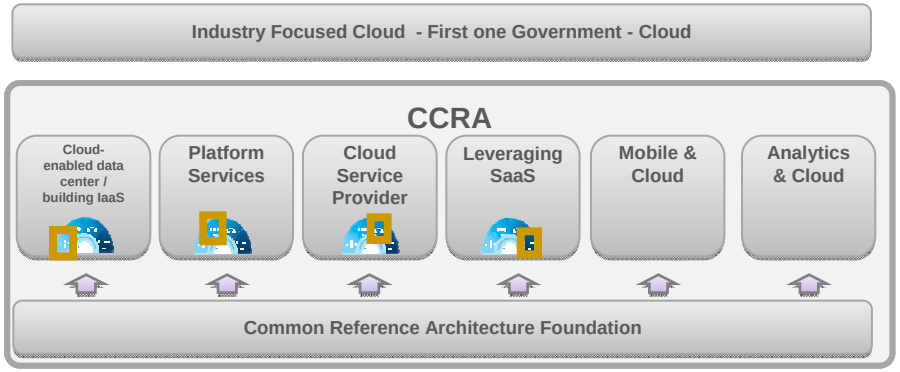
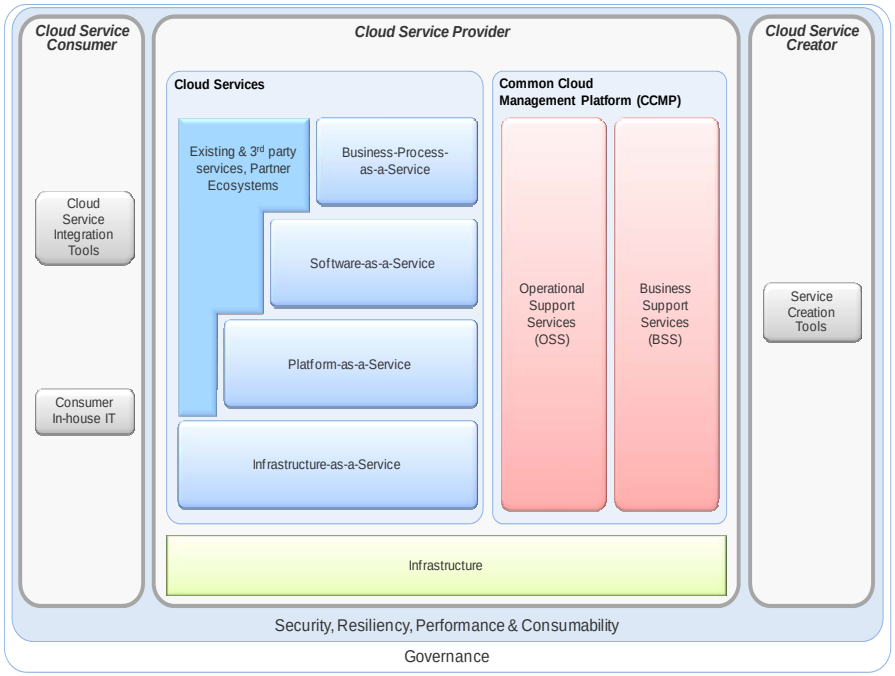
Cloud Computing Reference Architecture (CCRA) 4.0 Overview

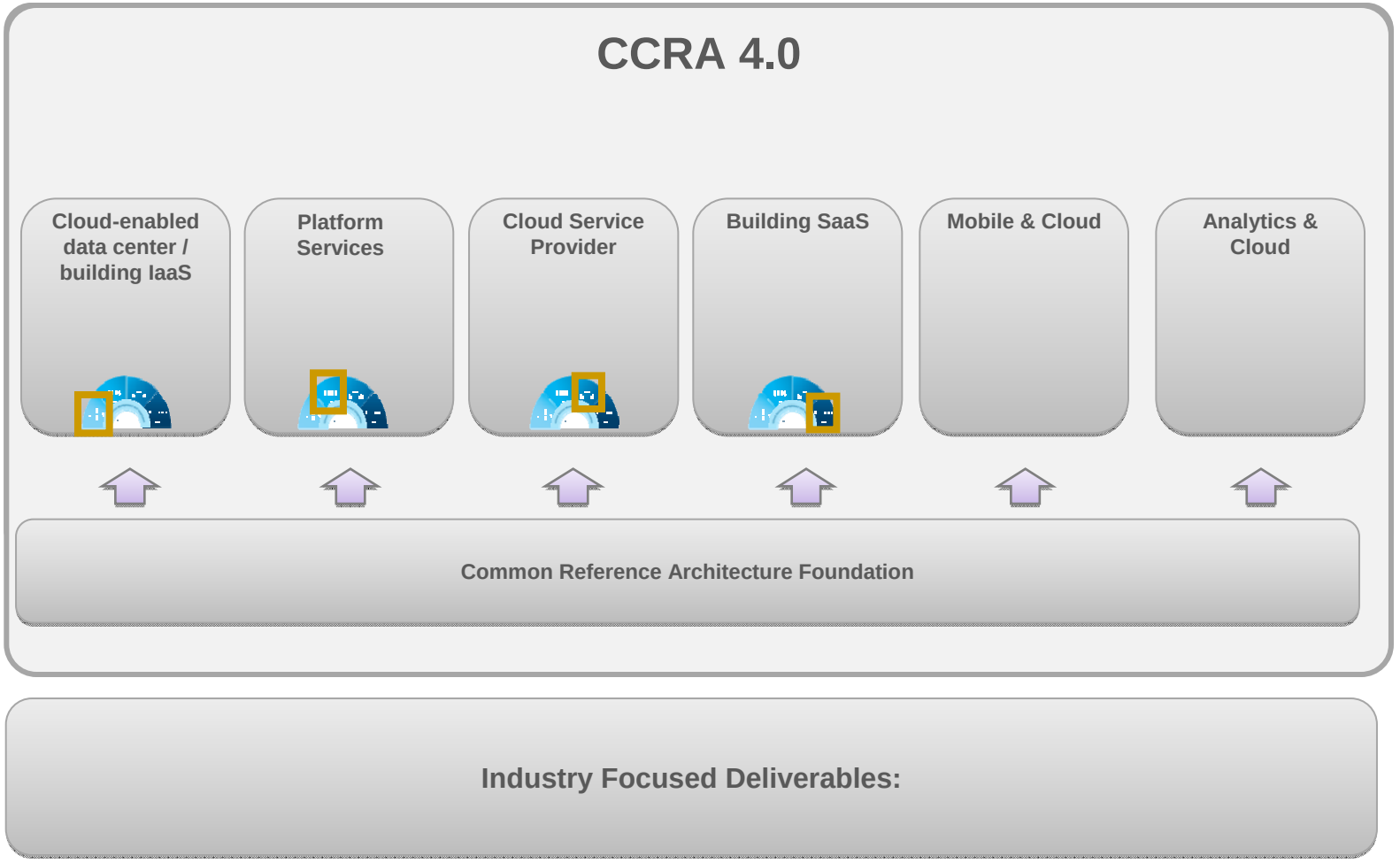
Cloud Computing Reference Architecture (CCRA) 4.0 Overview

- CCRA provides prescriptive guidance on how to build IaaS, PaaS, SaaS and Service Provider cloud solutions with IBM technology
- CCRA Aggregates experience from hundreds of cloud client engagements and IBM-hosted cloud implementations
- CCRA categorize the cloud business models and corresponding architecture by the following “cloud adoption patterns” :
  - Cloud Enabled Data Center (IaaS)
  - Platform-as-a-Service (PaaS) adoption pattern
  - Software-as-a-Service (SaaS)
  - Cloud Service Providers
  - Mobile
  - Analytics
  - Government - Cloud
- For each cloud adoption patterns, CCRA identifies:
  - common architecture patterns that describe the business drivers, the use-cases and the technologies that underlie each type of cloud computing implementation.
  - common architecture patterns for items that cut across all the adoption patterns including security, resiliency, performance, etc.





CCRA Structure



Why Use IBM's CCRA?

- The CCRA *saves your business time and money* by providing detailed documentation on the steps and components required for constructing a Cloud implementation across all deployment models.

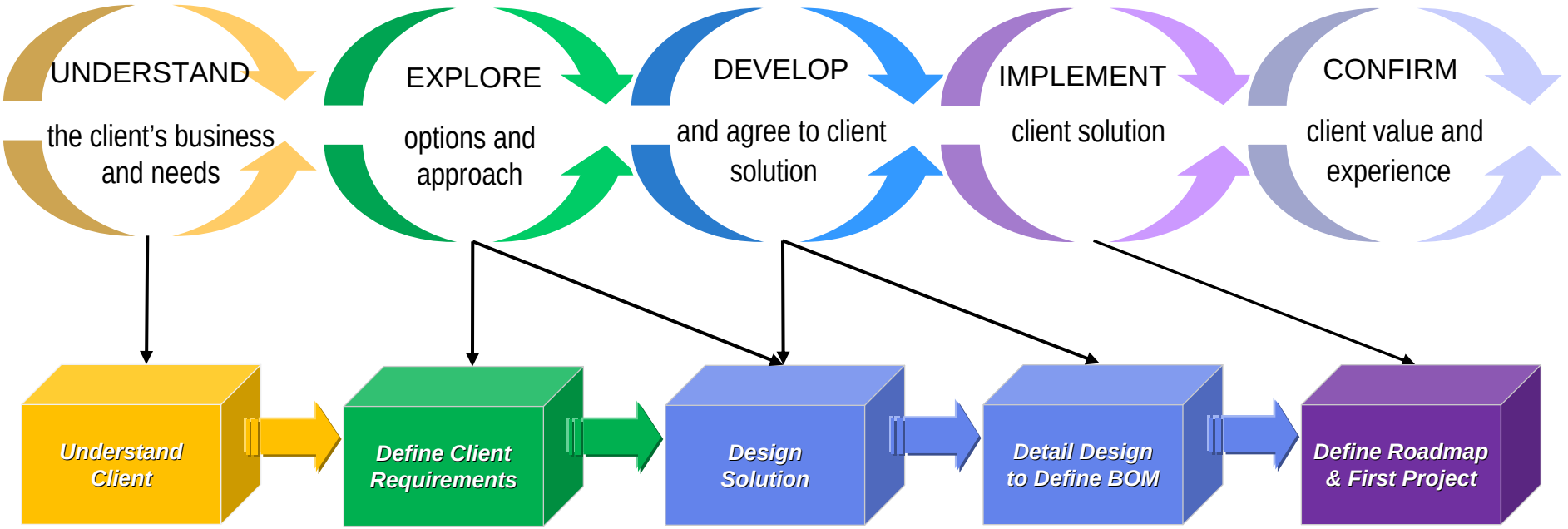
- Your business can *benefit from IBM's experience* in creating Public, Private, and Hybrid Clouds with one common architecture with reusable assets or product recommendations.

- Your business *receives a quicker start* to create an industrial strength Cloud with predefined use cases and documentation on the architectural requirements or decisions that must be made for security, service management, performance scalability, and virtualization.

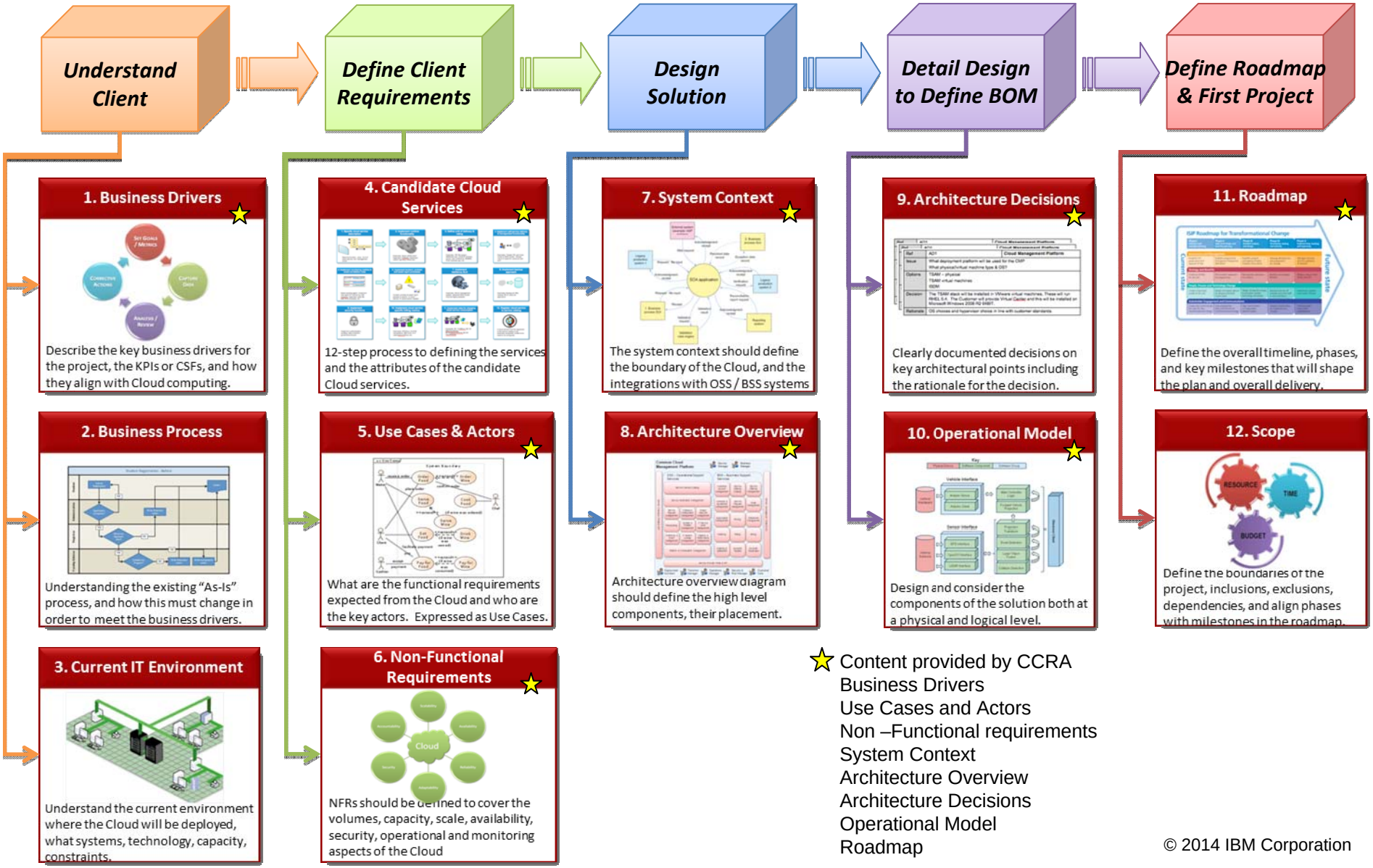
- The CCRA utilizes sound architectural principles to *speed development and reduce errors* across the entire development process, ensuring designs can scale for efficiencies and can fulfill important Cloud requirements such as elasticity, self-service and flexible sourcing.

