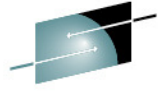




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# Realizing Cloud and SOA Enterprise Platforms, Solution Architectures and Roadmaps using the TOG's SOA RA

Nikhil Kumar

ApTSi (Applied Technology Solutions, Inc.)

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Session Number 11910





## Introductions

- **Jan 31<sup>st</sup> 2012**

- **Name**                      **Title**
- Nikhil Kumar              President, ApTSi  
Co-Chair SOA Reference Architecture Project, The Open Group  
Board Member, Henry Ford Health Systems Behavioral Health Board

Nikhil Kumar  
Email: [nikhil@ap-tech-solns.com](mailto:nikhil@ap-tech-solns.com)  
Blog: <http://blogs.ittoolbox.com/emergingtech/nikhil>  
Phone: (248) 797 8143

- Overview
- Reference Architectures for SOA and the Cloud
- Executing – Creating Actionable Cloud and SOAs'
- Success Factors
- Discussion

## What You Will Learn

- SOA, the Cloud, emerging technologies and the new IT model
- Reference Architectures and their role
  - The Open Groups SOA Reference Architecture
  - Initial view of the ApTSi's Actionable Cloud Reference Model
- Overview of the Open Group's SOA Reference Architecture
  - The use of the SOA for the Cloud
  - A Cloud Reference Architecture
- Using the SOA RA to create and evolve SOA's
  - Roadmapping, the RA and the OSIMM
  - Using It! – making it actionable and creating solution architectures
- Success Factors
  - Capabilities, Service Classification, Governance and Realization
- Examples
  - Day in the life of a modern Enterprise
- Q & A

# What's in it for me?!

- Organizations adopting or evolving SOA and Cloud solutions
  - It's vendor independent -- now you can compare, adopt and evolve..
  - It provides a holistic, common point of reference for all stakeholders
  - Provides a framework for conformance and solution architectures derivation
  - Provides a common language – Architects across different groups and even organizations share the same concepts and terminology!
  - It is scalable – your eco-system can leverage it too!
- Product Vendors
  - Provides a standard reference framework for compliance and differentiation
- For Systems Integrators
  - Use it to carry out implementations, and develop Cloud and SOA architectures
- For Standards Bodies
  - Use it to act as a reference to derive against, to focus on the specific instead of the generic

*The SOA RA provides the ability to adopt, evolve and transform SOA and Cloud Solutions. It is a vehicle for agility and reduces the cost of RA definition*

## Examples of using it..

- Assess an existing architecture
  - Checklist of layers, capabilities, architectural building blocks to validate against
  - “how can I assess whether I have the right things in place?”
- *Design* a new or *Extend* an existing architecture
  - “what are the things I need to build / design to my requirements?”
- *Incorporating* the cloud
  - “how do I move to the cloud and what role does the RA have?”

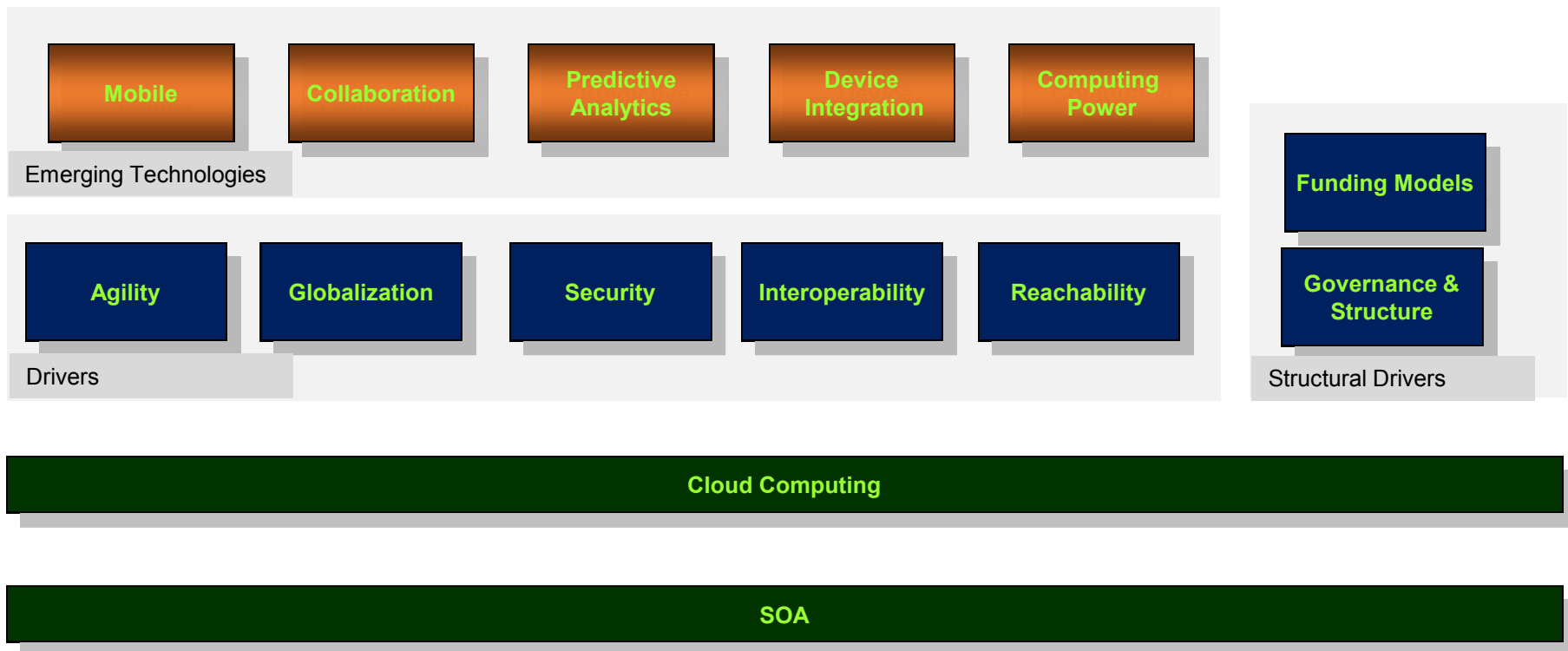
*The TOG SOA RA defines standard capabilities, ABBs, architectural decisions and other attributes to form a framework for understanding, evaluating and implementing SOA. The ApTSi Actionable Cloud Reference Model provides a reference around which to apply the TOG SOA RA and evolve Cloud implementations*

The SOA Reference Architecture is available at

<https://www2.opengroup.org/ogsys/jsp/publications/PublicationDetails.jsp?catalogno=c119>

Complete your sessions evaluation online at [SHARE.org/AnaheimEval](http://SHARE.org/AnaheimEval)

# SOA, the Cloud, emerging technologies and the new IT model



# Understanding the Cloud

- The cloud provides the commoditization of IT
- Cloud Solutions are starting to supplement organizational IT
- Cloud model adoption is based on the kind of business
  - Security
  - Quality of service
- The Cloud is service based
- Most BPaaS, SaaS and PaaS models involve a cloud-broker model
- SOA and cloud adoption and evolution is transformational
- Data and information is going to become more important

*The Cloud being Service Based is an instance of an SOA. The SOA RA forms the basis around which Cloud RAs can be developed.*



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# SOA, the Cloud, Services and Solutions

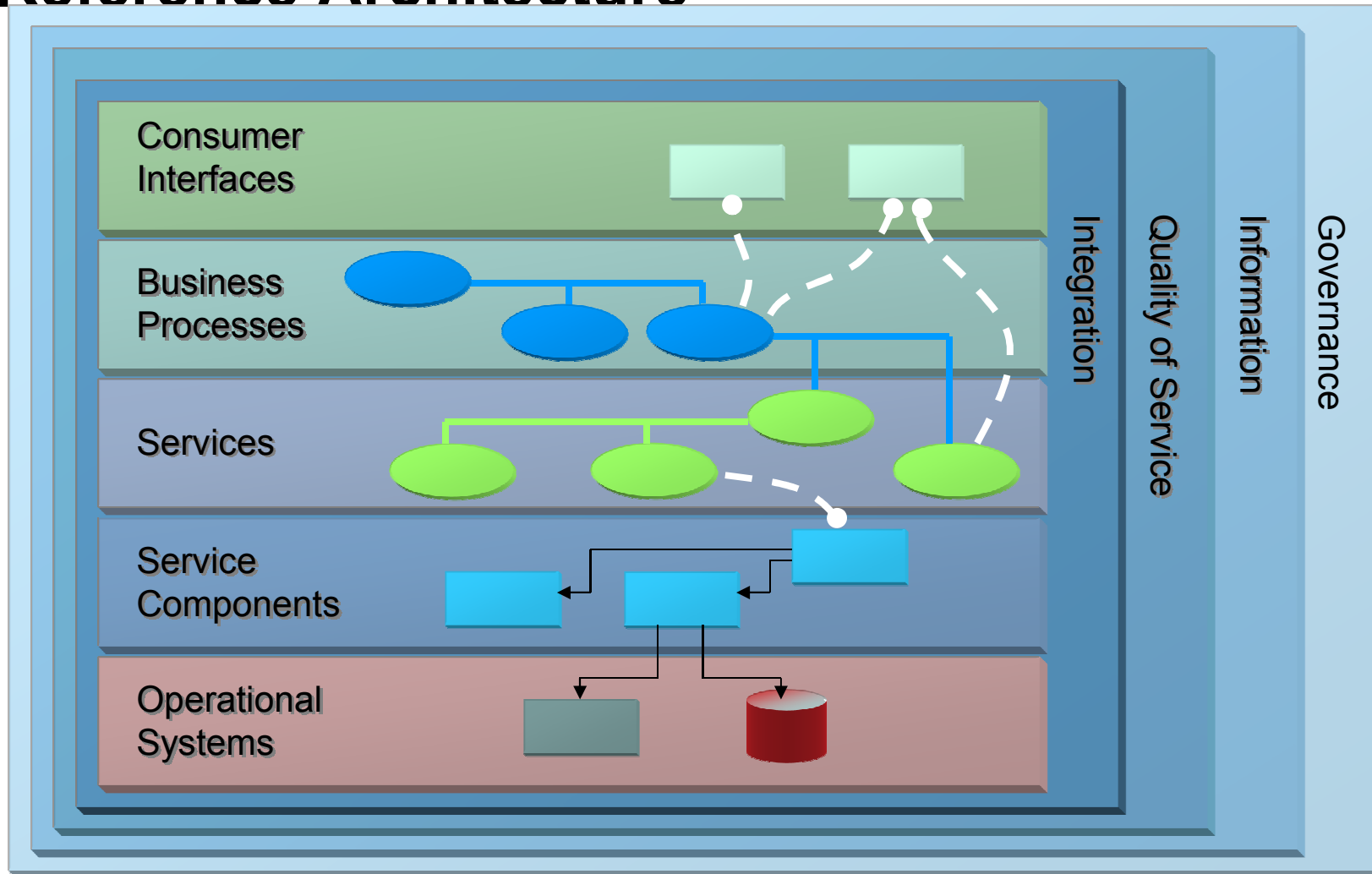
- Solutions are what meet business needs
- SOA solutions
  - Are based on a set of capabilities or services
    - that collectively fulfill business needs
  - Share a common SOA platform
- SOA provides a fabric to bind Business Strategy to IT delivery
  - Drive down from Business Architecture through EA to SOA
  - Use capabilities as a vehicle to address agility and map business/ IT
  - Use ABB's to define the realization
- SOA and cloud adoption and evolution is transformational
  - Phase it via a Roadmap (e.g. using OSIMM)

