SDC
STORAGE DEVELOPER CONFERENCE
SNIA SANTA CLARA, 2014

Delivering a Standards Based SDS Framework with an Open Stack SDS Controller Implementation

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Agenda

- Data Explosion & Storage Pain Points
- Software Defined Storage (SDS) vision
- SDS Controller Use Cases
- SDS gaps and response
- Summary

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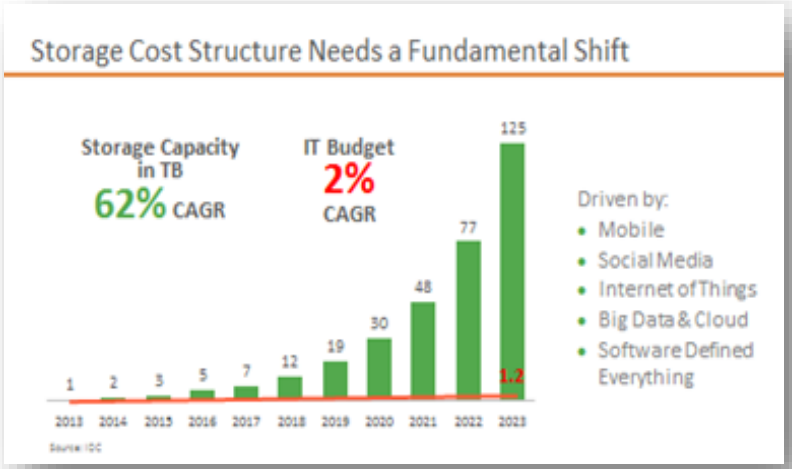
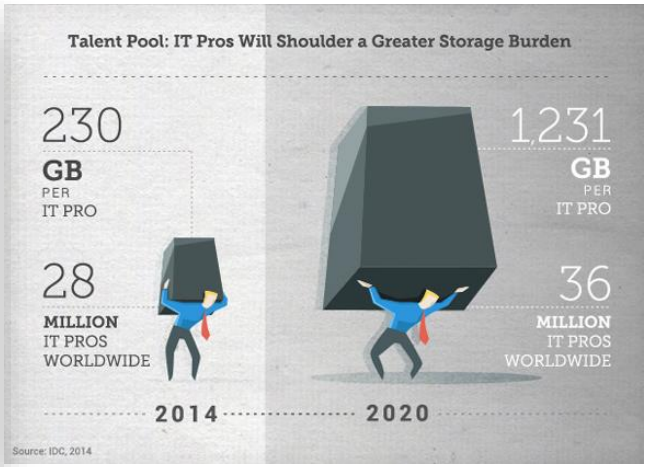
Data Explosion:

From 2013 to 2020, the digital universe will grow by a factor of 10, from 4.4 ZB to 44 ZB

It more than doubles every two years.





...cost challenges continue to grow...

....data complexity is increasing

.... and storage accounts for 40% of the data center budget.

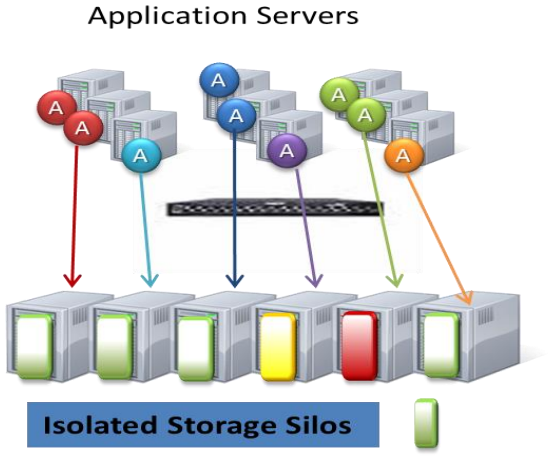
Data needs are growing at a rate unsustainable with today's infrastructure and labor costs

Source: IDC – The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things - April 2014

Storage Pain Points

Storage Silos (Traditional)

- Application mapped to specific appliance
- Storage resources optimized to run specific workload
- Isolated storage resources



Challenges

- Cost of managing diverse storage solutions
  - Data Growth
  - Maintenance, Operations & Support
  - Infrastructure
- Vendor lock-in
  - Limited scalability
  - Flexibility to innovate
- Need for massively shared data
  - But not yet cloud ready

