in the XaaS term can include BPaaS Business Process as a Service, Mobility and BYOD that pushed Virtual Desktop and Remote services into now Mobile Cloud services, personal cloud services and storage and other new forms of Internet enables services sometimes referred to as Internet of Things (IoT) and Ubiquitous Computing and context location aware services presence. This learning module explores these issues through case studies and topics the fit criteria of where different cloud enables solutions can support the requirements of an organization.

**IaaS.** The IaaS cloud environment offers specific challenges for the Architect role: types of virtual clouds, data centres and networks together with the standards and benchmarking processes needed to establish control and automation of these environments. In addition to the issues of workload definitions and VM deployment and maintenance lifecycles affect the service performance and user experience. Selection and design of IaaS architecture environments impact legacy architecture and types of application and data services that may be hosted in the IaaS environment and exposed through Marketplace stores, self-service and accessed on premise and remotely over the infrastructure.

**PaaS.** Platform as a Service is a rapid development environment that enables new cloud-enabled capabilities to be both used and developed. The Architecture decisions involve commodity or custom development of cloud services that may involve on premise or external development teams, architects, consumers and other stakeholders. Specific challenges in standards, tools, templates and how they are applied to solution architecture design and the overall enterprise architecture blue print and portfolio management of services, platform integration management and performance of the cloud solution architecture across different endpoint devices, locations and services.

**SaaS.** Software as a Service usage and environments potentially cover many of the main business enterprise and social media services in a modern organization. Email, collaboration, productivity, social media storage as well as main stream sales, finance, work activity and across various on premise and off premise locations and the interactions with businesses, marketplaces and consumers.

Cloud Architecture in the SaaS context may involve multiple SaaS solutions and services across a number of different SaaS providers, their impact on security, SLA contracts, Licensing and availability. There can be a number of potential architectural issues of mobility and smart device access using SaaS applications, the use of self-service marketplaces that may provide “Apps on Demand” to down load and use almost instantly across different devices and service networks owned by the enterprise or through 3rd party managed hosting services. The Cloud Architect role needs to understand and evaluate the benefits and issues that SaaS can enable and bring to the organization and the various different types of user communities and methods of using SaaS, its design and usage tracking and performance management.

**Unit 12. IaaS: Evaluating a IaaS Solution Architecture**

**Module Purpose and Overview**

*The aim of this module is to critically examine the issue for different cloud architectures so that the candidate can implement advanced features of cloud computing solutions.*

This module explores the specific IaaS architecture design issues and concerns relating to the evaluation, selection and use of IaaS.
Key Topics

Types of IaaS Workload in Cloud Architectures

IaaS architecture challenges

- Access and security
- Compatibility
- Isolation
- Personal data versus Company data management
- Containers
- Standard Operating Environments

IaaS Cloud Integration Mechanisms

- VPN virtual networks
- VPC virtual cloud environment, data centers
- APIs

IaaS Cloud Management Components in Detail

- Cloud security components
- Cloud management components
- Physical to virtual (P2V) and V2V portability
- On-boarding, configuration and certification of IaaS cloud environments

IaaS Cloud Management Operational Issues in Detail

- Backup, recovery, archive, audit
- Integration, data and service synchronization
- Interoperability and portability
- Multi-CSP (Cloud Service Provider) scenarios

Learning Objectives

- (L2) Explains the differing technical architectures available for IaaS cloud solutions.
- (L3) Shows how to manage the cloud integration challenges in a given scenario.
- (L4) Distinguishes the components and operational issues involved in managing cloud solutions.

References

Links to content and books

- IaaS Cloud requirements http://www.opendatacenteralliance.org/docs/tmforum_tr174enterprisegrade_computiaasrequirements.pdf
- Service Orchestration http://www.servicetechmag.com/l66/0912-1
Unit 13. IaaS: Writing a IaaS Solution Architecture Specification

Module Purpose and Overview

The aim of this module is to engage with the key architecture blueprints for cloud computing so that the candidate can begin to write their own IaaS solution architecture specification.

This module includes the differing types of IaaS architecture specifications and abstraction levels, namely the conceptual, logical and physical architecture models.

The second part of this section looks at the key IaaS architecture management components and systems for a cloud environment.