*The Cloud being Service Based is an instance of an SOA. The SOA RA forms the basis around which Cloud RAs can be developed.*

# Reference Architectures and their role

- Reference Architectures are cornerstones to modern IT
- Reference Architectures provide a means to:
  - Align
  - Share taxonomy
  - Execute
  - Govern
- Reference Architectures contain:
  - Architectural building blocks
  - Interactions
  - Architectural views
  - Cross-cutting concerns
  - Patterns defining and encapsulating the use of the building blocks
  - Capabilities that they satisfy

# Logical Solution View of the SOA Reference Architecture



# Closing the Overview - the Layers in a Nutshell



- The Functional Layers
  - **Consumer:** Access to services for consumers
  - **Business Process:** Workflow and Business Processing
  - **Services:** The Services, service categorization
  - **Service Component:** Components that support service realization and implementation
- The Cross-cutting (Supporting) Layers
  - **Integration:** Point where integration occurs and consolidates design decisions into a set of software components that facilitate and enable the actual integration of applications
  - **Information:** Data and information pertaining to each of the layers, including metadata, actual data and metadata
  - **Quality of Service:** Manages administration and control and monitoring of the non-functional requirements; includes security, availability, configuration, monitoring and management
  - **Governance Layer:** Provides a central point in which policies are set into registries and repositories. Governance capabilities and processes are administered and run by this layer.
    - Binds the layers
    - Relates to and touches all the functional and cross cutting layers
- The Runtime Layer
  - **Operational Systems Layer:** Runtime environment in which the components, legacy systems, all backend applications, and packaged applications reside and run

## Logical vs. Physical Architecture – What's the difference?

- Runtime elements (physical, operational, deployment) run in the Operational Systems Layer.
- The RA's Logical View provides a layered view which addresses running the SOA and meeting its functional capabilities.
  - The four horizontal layers enable the business capabilities required of the SOA
  - The four vertical layers provide the functionality provided by the SOA
  - The functional layers are the Service Component, Services, Business Process and Consumer
- Each aspect of the runtime is abstracted into a layer whose responsibility is significantly distinct from that of the other layers.
  - For example:
    - The Consumer Layer is responsible for interaction with service consumers
    - Service components implement the service
    - They run in containers in the Operational Systems Layer

*The TOG SOA RA enables you to map business capabilities against technical capabilities (the 8 horizontal and vertical layers) and map those to physical implementation – the Operational Systems Layer*

## What's the relationship between Capabilities, ABBs (architectural building blocks) and Layers?

- Layers are *Logical Groupings* of ABBs and Capabilities
- Capabilities provide *What* your SOA needs to support.
  - E.g. Mediation and routing are capabilities in the Integration Layer
- ABBs are the *Building Blocks* of a particular layer.
  - You can think of them as the components providing key capabilities that are expected from that layer
  - ABBs implement capabilities

*Capabilities are realized by a set of building blocks, each of which provides exactly that atomic unit of architectural capability you are seeking.*

## The Cloud and the SOA RA...

- Cloud architectures are extensions of SOAs
- The TRM on the next slide illustrates a typical perspective of the Cloud
- Cloud interactions typically follow a consumer/provider model
- A lot of the upcoming Cloud RA standard is going to be based on the SOA RA

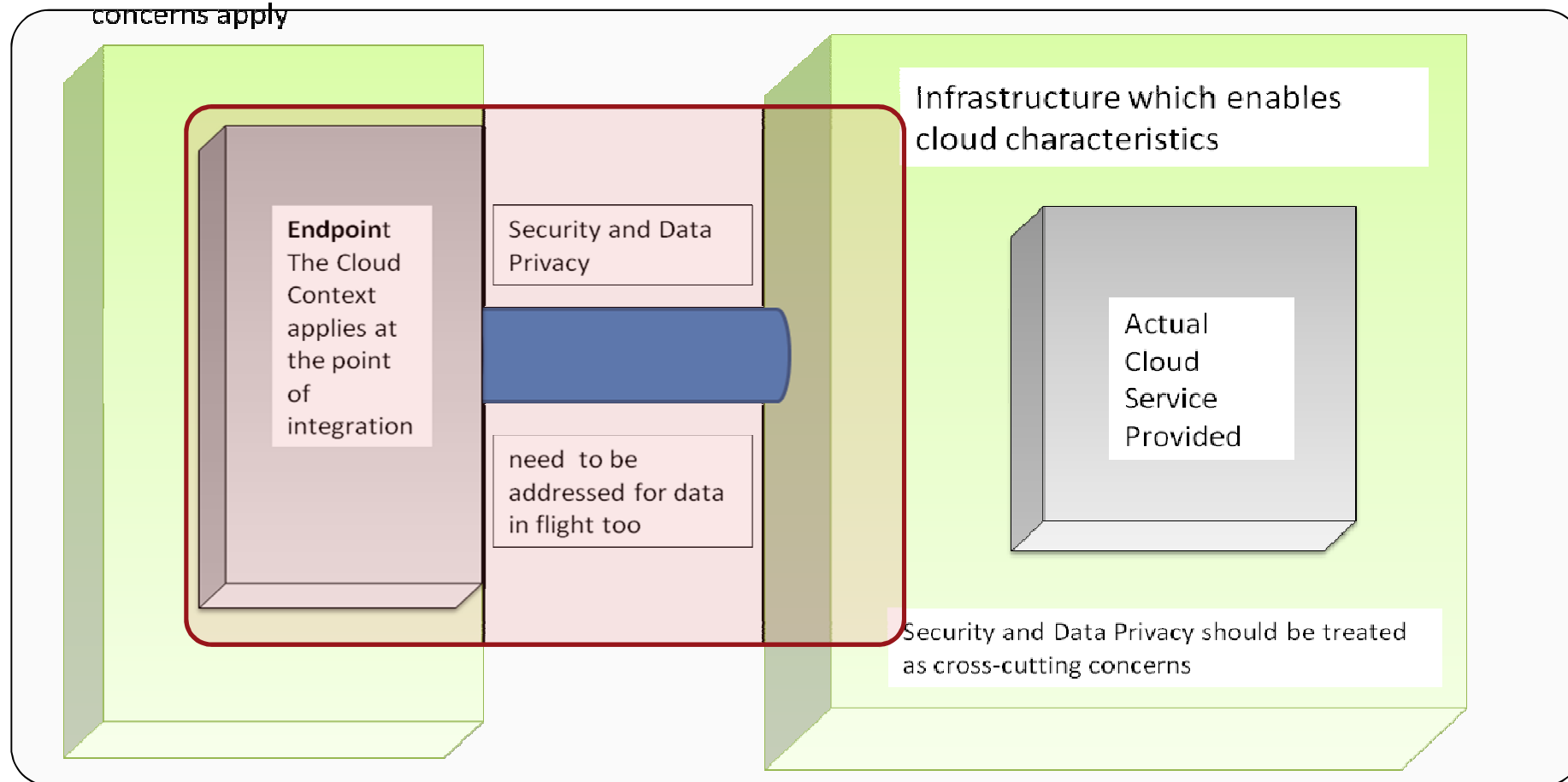
*The TOG SOA RA provides a basis to address Cloud Architectures!*



# A Consumer/Provider View of the Cloud...

**Cloud Consumer:** Once data is in the context of the consumer traditional or SOA concerns apply

**Cloud Provider:** Separating Infrastructure Concerns from the service provided

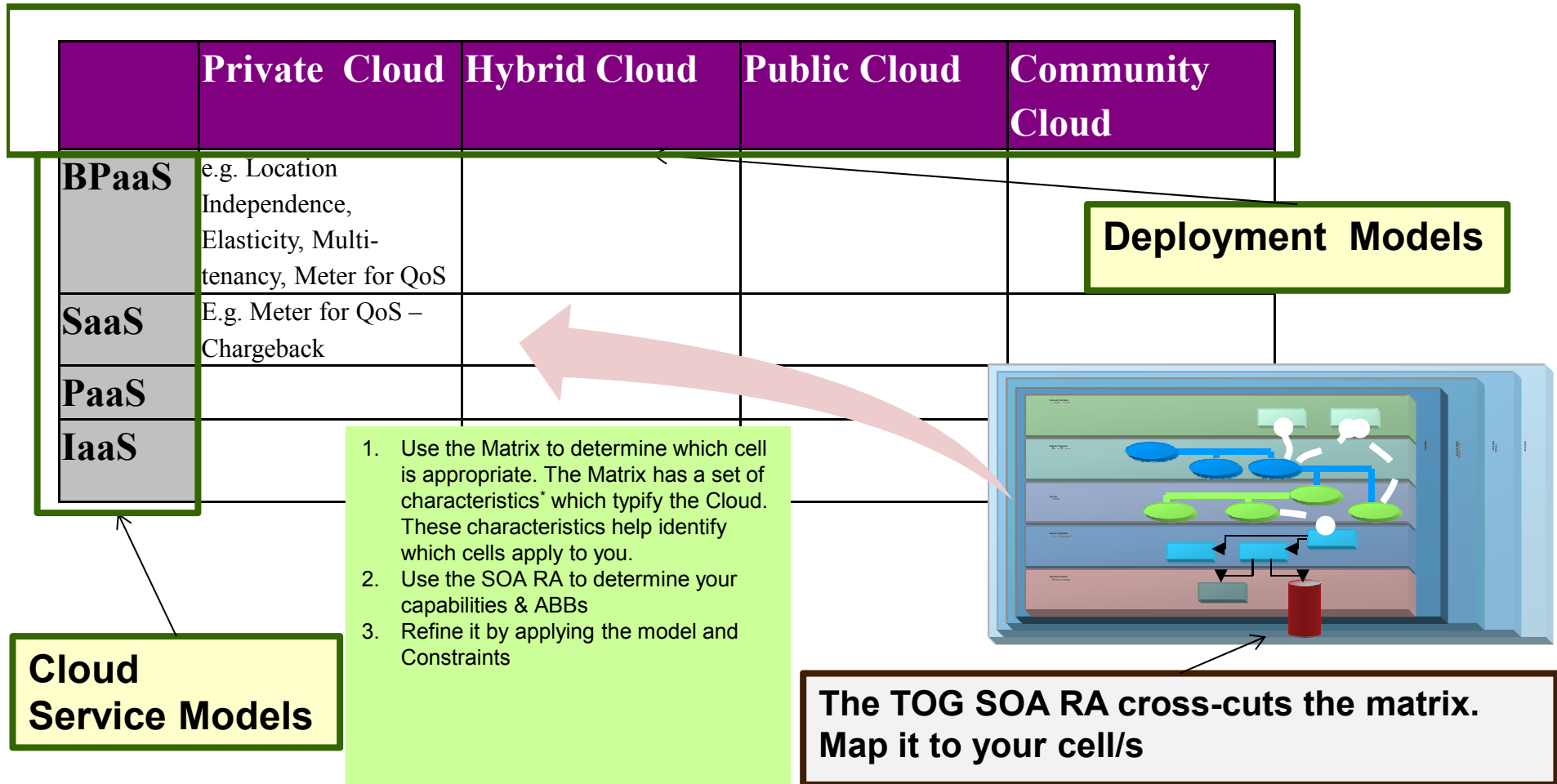


Derived from Kumar , 2011

Regulator

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# TOG SOA RA and Cloud solutions