Traditional storage management is too complex and inefficient

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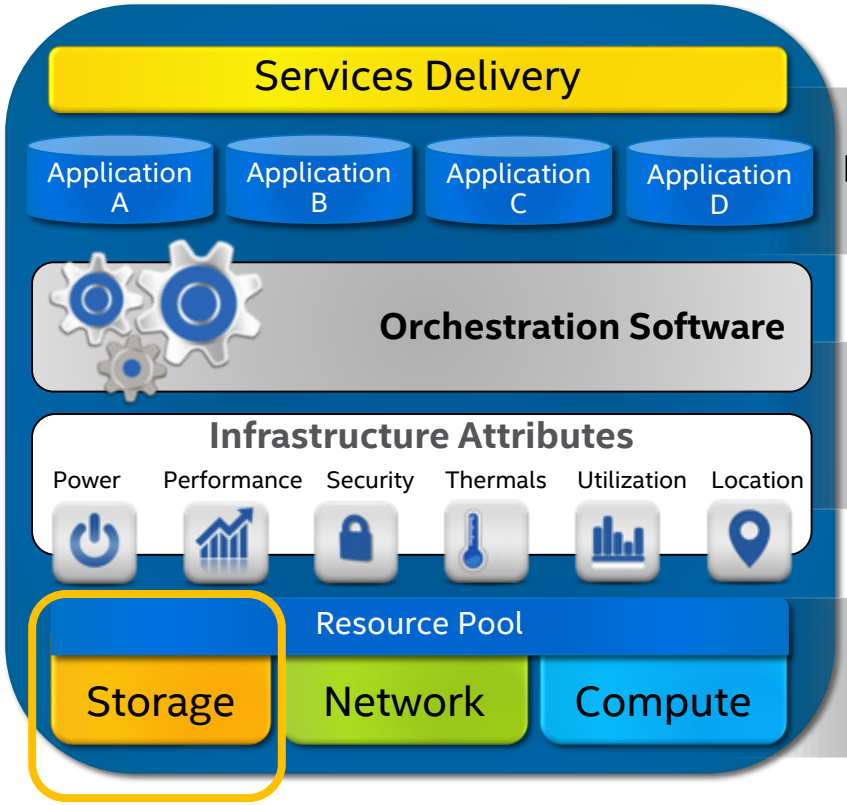
Software Defined Infrastructure (SDI)



SERVICE ASSURANCE

Policies and intelligent monitoring trigger dynamic provisioning and service assurance as applications are automatically deployed and maintained

PROVISIONING MANAGEMENT

Orchestration provisions, manages and optimally allocates resources based on the unique requirements of an application

POOLED RESOURCES

Network, Storage and Compute elements are abstracted into resource pools

SDS – A Key Component of SDI

Dynamic, policy-driven storage resource management

Abstracting Software from Hardware, providing flexibility & scalability

Aggregating diverse provider solutions, increasing flexibility and drive down costs