Key Topics

IaaS related Architecture Design Specification Standards

IaaS Architecture Patterns

• The separation of concerns
• Example IaaS Contextual architecture
• Example IaaS Conceptual architecture
• Example IaaS Logical architecture
• Example IaaS Physical architecture

Analysis and Evaluation of Specific Features in the IaaS Solution Architecture Specification:

• IaaS Technology architecture
• IaaS Security architecture
• IaaS Service integration architecture
• IaaS Governance and policy management architecture
• IaaS Service management architecture

IaaS Contracts, Security, Risk and Governance

• Security requirements
• Risk and governance
• Contract and legal issues

IaaS Solution Architecture Patterns

• Business on-demand use cases and IaaS architecture patterns
• Cloud product-oriented use cases and IaaS architecture patterns
• Custom and cloud hybrid use cases and IaaS architecture patterns
• Cloud ecosystem use cases and IaaS architecture patterns

IaaS Deployment Model Architecture Patterns

• Private IaaS Cloud
• Public IaaS Cloud
• Hybrid IaaS Cloud
• IaaS Consumer Personal Cloud
• IaaS Multi-CSP (Cloud Service Provider)
• IaaS Cloud Marketplace
• IaaS Mobile Cloud
Learning Objectives

• (L3) Shows the different types of cloud architecture specification and architecture patterns.
• (L4) Outlines the key architecture management components and systems for a cloud environment for different cloud solution scenarios in the case studies.

References

Links to content and books

• Cloud Enterprise Architecture and TOGAF http://cloudcomputing.sys-con.com/node/1621013
• Example Vendor Patterns http://www.infoq.com/presentations/Patients-for-Cloud-Computing

Unit 14. IaaS: Developing a IaaS Business Case

Module Purpose and Overview

The aim of this module is to introduce the concept of SLAs (Service Level Agreements) and different pricing and charging mechanisms relating to IaaS solutions so that the candidate can advise on a variety of important client needs and factors when constructing a cloud computing business case for IaaS.

In order to influence and persuade the full range of stakeholders, business cases for cloud architecture solutions must address a number of non-technical issues, including value, performance targets, organizational culture and return on investment. This module focuses on the specific issues relating to IaaS.

Key Topics

IaaS Value Propositions:
• Faster, better, cheaper

IaaS Monetization Strategies:
• On-demand, factional, elastic,

IaaS specific Metrics and IaaS Performance Management
• Cost, time, quality
• Macro economic and micro economic
• Management performance

IaaS specific Benchmarks and Standards
• Virtual environment performance measurement
• Standards for templates
• Standards for units of service

IaaS Strategic Alignment and Solutions
• Primary business services
• Support business services
• New business solution capabilities with cloud computing

IaaS Maturity Assessments for Cloud Adoption and Usage
• Business and IT culture readiness
• Technology readiness
• Industry and consumer readiness
• Risk, quality of service, security standards readiness assessment for cloud

“Running IT as a Business”
• Changes in cash flow models
• Changes in investment and ROI
• Managing marketplace catalogues
• provisioning and allocation of cloud resources and services to tenants and multi-tenants

IaaS Cash flow and ROI (Return on Investment) Models
• CapEx and OpEx models.
• Asset and annuity models
• Cash flow models for cloud computing
• Long-term TCO (Total Cost of Ownership)
• ROI models for cloud computing

Analyzing and Evaluation of IaaS Break Even Points
• Consumer perspectives
• Provider perspectives
• Intermediary perspectives

Corporate Asset Accounting Implications of IaaS
• balance sheet
• cash flow
• revenue (profit & loss)
• market value of company

Learning Objectives
• (L2) Explains the core components of an SLA and the relevant charging mechanisms.
• (L3) Shows the range of stakeholder issues and concerns for a new cloud solution.
• (L4) Illustrates a cloud solution business case with the key factors affecting different scenarios illustrated by solution case studies.

References
Links to content and books
• Cloud ROI model and KPIs http://www.opengroup.org/cloud/whitepapers/ccroi/kpis.htm
• Cost of cloud computing http://hosting.onestopclick.com/topic/152/452/the-cost-of-the-cloud-insights-into-calculating-cloud-roi.html
• Maximizing ROI from Cloud Computing http://blog.thehigheredcio.com/2012/03/13/6-step-cloud-adoption-strategy-to-maximize-roi/
• Standards for Cloud Services Units of Measure UOM. E.g. ODCA Usage scenarios.
Unit 15.  IaaS: Migration, Legacy Transition and Transformation

Module Purpose and Overview

The aim of this module is to foster a practical understanding of the wider benefits implications of a shift to IaaS cloud computing so that the candidate can conduct a seamless high level transition for the client.