- The CCRA provides *increased business flexibility* with a common Cloud reference architecture across all deployment models.

Approach used to design Cloud Adoption Patterns

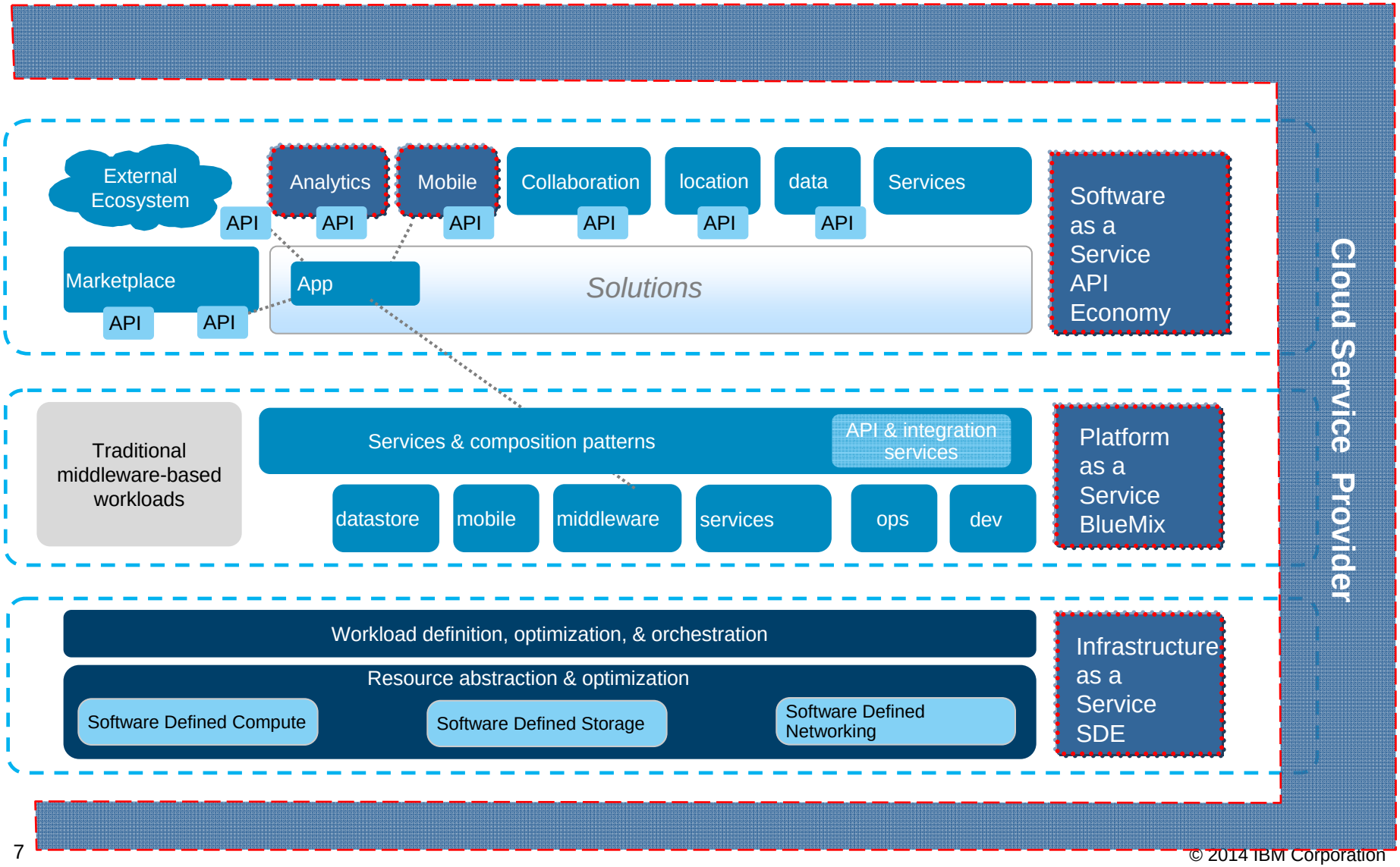


The CCRA Adoption Pattern material is based on TeamSD and applies to the entire sales cycle



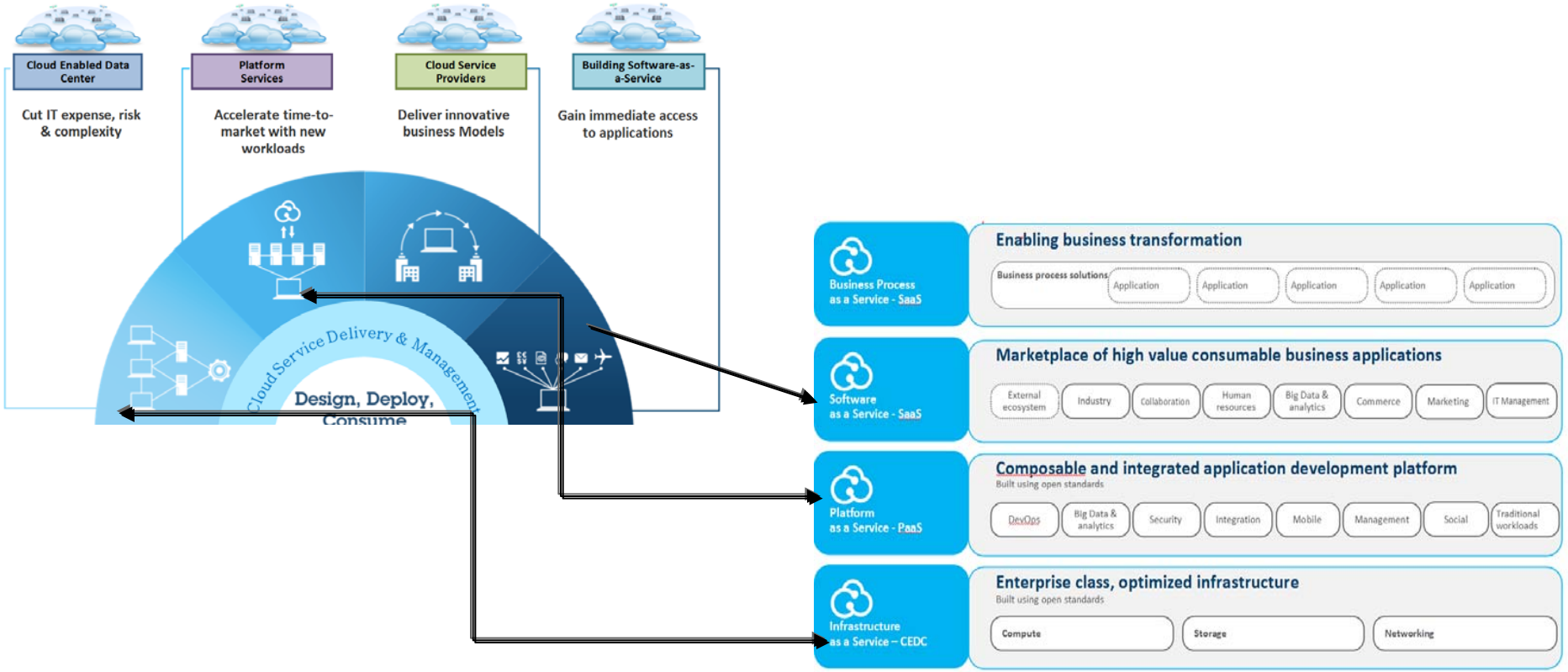
★ Content provided by CCRA
- Business Drivers
- Use Cases and Actors
- Non –Functional requirements
- System Context
- Architecture Overview
- Architecture Decisions
- Operational Model
- Roadmap

CCRA 4.0 Cloud Adoption Patterns & Next Generation Platform



Mapping of Cloud Adoption Patterns – IBM Cloud Capabilities

Cloud adoption patterns have emerged backed by proven best practices



Key concepts – adoption patterns / macro patterns / micro patterns

- **Adoption Pattern** – A collection of commonly observed functions and features that customers desire in their solution. Where a customer starts to solve a specific business problem, typically driven by the same business motivation. e.g. “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.”

- **Macro Pattern** – A collection of use-cases / micro-patterns commonly deployed together to achieve a level of service maturity. (e.g., simple VM-provisioning services; more advanced services for provisioning of VM, storage, and network elements; provisioning of services integrated with the enterprise ITIL enterprise processes; etc.).

- **Micro Pattern** – set of consistent use cases that relate to a specific cloud function. These use cases are best practice starting points for various aspects of cloud implementation.

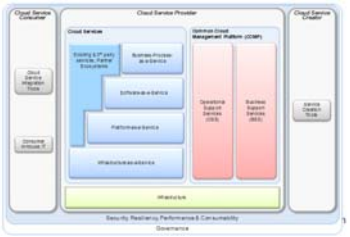
- **Solution** – a combination of products and services integrated and deployed together. Typically sold as a “solution” in a single sales transaction.

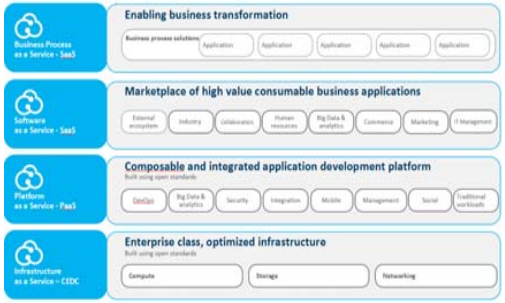
- **Product** – single isolated software or hardware component, typically bounded by how it is sold. Note that a single product may actually cover one or more capabilities/micro patterns.

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

Cloud Enabled Data Center - IaaS

- **Enable IaaS** with Virtualization Management and Governance
- **Implement IaaS** with Advanced Service Automation & Orchestration
- **Extend IaaS** with Enterprise Service Management
- **Consume IaaS** using a Public or Managed Cloud Service
- **Integrate IaaS** to Support a Hybrid Environment





Business Solutions on Cloud - SaaS

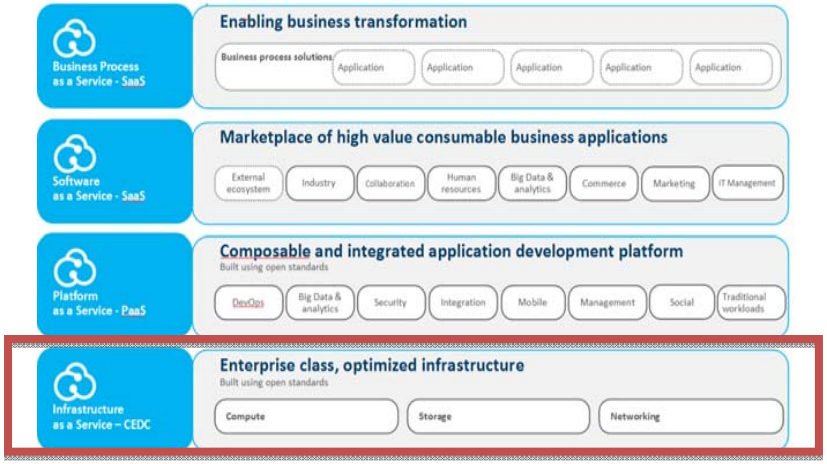
- **Implement Existing Applications to be Delivered as SaaS**
- **Implement Cloud Native Applications to be Delivered as SaaS**
- **Consume SaaS** Applications and Business Processes
- **Integrate SaaS** with Cloud and Enterprise Services

Cloud Platform Services- PaaS

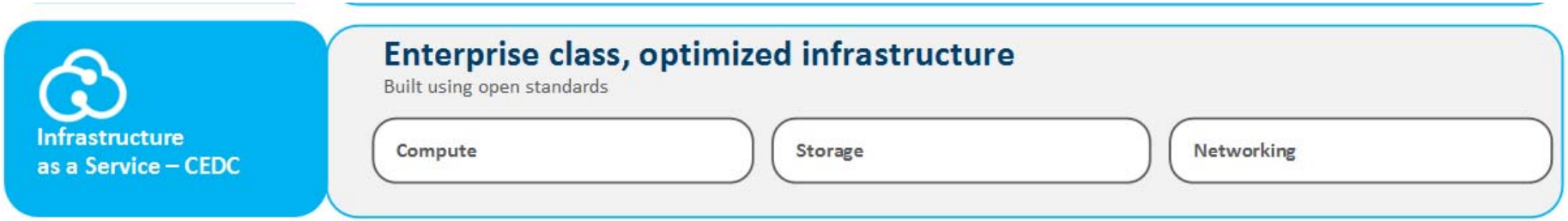
- **Implement PaaS** with Middleware Deployment and Management
- **Extend PaaS** with Programming Services
- **Implement Application Lifecycle Management (ALM) and DevOps**
- **Consume PaaS** using a Public or Managed Cloud Service
- **Integrate PaaS** to Support a Hybrid Environment

Cloud Service Provider (MSP/CSP)

- **Implement IaaS for a Service Provider** to Deliver Cloud Services
- **Implement IaaS and PaaS for a Service Provider** to Deliver Cloud Services
- **Implement Storefront and Service Brokering for a Service Provider** to Deliver Applications and Business Processes
- **Consume Public or Managed Services to Resell as a Service Provider** (White Label)



Cloud Enabled Data Center Adoption Pattern (IaaS)

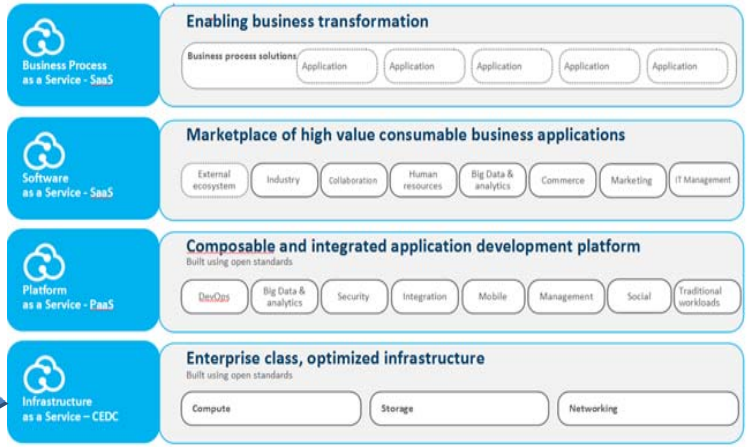


What's new in CeDC?