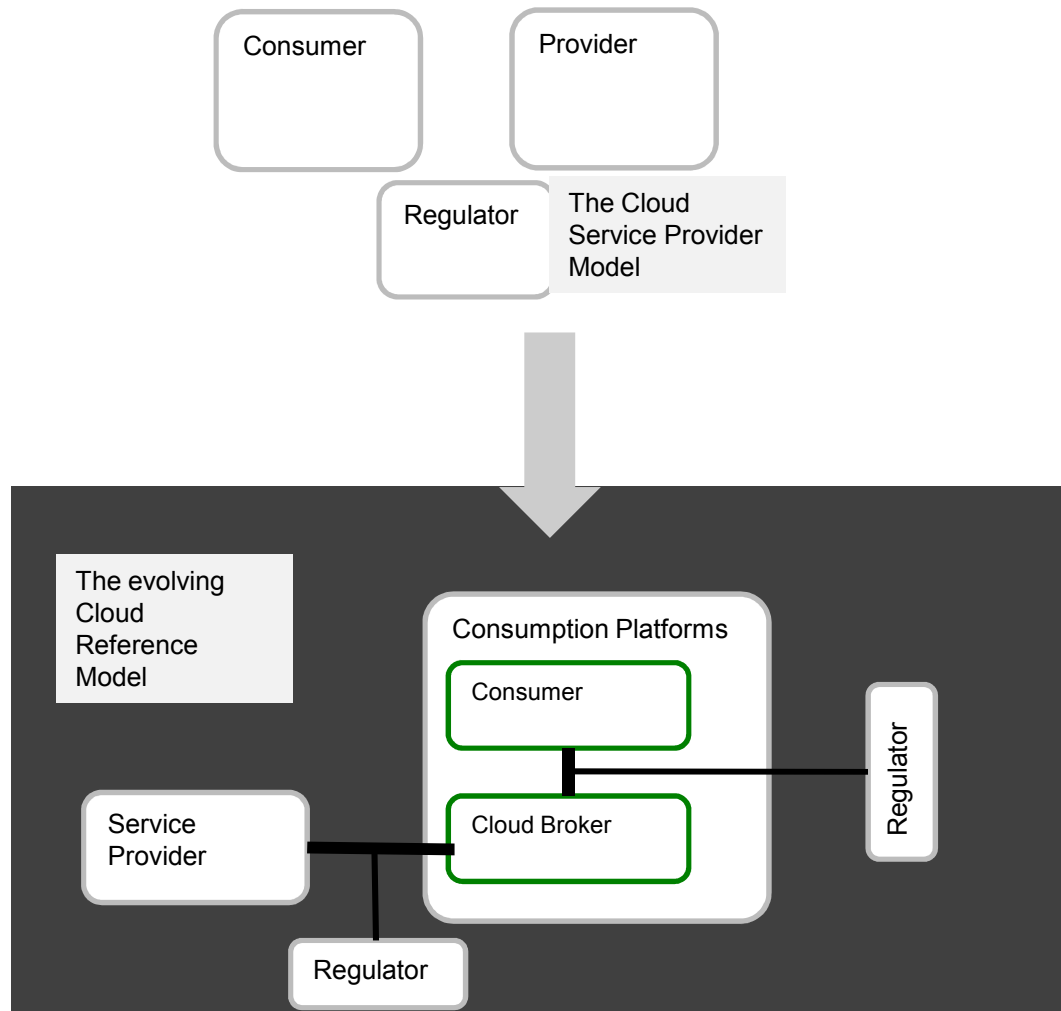
| Consumer Perspective                              | Provider Perspective                          | Regulator Perspective                                      |
|---|---|--|
| <i>Service Based</i>                              | <i>Service Based</i>                          | <i>Auditability</i>  |
| <i>On-demand self-service</i>                     | <i>On-demand self-service</i>                 | <i>Auditability</i>  |
|   | <i>Broad network access</i>                   |  |
| <i>Scalable and Elastic</i>                       | <i>Scalable and Elastic</i>                   |  |
|   | <i>Un-predictable Demand</i>                  |  |
|   | <i>Demand Servicing</i>                       |  |
|   | <i>Resource Pooling</i>                       |  |
| <i>Managed Shared Service</i>                     | <i>Managed Shared Service</i>                 |  |
| <i>Auditability</i>                               | <i>Auditability</i>                           | <i>Auditability</i>  |
| <i>Service Termination and Rollback</i>           | <i>Service Termination and Rollback</i>       | <i>Auditability of Compliance and Data De-provisioning</i> |
| <i>Charge by quality of service (QoS) and use</i> | <i>Meter for quality of service</i>           | <i>Accounting and Control</i>                              |
|   | <i>Monitor and account for use</i>            |  |
| <i>Location Independence</i>                      | <i>Location Independence</i>                  | <i>Location Independence</i>                               |
| <i>Compensation for Location Independence</i>     | <i>Compensation for Location Independence</i> | <i>Auditability</i>  |
| <i>Multi-tenancy</i>                              | <i>Multi-tenancy</i>                          | <i>Auditability of co-mingling</i>                         |

## Characteristics of the Cloud by Role.

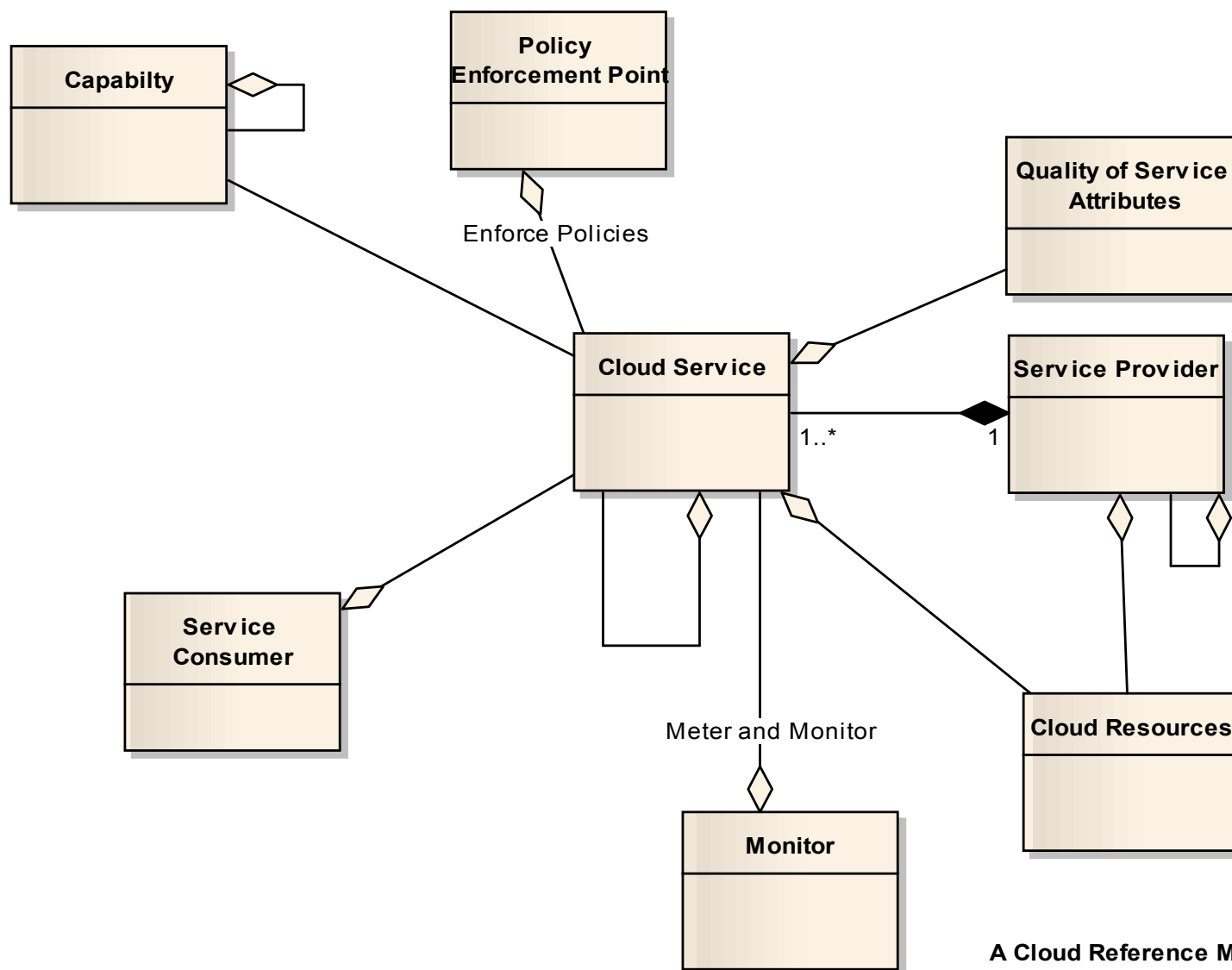
When determining what cell in the Matrix applies ask

1. What is my role (provider/ consumer/ regulator)
2. Use the set of characteristics based on the role to determine what cell/s in the Matrix apply to me

# The evolving cloud reference model



pkg Cloud Reference Model for Atomic Security Continuum Element



A Cloud Reference Model

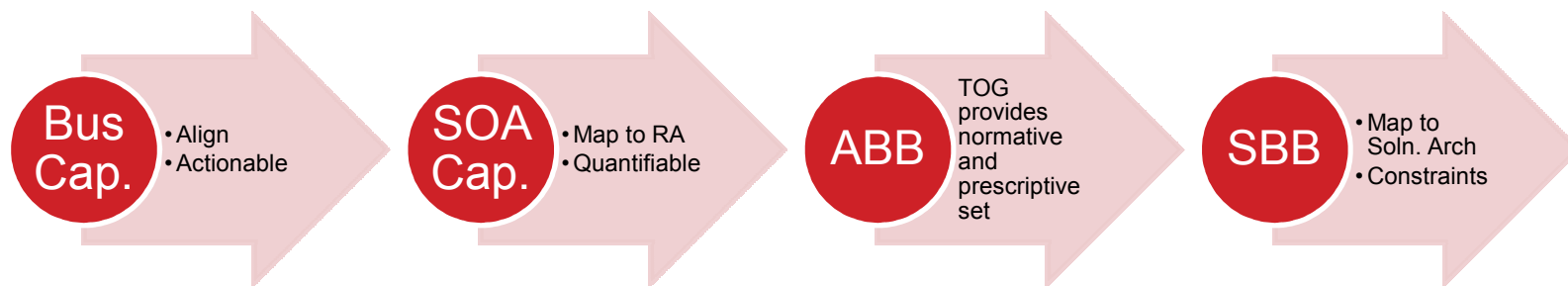
## Cloud Characteristics enable us to understand the Cloud and factors which are specific to the cloud

- The NIST Model has a set of characteristics, service models, and deployment models which has extensive adoption
  - The Gartner Model has also received some adoption and a number of key characteristics
- Then there are Consumer, Provider and Regulator perspectives
  - (Kumar, 2011)
- *These models help us understand what the Cloud means to each of the stakeholders*