Provisioning resources dynamically (pay-as-you-grow) increasing efficiency

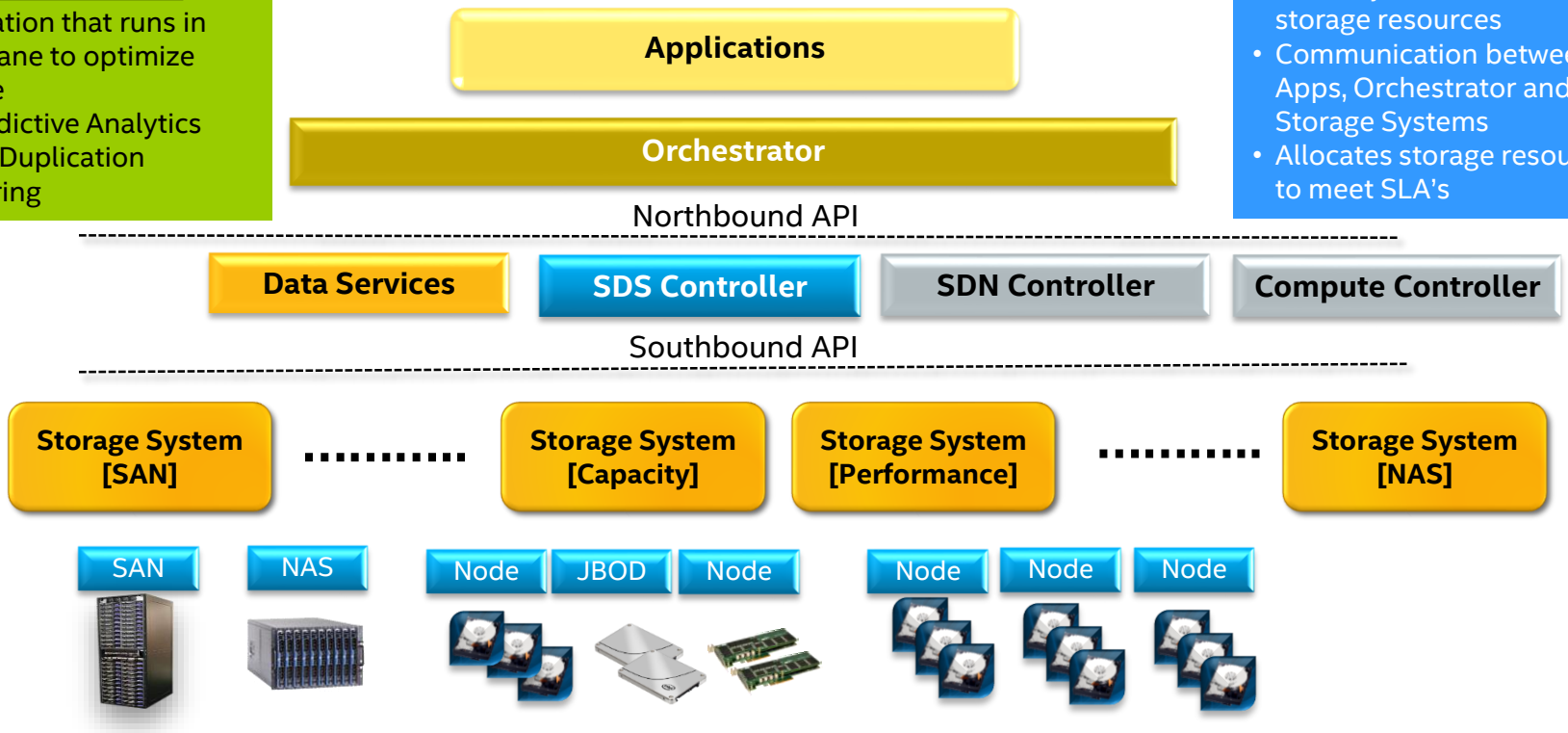
Orchestrating application access to diverse storage systems through Service Level Agreements (SLAs), increasing flexibility and handle data complexity

SDS is a framework that delivers a scalable, cost-effective solution to serve the needs of tomorrow's Data Center

SDS Architecture

Data Services
- Application that runs in data plane to optimize storage
- Ex: Predictive Analytics
- Ex: De-Duplication
- Ex: Tiering

SDS Controller
- Visibility and Control of ALL storage resources
- Communication between Apps, Orchestrator and Storage Systems
- Allocates storage resources to meet SLA's



SDS : Consolidated Management of Scale-Out and Scale-Up Storage and plug into SDI