The potential of cloud computing lies not only in cost reduction and faster time to provision; it can also transform whole marketplaces and change how business processes, operating models and business model strategies work. The shift from today’s legacy systems and business processes to a cloud-enabled environment and business involves a number of steps that affect the successful outcomes of the transition and transformation for consumers and providers.

Key Topics
IaaS Stakeholders and Investor Expectations
IaaS Users Groups and Communities on Line vs. Physical Value Chains and Networks.
IaaS Migration strategies
IaaS Legacy transition
IaaS Data migration and transformation in business organization
IaaS Processes to support working in the cloud

Learning Objectives

• (L2) Explains key stakeholder issues and concerns involved in the implementation of a cloud architecture.
• (L3) Shows the features of the role of IT pre- and post-cloud computing.
• (L4) Compares IT and Business transformational scenarios that cloud computing can enable.
• (L4) Illustrates a migration strategy for scenarios in the case studies that takes full account of both consumer and provider perspectives.

References

Links to content and books
• How Cloud Computing can transform Business, Bernard Golden 2010
• Cloud adoption and security issues http://www.net-security.org/secworld.php?id=13496
• Security certification and compliance
Unit 16. PaaS: Evaluating a PaaS Solution Architecture

Module Purpose and Overview

The aim of this module is to critically examine the issue for different cloud architectures so that the candidate can implement advanced features of cloud computing solutions.

This module explores the specific PaaS architecture design issues and concerns relating to the evaluation, selection and use of PaaS.

Key Topics

Types of PaaS Workload in Cloud Architectures
- Build versus Buy
- Rent versus Use
- Single tenancy and multi-tenancy
- Shared versus private code base
- Open source and cloud

PaaS architecture challenges
- Access and security
- Code Compatibility, Operating systems
- Configuration and version management
- IDE management
- SDK management
- Licensing and IP
- Synchronous and asynchronous systems
- RESTful vs. SOAP

PaaS Cloud Integration Mechanisms
- APIs
- Application stores
- Mash-ups, service choreography
- Workflow and business process management orchestration
- Idempotency vs. state transitions

PaaS Cloud Management Components in Detail
- Cloud security components
- Cloud management components
- Code portability and replication
- On-boarding, configuration and certification of PaaS cloud environments

PaaS Cloud Management Operational Issues in Detail
- Backup, recovery, archive, audit
- Integration, data and service synchronization
- Interoperability and portability
- Multi-CSP (Cloud Service Provider) scenarios

Learning Objectives
- (L2) Explains the differing technical architectures available for cloud solutions.
• (L3) Shows how to manage the cloud integration challenges in a given scenario.
• (L4) Distinguishes the components and operational issues involved in managing cloud solutions.

References
Links to content and books
• PaaS Cloud requirements http://searchcloudapplications.techtarget.com/news/2240100097/Understanding-requirements-key-when-choosing-a-PaaS-provider
• PaaS features http://techcrunch.com/2008/10/06/seven-key-requirements-corporate-it-needs-from-paas/
• RESTful Web Services and Cloud Computing http://www.infoq.com/presentations/Mobile-Cloud-REST
• APIs and Cloud Computing http://www.infoworld.com/d/cloud-computing/3-reasons-we-wont-see-cloud-api-standard-196056
• Service Orchestration http://www.servicetechmag.com/I66/0912

Unit 17. PaaS: Writing a PaaS Solution Architecture Specification

Module Purpose and Overview
The aim of this module is engage with the key architecture blueprints for cloud computing so that the candidate can begin to write their own PaaS solution architecture specification.

This module includes the differing types of PaaS architecture specifications and abstraction levels, namely the conceptual, logical and physical architecture models.

The second part of this section looks at the key PaaS architecture management components and systems for a cloud environment.

Key Topics
PaaS related Architecture Design Specification Standards
PaaS Architecture Patterns
• The separation of concerns
• Example PaaS Contextual architecture
• Example PaaS Conceptual architecture
• Example PaaS Logical architecture
• Example PaaS Physical architecture

Analysis and Evaluation of Specific Features in the PaaS Solution Architecture Specification and Cloud Computing covering:
• PaaS and Business architecture
Unit 18.  PaaS: Developing a PaaS Business Case

Module Purpose and Overview

The aim of this module is to introduce the concept of SLAs (Service Level Agreements) and different pricing and charging mechanisms so that the candidate can advise on a variety of important client needs and factors when constructing a cloud computing business case using a PaaS solution architecture.
In order to influence and persuade the full range of stakeholders, business cases for cloud architecture solutions must address a number of non-technical issues, including value, performance targets, organizational culture and return on investment.

