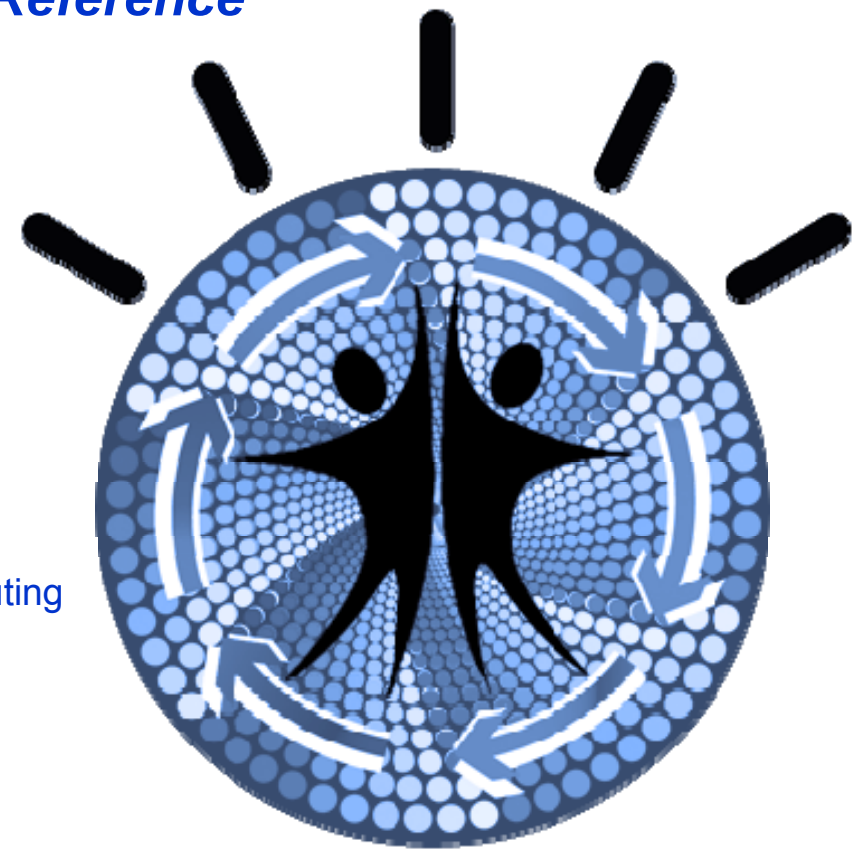
Cloud Computing

Architect our Smarter Planet

CLOUD Computing –
IBM Cloud Computing Reference Architecture



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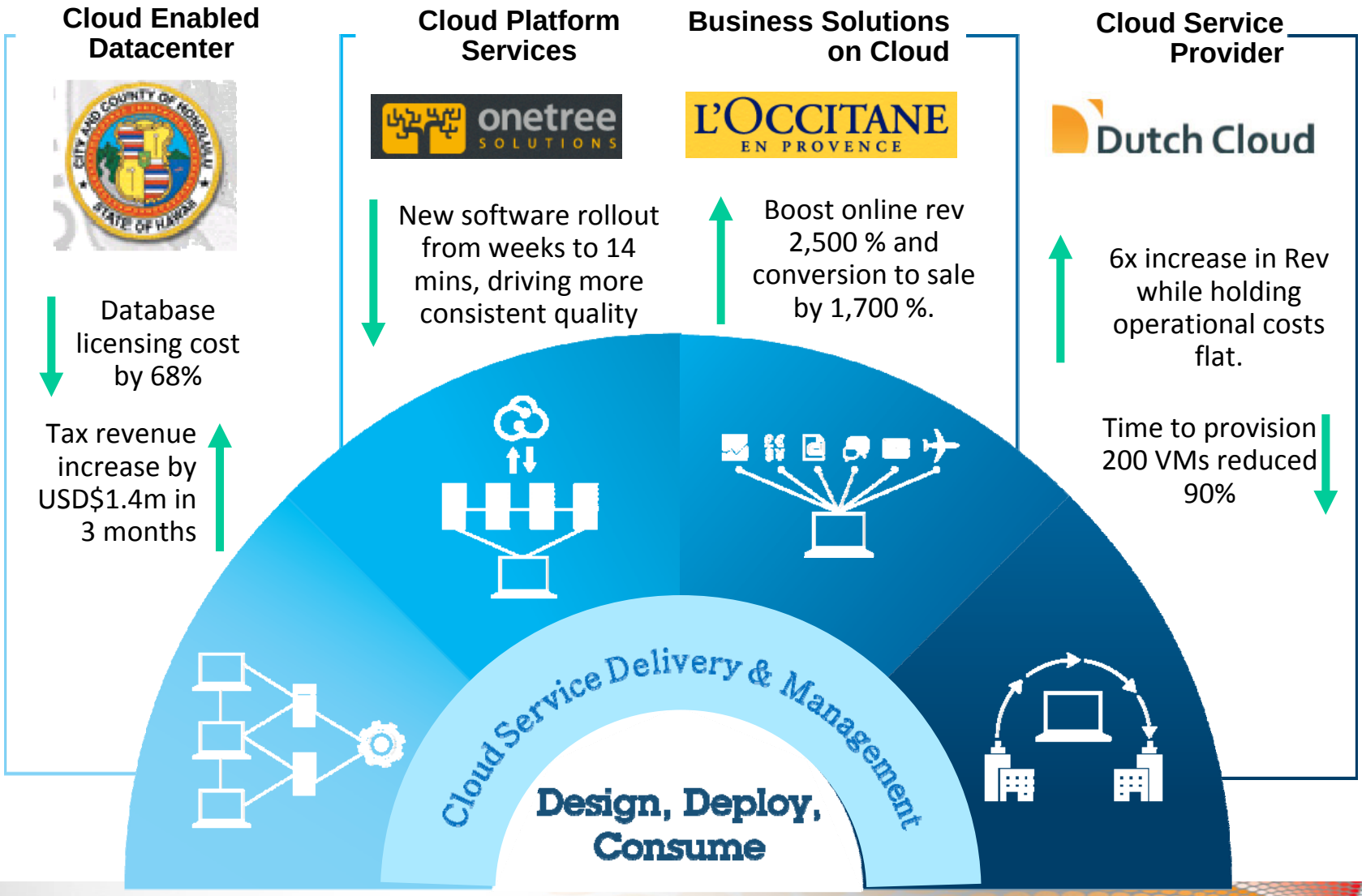
CTO SWG Tech Sales Cloud Computing

IBM Cloud Computing Reference Architecture

Adoption patterns to help customers achieve real business value



The IBM Cloud Computing Reference Architecture (CCRA)

Represents the aggregate experience from hundreds of cloud client engagements and IBM-hosted cloud implementations

Public Cloud RA whitepaper available on ibm.com:
http://public.dhe.ibm.com/common/ssi/ecm/en/ciw03078usen/CIW03078USEN.PDF
CCRA OpenGroup submission:
http://www.opengroup.org/cloudcomputing/uploads/40/23840/CCRA.IBMSubmission.02282011.doc

- –Based on knowledge of IBM's services, software & system experiences, including IBM Research

Provides prescriptive guidance on how to build IaaS, PaaS, SaaS and service provider clouds using IBM technologies

Reflected in the design of

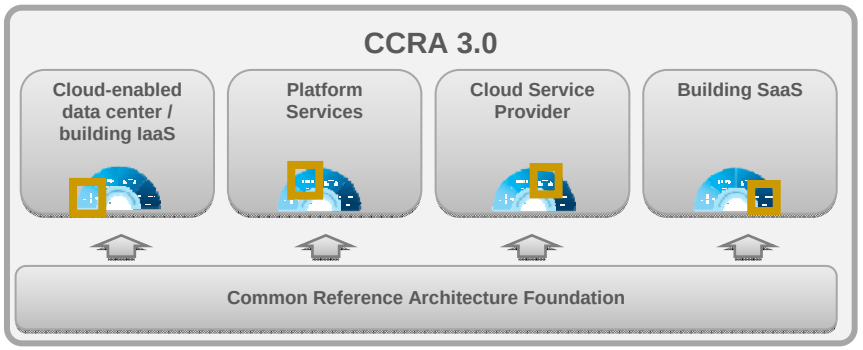
- –Clouds IBM implements for clients
- –IBM-hosted cloud services
- –IBM cloud appliances
- –IBM cloud products

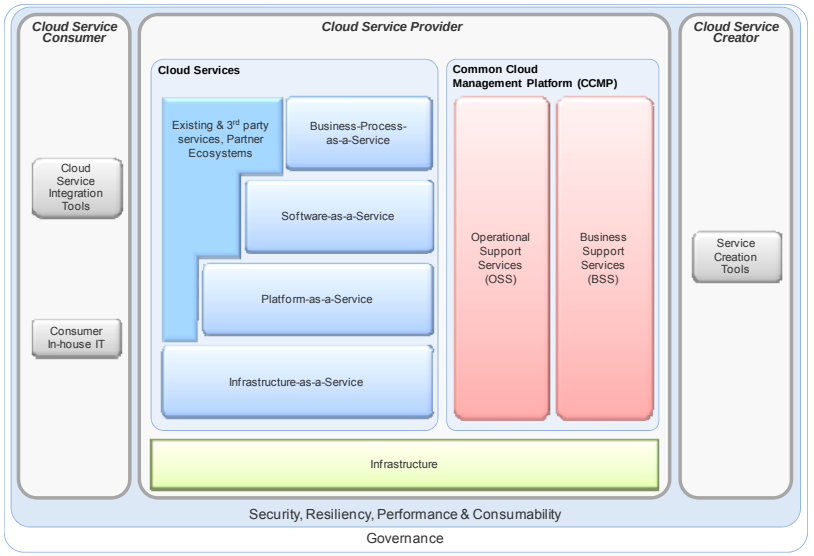
Focuses on cloud specifics

- –Radical cost reduction
- –Achievement of high degrees of security, reliability, scalability and control