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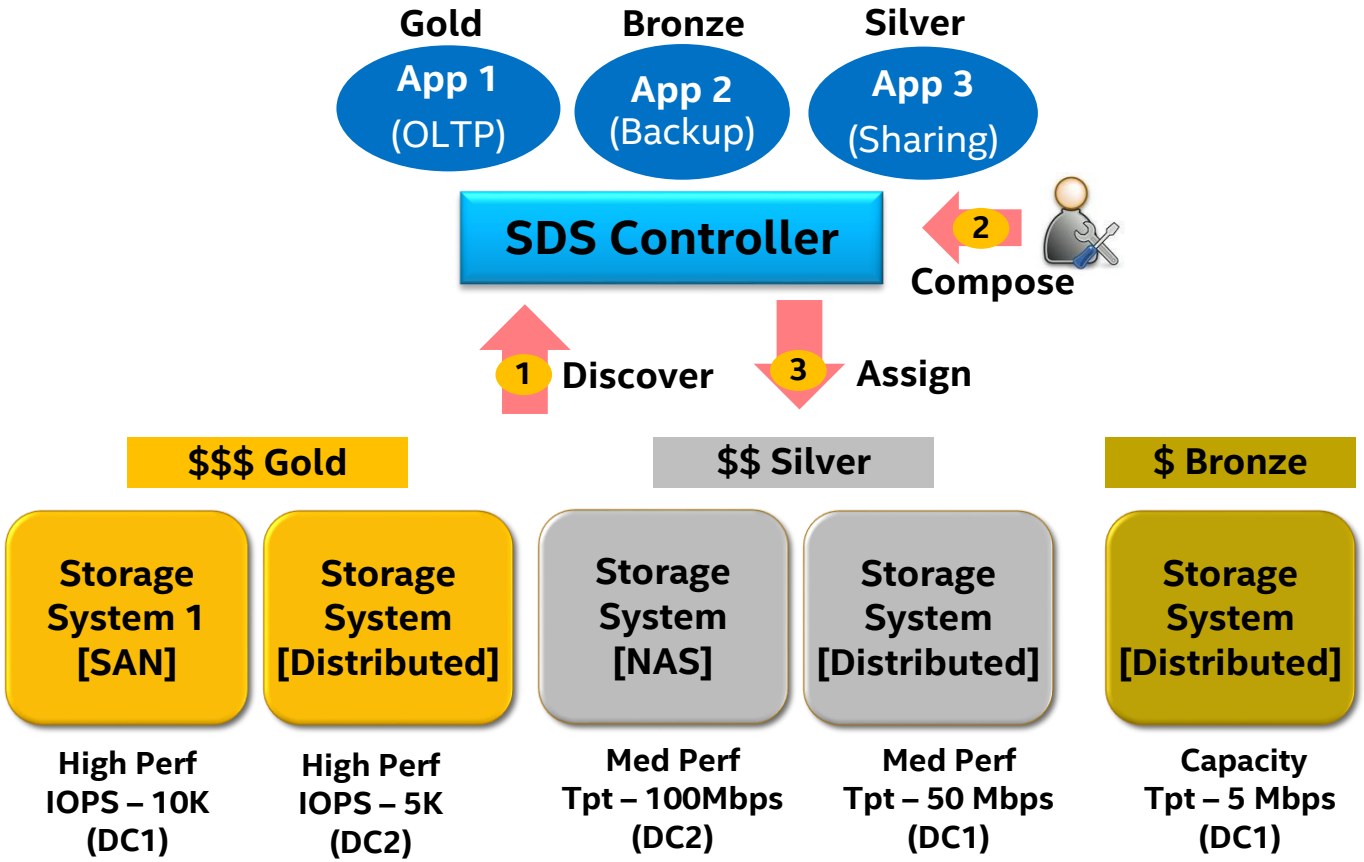
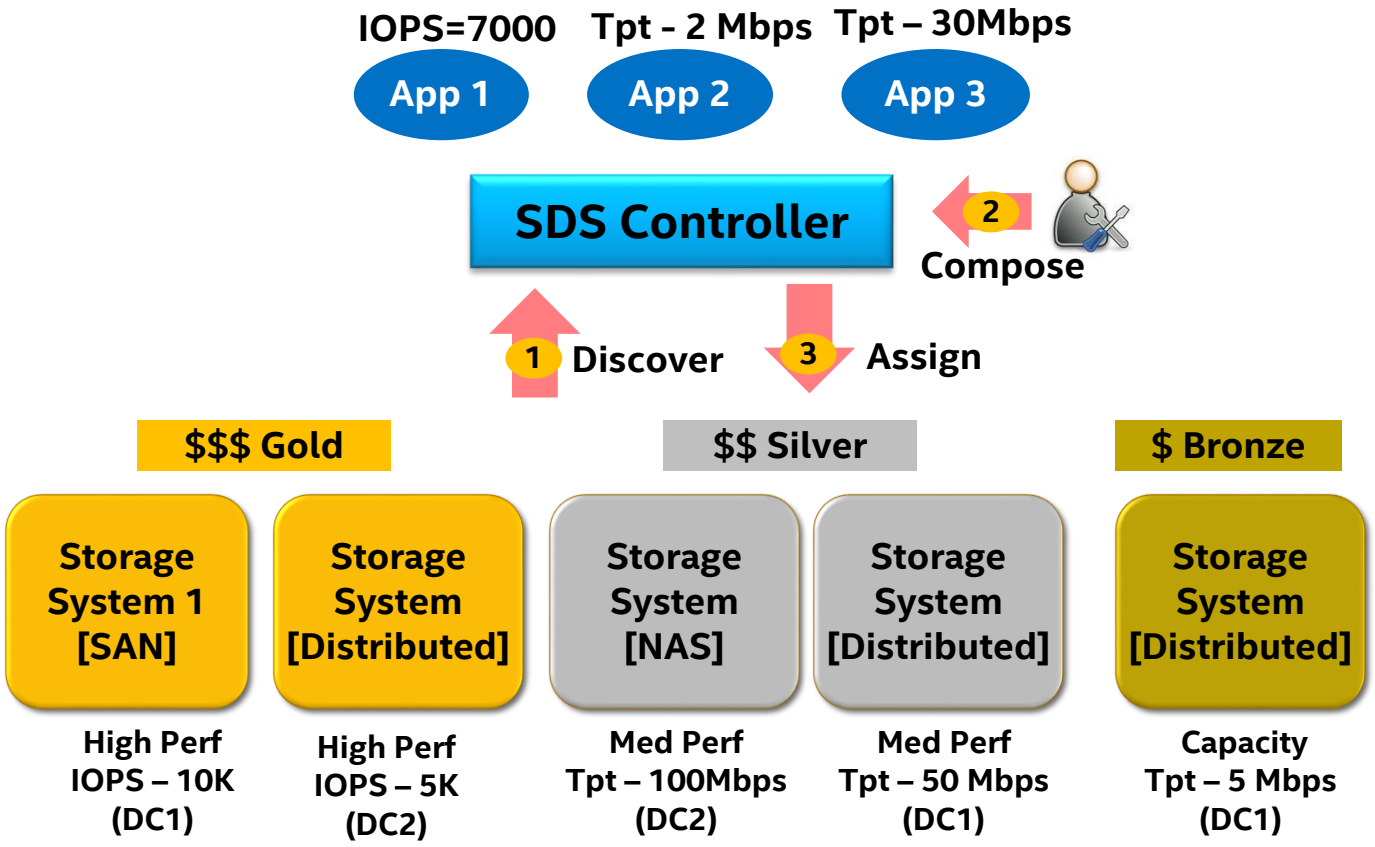
SDS Controller Use Case: Application Assignment (Logical Pools)