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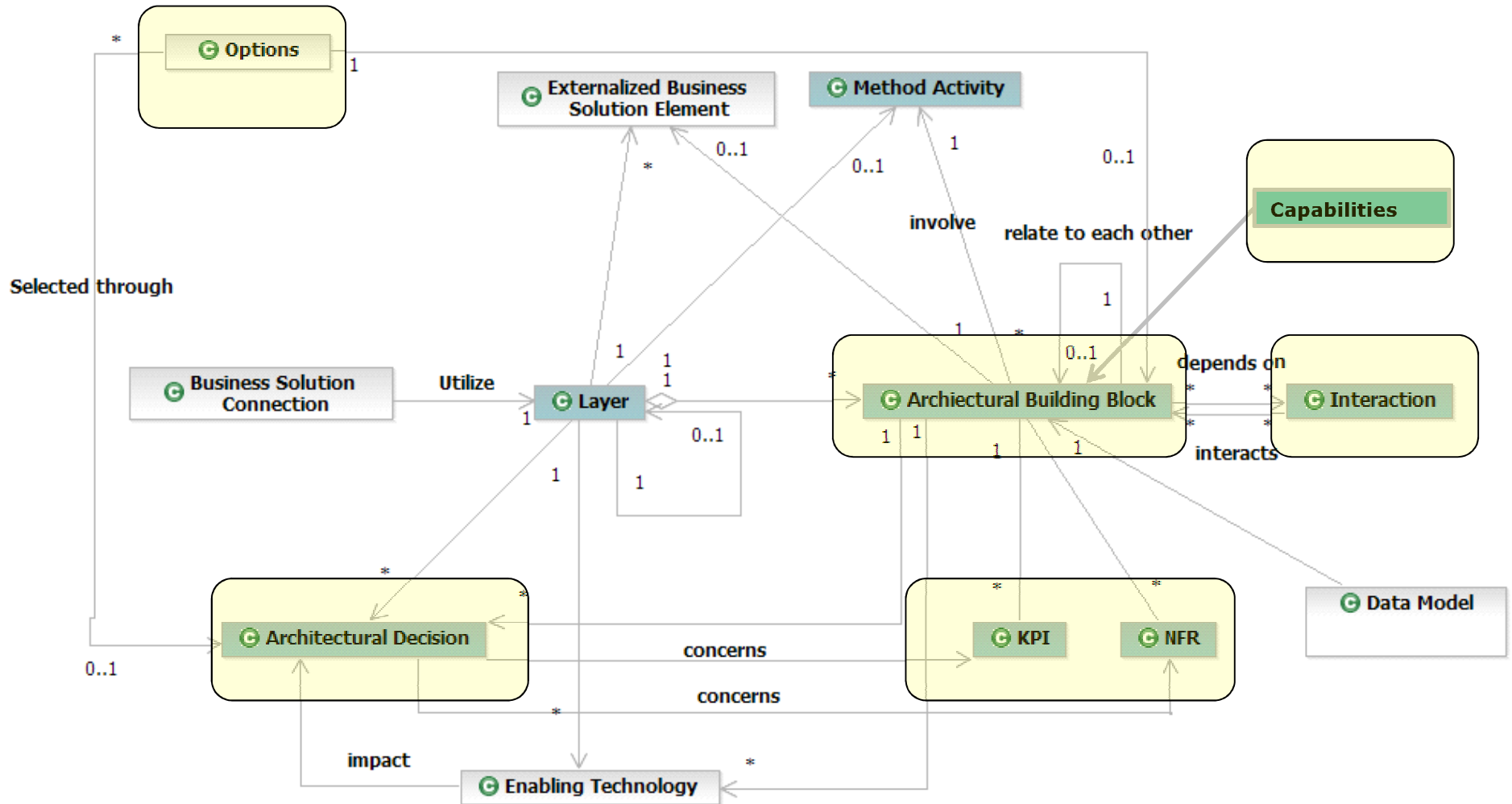
## Using It!

- It is capable of being instantiated to produce
  - Intermediary industry architectures
  - Concrete Solution Architectures



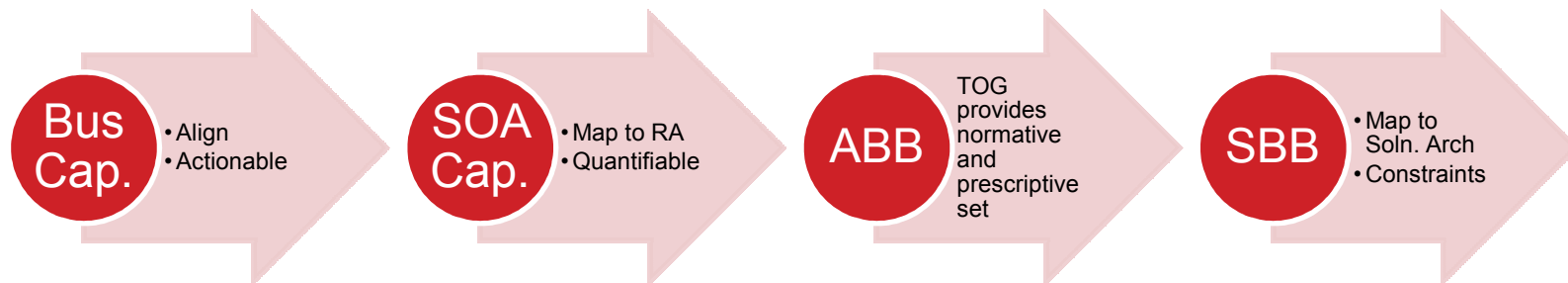


# A Quick look at the SOA RA Meta-Model



## Using It!

- Here's how you instantiate the SOA RA ....
- KPIs, NFRs and Business Capabilities help *Constrain* the RA
  - They help to come to *Architectural Decisions*
  - You pick *Options* based on these *Constraints*
  - This helps *Determine* the required capabilities, ABBs and SBBs

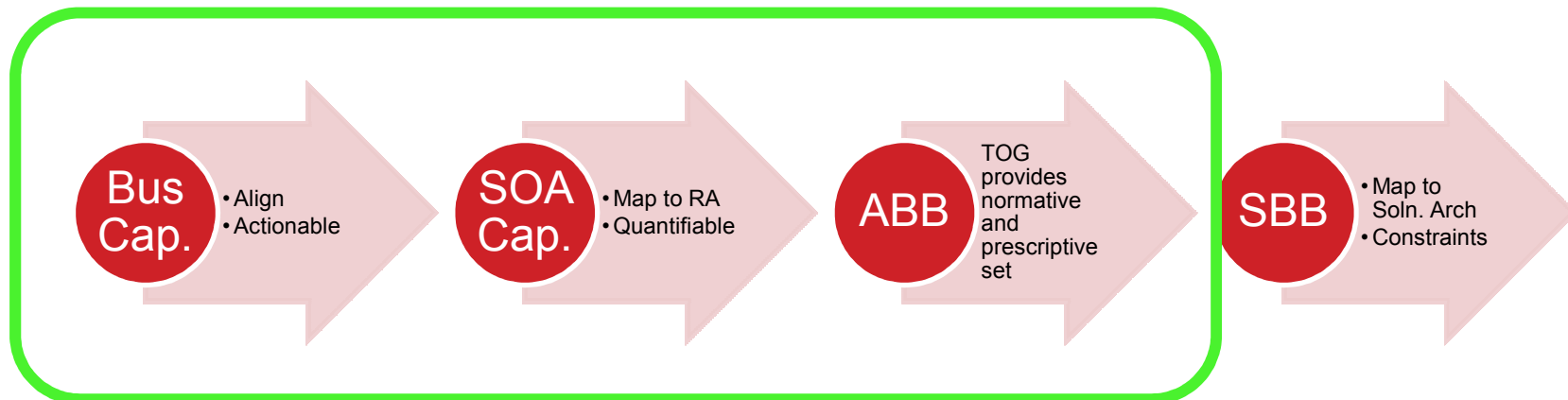


## Common use-cases

- *Establish* Enterprise SOAs
- *Design* solution architectures
- *Assess* an existing solution or architecture
- Product and Platform *Selection*
- *Build* an industry reference architecture

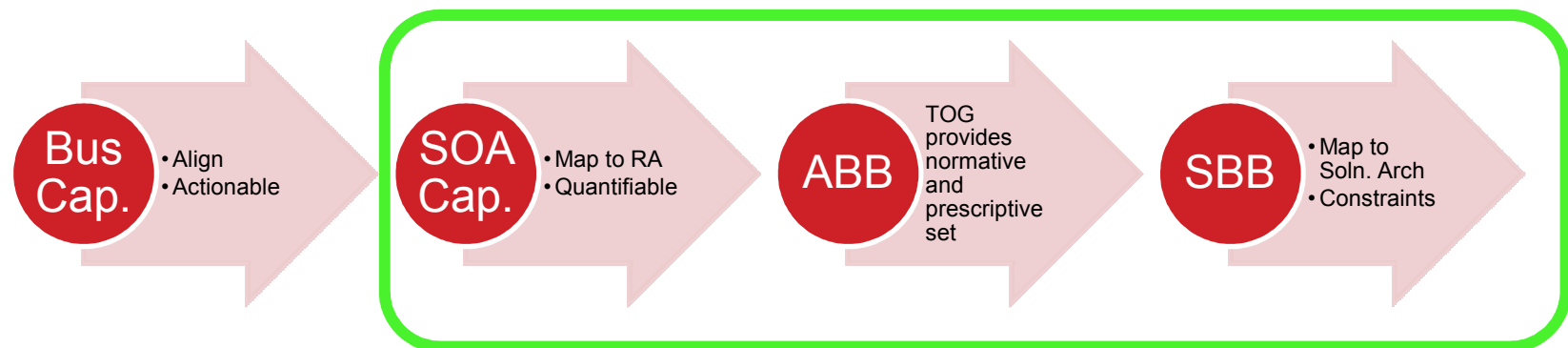
# Establish Enterprise SOA's

- Know your Capabilities!
  - What are your business capabilities?
  - What are the corresponding technical capabilities?
- So what part of the RA do I need?
  - Map them to the SOA RA Capabilities
  - Now you know your Layers!
  - You can now, based on size and culture
    - *Determine your ABB's by Layer*
    - *Capture your specific constraints*



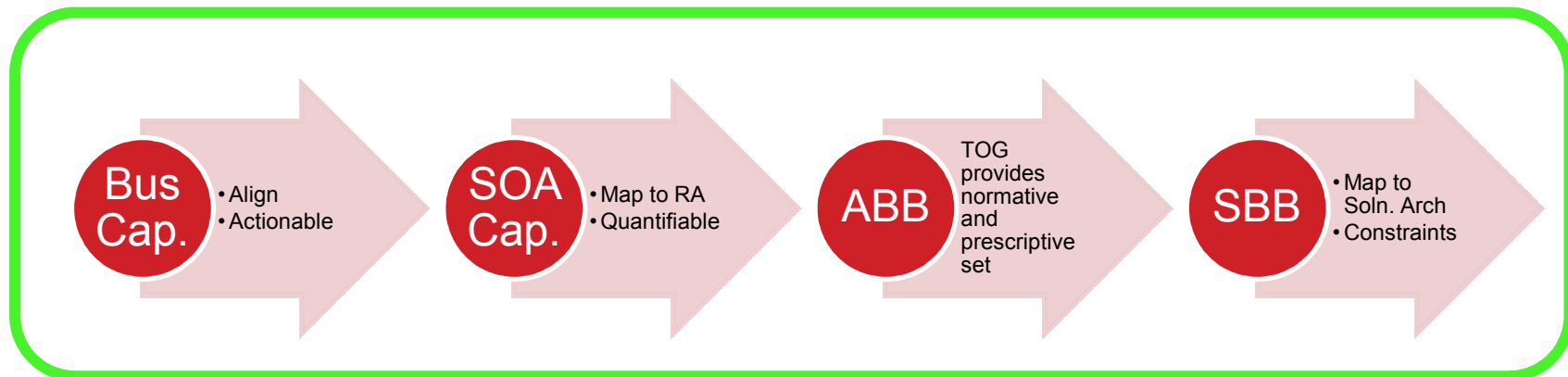
# Design Solution Architectures

- Know your Capabilities!
  - Get more Granular! – e.g. We need to provide mobile self service
- Know your Constraints!
  - What are the options? E.g. We have a m/f backend and JEE Provider modules
  - What are the KPIs and NFRs? E.g. 5 sec. response time and multi-factor authentication
  - What are the Architectural Decisions? E.g. select integration adapters, routing and mediation
- So what part of the RA do I need?
  - Map the Enterprise SOA RA (if it exists) or the TOG SOA RA Capabilities to Solution Capabilities
  - Determine your Constraints!
  - You can now Determine your Solution Architecture!!