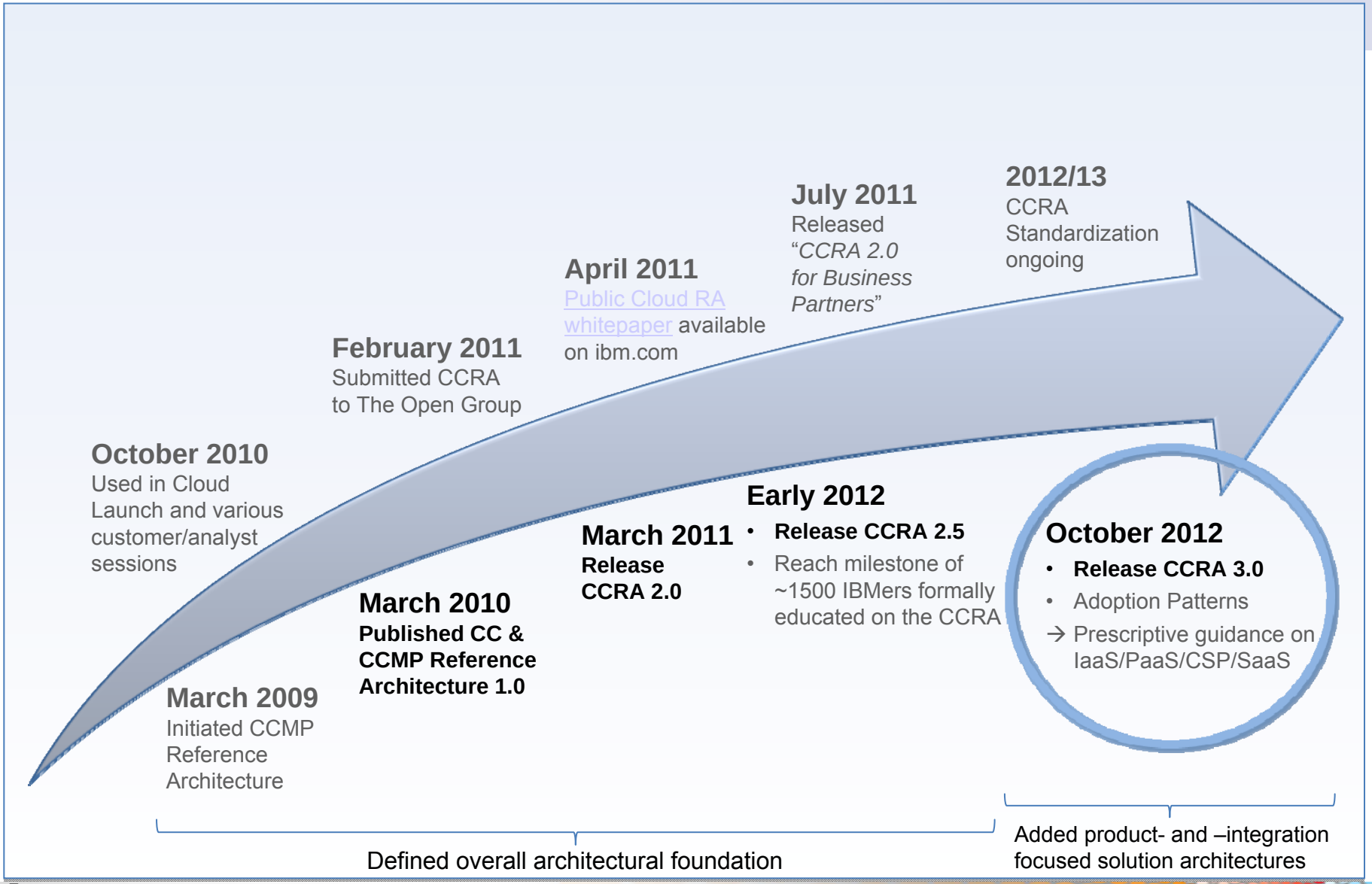
Consists of multiple detailed documents representing best-of-industry knowledge and insight

- –How to architect, design and implement clouds





Evolution of the Cloud Computing Reference Architecture (CCRA 3.0)



The Business Benefits of the IBM Cloud Computing Reference Architecture

The IBM Cloud Computing Reference Architecture (CCRA) ***saves the client time and money*** by providing detailed documentation on the steps and components required for constructing a cloud implementation across all deployment models.

Customers can ***benefit from IBM's experience*** in creating public, private and hybrid clouds with one common architecture with reusable assets or product recommendations.

Clients receive a quicker start to creating an industrial strength cloud with pre-defined use cases and documentation on the architectural requirements or decisions that must be made for security, service management, performance, scalability and virtualization.

Utilize sound architectural principles to ***speed development and reduce errors*** across the entire development process ensuring designs can scale for efficiencies and can fulfill important cloud requirements such as elasticity, self-service and flexible sourcing

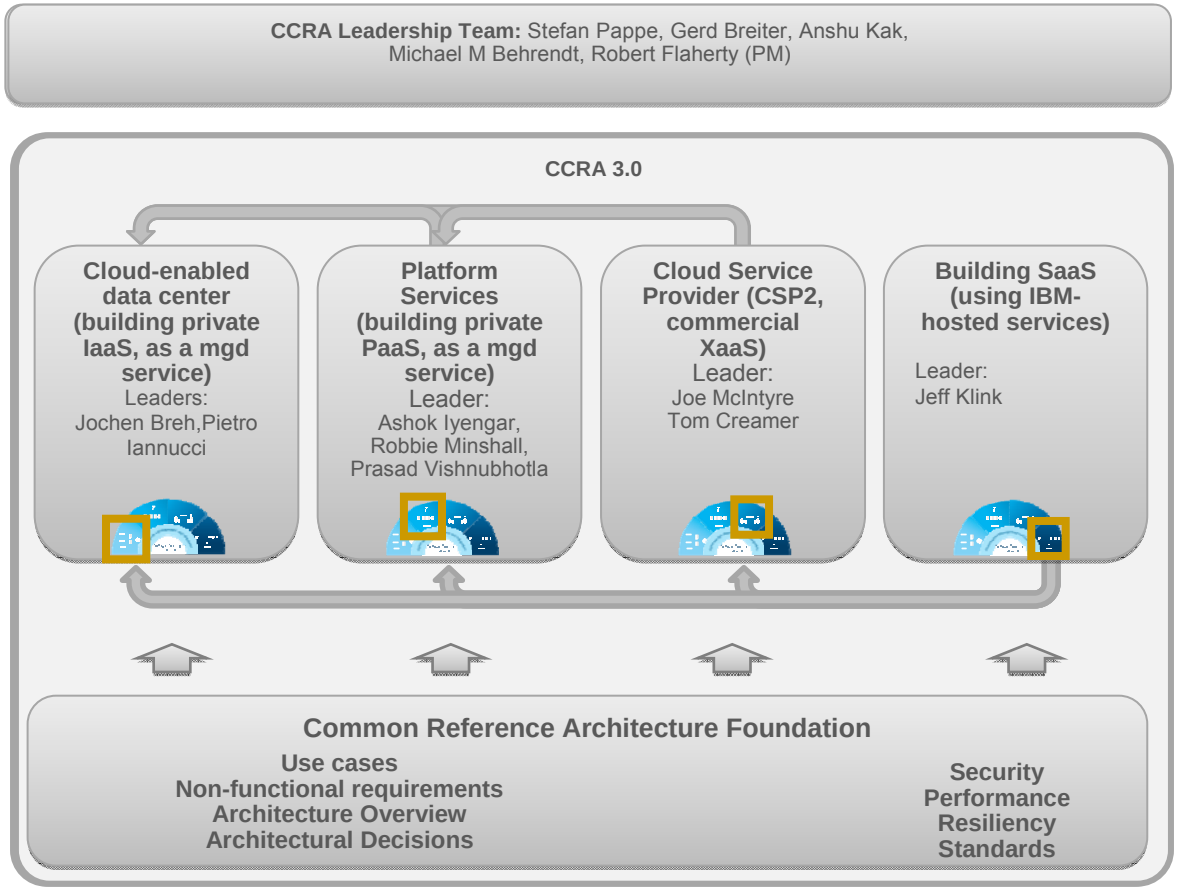
Increased business flexibility with a common cloud reference architecture across deployment models (private, public or hybrid cloud implementations)

WHAT IS NEW IN CCRA 3.0

- **Delivers prescriptive guidance to architect solutions for IaaS, PaaS or SaaS with IBM product recommendations and roadmap to get on cloud journey**
- **Consists of various architectural work products** representing best of breed IT industry knowledge and insight on how to architect, design, implement and manage clouds
- **Defines the business and technical requirements** needed for various cloud roles and responsibilities such as the cloud consumer, the cloud provider and the cloud services creator
- **Is a modular framework** that allows you to focus on the area that's most important for your cloud deployment (IaaS, PaaS, SaaS, CSP)
- **Provides the comparison blueprint** to perform client cloud gap analysis and to identify integration points

CCRA 3.0 organizational structure - Prescriptive solution architectures per cloud adoption pattern

New four main workstreams **have been added as part of the CCRA 3.0**
Pre-3.0 content has been reworked in the context of 4 top-level workstreams



" Cloud Adoption Pattern" deliverables

One presentation per adoption pattern (4 in total) containing:

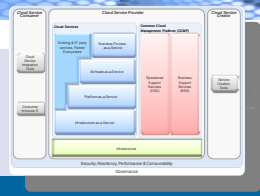
- Business Drivers
- Actors & Use Cases
- Non-functional requirements
- System Context
- Architectural Decisions
- Architecture Overview
- Component Model
- Operational Model
- Roadmap

Cross-cutting documents for:

- Introduction & Architecture Overview
- Use Cases & Roles
- Non-functional requirements
- Architectural Decisions
- Security
- Performance & Scalability
- Resiliency
- Hybrid Cloud
- Workload Migration
- Standards
- Consumability