**Key Topics**

**PaaS Value Propositions:**
- Faster, better, cheaper

**PaaS Monetization Strategies:**
- On-demand, factional, elastic,

**PaaS specific Metrics and Performance Management**
- Cost, time, quality
- Macro economic and micro economic
- Management performance

**PaaS specific Benchmarks and Standards**
- Virtual environment performance measurement
- Standards for templates
- Standards for units of service

**PaaS Strategic Alignment and Solutions**
- Primary business services
- Support business services
- New business solution capabilities with cloud computing

**PaaS Maturity Assessments for Cloud Adoption and Usage**
- Business and IT culture readiness
- Technology readiness
- Industry and consumer readiness
- Risk, quality of service, security standards readiness assessment for cloud

“Running IT as a Business”
- Changes in cash flow models
- Changes in investment and ROI
- Managing marketplace catalogues
- Provisioning and allocation of cloud resources and services to tenants and multi-tenants

**PaaS Cash flow and ROI (Return on Investment) Models**
- CapEx and OpEx models.
- Asset and annuity models
- Cash flow models for cloud computing
- Long-term TCO (Total Cost of Ownership)
- ROI models for cloud computing

**Analyzing and Evaluation of PaaS Break Even Points**
- Consumer perspectives
- Provider perspectives
- Intermediary perspectives
Corporate Asset Accounting Implications of PaaS

- balance sheet
- cash flow
- revenue (profit & loss)
- market value of company

Learning Objectives

- (L2) Explains the core components of an SLA and the relevant charging mechanisms.
- (L3) Shows the range of stakeholder issues and concerns for a new cloud solution.
- (L4) Illustrates a cloud solution business case with the key factors affecting different scenarios illustrated by solution case studies.

References

Links to content and books

- Cloud ROI model and KPIs http://www.opengroup.org/cloud/whitepapers/ccroi/kpis.htm
- Standards for Cloud Services Units of Measure UOM. E.g. ODCA Usage scenarios.

Unit 19. PaaS: Migration, Legacy Transition and Transformation

Module Purpose and Overview

The aim of this module is to foster a practical understanding of the wider benefits implications of a shift to PaaS cloud computing so that the candidate can conduct a seamless high level transition for the client.

The potential of cloud computing lies not only in cost reduction and faster time to provision; it can also transform whole marketplaces and change how business processes, operating models and business model strategies work. The shift from today’s legacy systems and business processes to a cloud-enabled environment and business involves a number of steps that affect the successful outcomes of the transition and transformation for consumers and providers.

Key Topics

PaaS Stakeholders and Investor Expectations
PaaS Users Groups and Communities on Line vs. Physical Value Chains and Networks.
PaaS Migration strategies
PaaS Legacy transition
PaaS Data migration and transformation in business organization

PaaS Processes to support working in the cloud

**Learning Objectives**

- (L2) Explains key stakeholder issues and concerns involved in the implementation of a cloud architecture.
- (L3) Shows the features of the role of IT pre- and post-cloud computing.
- (L4) Compares IT and Business transformational scenarios that cloud computing can enable.
- (L4) Illustrates a migration strategy for scenarios in the case studies that takes full account of both consumer and provider perspectives.

**References**

Links to content and books

- How Cloud Computing can transform Business, Bernard Golden 2010

**Unit 20. SaaS: Evaluating a SaaS Solution Architecture**

**Module Purpose and Overview**

*The aim of this module is to critically examine the issue for different cloud architectures so that the candidate can implement advanced features of cloud computing solutions.*

This module explores the specific SaaS architecture design issues and concerns relating to the evaluation, selection and use of SaaS.

**Key Topics**

**Types of SaaS Workload in Cloud Architectures**

SaaS architecture challenges

- Build versus Buy
- Rent versus Use
- Single tenancy and multi-tenancy
- Shared versus private code base
- Open source and cloud

SaaS Integration Mechanisms

- Access and security
- Code Compatibility. Operating systems
- Configuration and version management
- Tenancy and usage of SaaS
- Open source SaaS
- In house SaaS and 3rd party hosted SaaS
• Use of Apps stores
• SaaS Data synchronization
• Licensing and IP
• Synchronous and asynchronous systems
• RESTful vs. SOAP

SaaS Management Components in Detail
• Cloud security components
• Cloud management components
• Mashups and Data management an synchronization with SaaS solutions
• SaaS portability and controls
• On-boarding, configuration and certification of SaaS cloud environments

SaaS Management Operational Issues in Detail
• Backup, recovery, archive, audit
• Integration, data and service synchronization
• Interoperability and portability
• Multi-CSP (Cloud Service Provider) scenarios

Learning Objectives
• (L2) Explains the differing technical architectures available for cloud solutions.
• (L3) Shows how to manage the cloud integration challenges in a given scenario.
• (L4) Distinguishes the components and operational issues involved in managing cloud solutions.