- UPDATED: CeDC Adoption pattern now based on SmartCloud Orchestrator 2.3 as the core cloud product
- NEW: Include Software-defined Environment (and OpenStack) concepts in CEDC
- NEW: Define integration points with Softlayer
- NEW: Define integration points with Bluemix
- NEW: Define managed services for cloud

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
- Use other Clouds when I need extra capacity

Extend IaaS with Enterprise Service Management (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

Implement IaaS with advanced Service Automation and Orchestration
Allows creating a more sophisticated cloud infrastructure for the delivery of more complex and critical IaaS services in highly demanding environments

3

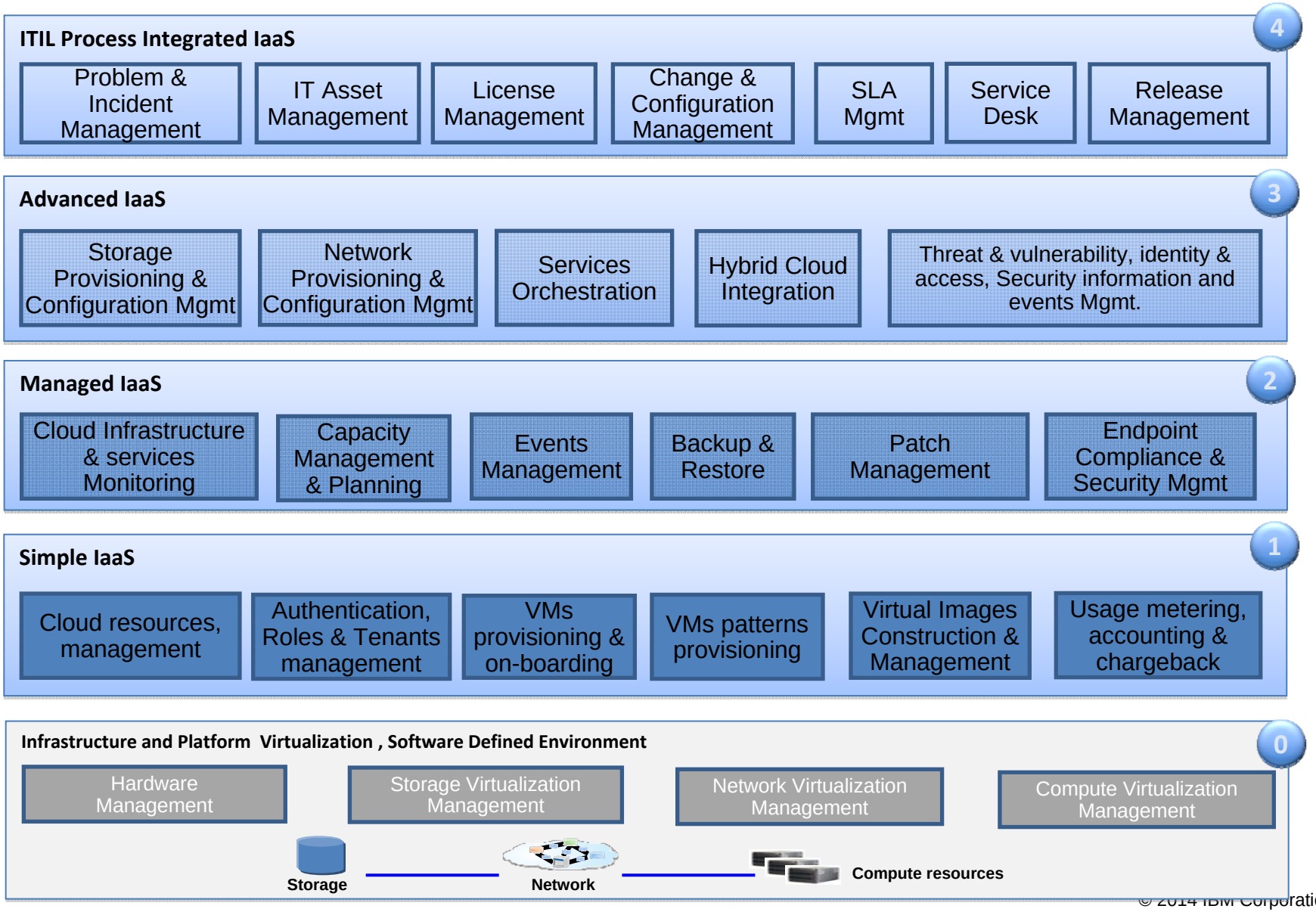
Enable IaaS with Governance
Complements the first macro-pattern by adding governance capabilities that allow to effectively manage aspects like **SLAs, security, resiliency, capacity planning, etc…** for both the virtualized infrastructure that provides the cloud service as well as the cloud service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

2

Enable IaaS with Virtualization Management
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

CEDC use-cases



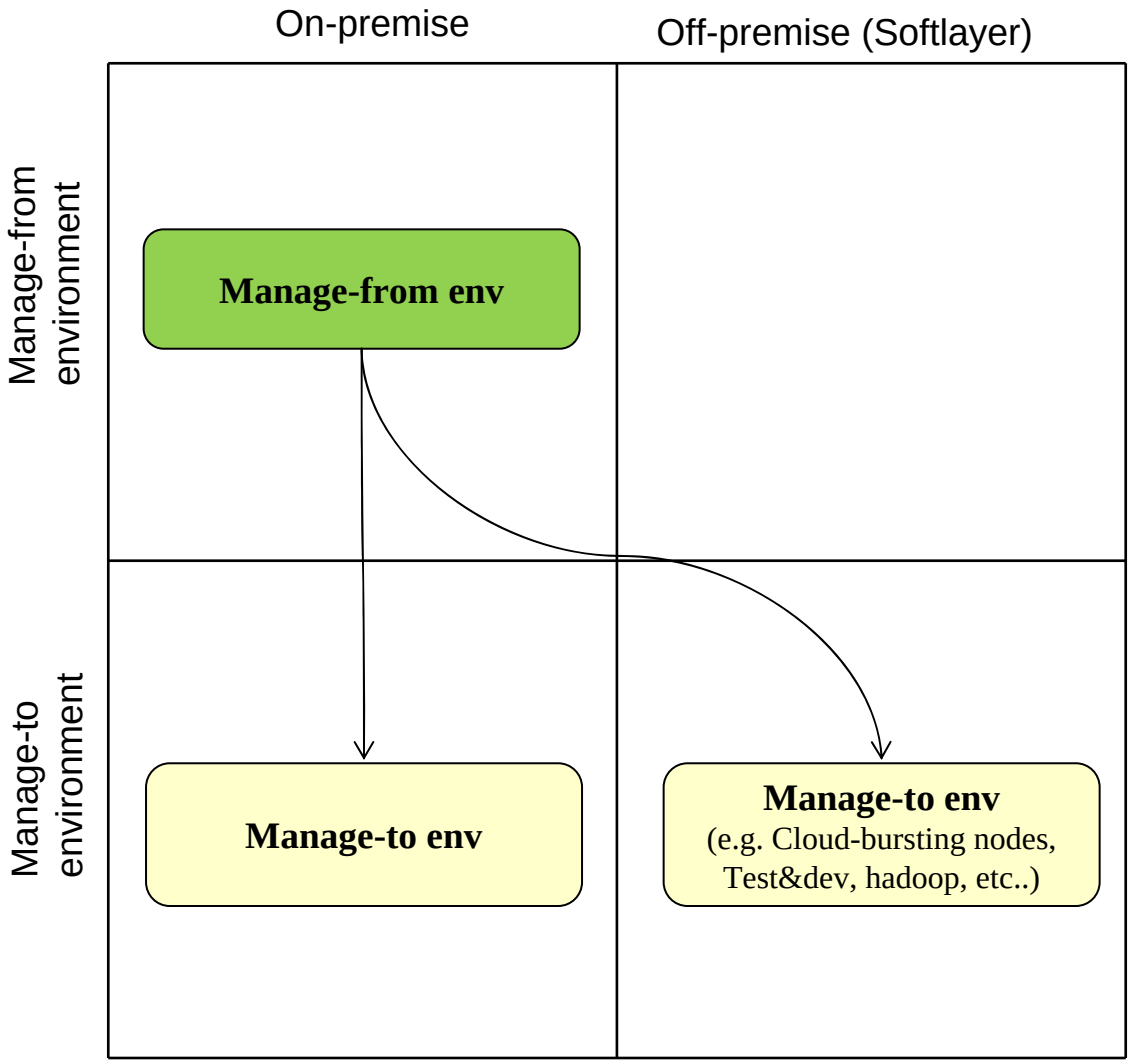
Different CeDC implementation models (CCRA 4.0)

- A CeDC can be implemented by using one of the following three models
  - On-premise-hybrid
  - Off-premise-hybrid
  - Full off-premise

Model Type	Manage-from	Manage-to
On-premise-hybrid	On-premise	On-premise *and/or* on Softlayer
Off-premise-hybrid	Softlayer	Softlayer *and/or* On-premise
Full off-premise	Softlayer	Softlayer

- Each model above is represented by a slightly different Architecture Overview Diagram (AOD) in this CeDC architecture

On-premise-hybrid model



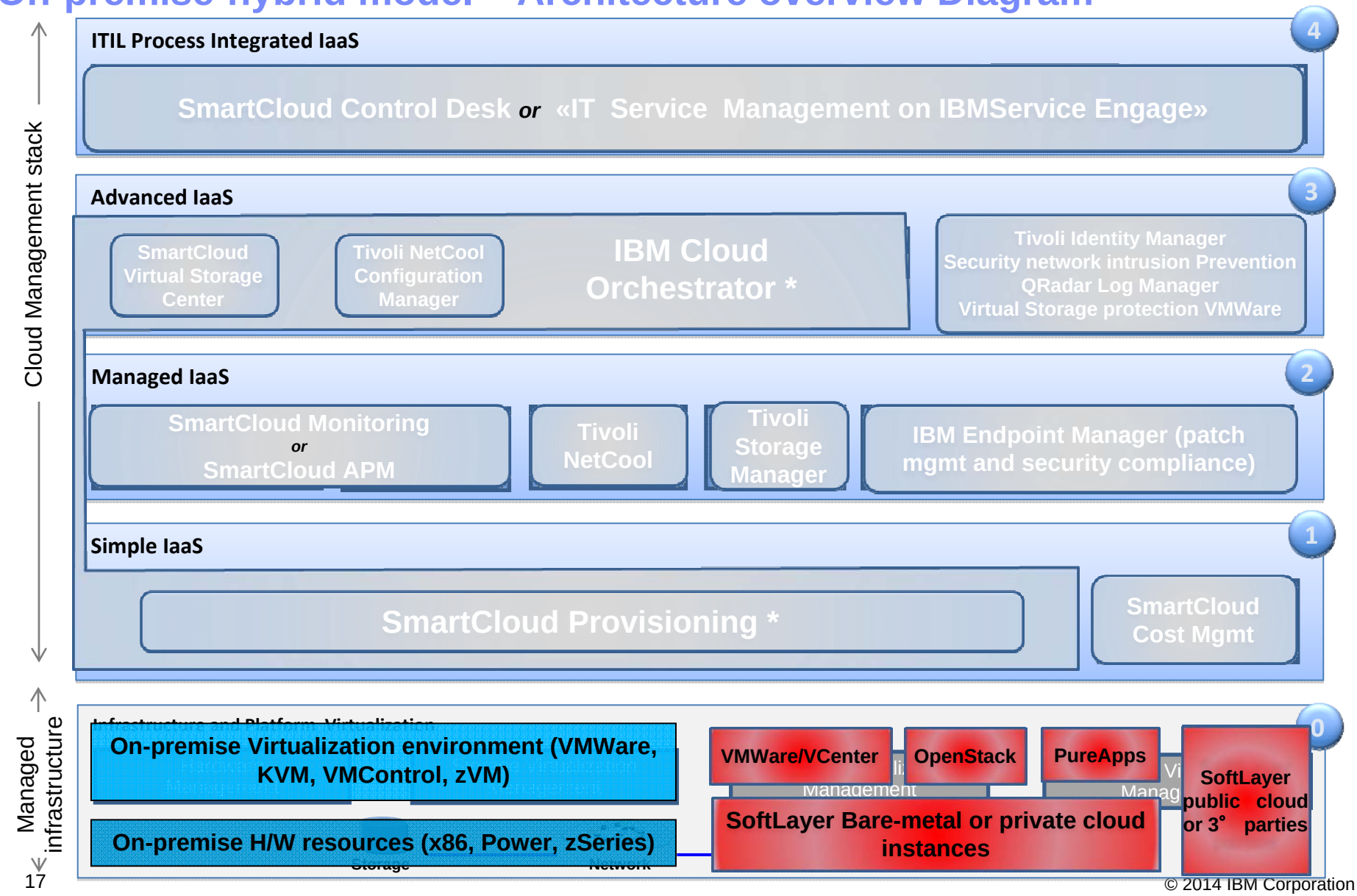
This model is typically used to implement IT-transformation projects.

Allows to deliver IT services more efficiently through the adoption of a cloud delivery model.

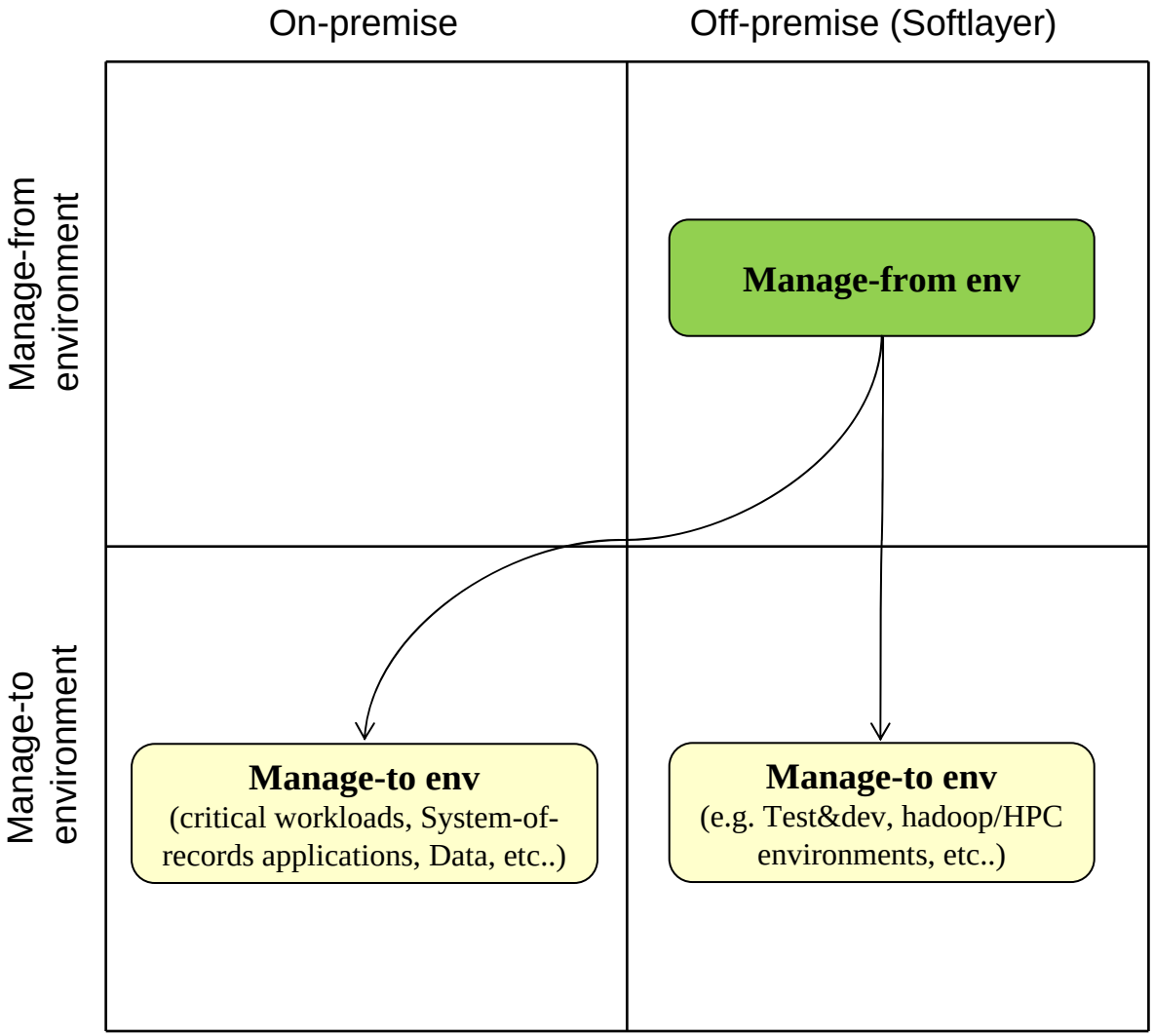
Allows to leverage external cloud service providers (as for example Softlayer) to burst uplanned, peak or very dynamic workloads into a third party infrastructure in a very dynamic and cost-effective way.