Public Cloud RA whitepaper available on ibm.com:
http://public.dhe.ibm.com/common/ssi/ecm/en/ciw03078usen/CIW03078USEN.PDF
CCRA OpenGroup submission:
http://www.opengroup.org/cloudcomputing/uploads/40/23840/CCRA.IBMSubmission.02282011.doc

Prescriptive, Consumable IBM Solutions
Cloud Adoption Patterns - driven by clients



CCRA Adoption Patterns

Cloud Enablement Data Center

Simple IaaS with Cloud Governance

VMs provisioning and images mgmt Usage metering and Accounting Monitoring & Capacity PlanningBackup&Restore,Endpoint compliance and Patch-Mgmt

Events Management

Advanced IaaS

Cloud Services Orchestration

Storage Provisioning and mgmt

Network Provisioning and mgmt

Hybrid Cloud Integration

Advanced Security (Identity & access mgmt, security information, events mgmt

ITIL Managed IaaS

Change&configutation mgmt, Problem mgmt, Incident mgmt, License mgmt

Platform Services

- Management & deployment of middleware
- Application Lifecycle Mgmt DevOps, Dev test
- Cloud Service Integration "Southbound" integration with CEDC / IaaS

Building SaaS (using IBM-hosted services)

•Business Solutions in cloud
•Exploit IaaS and PaaS for building a SaaS
•Address ISV space
•Use of hosted offerings
•Multi-tenancy options & design considerations
•Cost considerations
-3rd party tools recommended where appropriate

Cloud Service Provider (CSP2, commercial XaaS)

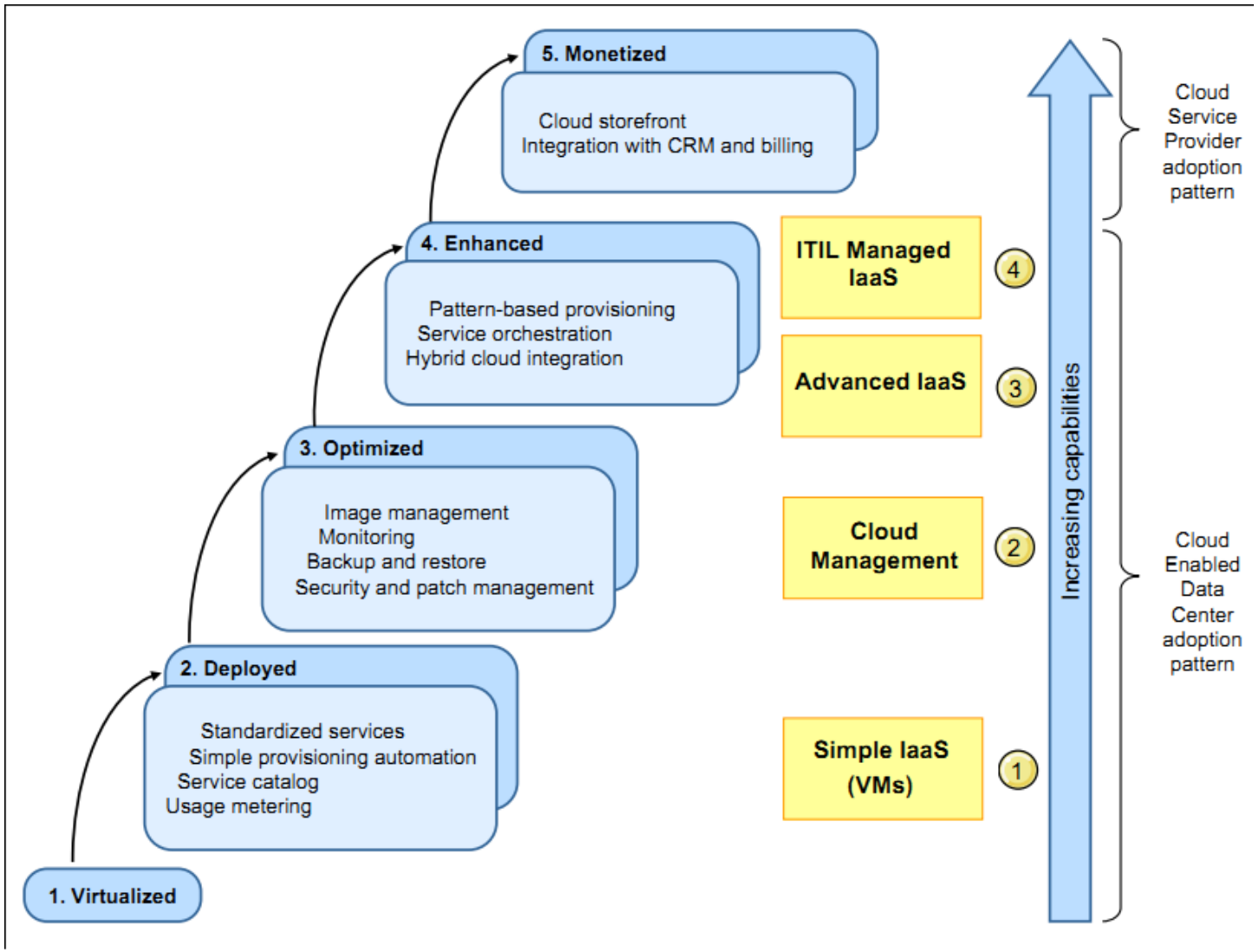
•Storefront
•Business Support Services
•Customer, User & Partner Management
•White-labeling
•Billing integration
•Order Management
•Integrates with "cloud-enabled data center" content

Common Reference Architecture Foundation

Use cases | Architecture Overview & Introduction | Security | Standards

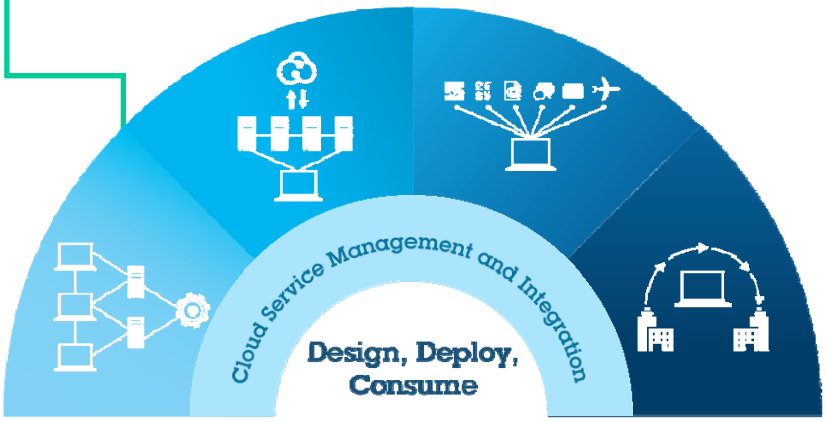
Non-functional requirements | Architectural Decisions | Performance & Scalability

IaaS Cloud Maturity Model



IBM Cloud Reference Architecture – Cloud Enabled Data Center Pattern

IaaS: Cut IT expense and complexity through a cloud enabled data center



Key Business Drivers:

- Decrease costs and delivery time for new services
- Align IT Services with business goals
- Increase service level compliance
- Centralized accounting & billing
- Industrialization of IT

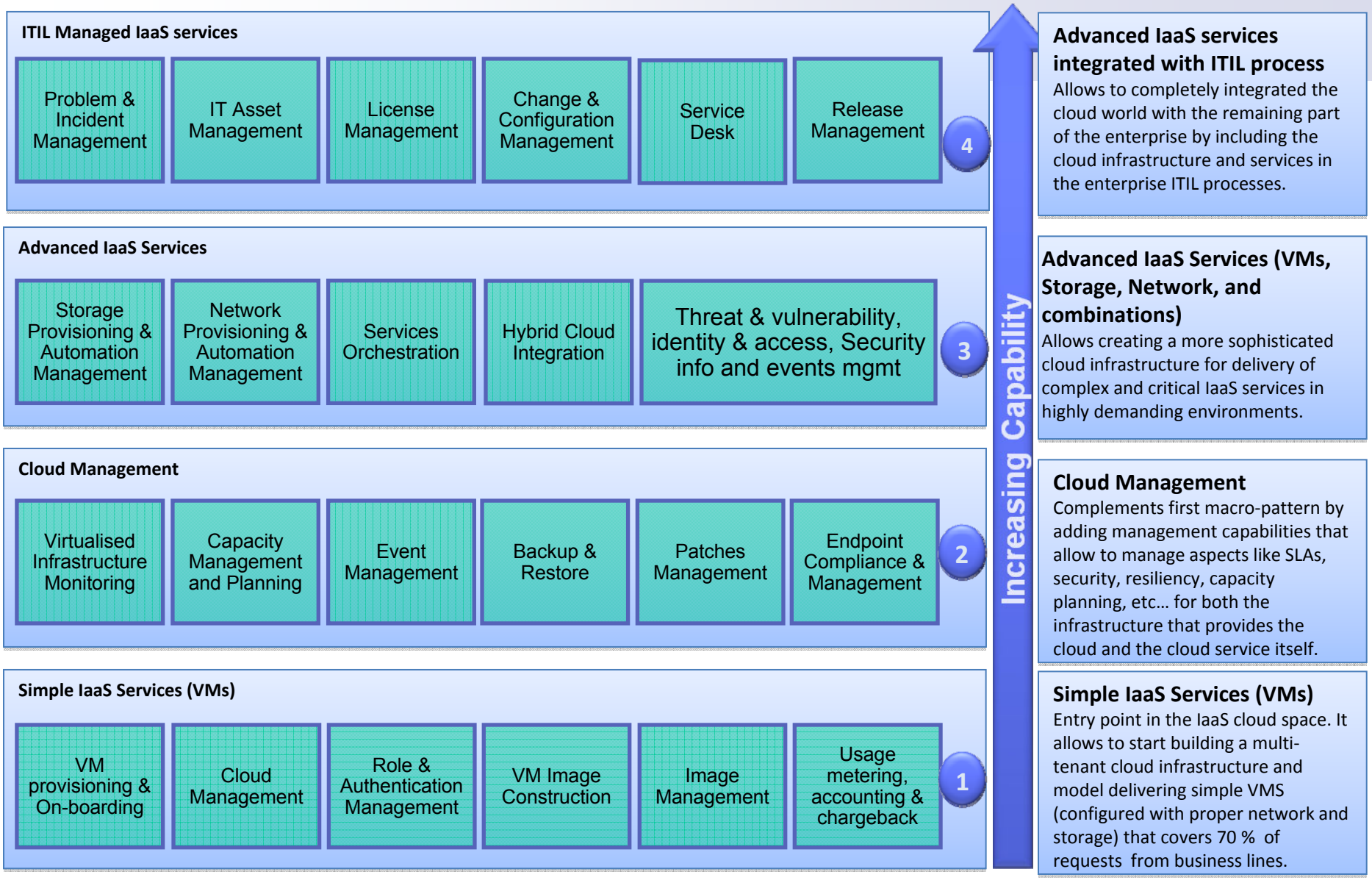
Advanced IaaS services integrated with ITIL processes
Allows to completely integrated the cloud world with the remaining part of the enterprise by including the cloud infrastructure and services in the enterprise ITIL processes.
4