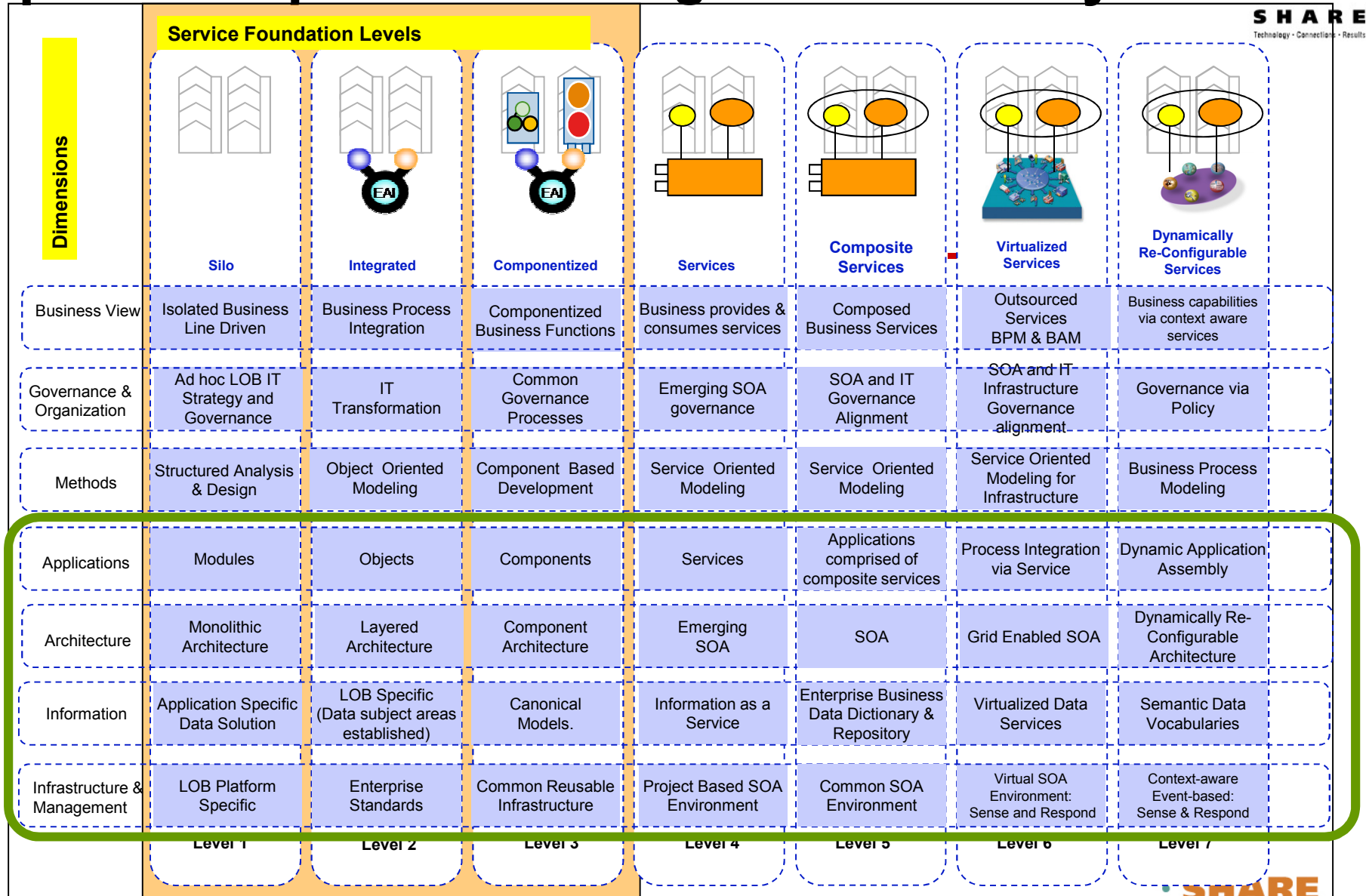


# Assess a Solution or SOA RA

- Know your Capabilities and Constraints! – They are the basis
  - What are your business capabilities?
  - What are the corresponding technical capabilities?
- Map against the RA!! – That is your rubric!!
  - Map them to the SOA RA Capabilities
  - Now you know your Layers!
  - Do you see discrepancies?
  - Do you see thing missing?
  - Do see mappings to a Roadmap?



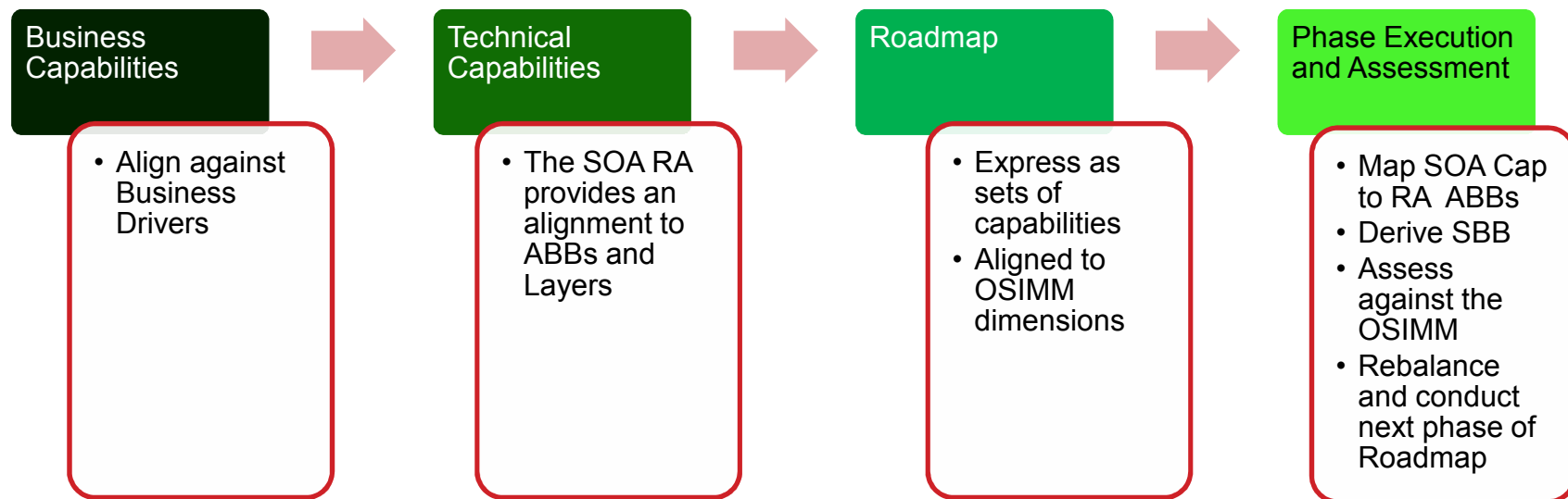
# Open Group Service Integration Maturity Model



Complete your sessions evaluation online at [SHARE.org/AnaheimEval](http://SHARE.org/AnaheimEval)

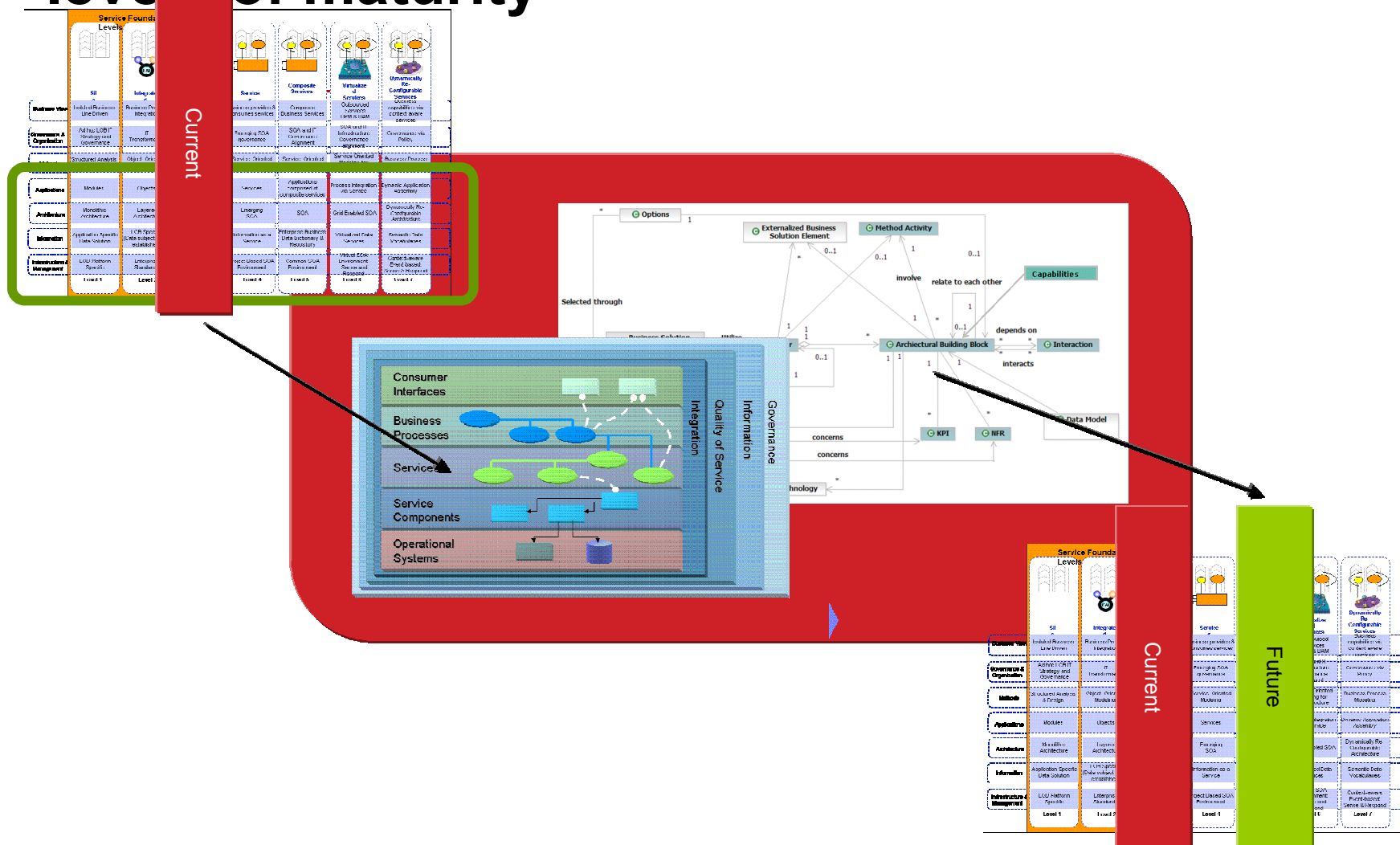
# Using It! Roadmapping

- The TOG SOA RA and OSIMM enable Roadmapping
  - The OSIMM forms a rubric to assess conformance
  - The RA provides the what and how
  - Used together, you can plot how to evolve an RA and respond to change