Allows to reserve more performant on-premise resources for critical workload and run tier-2 or less-critical workloads (like for example dev&test environments) off-premise.

On-premise-hybrid model – Architecture overview Diagram



Off-premise-hybrid model

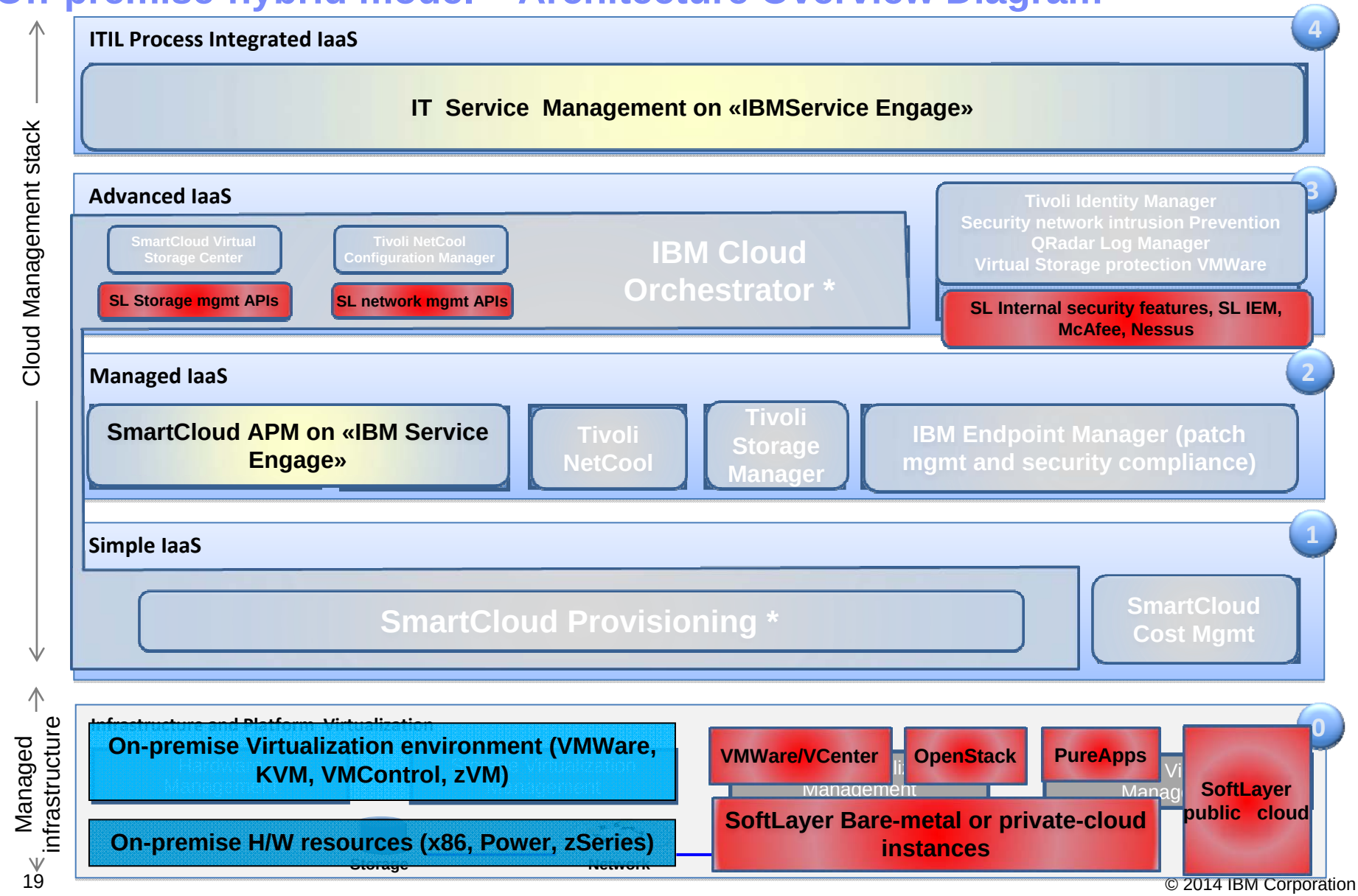


This model is the recommended approach to build a CeDC environment with the minimum investment in terms of H/W resources and total cost of ownership and to connect it to your on-premise resources, data and applications.

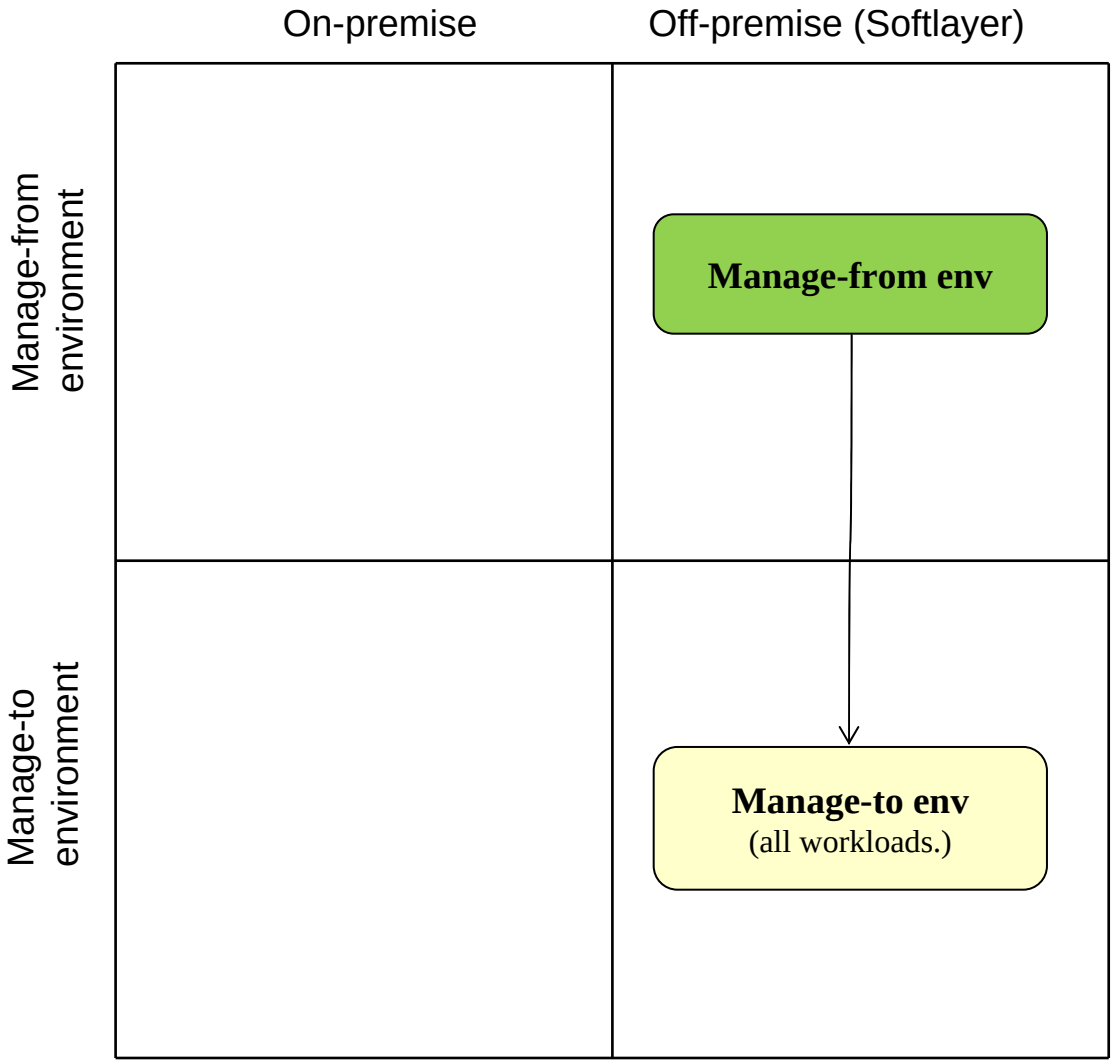
GTS Private Modular Cloud service offering allows to allocate (and deallocate) a ready to use «cloud management» and managed infrastructure in Softlayer in few hours.

Softlayer provides a set of secured network connectivity services that allows to safely allocate or connect to resources on-premise

Off-premise-hybrid model – Architecture Overview Diagram



Full off-premise model

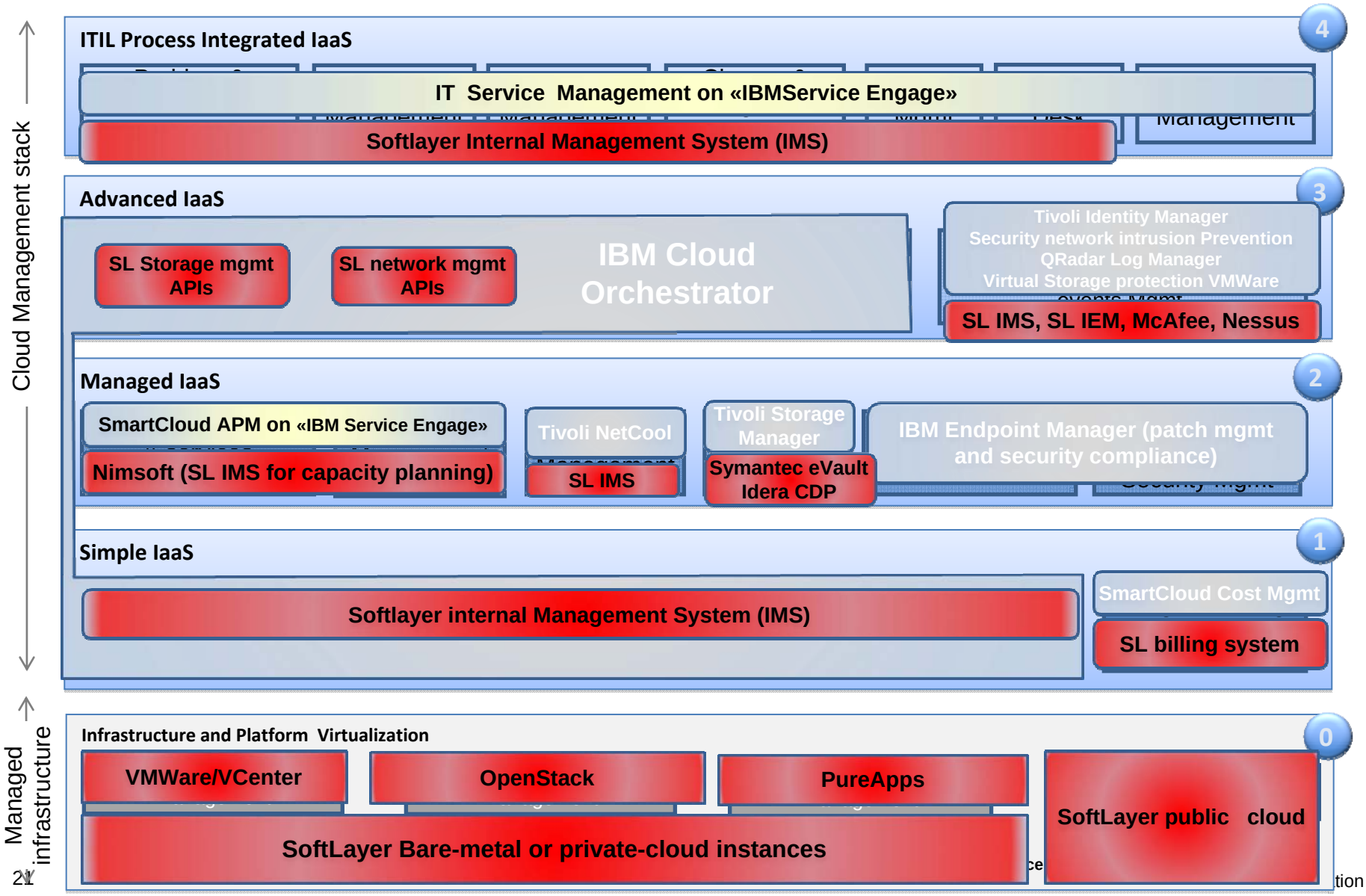


This model can be used to build a CeDC environment with the minimum investment in terms of H/W resources and total cost of ownership.

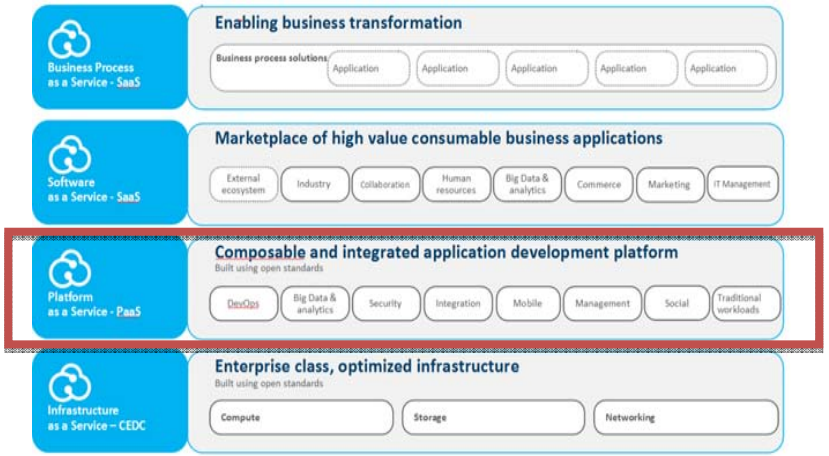
This cloud environment can be used to deliver specific services (like test&dev environments) or scale-out applications/services (like hadoop, HPC, etc..) to IT users and business lines.