Advanced IaaS Services (VMs, Storage, Network or their combinations)
Allows creating a more sophisticated cloud infrastructure for the delivery of more complex and critical IaaS services in highly demanding environments.
3

Virtualization Management
Complements the first macro-pattern by adding governance capabilities that allow to effectively manage aspects like **SLAs, security, resiliency, capacity planning, etc…** for both the virtualized infrastructure that provides the cloud service as well as the cloud service itself.
2

Simple IaaS Services (VMs)
The entry point in the IaaS cloud space since it allows to start building a multi-tenant cloud infrastructure and model for the delivery of simple VMS (configured with the proper network and storage) that covers the 70 % of the requests coming from the different business lines.
1

Incremental approach for building Cloud enabled Data Center solutions



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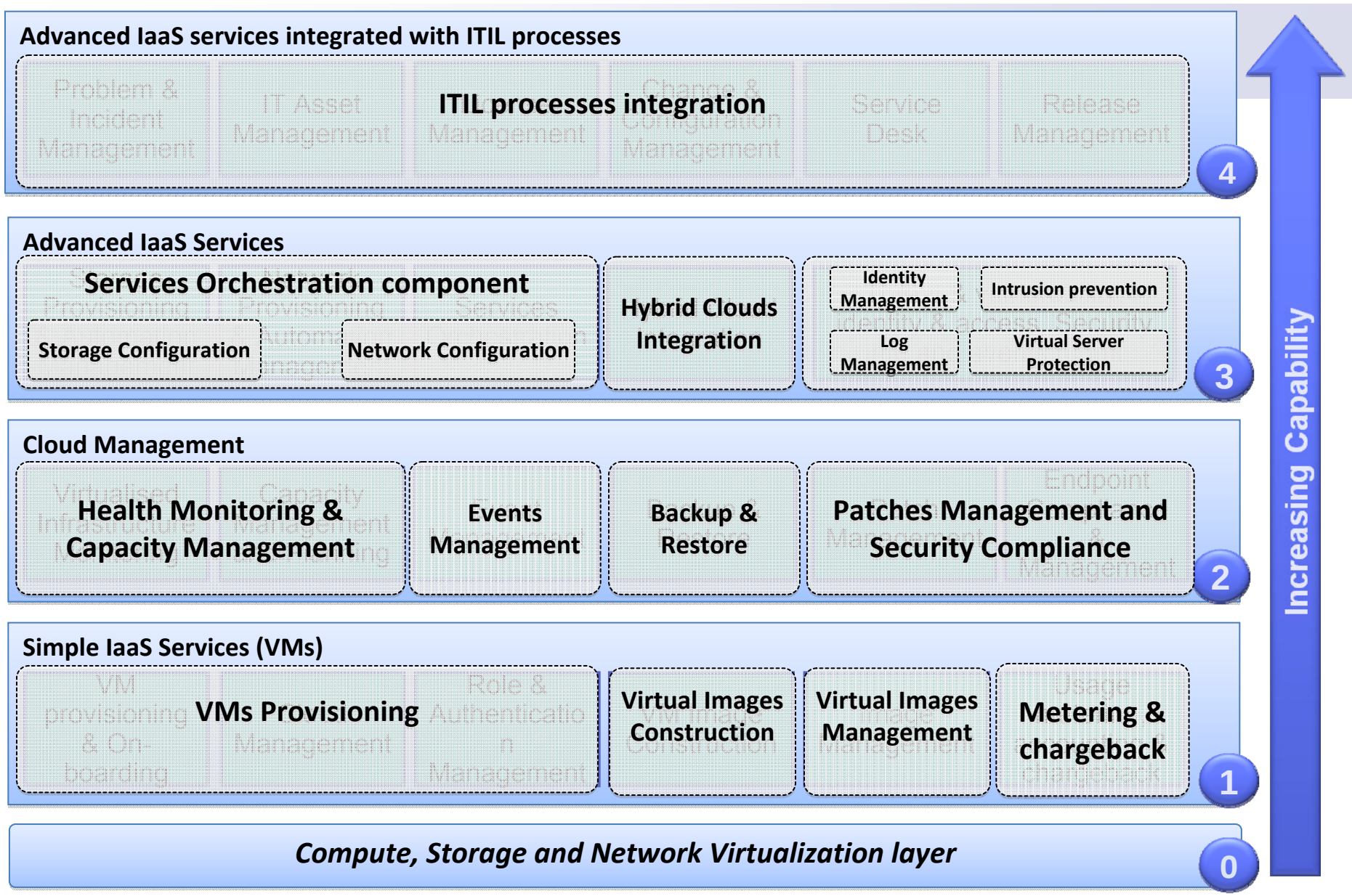
Allows to completely integrated the cloud world with the remaining part of the enterprise by including the cloud infrastructure and services in the enterprise ITIL processes.

Advanced IaaS Services (VMs, Storage, Network, and combinations)
Allows creating a more sophisticated cloud infrastructure for delivery of complex and critical IaaS services in highly demanding environments.

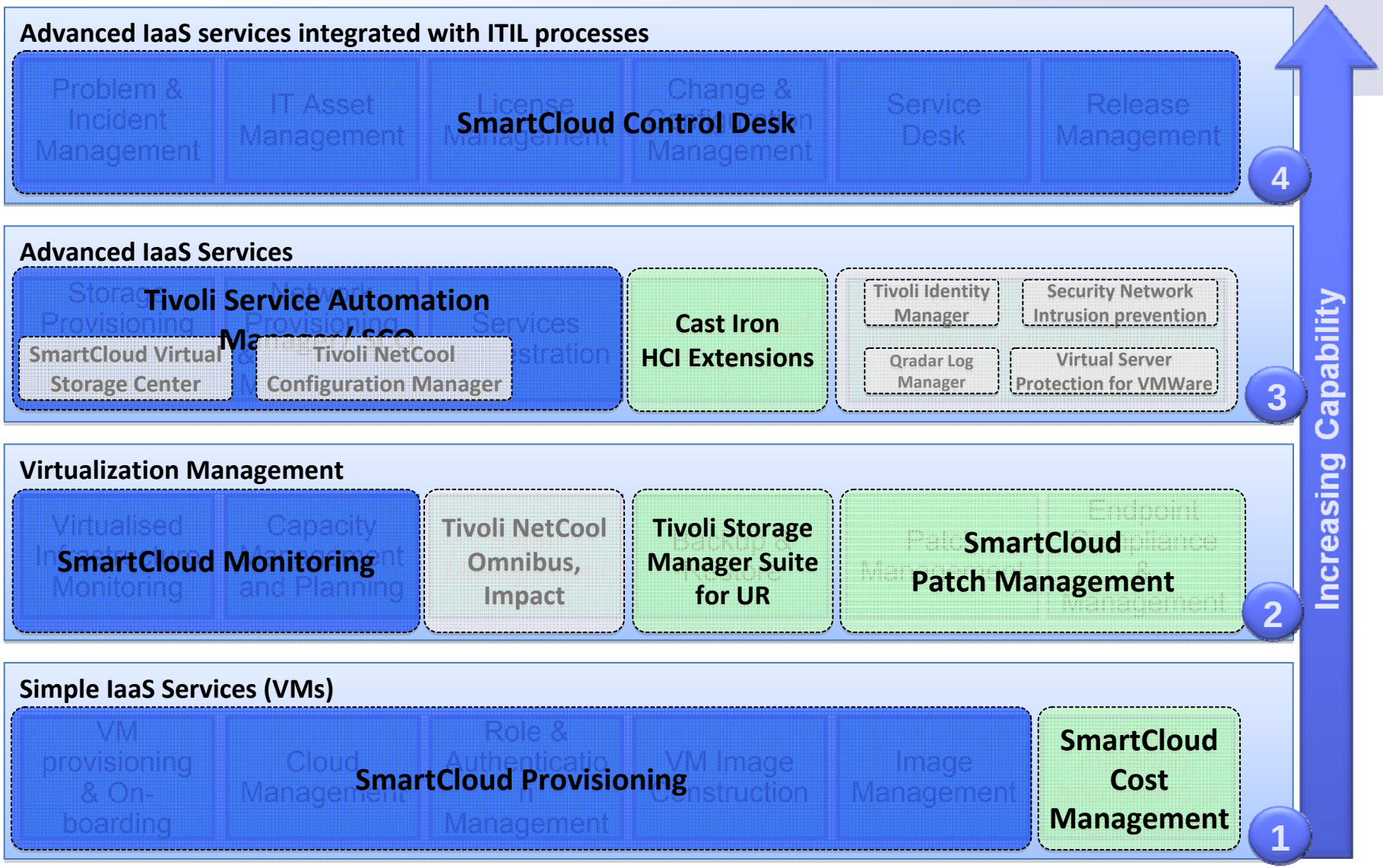
Cloud Management
Complements first macro-pattern by adding management capabilities that allow to manage aspects like SLAs, security, resiliency, capacity planning, etc… for both the infrastructure that provides the cloud and the cloud service itself.