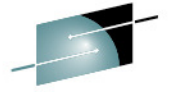




# Applying the SOA RA to achieve higher level of maturity



Complete your sessions evaluation online at [SHARE.org/AnaheimEval](http://SHARE.org/AnaheimEval)

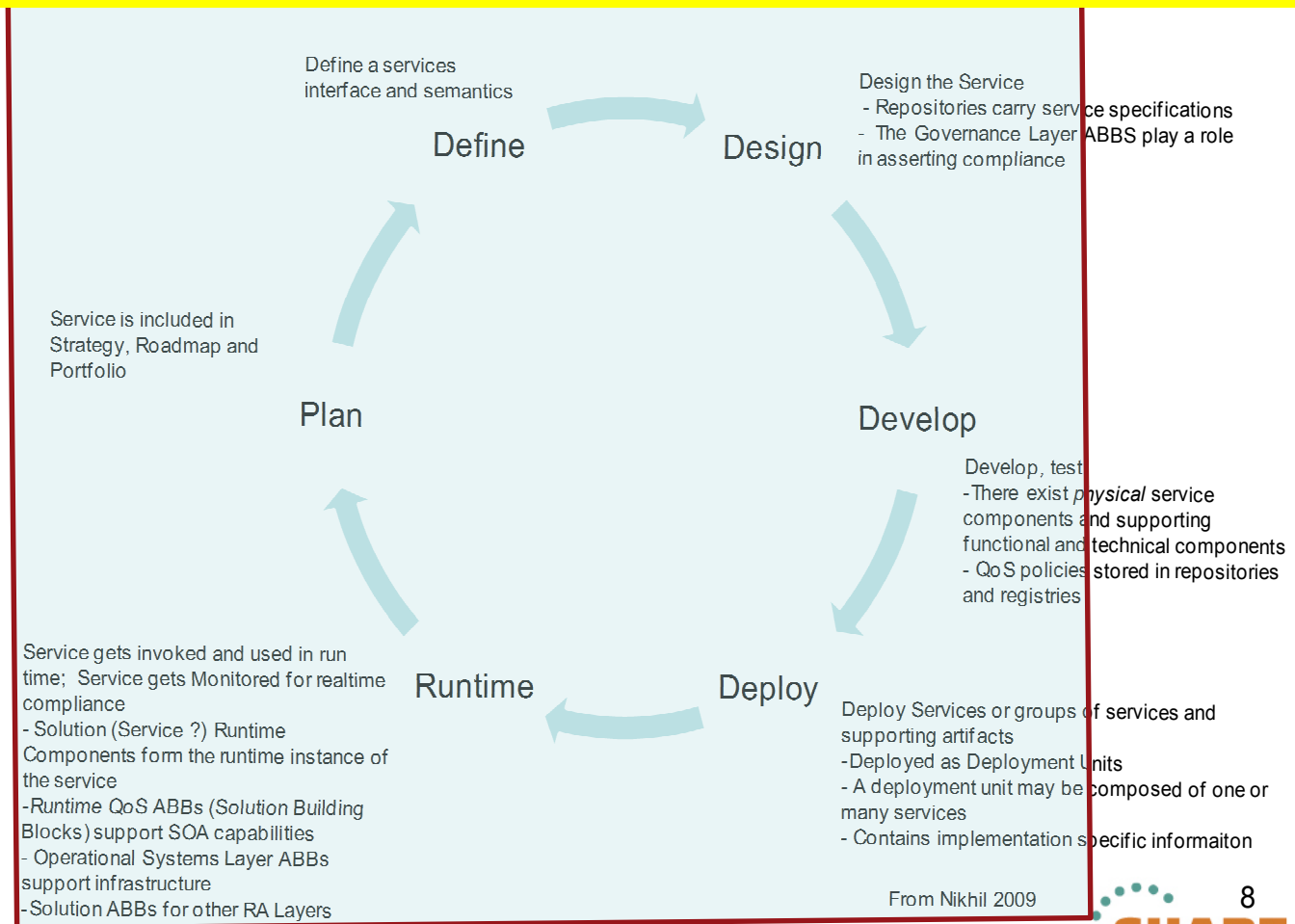


## *Use a Day-In-The life model to provide context to all stakeholders*

### **Caveat: The Stages in a Service Lifecycle are not prescribed in the TOG RA**

*It's critical to define the SOA in terms about how it affects the organization on a day-to-day basis.*

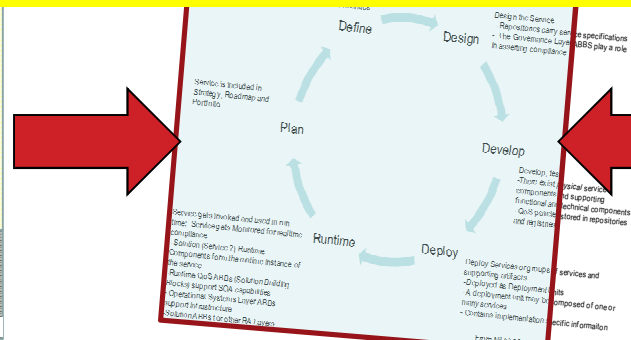
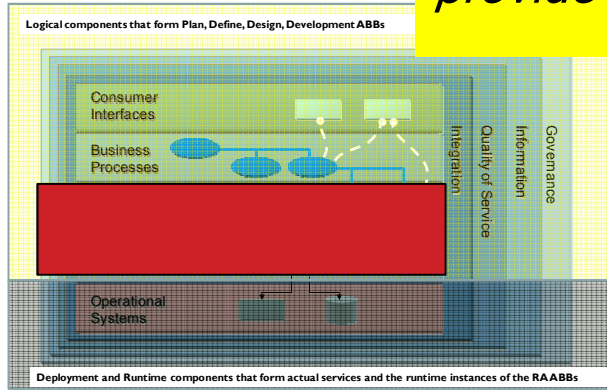
*The RA forms a unifying core around which organizations can share terminology and vision*



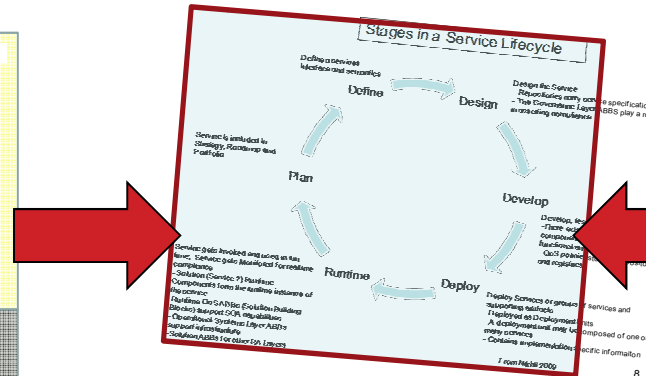
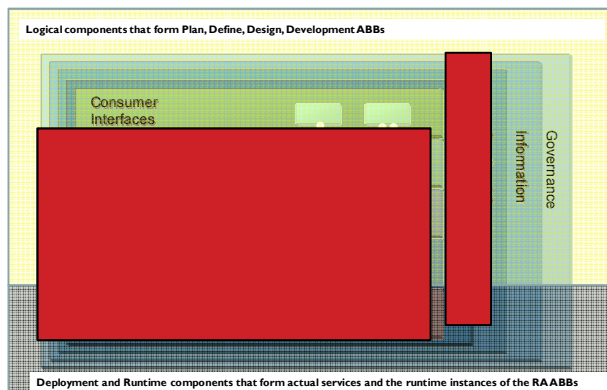
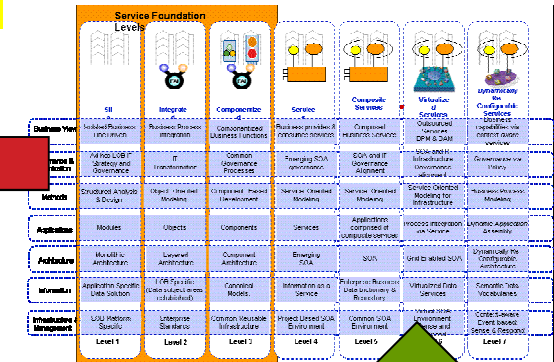
Each level of maturity will utilize a different combination of layers and ABB's (capabilities) in the RA



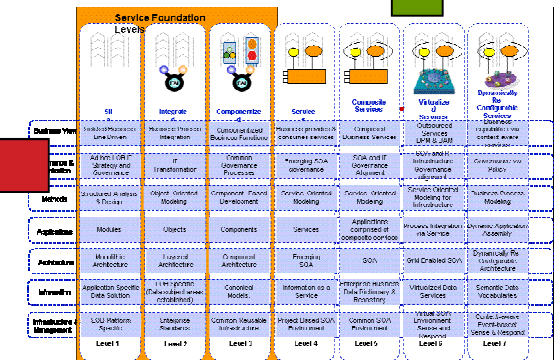
*Use a Day-In-The life model to provide context to all stakeholders*



Maturity Level 2



Maturity Level 0



*The RA ABBs map to the Service Lifecycle at each level as we associate new capabilities*

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# Success Factors

- Understand the TOG SOA RA
  - Don't Reinvent – use it!!
  - Think of the TOG RA as a reference model and language that all can use

*The TOG SOA RA along with other standards such as the OSIMM and Governance Standard provides a rubric to reduce cost, increase focus and agility*

# Success Factors

- When using it to develop Enterprise SOA RA's
  - Bind it to your constraints and capabilities
  - Establish a Day in the Life Model – and get folks on board!!!!
  - Define your Service Categorization
  - Create a Roadmap – Expect Roadmaps to evolve and put that into your governance framework
  - Define a canonical model or ontology
    - Keep it simple, use Nouns and Verbs
    - Keep it simple Again!
  - Put together some key enablers
    - Service Versioning specs
    - Service Fault Models
    - Governance processes – scale appropriately!!!!
  - Put together a capability mapping model – and map to the RA
    - Map capabilities to projects; provide tangible value by reducing cost/risk + increasing agility

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Nikhil Kumar  
Email: [nikhil@ap-tech-solns.com](mailto:nikhil@ap-tech-solns.com)  
Blog: <http://blogs.ittoolbox.com/emergingtech/nikhil>  
Phone: (248) 797 8143



# Supporting Materials

## More Goodies!

# The Importance of the SOA Reference Architecture

- **Architecture**
  - A formal description of a system, or a detailed plan of the system at component level to guide its implementation
- **Reference Architecture**
  - A template from which architectures can be derived; instantiated based on context
- **A SOA RA helps organizations to create:**
  - Service-oriented and cloud ecosystems
  - Service-oriented and cloud enterprise architectures
  - Service-oriented and cloud enterprise reference architectures
  - Service-oriented and cloud solution architectures
- **Enables Compliance with EA's**
- **Addresses the gap between EA TRMs and implementation**
  - TRM = Technical Reference Model

## From an EA Perspective..

- A uniform way to introduce consistency and repeatability
  - (design policies?)
  - Cuts costs and time – shared product taxonomy, assets, skill sets, vocabulary, understanding of personnel
- Need to assess existing or upcoming solution based on a set of standard criteria?
  - (assessment policies?)
  - Consistency, Uniformity, Predictability, Skill sets
- Shared Capabilities and Services
  - (governance and Business to IT binding?)
  - Shared capabilities, easier management of program risk, greater agility, reduced cost

## FAQ

- Q: Does the consumer layer consist primarily of things like GUI or is it a programmatic means of access to the services or both?
- A: It is both. The Consumer Layer provides access to services. It allows consumers to consume services. The means of consumption of services can be a graphical user interface or an API-like connection to the services.
- Q: Can Integration Layer access services?
- Answer: Yes. in fact the integration layer is a layer of choice through which services are invoked, but it is not the only means to invoke services. Services can, in a less mature SOA, be invoked directly by the consumer without the level of indirection associated with an Integration Layer.
- Q: Which layer is responsible for invoking the service end point?
- A: The Consumer Layer is responsible for invoking the service end point. It accesses the services via the Integration Layer. Or it can access the service directly if the given architecture does not wish to implement an Integration Layer. Invocation is done by opening up access to the Consumer Layer.