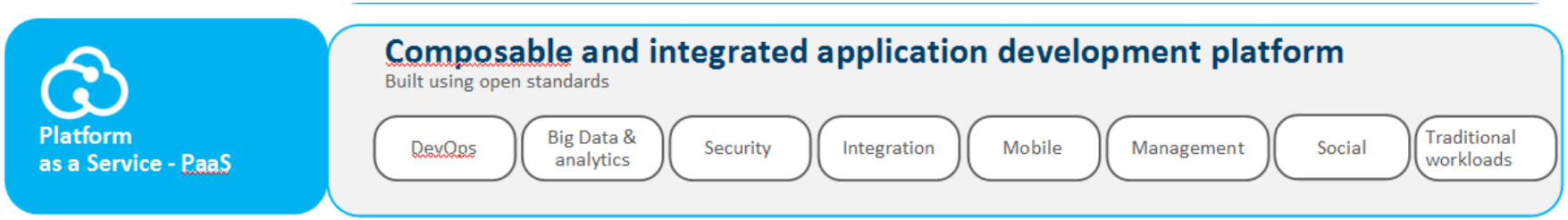
This solution could be also used to build cloud-service-provider IaaS solutions where the service provider provides and sells additional value (e.g. Application templates) on top of thre pure infrastructure provided by Softlayer

Full off-premise-hybrid model – AOD



Platform Services Adoption Pattern - PaaS





Business Challenges from Clients

"Drive innovation and differentiation of new services to the market."

"Respond quickly to business events, to stay ahead or react to the competition."

"Dramatically drive down the cost of introducing new applications."

"Reduce the time it takes to develop, test and deploy new capabilities."

"Improve the availability of our applications through standardisation."

"Manage Compliance and Audit needs thru automation and orchestration of complex deployments."

"Improve product quality and reduce risk thru rapid feedback thru entire delivery cycle."

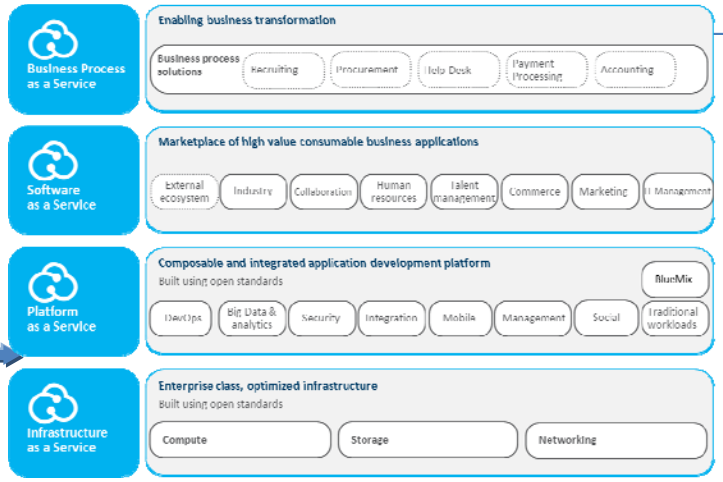
Innovation

Business Agility

Speed

IBM Cloud Reference Architecture – PaaS Macro patterns

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



Process Oriented PaaS
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 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

3

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

2

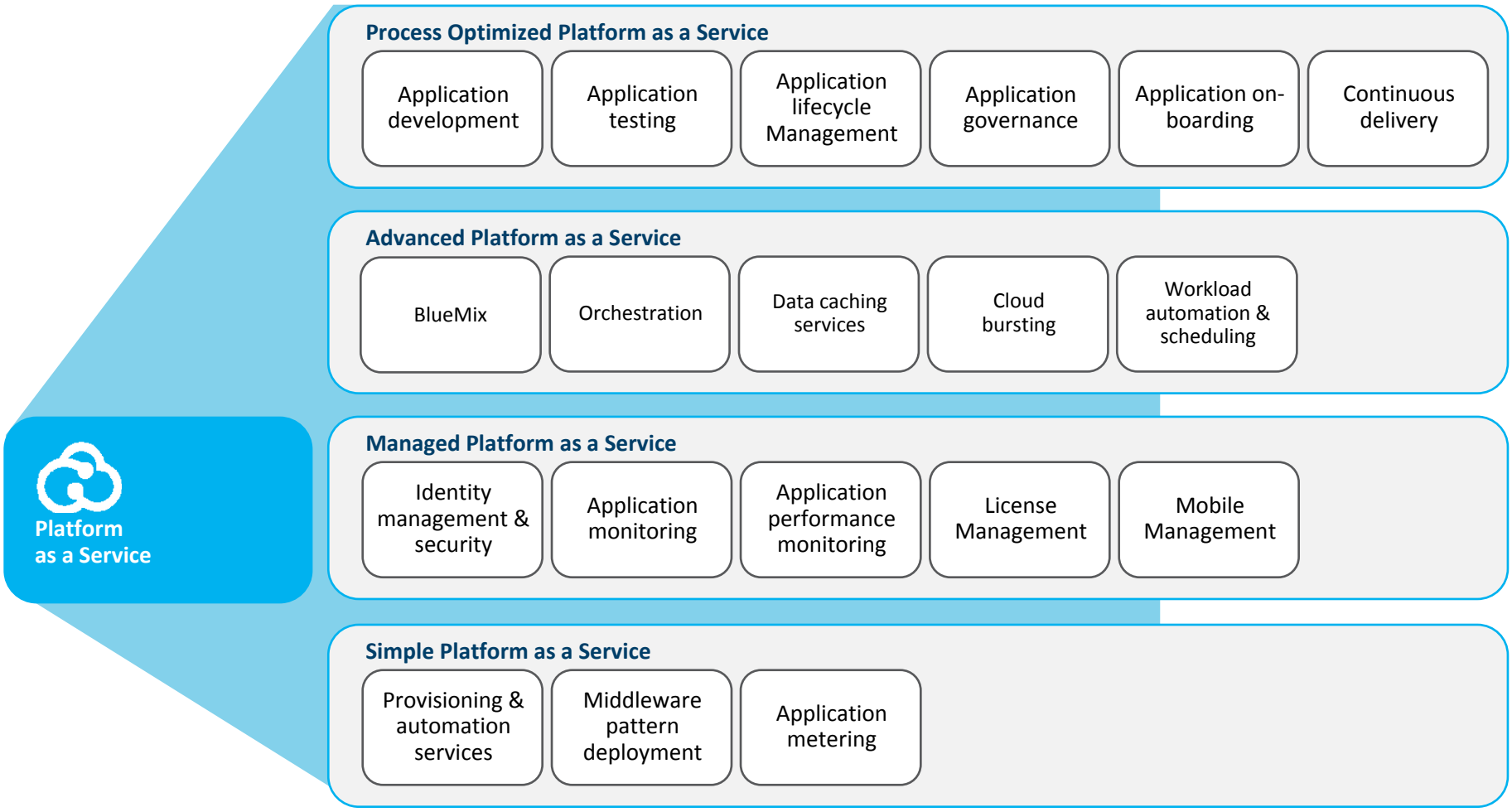
Simple PaaS Services
The entry point into the PaaS space, it allows to model multi-tiered middleware patterns, expose them as services into a self-service catalogue, automate their deployment and meter the resources used by this service.

1

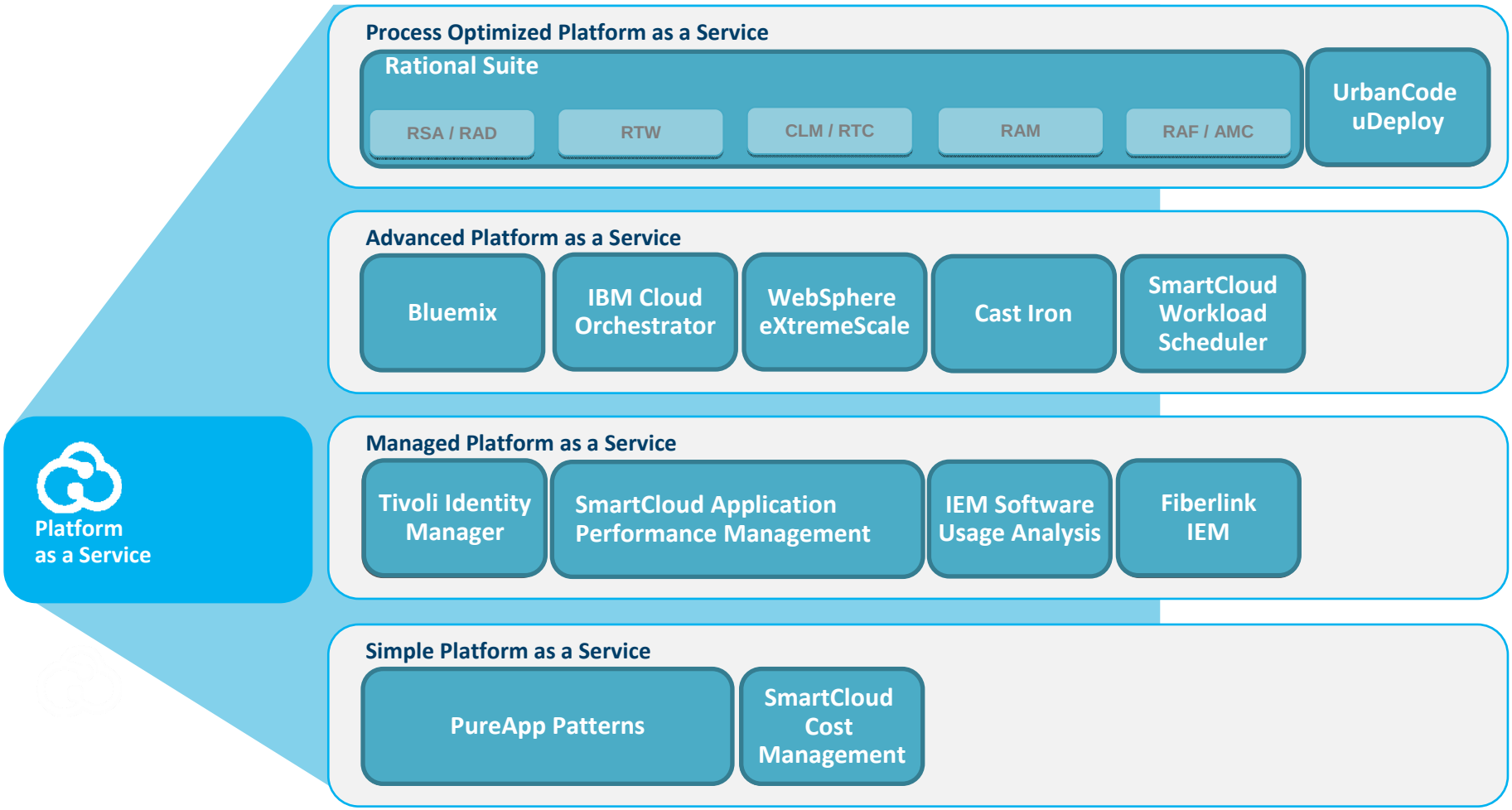
Key Business Drivers:

- 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.

IBM Cloud Capabilities – PaaS Adoption pattern



PaaS Adoption pattern – Key Software Group products



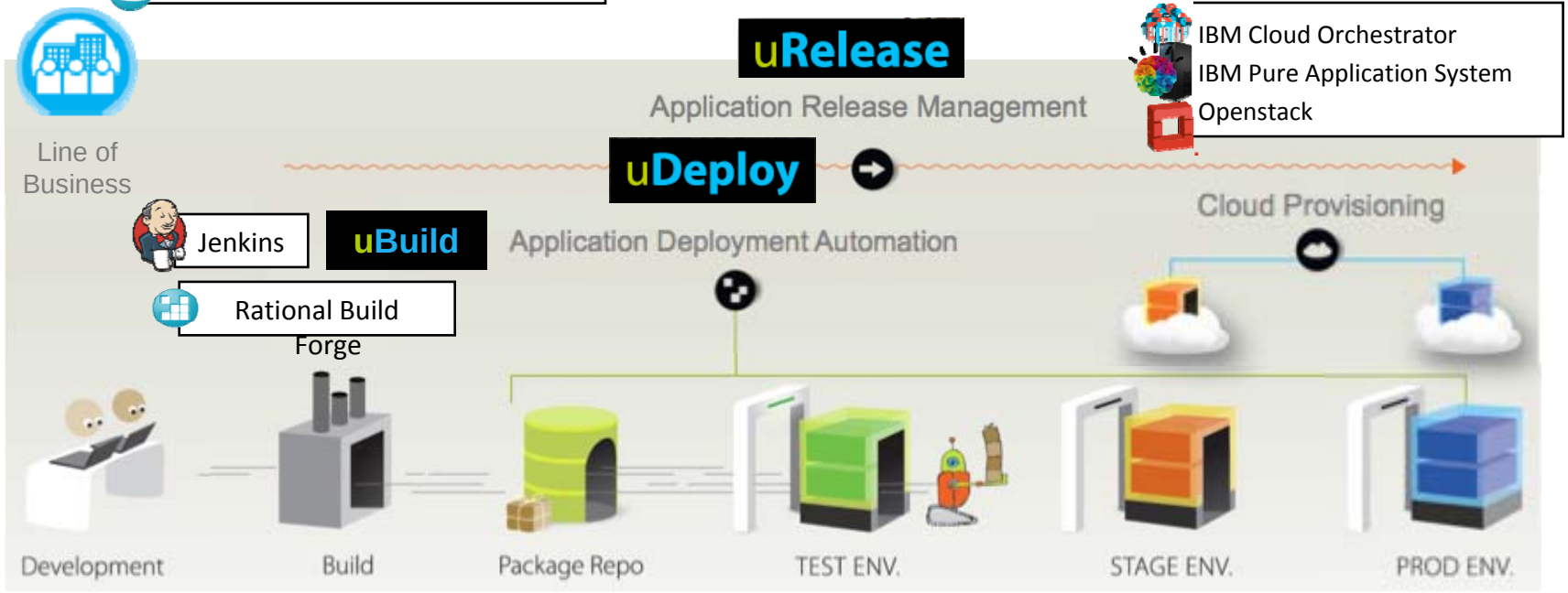
DevOps Tool Chain (packaged)