References
Links to content and books
• RESTful Web Services and Cloud Computing http://www.infoq.com/presentations/Mobile-Cloud-REST
• APIs and Cloud Computing http://www.infoworld.com/d/cloud-computing/3-reasons-we-wont-see-cloud-api-standard-196056
• Service Orchestration http://www.servicetechmag.com/66/0912-1
• Social Enterprise, Social Cloud  http://www.ksri.kit.edu/Upload/Publications/aface0bb-d437-49db-bf6d-a943034c9870.pdf

Unit 21.  SaaS: Writing a SaaS Solution Architecture Specification

Module Purpose and Overview
The aim of this module is engage with the key architecture blueprints for cloud computing so that the candidate can begin to write their own SaaS solution architecture specification.
This module includes the differing types of SaaS architecture specifications and abstraction levels, namely the conceptual, logical and physical architecture models.

The second part of this section looks at the key SaaS architecture management components and systems for a cloud environment.

**Key Topics**

SaaS related Architecture Design Specification Standards

SaaS Architecture Patterns

• The separation of concerns
• Example SaaS Contextual architecture
• Example SaaS Conceptual architecture
• Example SaaS Logical architecture
• Example SaaS Physical architecture

Analysis and Evaluation of Specific Features in the SaaS Solution Architecture Specification and Cloud Computing covering:

• SaaS and Business architecture
• SaaS Information systems architecture
• SaaS Application architecture
• SaaS Information architecture
• SaaS Technology architecture
• SaaS Security architecture
• SaaS Service integration architecture
• SaaS Governance and policy management architecture
• SaaS Service management architecture

SaaS Contracts, Security, Risk and Governance

• Security requirements
• Risk and governance
• Contract and legal issues

SaaS Solution Architecture Patterns

• Business on-demand use cases and SaaS architecture patterns
• Cloud product-oriented use cases and SaaS architecture patterns
• Custom and cloud hybrid use cases and SaaS architecture patterns
• Cloud ecosystem use cases and SaaS architecture patterns

SaaS Deployment Model Architecture Patterns

• Private SaaS Cloud
• Public SaaS Cloud
• Hybrid SaaS Cloud
• SaaS Multi-CSP (Cloud Service Provider)
• SaaS Cloud Marketplace
• SaaS development for Mobile cloud and mobility apps

**Learning Objectives**

• (L3) Shows the different types of cloud architecture specification and architecture patterns.
• (L4) Outlines the key architecture management components and systems for a cloud environment for different cloud solution scenarios in the case studies.

References

Links to content and books

• Cloud Enterprise Architecture and TOGAF http://cloudcomputing.sys-con.com/node/1621013
• Example Vendor Patterns http://www.infoq.com/presentations/Patterns-for-Cloud-Computing

Unit 22. SaaS: Developing a SaaS Business Case

Module Purpose and Overview

The aim of this module is to introduce the concept of SLAs (Service Level Agreements) and different pricing and charging mechanisms so that the candidate can advise on a variety of important client needs and factors when constructing a cloud computing business case using a SaaS solution architecture.

In order to influence and persuade the full range of stakeholders, business cases for cloud architecture solutions must address a number of non-technical issues, including value, performance targets, organizational culture and return on investment.