Simple IaaS Services (VMs)
Entry point in the IaaS cloud space. It allows to start building a multi-tenant cloud infrastructure and model delivering simple VMS (configured with proper network and storage) that covers 70 % of requests from business lines.

Cloud enabled Data Center Architecture Overview

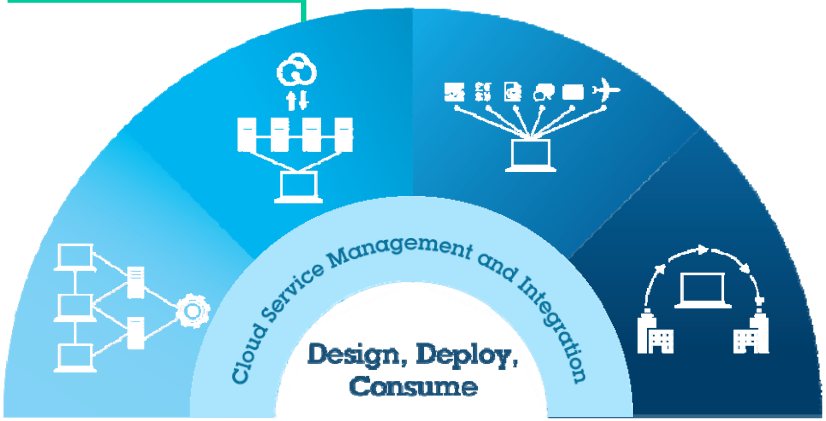


Cloud enabled Data Center Solution stack



IBM Cloud Reference Architecture – PaaS Pattern

Accelerate time-to-market with new workloads with Cloud Platform Services



Key Business Drivers:

•Reduce CAPEX (Capital Expenditure) and OPEX (Operational Expenditure) to deliver business services.

•Drive down IT costs by improving delivery time and quality, and lowering risks associated with delivery of new IT environments to business and software application development and delivery. Increase flexibility and integration between middleware components.

Paas based Lifecycle or PaaS based DevOps
Allows to implement a DevOps process by creating a continuous delivery flow that automates the build, test and delivery of applications into a cloud environment

4

Advanced/ Autonomic PaaS Services
In addition to the managed middleware patterns, applications can leverage additional services like programming services (e.g. DB or data-caching services) or integration services that allow to integrate with external application or public clouds and to implement auto-scaling and cloud-bursting scenarios, Cloud Integration

3

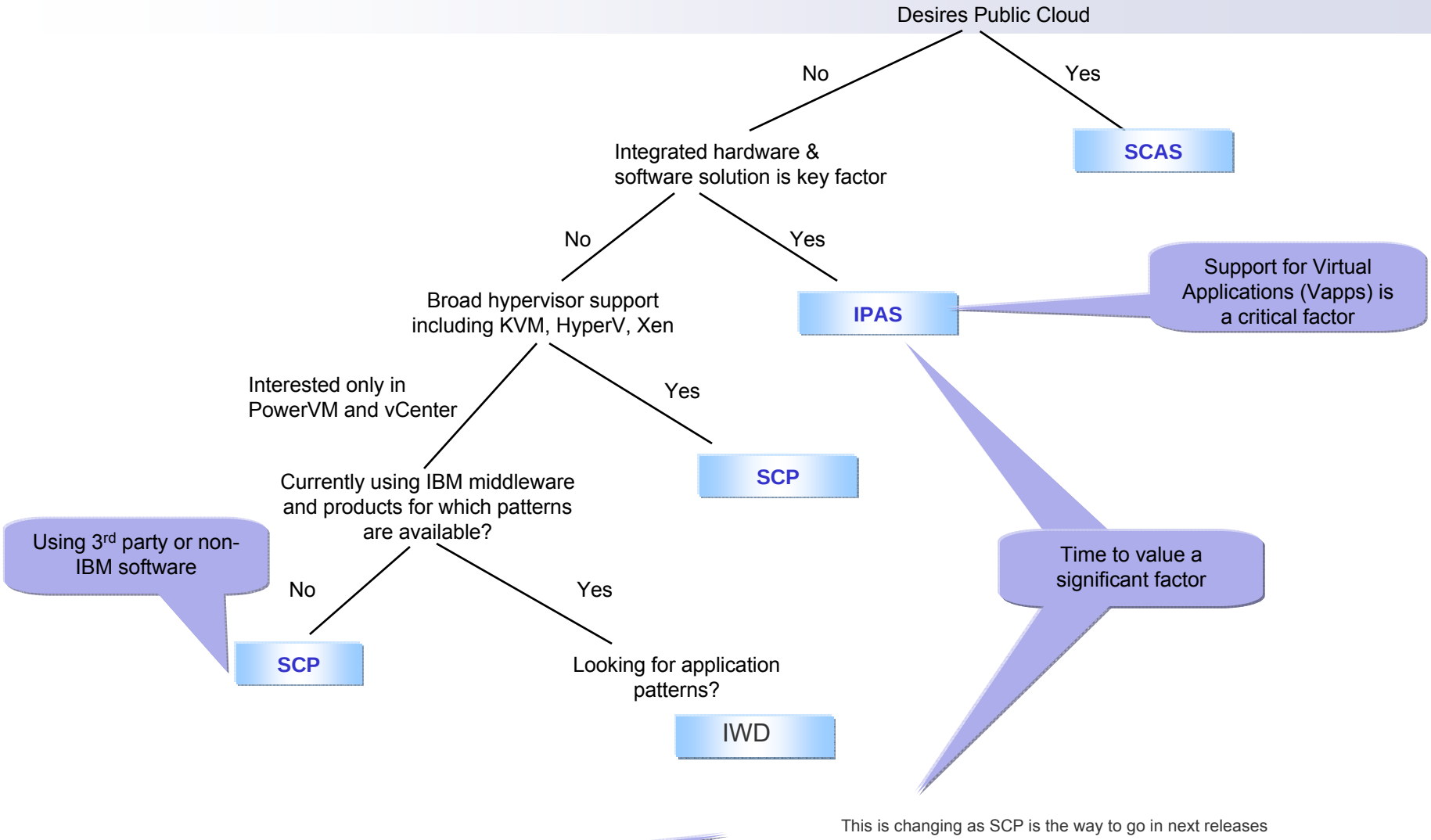
Managed PaaS
Complements the first macro-pattern by adding governance services that allow to effectively manage the SLAa and QoS aspects of the provisioned middleware, like for example resiliency, application performance, security, etc..

2

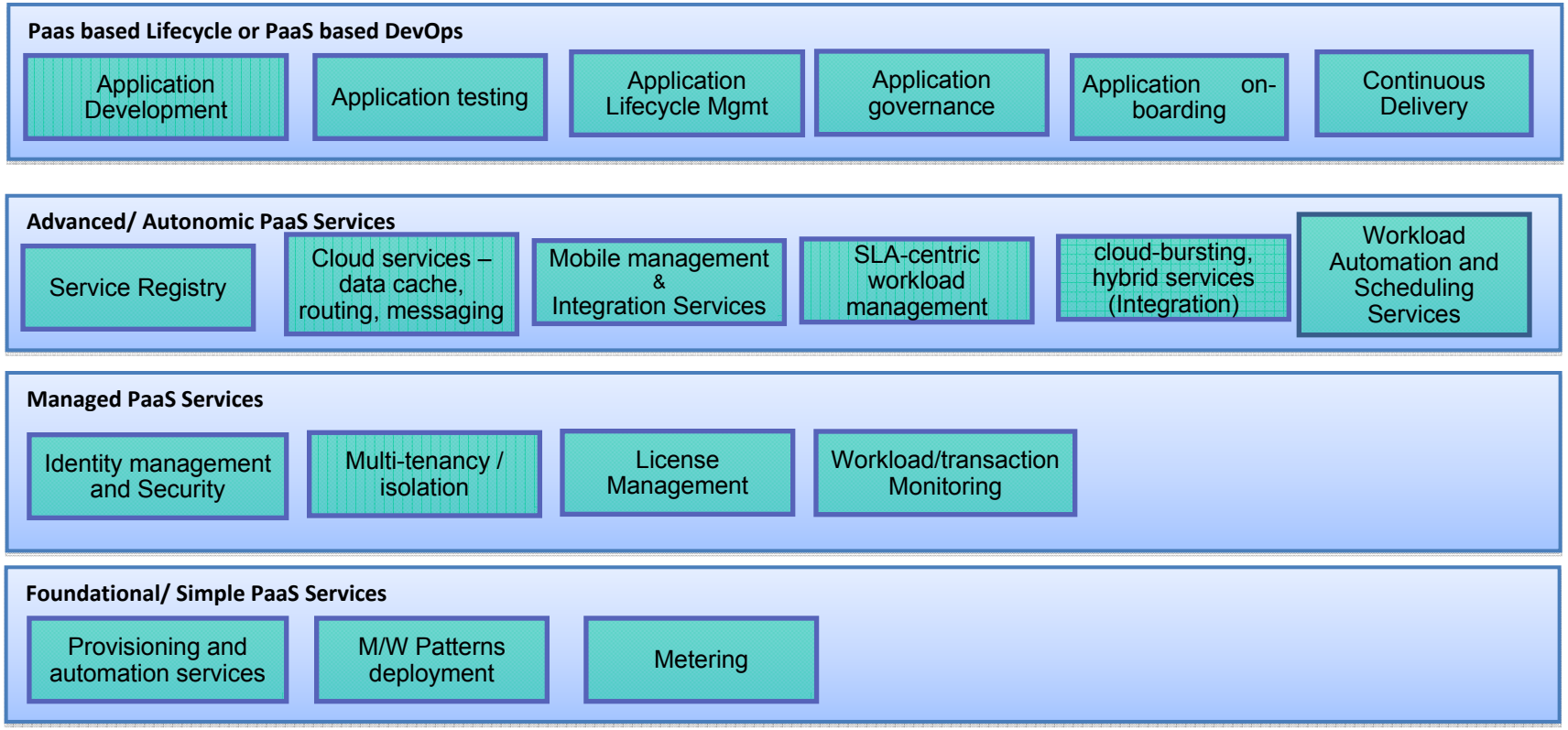
Foundations /Simple PaaS Services
The entry point into the PaaS space, it allows to model multi-tiered middleware patterns, expose them as services into a self-service catalogue, automate their deployment and meter the resources used by this service.