Plan and Measure

Rational Focal Point
Rational Requirements Composer

Release and Deploy

IBM Cloud Orchestrator
IBM Pure Application System
Openstack



Rational Team Concert

Rational Quality Manager
Rational Test Workbench
Rational Test Virtualization Server

SmartCloud Control Desk

SmartCloud Application Performance Management

tealeaf

Develop and Test

Monitor and Optimize

Developer centric platform, marketplace & services in a Cloud Operating Environment

Value

Fast, automated composition of services

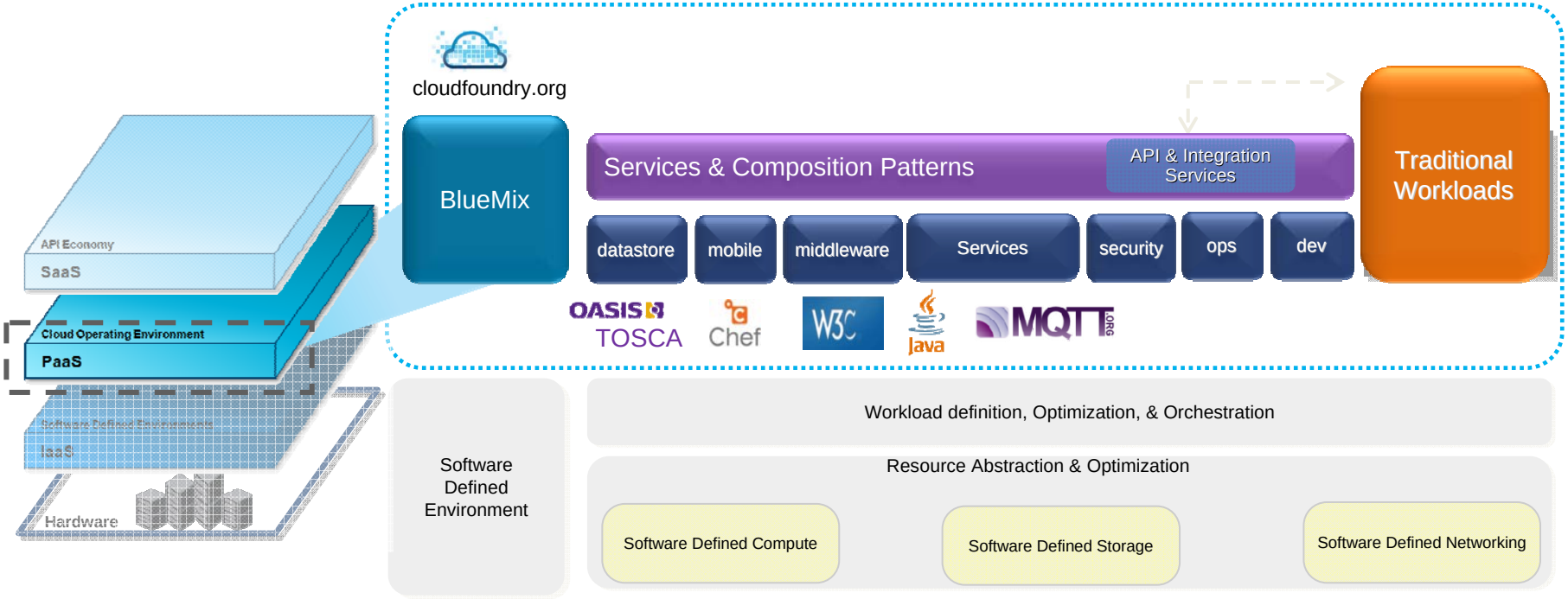
Repeatable patterns-of-expertise

Capability

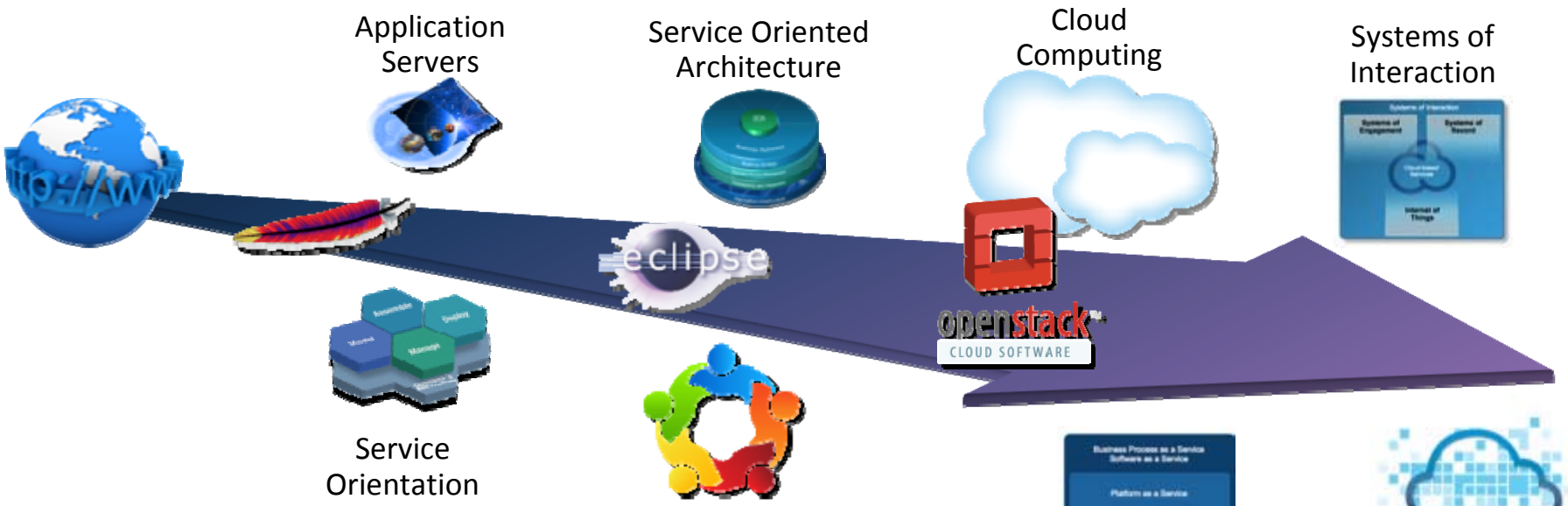
OPEN ecosystem of composable services

Optimized workload deployment

Integration patterns with systems of record



IBM embraces & invests in open source to foster innovation



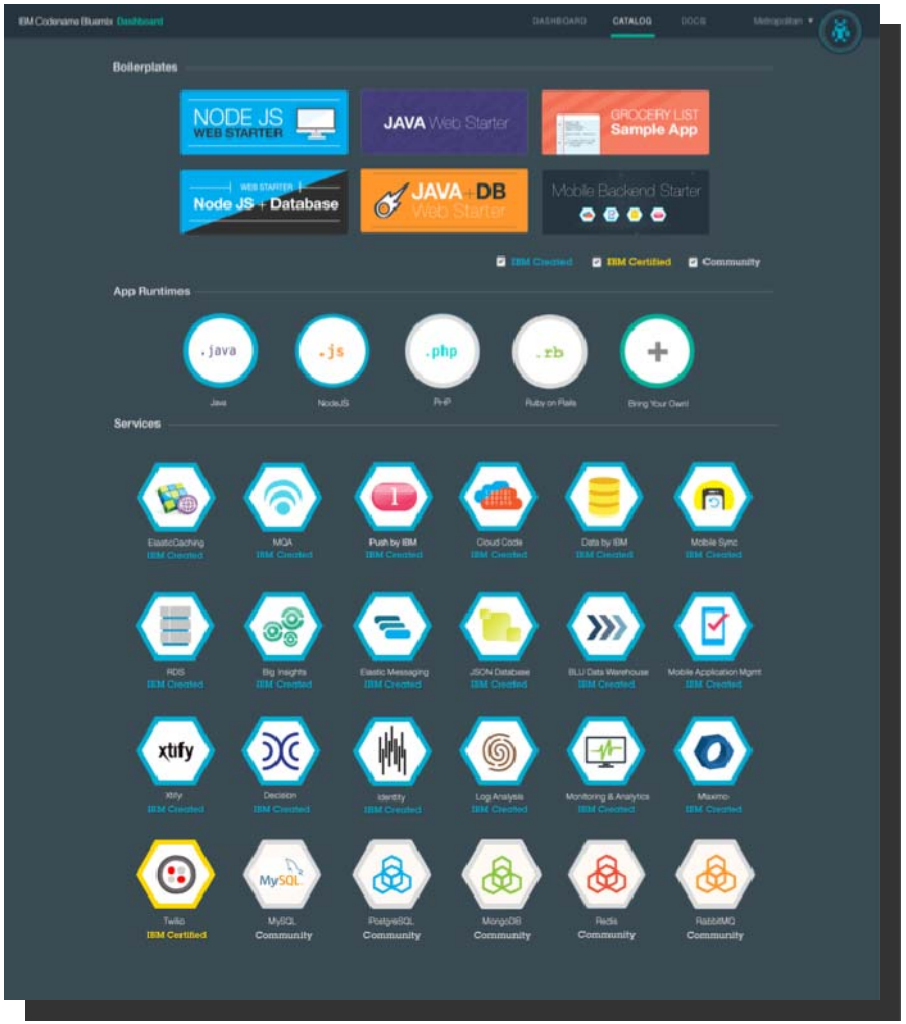
June 1998: IBM enters into an engineering agreement with The Apache Group for development of the open-source Apache HTTP server software eventually becoming the leader of the new Application Server market

September 1999: IBM capitalizes on an untapped market trend and begins participating in the community development of Linux with a $60M annual investment

November 2001: IBM rallies 150 influential vendors and the development community around a new tools environment with a $40 Million software donation disrupting the leadership of the software development ecosystem

September 2012: IBM orchestrates the launch of The OpenStack Foundation boasting $10 million in funding and 5,600 members changing the dynamics of the Cloud ecosystem

IBM Bluemix



Run Your Apps

The developer can chose any language runtime or bring their own. Just upload your code and go.

DevOps

Development, monitoring, deployment and logging tools allow the developer to run the entire application

APIs and Services

A catalog of open source, IBM and third party APIs services allow a developer to stitch together an application in minutes.

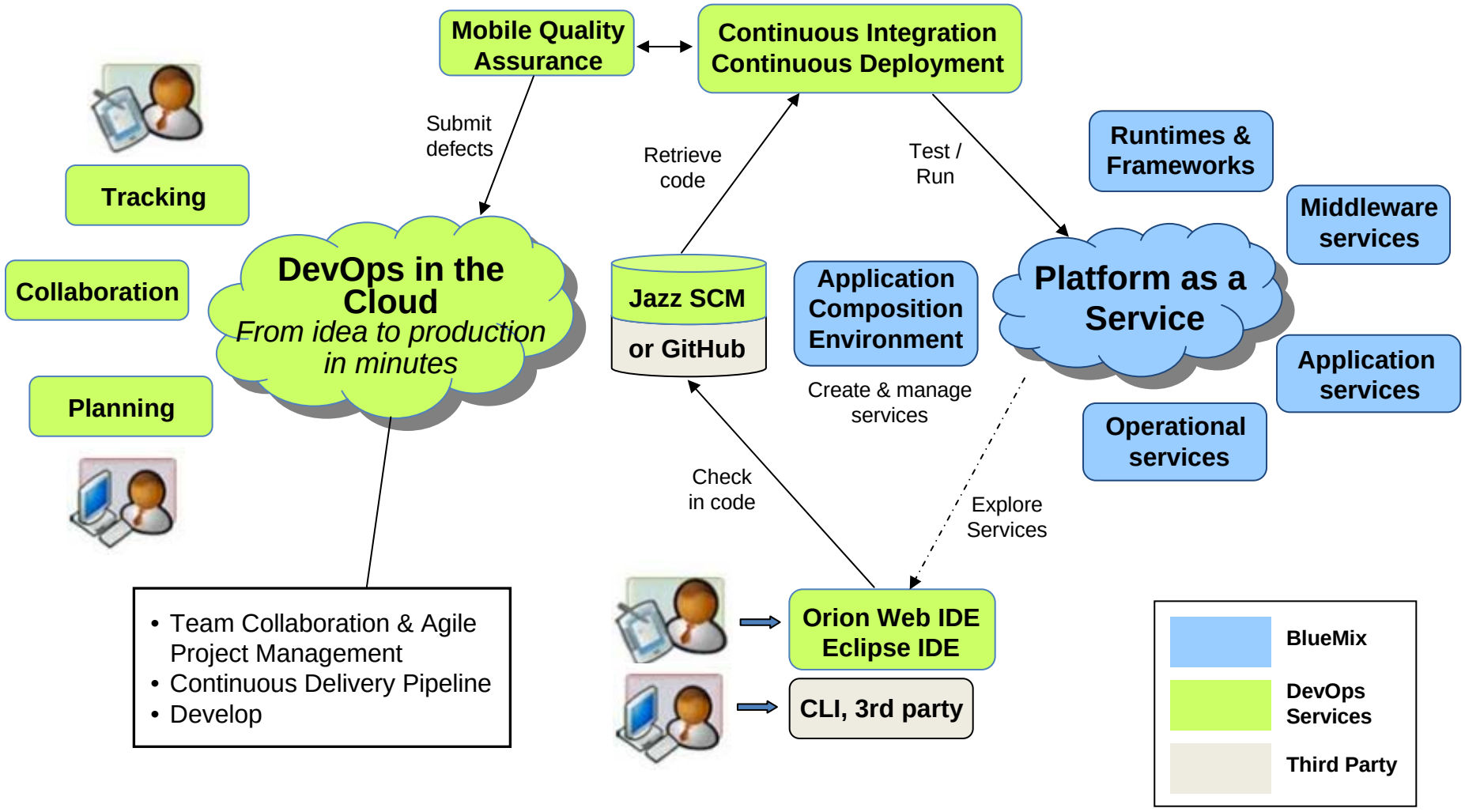
Cloud Integration

Build hybrid environments. Connect to on-premises systems of record plus other public and private clouds. Expose your own APIs to your developers.