Key Topics

SaaS Value Propositions:
• Faster, better, cheaper
SaaS Monetization Strategies:
• On-demand, factional, elastic,
SaaS specific Metrics and Performance Management
• Cost, time, quality
• Macro economic and micro economic
• Management performance
SaaS specific Benchmarks and Standards
• Virtual environment performance measurement
• Standards for templates
• Standards for units of service
SaaS Strategic Alignment and Solutions
• Primary business services
• Support business services
• New business solution capabilities with cloud computing
SaaS Maturity Assessments for Cloud Adoption and Usage
• Business and IT culture readiness
• Technology readiness
• Industry and consumer readiness
• Risk, quality of service, security standards readiness assessment for cloud

“Running IT as a Business”
• Changes in cash flow models
• Changes in investment and ROI
• Managing marketplace catalogues
• Provisioning and allocation of cloud resources and services to tenants and multi-tenants

SaaS Cash flow and ROI (Return on Investment) Models
• CapEx and OpEx models.
• Asset and annuity models
• Cash flow models for cloud computing
• Long-term TCO (Total Cost of Ownership)
• ROI models for cloud computing

Analyzing and Evaluation of SaaS Break Even Points
• Consumer perspectives
• Provider perspectives
• Intermediary perspectives

Corporate Asset Accounting Implications of SaaS
• balance sheet
• cash flow
• revenue (profit & loss)
• market value of company

Learning Objectives
• (L2) Explains the core components of an SLA and the relevant charging mechanisms.
• (L3) Shows the range of stakeholder issues and concerns for a new cloud solution.
• (L4) Illustrates a cloud solution business case with the key factors affecting different scenarios illustrated by solution case studies.

References
Links to content and books
• Cloud ROI model and KPIs http://www.opengroup.org/cloud/whitepapers/ccroi/kpis.htm
• Cost of cloud computing http://hosting.onestopclick.com/topic/152/452/the-cost-of-the-cloud-insights-into-calculating-cloud-roi.html
• Maximizing ROI from Cloud Computing http://blog.thehigheredcio.com/2012/03/13/6-step-cloud-adoption-strategy-to-maximize-roi/
• Standards for Cloud Services Units of Measure UOM. E.g. ODCA Usage scenarios.
Unit 23. SaaS: Migration, Legacy Transition and Transformation

Module Purpose and Overview

The aim of this module is to foster a practical understanding of the wider benefits implications of a shift to SaaS cloud computing so that the candidate can conduct a seamless high level transition for the client.

The potential of cloud computing lies not only in cost reduction and faster time to provision; it can also transform whole marketplaces and change how business processes, operating models and business model strategies work. The shift from today’s legacy systems and business processes to a cloud-enabled environment and business involves a number of steps that affect the successful outcomes of the transition and transformation for consumers and providers.

Key Topics

SaaS Stakeholders and Investor Expectations
SaaS Users Groups and Communities on Line vs. Physical Value Chains and Networks.
SaaS Migration strategies
SaaS Legacy transition
SaaS Data migration and transformation in business organization
SaaS Processes to support working in the cloud

Learning Objectives

• (L2) Explains key stakeholder issues and concerns involved in the implementation of a cloud architecture.
• (L3) Shows the features of the role of IT pre- and post-cloud computing.
• (L4) Compares IT and Business transformational scenarios that cloud computing can enable.
• (L4) Illustrates a migration strategy for scenarios in the case studies that takes full account of both consumer and provider perspectives.

References

Links to content and books
• How Cloud Computing can transform Business, Bernard Golden 2010
• Cloud adoption and security issues http://www.net-security.org/secworld.php?id=13496
• Security certification and compliance

7. Specific Architecture Knowledge for Cloud Architect

The aim of this chapter is to suggest a variety of vendor-based potential courses of further study for cloud architects so that the candidate can plan their on-going personal development in the role.
• Microsoft Learning - IaaS, PaaS, SaaS
• VMware vCloud: Architecting the VMware Cloud v1.0
• VMware Certified Professional (VCP), Certified Advanced Professional (VAP)
• Cisco, EMC, VMware alliance Cloud Training
• Cloud Architect EMC Education, Training and certification
• Foundations in IBM Cloud Computing Architecture IBM Training
• IBM Cloud Computing Infrastructure Architect IBM Training
• Cloud Architect, HP ASE
• AWS Training – Architect
• Google Apps Certified Deployment specialist
• Cloud Architect Red Hat
• 3Tera Cloud Computing Certifications
8. Course & Exam Details

Course Details
Suggested delivery format is instructor-led classroom-based learning.
Suggested duration: 24 learning hours.

Exam Details

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<td>Exam Type</td>
<td>Scenario Based, Complex Multiple Choice</td>
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<td>Nr of Questions</td>
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<td>Duration</td>
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<tr>
<td>Provisions for additional time relating to language</td>
<td>15 minutes of additional time</td>
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<tr>
<td>Prerequisite</td>
<td>None. However, it is recommended to have passed Cloud Essentials or Virtualization Essentials certification.</td>
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<td>Open Book</td>
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