Example: Application provides storage pool



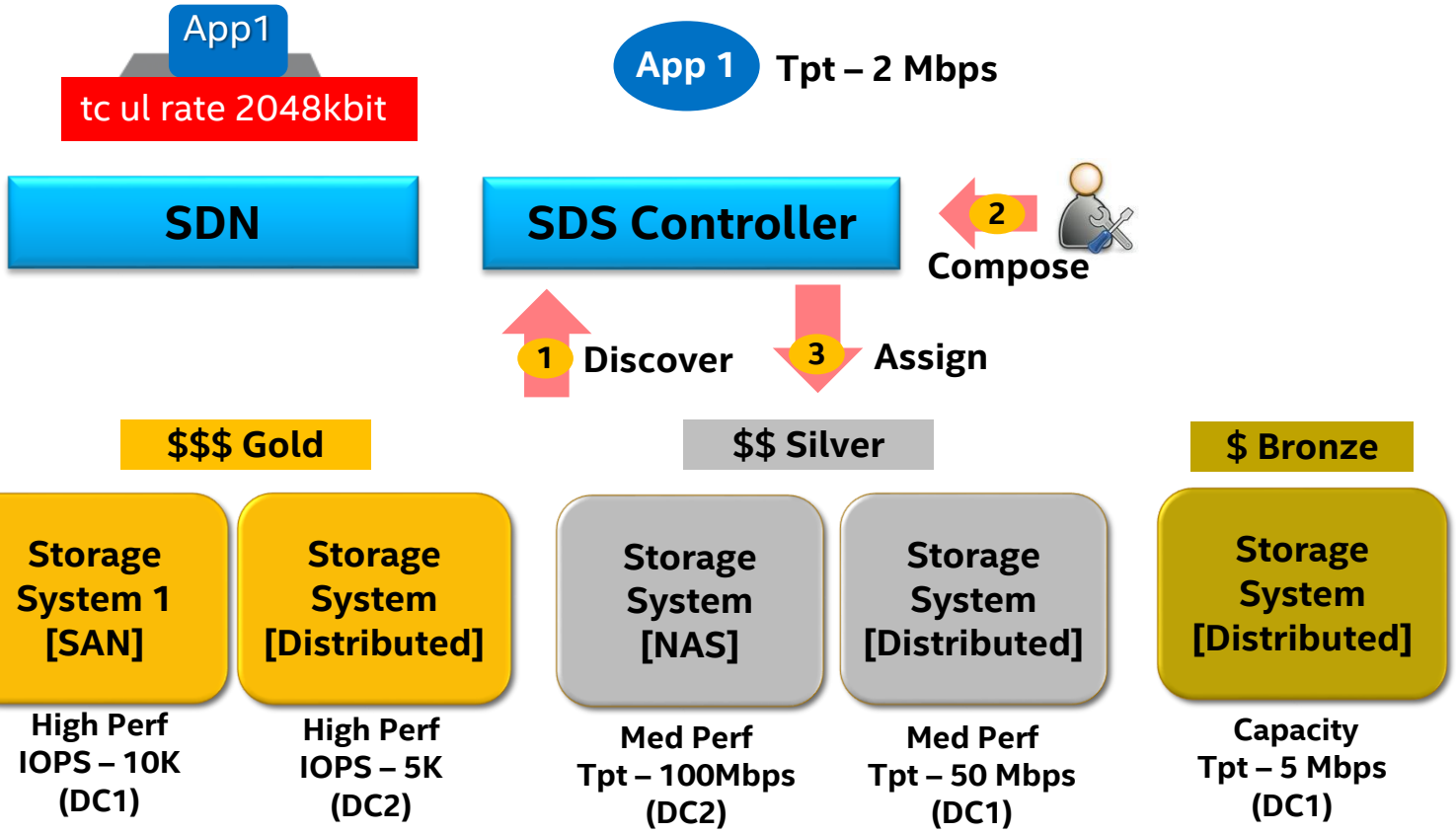
SDS Controller Use Case: Application Assignment (SLOs)