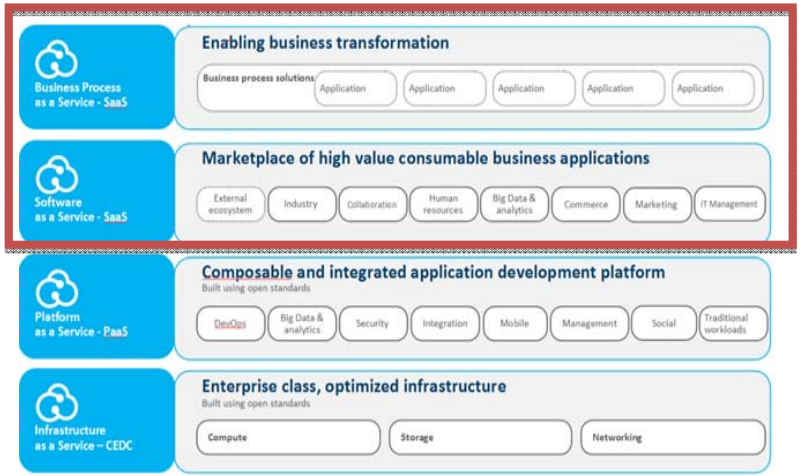
Extend SaaS Apps

Drop in SaaS App SDKs and extend to new use cases (e.g,. Mobile, Analytics, Web)

BlueMix – DevOps services



Software as a Service Adoption Pattern



Through the IBM SmartCloud, clients tap into SaaS solutions aligned by role and collaboration between business functions

SmartCloud for Human Resources
Talent Management
Learning and Certification
Employee Onboarding

SmartCloud for Procurement
Contract Management
Spend Analysis
Strategic Sourcing

SmartCloud for Customer Care & Support
Engagement Advice
Experience Management
Client Success

SmartCloud for Legal
Contract Management
Risk Analytics
Document Management

SmartCloud for Social Business
Collaboration Suite

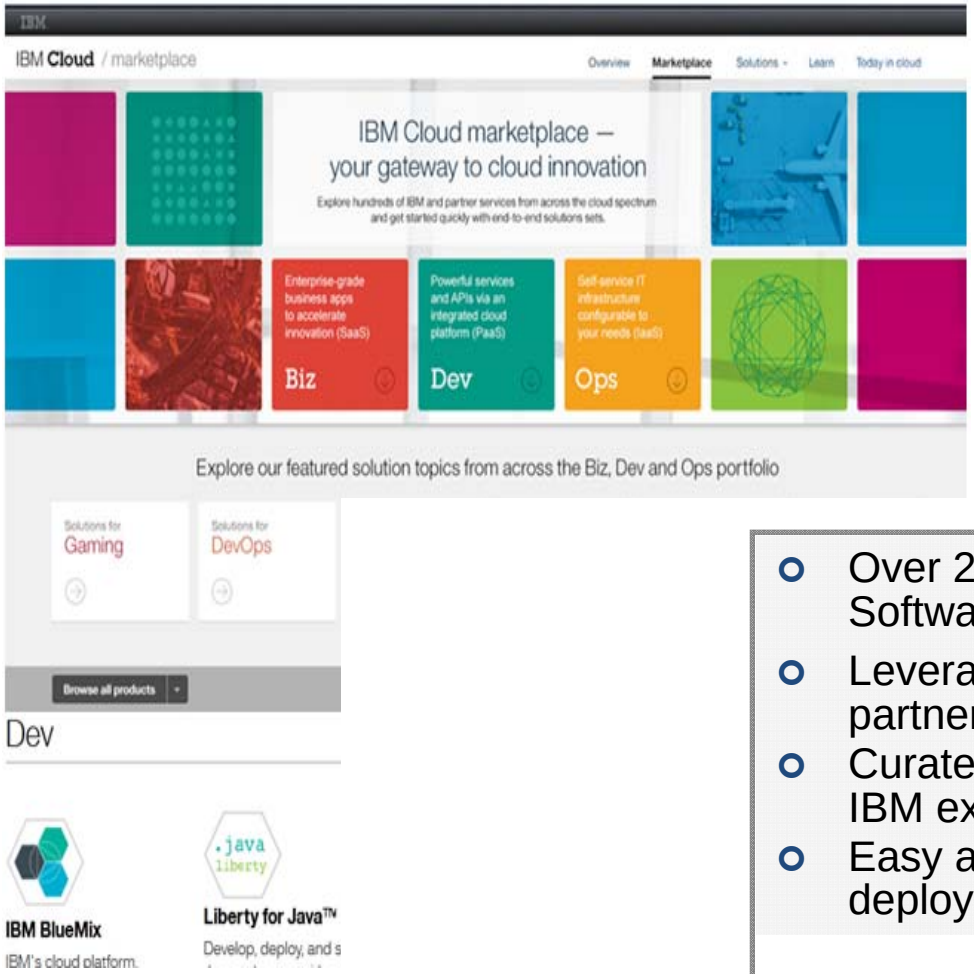
SmartCloud for Sales & Commerce
eCommerce
Performance Analytics
Quote Management

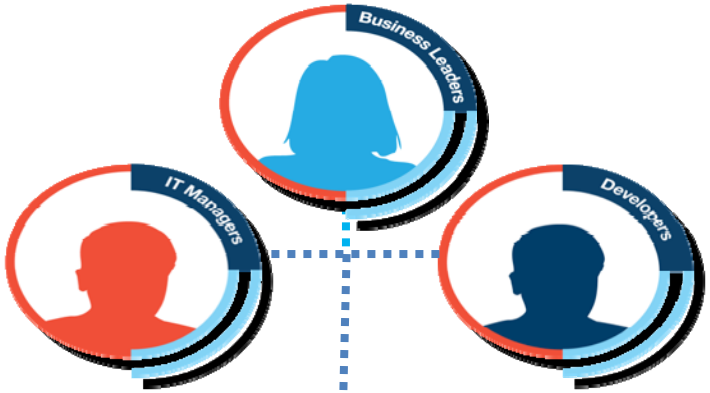
SmartCloud for City Operations
Transportation Planning
Water Management
Utility Optimization

SmartCloud for Marketing
Demand Generation
Campaign Analytics
Agency Collaboration

Introducing IBM Cloud Marketplace

http://www.ibm.com/cloud-computing/us/en/marketplace.html

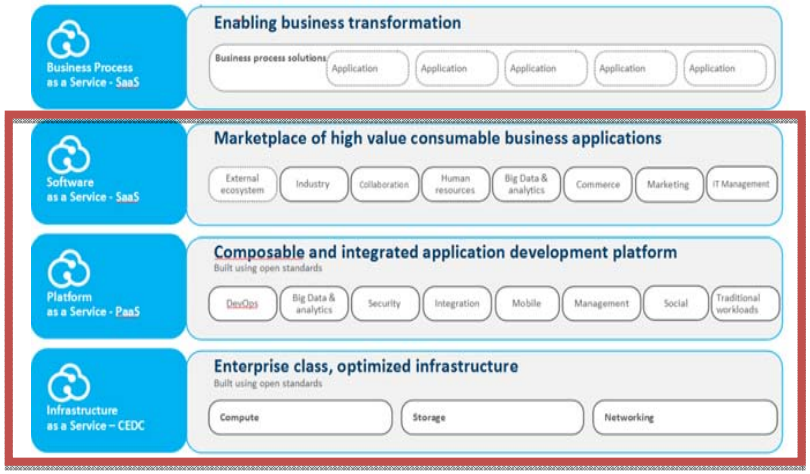


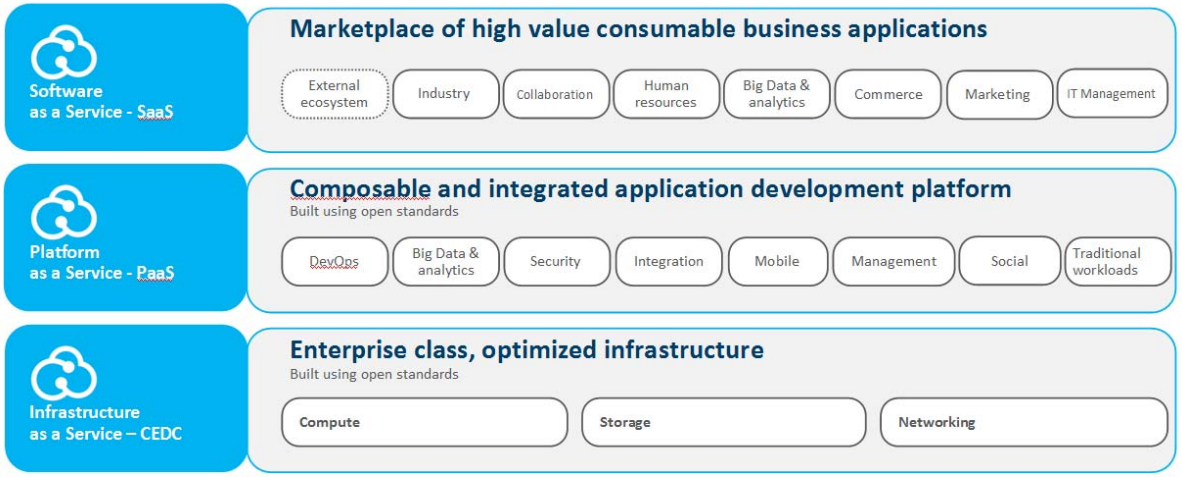


New Buying Experience

- Over 200 IBM and Third-Party Software and Services
- Leverage world-class IBM partner ecosystem
- Curated solution pages with IBM expertise
- Easy access to build, consume, deploy and purchase services

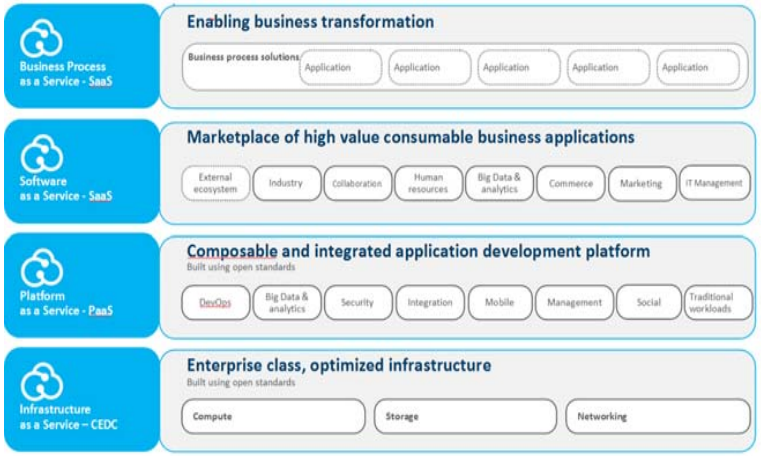
Cloud Service Provider





IBM Cloud Reference Architecture - CSP Macro pattern

Deliver innovative business Models as a Cloud Services Provider



Advanced CSP Services
Provides an highly customizable storefront that includes the most typical e-commerce features like shopping-kart, credit-card-payment, etc.. and that allows a cloud service provider to sell its own services or to resell, white-label or broker third –party cloud services to consumer users

2

Simple CSP Services
Provides deployment, automation, security, customer management, metering and billing services that allow to delivery IaaS/PaaS services in a simple, repeatable and secure way to end-users inside or outside the enterprise boundaries and to account them for these services use

1

Key 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)

What's New in CCRA, CSP v4 …

Phase-1: Understand the Client

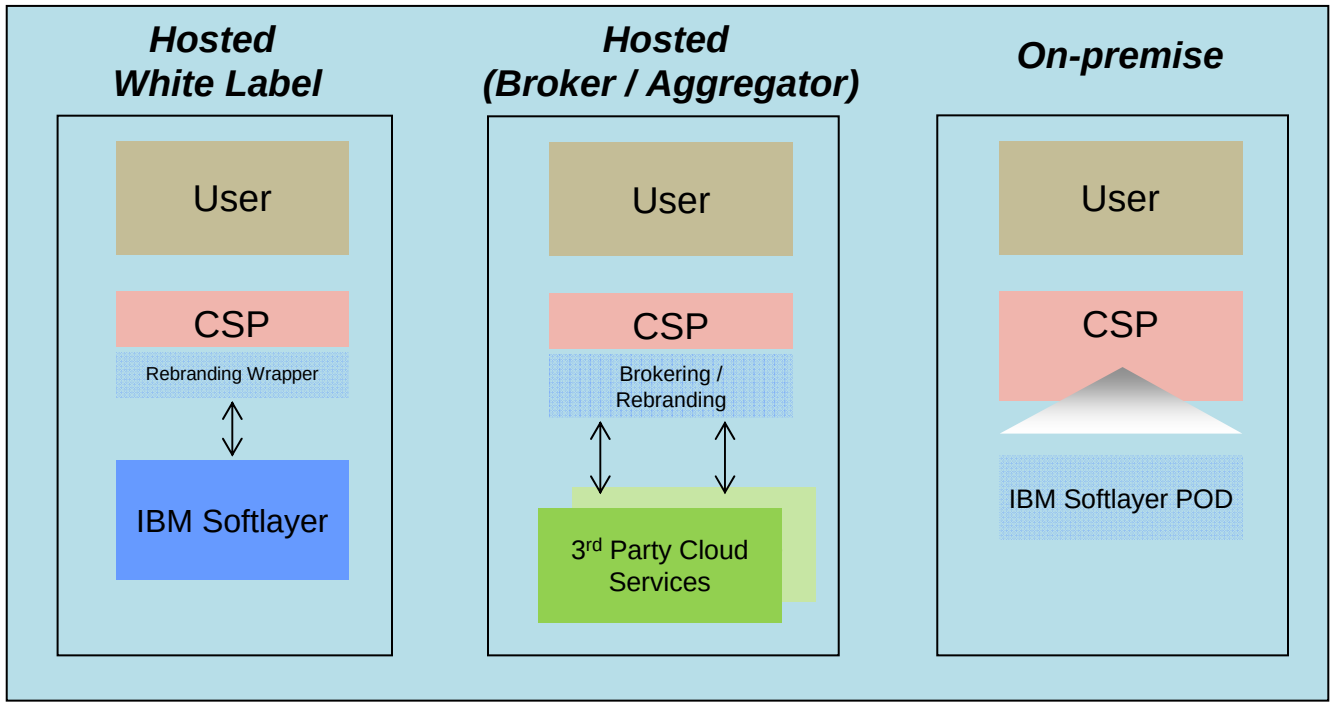
- Added some customer segmentation insights based on the latest corporate Strategy Team work.

Phase-4: Detail Design

- Restructured the section to include sample CSP Services, starting with two:
  1. IaaS (Infrastructure as a Service)
  2. VDI (Virtual Desktop Infrastructure)
- Added some notes about Parallel's Automation Platform – a partner solution recommended by IBM for large scale CSP implementations
- Focus on service brokering
- Also added some comparison between the legacy ISDM product and SCO (Smart Cloud Orchestrator) as an aid for customer migration scenarios
- Refreshed the many pattern deployment examples to reflect the latest changes in IBM product line.
- Updated the pattern material to be in line with the latest changes in CEDC v4 pattern.