1

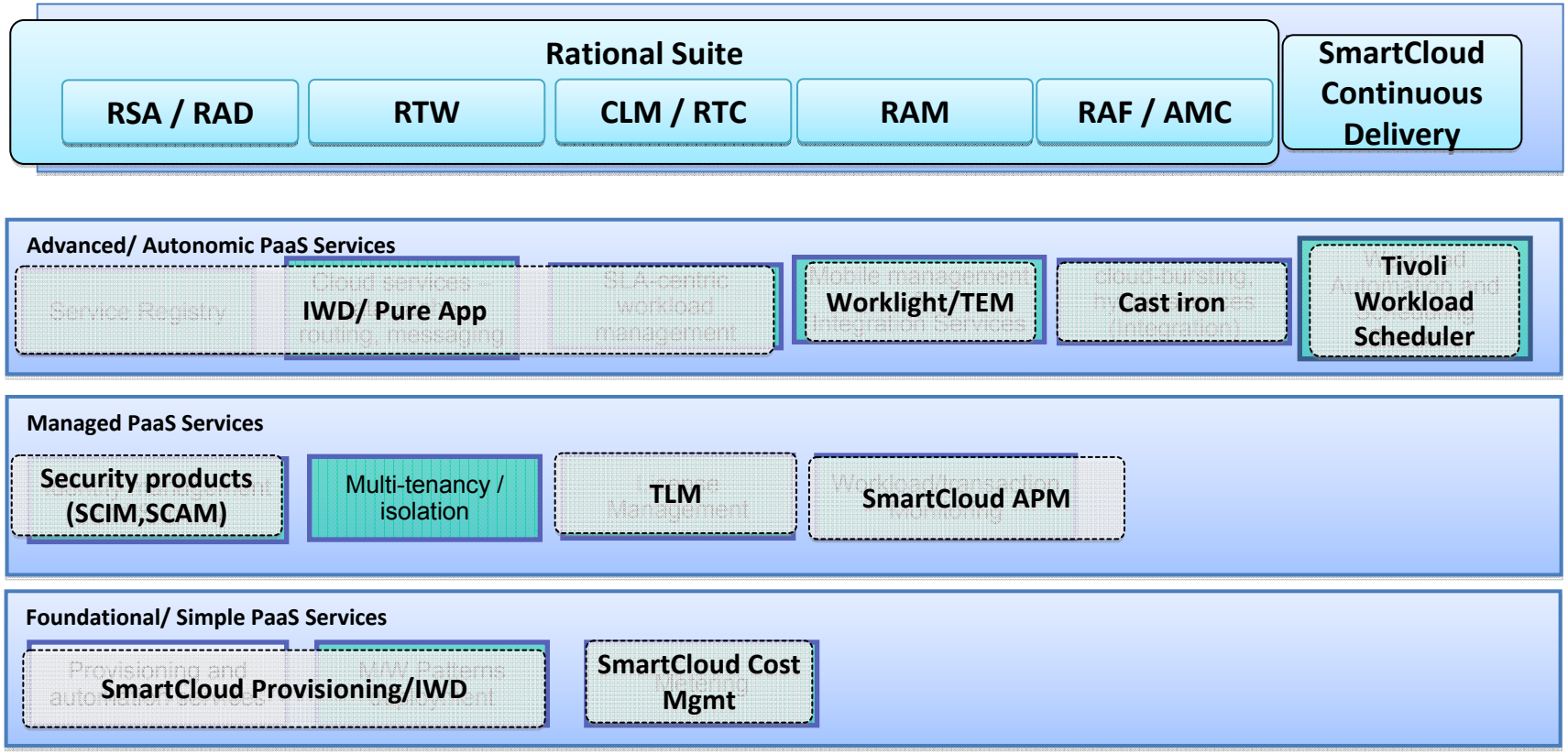
Middleware Deployment & Management Platform



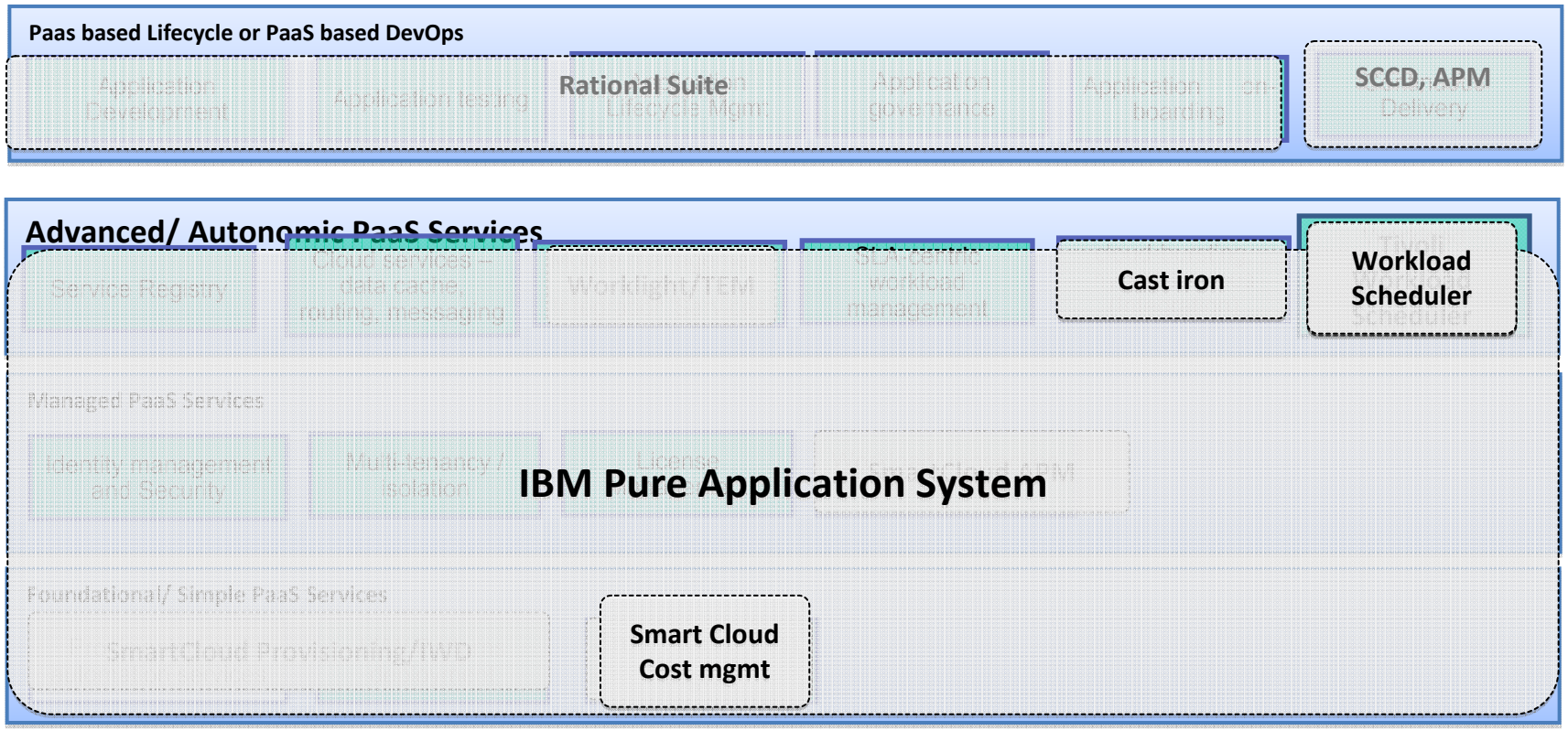
PaaS



PaaS



PaaS



Cloud Adoption Pattern – Cloud Service Provider (CSP)

Business Drivers – Competitive environment to become CSP, cost effective delivery, Retain and enhance customer relationship, differentiation in products offered (value of the products in realizing market leadership) differentiation in service provided (value of the Service Provider brand), Monetize their infrastructure.