## FAQ

- Q: Who provisions the service?
- A: Provisioning means making the service available for consumers to be able to invoke rather than who does it. Governance has registry which contains the service meta-data for the consumer to find and bind.
- Q: Are all the architectural building blocks (ABB) of a layer required for every SOA implementation? Or can we pick and choose from among the ABBs based on the needs of individual projects?
- A: Not all architectural building blocks are required for every single implementation of an SOA. Instead every project will choose from the list of building blocks within each layer of the SOA RA and select those that are appropriate for the particular project. In the case where SOA RA is applied for enterprise architecture standard within an organization, there will be patterns of architectural building blocks within the layers that will be selected. Some will be mandatory and some will be optional and projects will be chosen to conform to a fixed set of patterns and configurations of the architectural building blocks along with product selections and implementations.

## FAQ

- Q: Registries and repositories may need to exist in multiple layers during a physical implementation in my projects. Where are they considered to be in the SOA RA?
- A: We have chosen to organize the registry and repository location in the Governance Layer of the SOA RA. In this way, we can manage, monitor and administrate the registry and/or repository from a single logical location, even though physically we may have federation or distribution.
- Q: Can you tell us about how the nine layers would be utilized in practice for realization of the architecture?
- A: The four vertical or cross cutting layers, namely, Integration Layer, Quality of o Service Layer, Information Architecture Layer, and Governance Layer are basically supporting capabilities realized through vendor products. The four functional or horizontal layers, namely Service Component Layer, Services Layer, Business Process Layer and Consumer Layer will support the functional capabilities of architecture. The Operational Systems

## What are the architectural building blocks in each layer?

- A: They are the key building blocks of a particular layer.
- You can think of them as the components providing key capabilities that are expected from that layer.
- For example, the Integration Layer is expected to provide mediation, routing, protocol transformation capabilities.
- Therefore these capabilities are realized by a set of building blocks, each of which provides exactly that atomic unit of architectural capability you are seeking.

# FAQ

- Q: What kind of architectural building blocks do we have?
- A: We have some architectural building blocks that are related to the functionality within an application such as:
  - **Consumer Layer:** Portal to loan processing application
  - **Business Process Layer:** Initiation of a loan processing application
  - **Services Layer:** Services that are required to support the loan processing application
  - **Component Layer:** Software components that need to be built that support the realization and implementation of the services.
  - **Operational Systems Layer:** Actual runtime environment in which the components, legacy systems, all backend applications, and packaged applications reside and run.
- Then we have the cross cutting layers which include the Integration Layer that serves as the central point where integration occurs across the enterprise and consolidates the design decisions into a set of software components that facilitate and enable the actual integration of applications.
- The **Information Architecture** Layer includes all data and information pertaining to each of the layers. Note that it is a cross cutting layer indicating that each of the horizontal layers may have and will have data associated with their functioning and they will draw upon this data from the Information Architecture Layer via metadata, actual data or analytics.
- The **Quality of Service Layer** ensures quality of service by serving as a collection point for the administration and control, or monitoring and management of most if not all of the non-functional requirements. This includes security, availability, configuration, monitoring and management capabilities to name a few.
- Lastly, the **Governance Layer** provides a central point in which policies are set into registries and repositories. In general governance capabilities and processes are administered and run centrally via this layer. Note again that this layer is the underlying layer for all of the other layers within the architecture and it relates to and touches upon all other functional and cross cutting layers of the SOA RA.

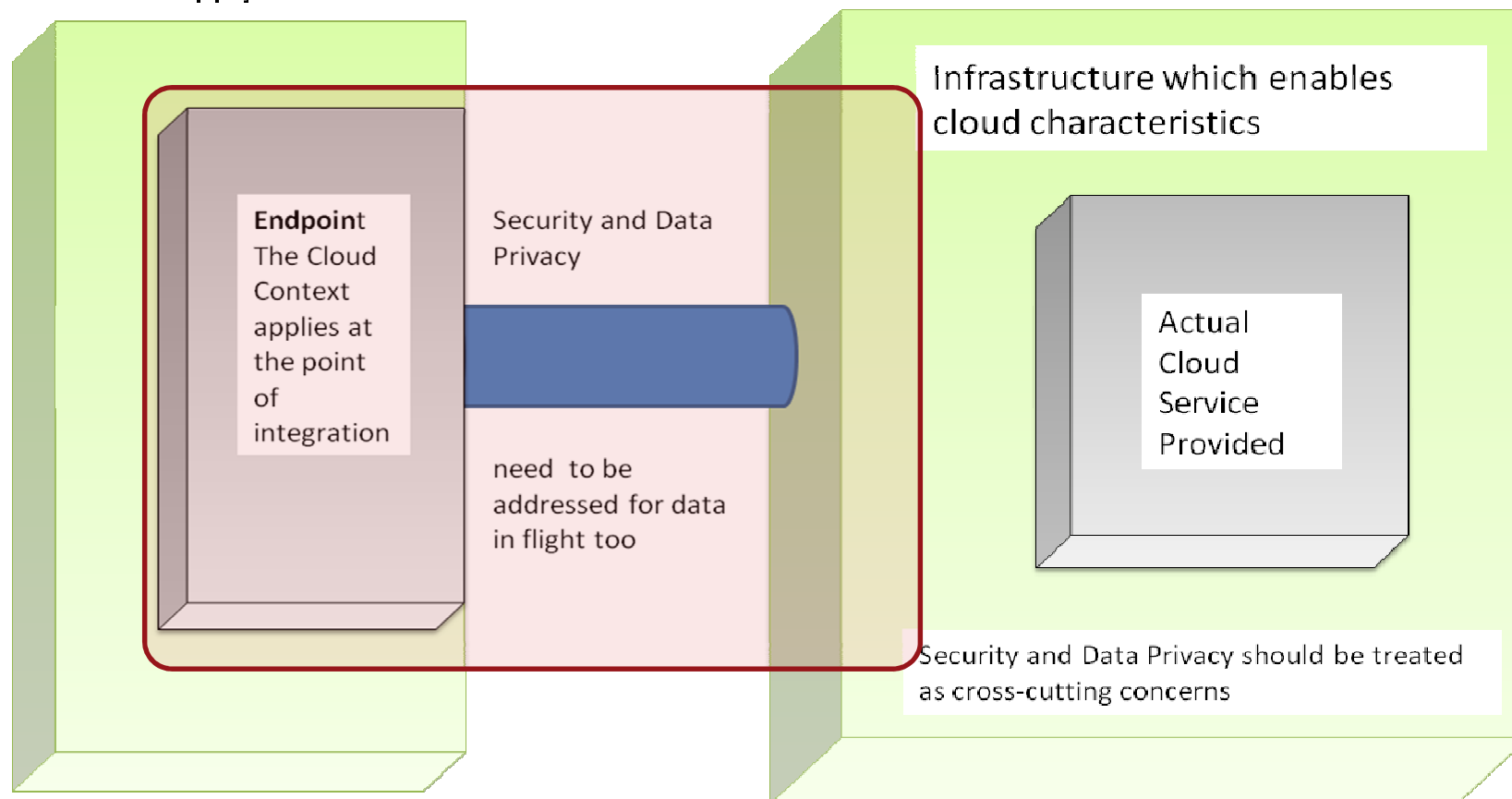


# Cloud Stakeholders and Perspectives

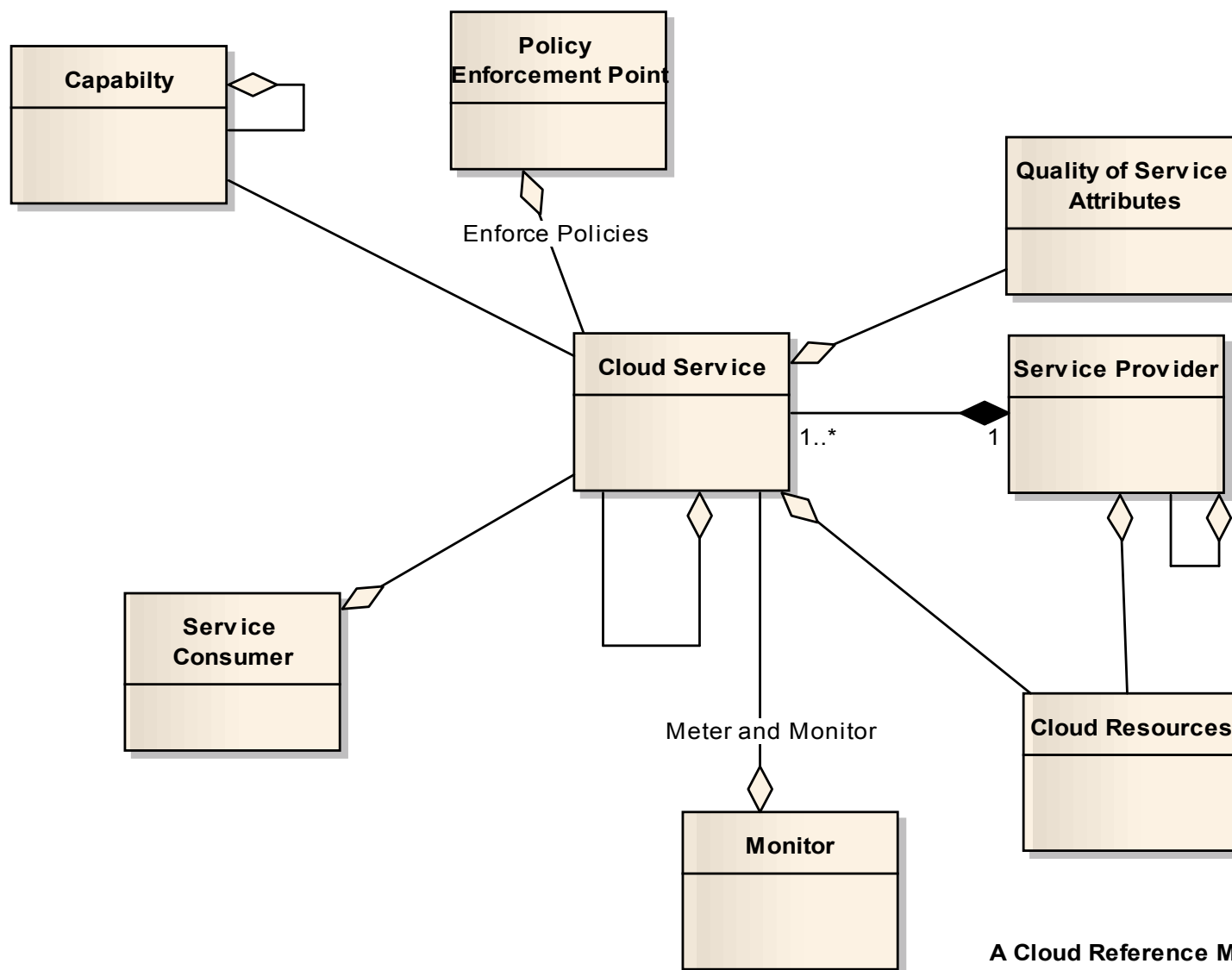
- There are 3 key stakeholders from a Cloud perspective
  - Consumer
  - Provider
  - Regulator
  