There are several options to become a CSP

Use 3rd Party

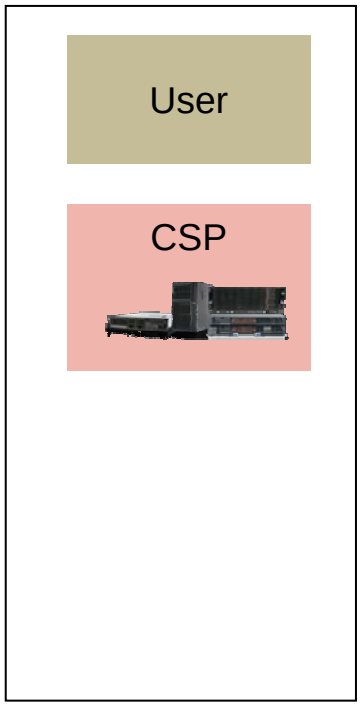


- Data Centre hosted with another CSP with rebranded front-end;
- Faster time-to-market , but less control
- **Example: White labeling IBM's Softlayer**

- Similar to white labeling, but can aggregate one or more 3rd party Cloud Services with rebranding front-end;
- Faster time-to-market, but less control
- **Example: AppDirect.com (used by GTS), Jam Cracker, etc.**

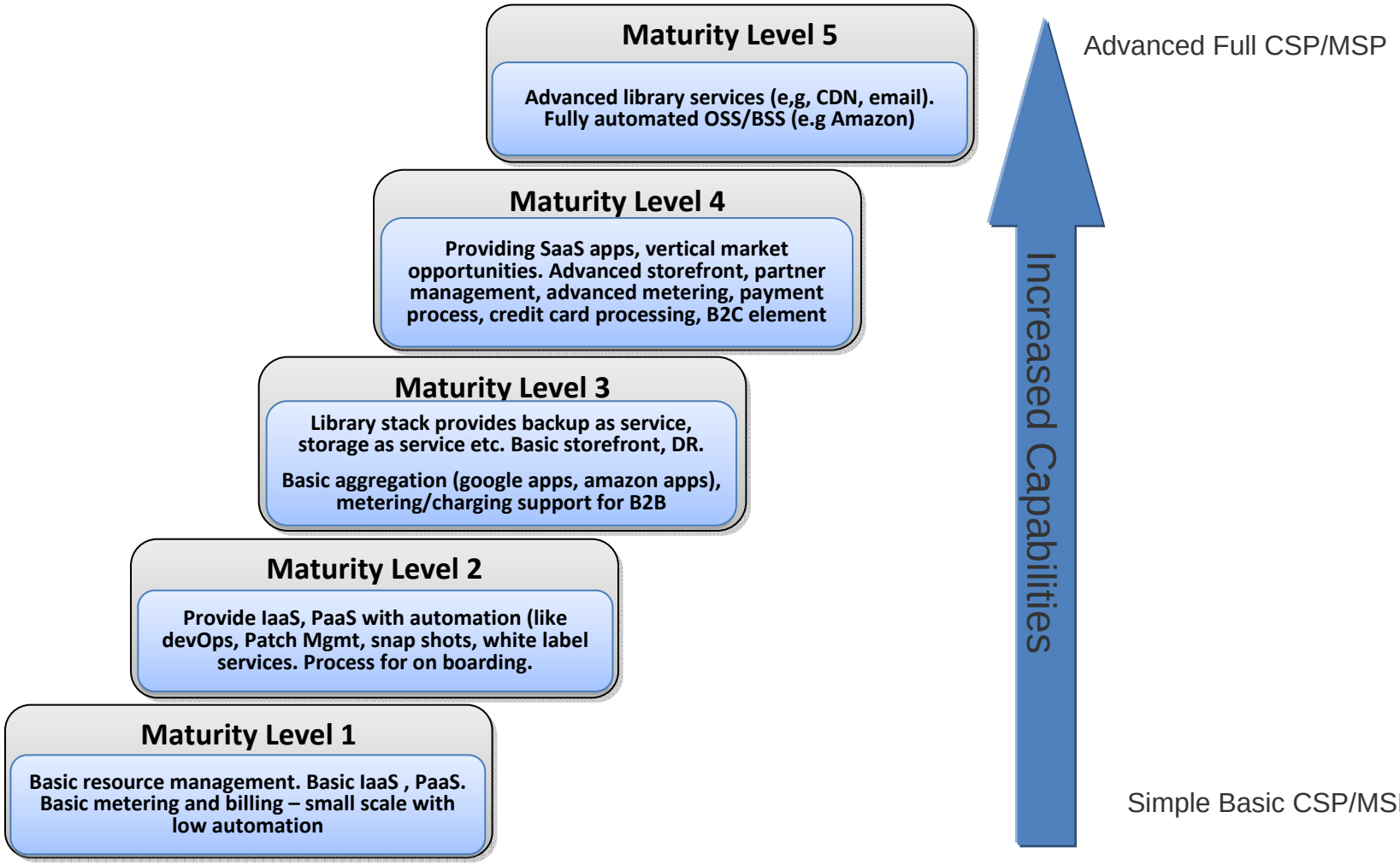
- Similar to White labeling but with on-premise installation of a 3rd party design.
- Faster time-to-market with slightly more control
- **Example: IBM Softlayer POD** (=Point of Delivery)

Build it

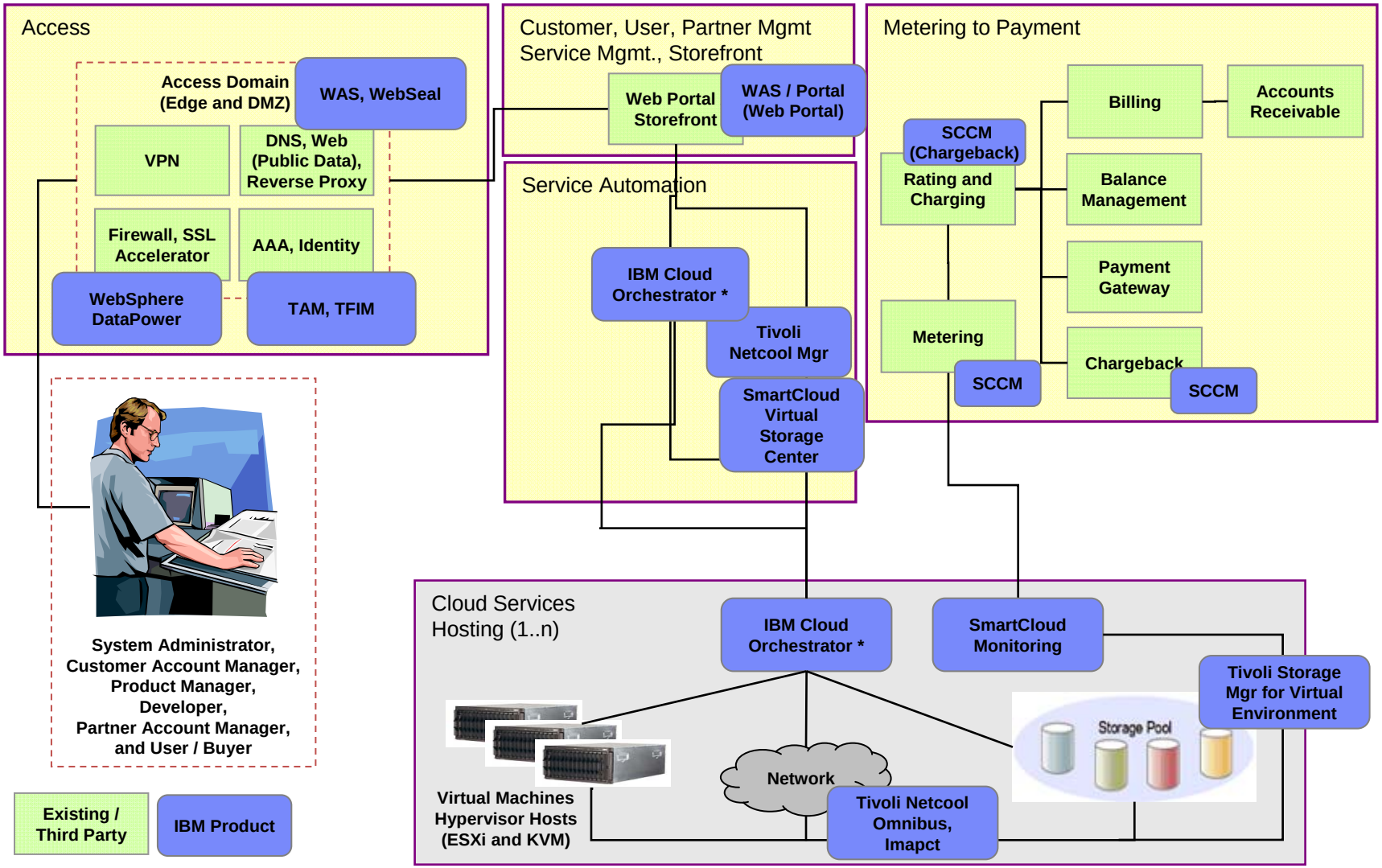


- From the ground-up design, build and installation of on-premise Cloud Data Center Solution.
- Takes more time to build; full control; possibly more profitable.
- More suitable for existing MSP's and/or Enterprise and Government type CSP's

CSP's are not all created equal: CSP Maturity Model



High-Level Deployment Model with Product Mapping



* Refers to a common installation, used to address different capabilities

Federal Government – Business Drivers

1. Data Center Consolidation
2. Outsourcing Managed Services on the Cloud
3. Application Capitalization in the Cloud (PaaS, SaaS, BPaaS)
4. Increasing need of security compliance
5. Transformation – Delivery models from traditional to cloud
6. Decrease cost
7. Dynamically scalable data centers
8. Increase service level compliance, accuracy, repeatability, and traceability
9. Agility to deploy new capabilities
10. Enable to become a cloud service provider
11. Centralized accounting and billing

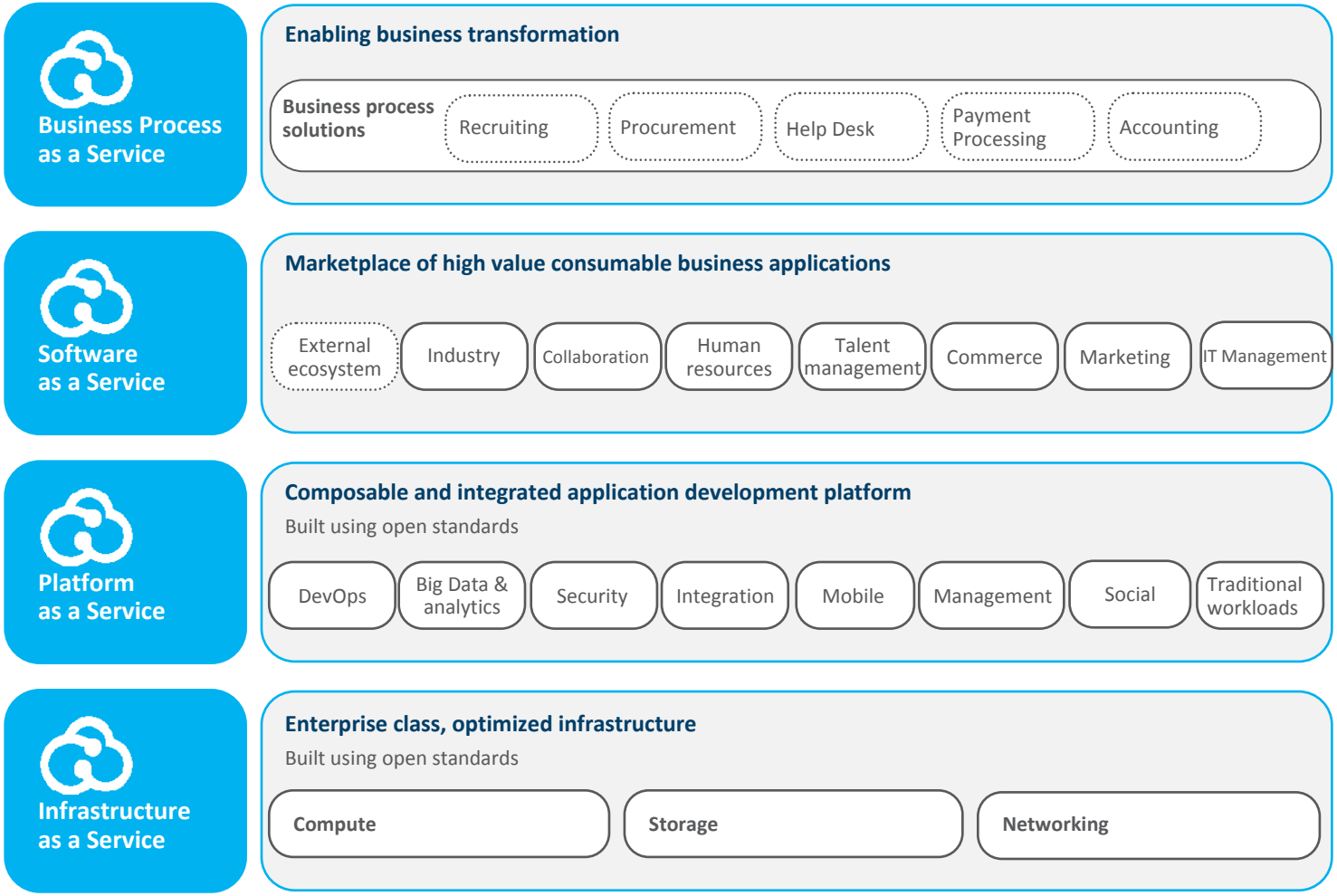
Federal Government – Cloud specific Standards

1. Digital Privacy Controls and Data Privacy
2. Digital Government Strategy
3. Cloud First in Federal
4. Open Data Policy
5. Cyber Security Policy
6. Standard Compliance
    1. Example Security FIPS 140-2, Accessibility, FedRAMP etc
7. Hybrid Cloud and Disaster recovery
8. Cost Effective Deployments and Interoperability

HOW IT ALL COMES TOGETHER WITH OUR PORTFOLIO

An Entire Continuum Working Together

Architectural Model for Cloud Services and IBM capabilities



Smarter **Commerce**
Smarter **Analytics**
Smarter **Cities**
Smarter **Workforce**
Watson Solutions
IBM **Service Engage**
Software solutions
API Economy
Marketing Services
Maximo Solutions

BlueMix PaaS Platform
Open Standards-based Middleware solutions given by Pure App System, Pure Data System, DevOps portfolio

IBM Cloud Orchestrator, SoftLayer, IBM Cloud Management services

Reference Material

Publically available material

Getting Cloud Computing Right (whitepaper about the CCRA)

http://www-05.ibm.com/de/cloud/pdf/Gettingcloudcomputingright.pdf

Redguide about Cloud Enabled Data Center adoption pattern

http://www.redbooks.ibm.com/redpapers/pdfs/redp4893.pdf

Redguide about Cloud Service Provider adoption pattern

http://www.redbooks.ibm.com/redpapers/pdfs/redp4912.pdf

IBM PaaS PoV

http://www.redbooks.ibm.com/abstracts/redp5041.html?Open

Academy Technote about the CCRA

http://www-05.ibm.com/it/cloud/downloads/Cloud_Computing.pdf