Example: Application provides SLO attributes (performance)



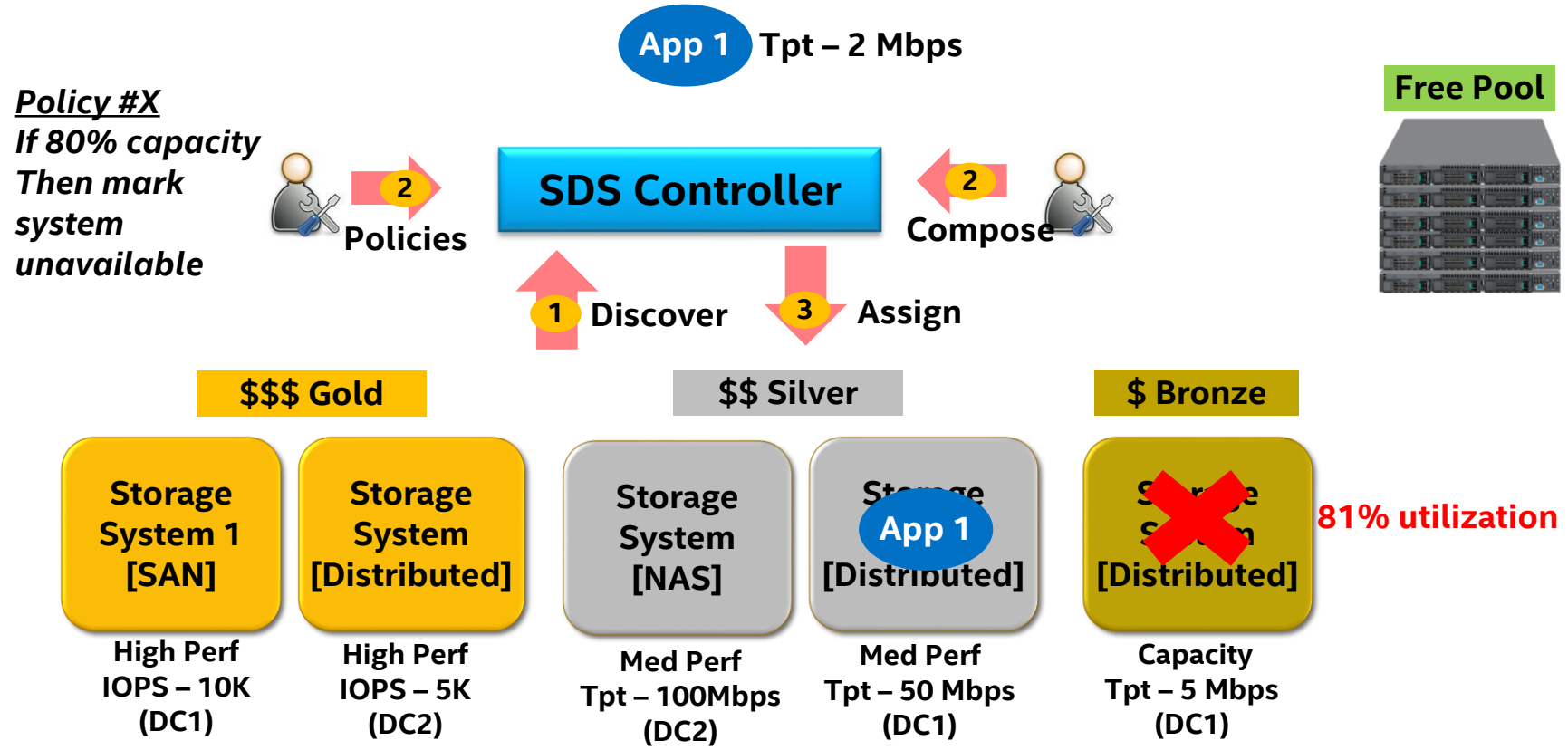
SDS Controller Use Case: Application Assignment (SLOs & Policies)