Solutions/ Patterns

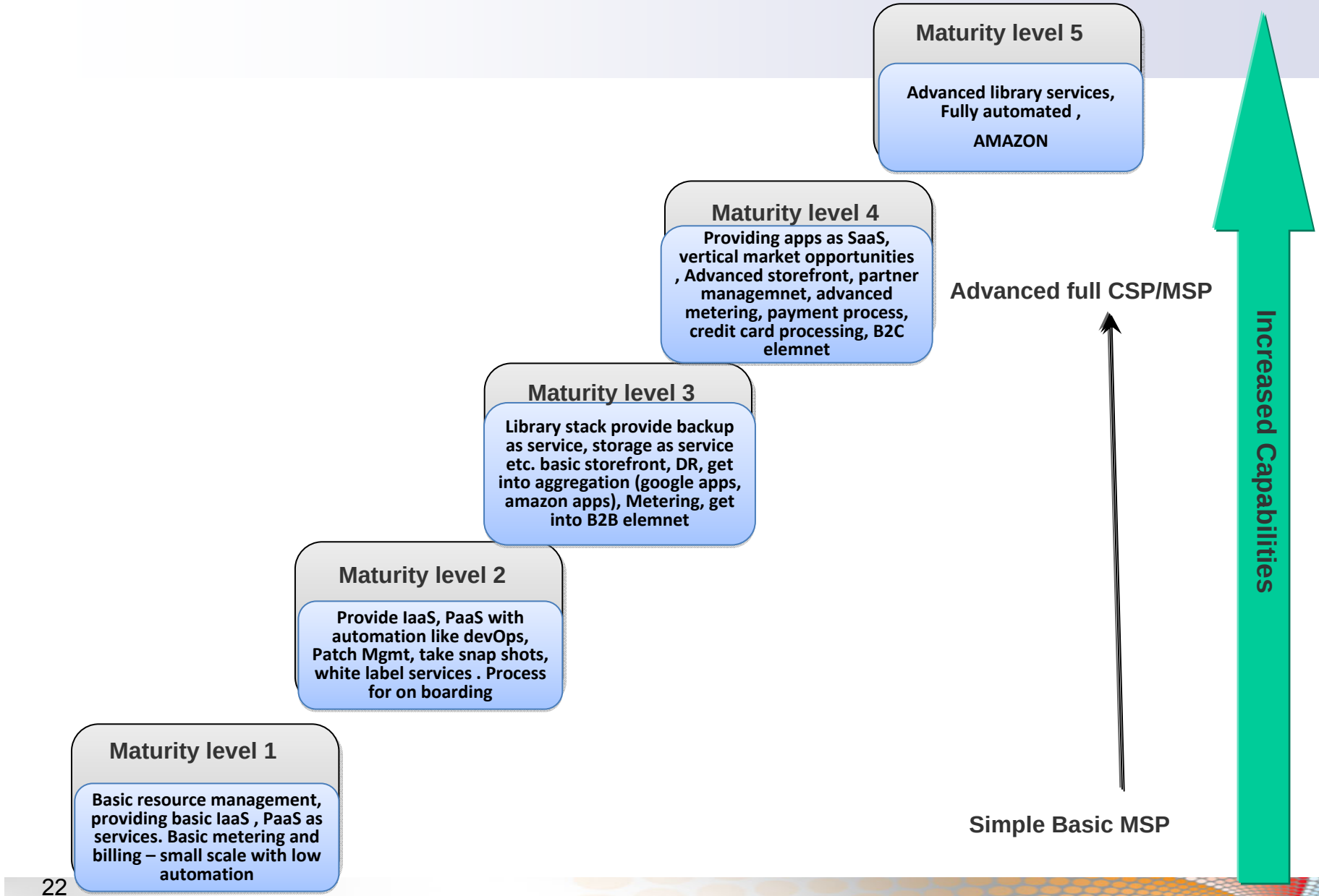
- Develop Strategy and Select Business Models to become a successful CSP
- Select Services and Infrastructure
- Develop Ecosystem and Supporting Infrastructure
- Extend Applications in Cloud
  - Customer Applications
  - Provider Applications
  - Third Party Applications
  - Cloud Aggregation
  - White-label Cloud

Incorporate hosted Clouds built on IaaS and PaaS architecture from “cloud-enabled data center” and “platform services” solutions

CSP Patterns, Micro-Patterns, Capabilities & Explanation

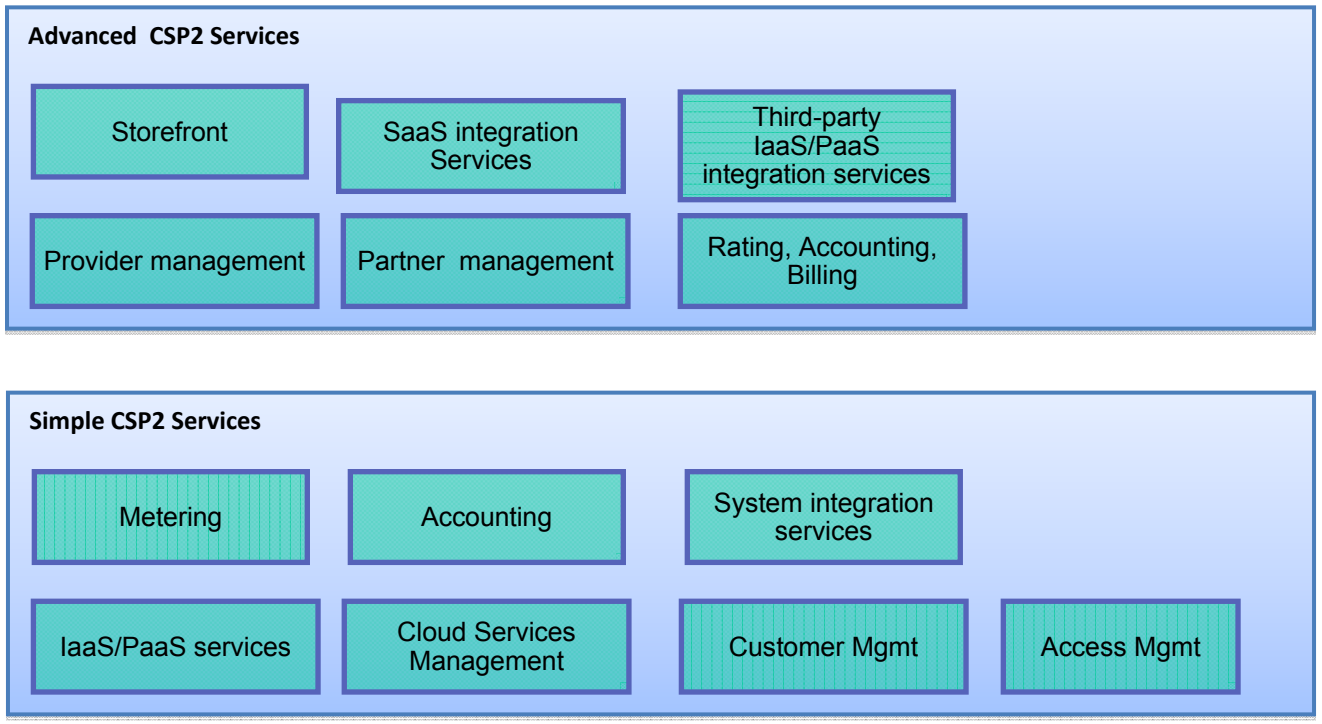
Patterns	Capabilities	Explanation
Cloud Services Host for Customer Applications	• Storefront • Customer Access Management • Customer Management • Service Onboarding • Service Management • Customer Images Management	Extend cloud deployment to allow customers to host their applications. Focus areas: Multi-tenancy, customer management
Cloud Services Host for Provider Applications	• Storefront • Provider Access Management • Provider Service Management • Provider Service Onboarding • Provider Image Management	Offer services hosted on (internal) cloud to customers. Focus areas: Multi-tenancy, Application & Service Management
Cloud Hosting Third-party Applications	• Storefront • Partner Access Management • Provider Service Management • Provider Service Onboarding • Provider Image Management	Extend cloud to offer both Provider and Third-Party services Focus areas: Multi-tenancy, access control, service management
Cloud Aggregation	• Cloud Hosting Third-Party Applications Capabilities and OSS/BSS integration	Federated cloud with on-/off- premise services Focus areas: Multi-tenancy, granular access control, service management, OSS/BS integration
Cloud Provider Front-end for White-label Cloud	• Portal Re-branding Wrappers • Cloud Management (OSS/BSS) re-branding wrappers	Enable customer to re-brand cloud (and hosted services) Focus areas: Multi-tenancy, storefront & OSS/BSS integration