- Most of our Cloud decision points are based on meeting one of these 3 perspectives

**Cloud Consumer:** Once data is in the context of the consumer traditional or SOA concerns apply

**Cloud Provider:** Separating Infrastructure Concerns from the service provided



pkg Cloud Reference Model for Atomic Security Continuum Element



A Cloud Reference Model

# Understanding the Cloud Reference Model



- From a Consumer Perspective, the Endpoint is the only part aware of the Cloud Provider
  - This enhances decoupling
  - Increases agility
- What is the part of the Consumer which is impacted
  - The Endpoint
  - That is where we integrate with the Provider
  - That is where we impose Quality of Service policies
- The Provider has an endpoint too
  - However, in the case of the Provider we care about more than just the service endpoint, we also care about the service level agreement
- There is a transport channel between the two

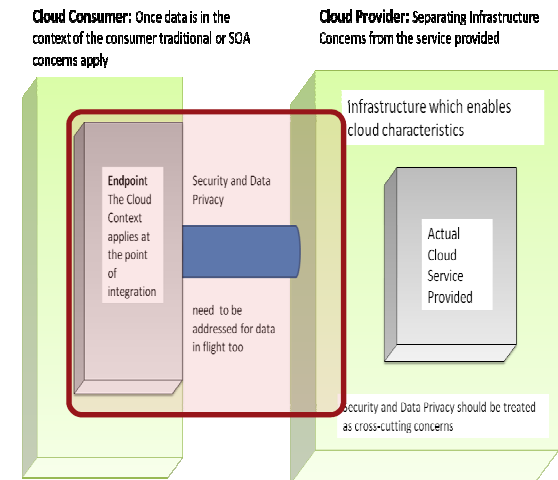
# Understanding the Cloud Reference Model

- However to understand the Cloud Reference model let us apply it to the Cloud Service Models as defined by NIST
- To understand the implications of how each the reference model applies to each service model, we need to apply the different parts of the model for each component

# IaaS and the Model

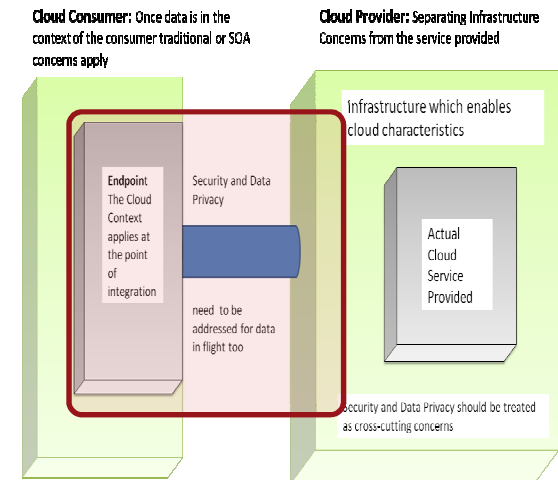
- Lets take an example
  - We have Acme IaaS provider which provides UNIX server images
  - Each server image is warranted to be up 99.99 24/7
  - Now lets apply the model

- For the Consumer
  - What is the endpoint?
- For the transport
  - What is the transport and what are our QoS parameters?
- For the Provider
  - What are my audit requirements?
  - What are my SLA commitments?
  - What are my standards commitments?



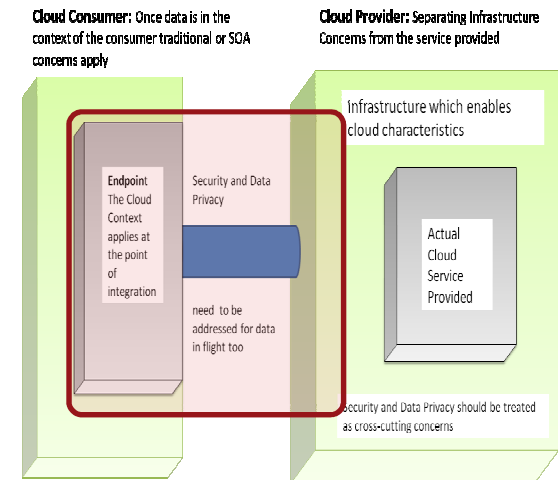
# PaaS and the Model

- Lets take an example
  - We have Acme PaaS provider which provides Database as a Service capabilities
  - The Database is warranted to be up 99.99 24/7
  - Data is secure and safe harbor applies
  - It provides x CPU, y storage, and z i/o rates
  - Now lets apply the model
- For the Consumer
  - What is the endpoint?
- For the transport
  - What is the transport and what are our QoS parameters?
- For the Provider
  - What are my audit requirements?
  - What are my SLA commitments?
  - What are my standards commitments?



# SaaS and the Model

- Lets take an example
  - We have Acme SaaS provider which provides CRM capabilities
  - The s/w is warranted to be up 99.99 24/7
  - Data is secure and safe harbor applies
  - Now lets apply the model
- For the Consumer
  - What is the endpoint?
- For the transport
  - What is the transport and what are our QoS parameters?
- For the Provider
  - What are my audit requirements?
  - What are my SLA commitments?
  - What are my standards commitments?





# Understanding the Perspectives

- Let us ask the question:
- In general, what does this perspective help us understand from the point of view addressing:
  - The interface
  - The business capability
  - The Quality of Service (addressing performance, security, privacy, data quality and other issues)

# The Consumer Perspective

- Examples, from a QoS perspective, some questions from the Consumer point of view are:

How do I do my due diligence when deploying to cloud? What are the associated costs? What risk is posed to the organization if the cloud vendor were to vanish (vendor lock-in)? What risk is there from an on-going monitoring and audit perspective when the cloud solution is in use? When I am done how do I de-provision and transition assets out of the cloud vendor to another location or context?

(Kumar, 2011)

- In general, this perspective helps us understand the interaction from the consumers point of view addressing:
  - The interface
  - The business capability
  - The Quality of Service (addressing performance, security, privacy, data quality and other issues)

# The Provider Perspective

- Examples, from a QoS perspective, of some questions from the Provider point of view are:

*What will be the cost to me to provision and de-provision assets? What happens when data privacy laws change? How do I manage the security of assets? What are my risks (both ethical and legal) if, in my role as cloud provider I am in possession of information assets and other organizations such as the government ask for, directly or in-directly, access to information assets? What data protection and monitoring needs are there? What commitments do I need to make in the context of data integrity? How do I provide access to regulators without any risk to privacy or loss of protection of the assets in my care? What are my responsibilities towards these assets?*

(Kumar, 2011)

# The Regulatory Perspective

- Examples, from a QoS perspective, some questions from the Regulator point of view are:

Is there the ability to review and access audit data to manage and ensure that controls are in place and have been used for information assets keeping in mind data privacy and protections laws that are rapidly evolving? Can we keep this data obfuscated?

(Kumar, 2011)

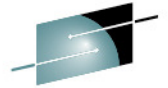
- In general, this perspective helps us understand the interaction from the consumers point of view addressing:
  - The interface
  - The business capability
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## Cloud Characteristics enable us to understand the Cloud and factors which are specific to the cloud

- The NIST Model has a set of characteristics, service models, and deployment models which has extensive adoption
  - The Gartner Model has also received some adoption and a number of key characteristics
- Then there are Consumer, Provider and Regulator perspectives
  - (Kumar, 2011)
- *These models help us understand what the Cloud means to each of the stakeholders*

The table is derived from Kumar (2011)

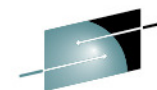
| Cloud Characteristics | NIST                          | Gartner                           | Consumer Perspective  | Provider Perspective  | Regulator Perspective                                      |
|-----------------------|-------------------------------|-----------------------------------|---|---|--|
|                       |                               | <i>Service-Based</i>              | <i>Service Based</i>  | <i>Service Based</i>  | <i>Auditability</i>  |
|                       | <i>On-demand self-service</i> |                                   | <i>On-demand self-service</i>   | <i>On-demand self-service</i>   | <i>Auditability</i>  |
|                       | <i>Broad network access</i>   |                                   |   | <i>Broad network access</i>   |  |
|                       | <i>Rapid elasticity</i>       | <i>Scalable and Elastic</i>       | <i>Scalable and Elastic</i>   | <i>Scalable and Elastic</i>   |  |
|                       |                               |                                   |   | <i>Un-predictable Demand</i>  |  |
|                       |                               |                                   |   | <i>Demand Servicing</i>   |  |
|                       |                               |                                   |   | <i>Resource Pooling</i>   |  |
|                       | <i>Resource pooling</i>       | <i>Shared</i>                     | <i>Managed Shared Service</i>   | <i>Managed Shared Service</i>   |  |
|                       |                               |                                   | <i>Auditability</i>   | <i>Auditability</i>   | <i>Auditability</i>  |
|                       |                               |                                   | <i>Service Termination and Rollback</i>   | <i>Service Termination and Rollback</i>   | <i>Auditability of Compliance and Data De-provisioning</i> |
|                       |                               | <i>Metered by Use</i>             | <i>Charge by quality of service (QoS) and use</i>   | <i>Meter for quality of service</i>   | <i>Accounting and Control</i>                              |
|                       |                               |                                   |   | <i>Monitor and account for use</i>  |  |
|                       | <i>Measured Service</i>       | <i>Uses Internet Technologies</i> | <i>Location Independence</i>  | <i>Location Independence</i>  | <i>Location Independence</i>                               |
|                       |                               |                                   | <i>Compensation for Location Independence</i>   | <i>Compensation for Location Independence</i>   | <i>Auditability</i>  |
|                       |                               |                                   | <i>Multi-tenancy</i>  | <i>Multi-tenancy</i>  | <i>Auditability of co-mingling</i>                         |
|                       |                               |                                   | Security characteristics: <ul style="list-style-type: none"> <li>Confidentiality</li> <li>Integrity</li> <li>Authenticity</li> <li>Accounting and Control</li> <li>Collaboration Oriented Architecture</li> <li>Federated access and identity management</li> </ul> | Security characteristics: <ul style="list-style-type: none"> <li>Confidentiality</li> <li>Integrity</li> <li>Authenticity</li> <li>Accounting and Control</li> <li>Collaboration Oriented Architecture</li> <li>Federated access and identity management</li> </ul> |  |



| Cloud Characteristics | NIST                          | Gartner                     | Consumer Perspective          | Provider Perspective          | Regulator Perspective |
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|                       |                         |                       |   | <i>Monitor and account for use</i>      |  |





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Results

| Cloud Characteristics | NIST                    | Gartner                           | Consumer Perspective   | Provider Perspective   | Regulator Perspective              |
|-----------------------|-------------------------|-----------------------------------|--|--|------------------------------------|
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## A Matrix for determining EA implications based on Cloud Service and Deployment Models

|      | Private Cloud | Hybrid Cloud | Public Cloud | Community Cloud |
|------|---------------|--------------|--------------|-----------------|
| SaaS |               |              |              |                 |
| PaaS |               |              |              |                 |
| IaaS |               |              |              |                 |

The EA team would use this rubric along with the characteristics and reference model to determine decision points

- Peter Mell, T. G. (2009). *The NIST Definition of Cloud Computing, V15*. NIST.
- SEI, [http://www.sei.cmu.edu/productlines/frame\\_report/PL.essential.act.htm](http://www.sei.cmu.edu/productlines/frame_report/PL.essential.act.htm)
- Nikhil Kumar, Auditing Cloud Computing: A Security and Privacy Guide, “Protection and Privacy of Information Assets in the Cloud”, July 2011