CSP Maturity model

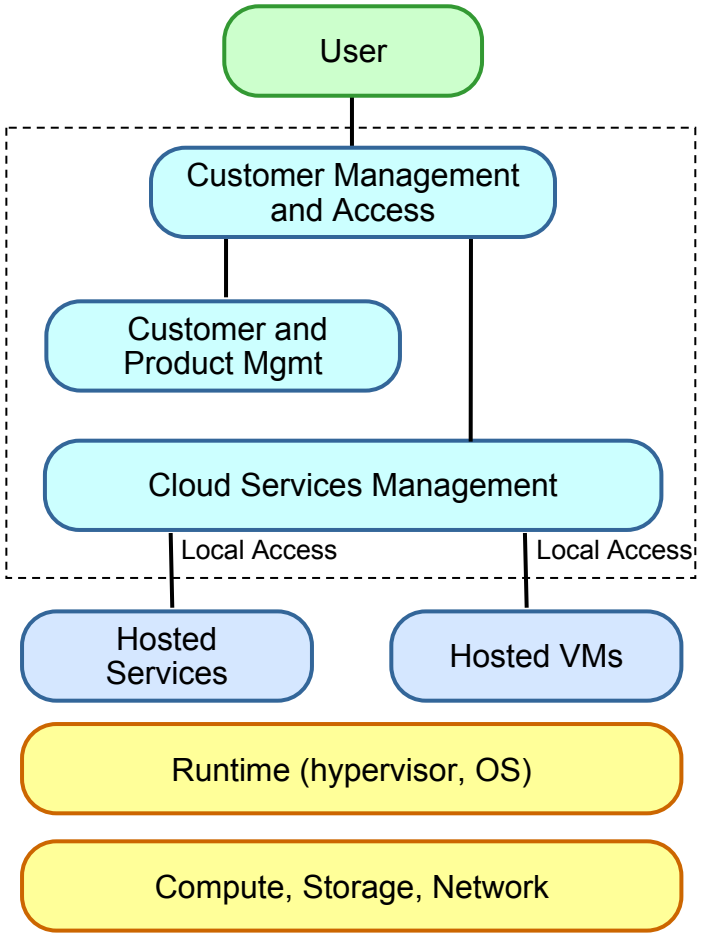


IBM Cloud Reference Architecture for CSP2 solutions

Cloud Service Provider



Solution view: IaaS Entry Point using SCP



IBM SmartCloud Provisioning
IBM SmartCloud Monitoring

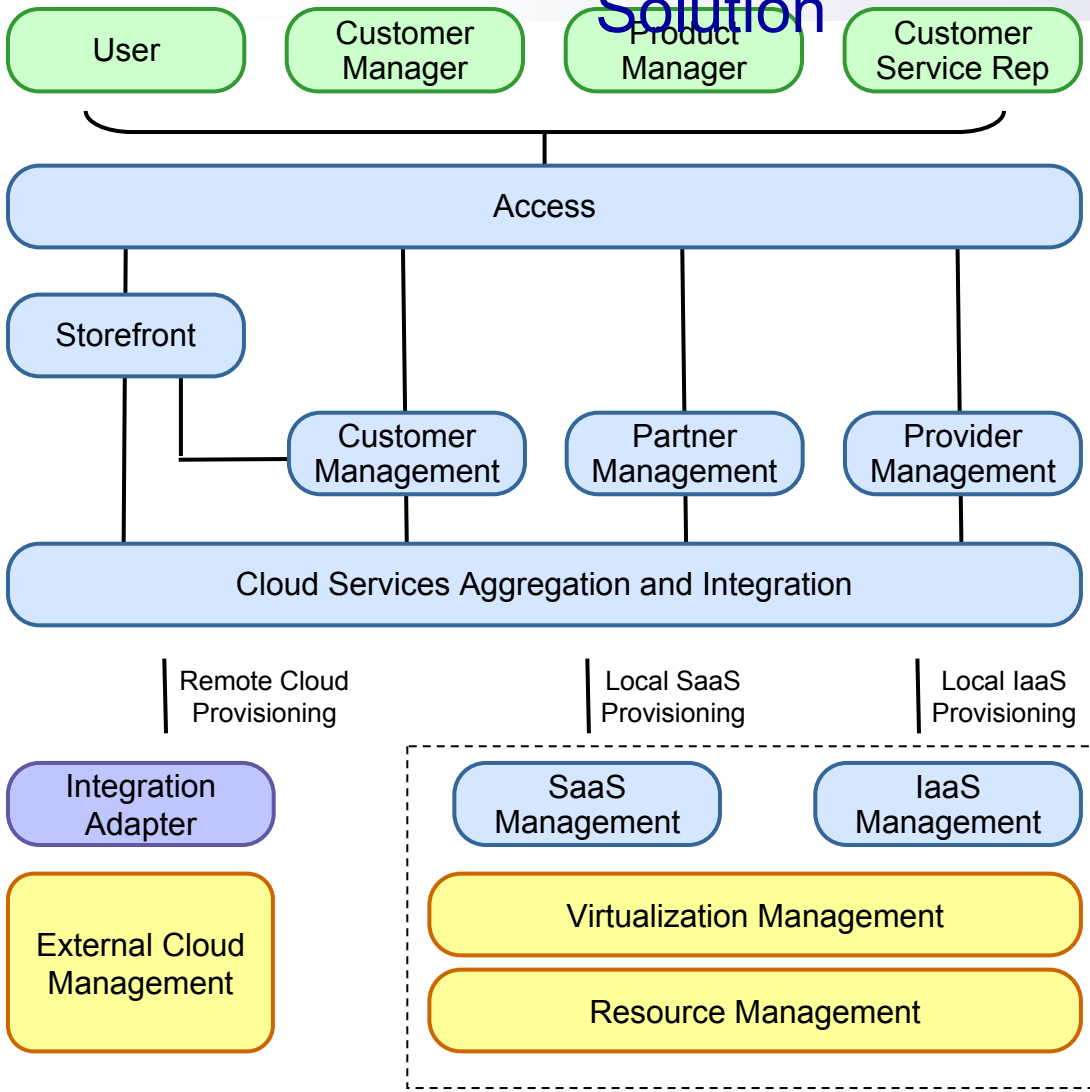
Support Systems Integration

IBM WebSphere MQ
FTP (OS provided)

VMWare, KVM

Compute: IBM xSeries, pSeries, PureFlex
Storage: IBM v7000 Unified
Network: Juniper, Cisco

Solution view: Cloud Service Provider Solution



Tivoli WebSeal, Tivoli Access Manager, Tivoli Federated Identity Manager

Parallels or Jamcracker or Provider Specific

IBM Service Delivery Manager/SCO

IBM Cloud Services Aggregation and Integration Pack
IBM WebSphere Cast Iron Integration
IBM WebSphere MQ / FTP (OS provided)

IBM Service Delivery Manager/SCO

VMWare, KVM

Compute: IBM xSeries, pSeries, PureFlex
Storage: IBM v7000 Unified
Network: Juniper, Cisco

SaaS Adoption Pattern

- Following topics of prescriptive guidance
  - Security
  - Governance
  - Business Models
  - BSS (Business Support Services)
  - OSS (Operations Support Services)
- Three primary models of SaaS delivery
  - Primary Hybrid
    - Extending on-premise or hosted deployments into a cloud environment
  - Hybrid Cloud
    - Attaching one or more on-premise or hosted environments to a true IaaS or PaaS environment.
  - Full Cloud & Extended Cloud
    - Delivering a production-ready solution using only cloud services from one or more cloud providers.

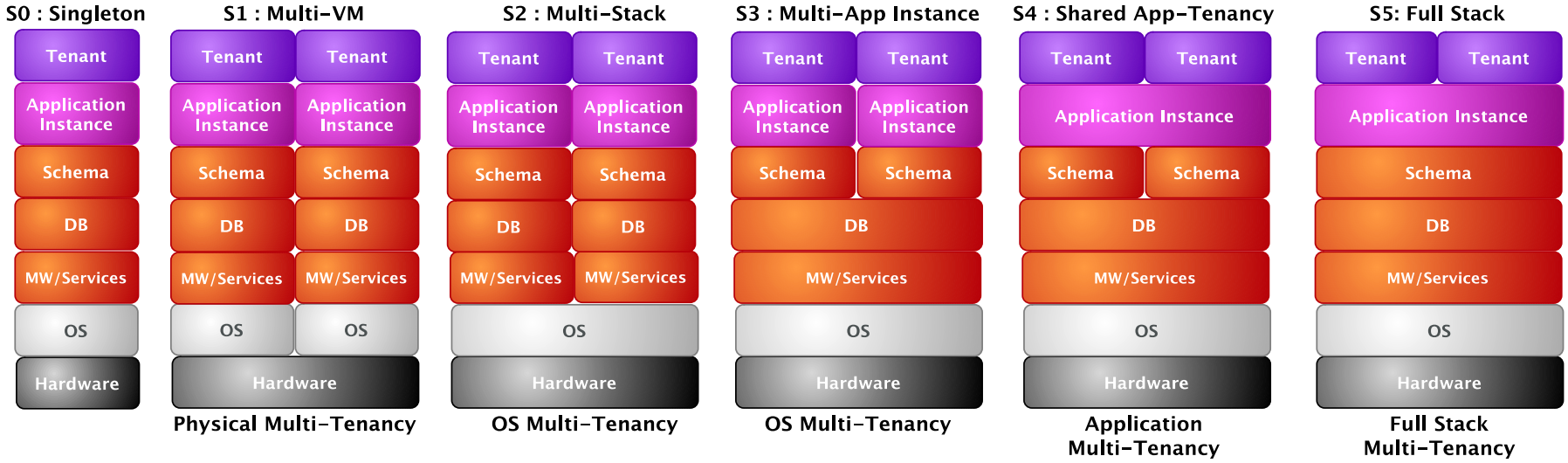
SaaS and Multi-Tenancy

What is tenancy and how does it relate to SaaS?

- A client, end-user, or customer is considered a tenant of an application or service.
- Multi-tenancy allows a shared environment appear to each tenant as if it was dedicated. In this context, a "virtual slice" is assigned to each tenant and is isolated from the others, in terms of availability, performance & security.
- The introduction of multi-tenancy to SaaS has allowed businesses to realize methods for attaining their goals of decreased cost for delivery and operation.
- Multi-tenancy uses the full spectrum of virtualization and application capabilities, from physical hardware to run-time application configuration options.

Note: Tenancy is an optional component of any SaaS deployment.

The Tenancy Spectrum – Tenancy Diagram



Different cloud deployment models also change the way we think about security

Private cloud

On or off premises cloud infrastructure operated solely for an organization and managed by the organization or a third party

Hybrid IT

Traditional IT and clouds (public and/or private) that remain separate but are bound together by technology that enables data and application portability

Public cloud

Available to the general public or a large industry group and owned by an organization selling cloud services.

Changes in Security and Privacy

- *Customer responsibility for infrastructure*
- *More customization of security controls*
- *Good visibility into day-to-day operations*
- *Easy to access to logs and policies*
- *Applications and data remain "inside the firewall"*

- *Provider responsibility for infrastructure*
- *Less customization of security controls*
- *No visibility into day-to-day operations*
- *Difficult to access to logs and policies*
- *Applications and data are publically exposed*

Help the client develop their reference architecture over time

- Reference architectures can take a long time to create
  - Harvested from repeated successes
  - Generally broad in scope
- Reference architectures are not created in a vacuum
  - Help the client begin with one or more reference implementations
  - Determine what does and does not work in the client environment
  - Use portions of the CCRA as a template, but modify with client-specific aspects
  - Creating a client-specific reference architecture requires participation and input from the client
    - Gather client-specific standards
    - Understand client processes
    - Applicability of the RA is usually at an enterprise level, not limited to a particular department

Resources

- Publically available material
  - Whitepaper about the CCRA
    http://www-05.ibm.com/de/cloud/pdf/Gettingcloudcomputingright.pdf
  - Redguide about the “Cloud-Enabled Data center / IaaS” adoption pattern
    http://www.redbooks.ibm.com/abstracts/redp4893.html?Open
  - Redguide about the “Cloud Service Provider” adoption pattern
    http://www.redbooks.ibm.com/redpapers/pdfs/redp4912.pdf
  - Academy TechNote about the CCRA
    http://www-05.ibm.com/it/cloud/downloads/Cloud_Computing.pdf
  - CCRA Submission to the OpenGroup
    http://www.opengroup.org/cloudcomputing/uploads/40/23840/CCRA.IBMSubmission.02282011.doc

Thank you