Example: Application provides SLO attributes (Throughput, noisy neighbor policy)



SDS Controller Use Case: Storage Overflow

Example: Application provides SLO attributes (Performance but storage is full)



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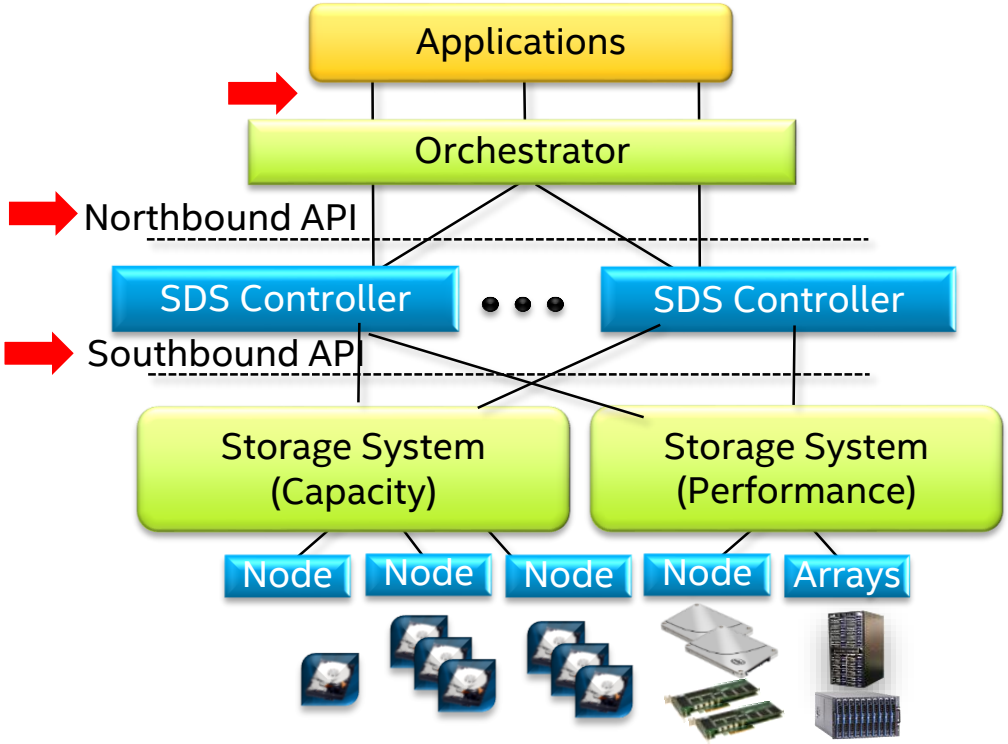
SDS Gaps: Clear Standards

Clear Standards

SDS Controller

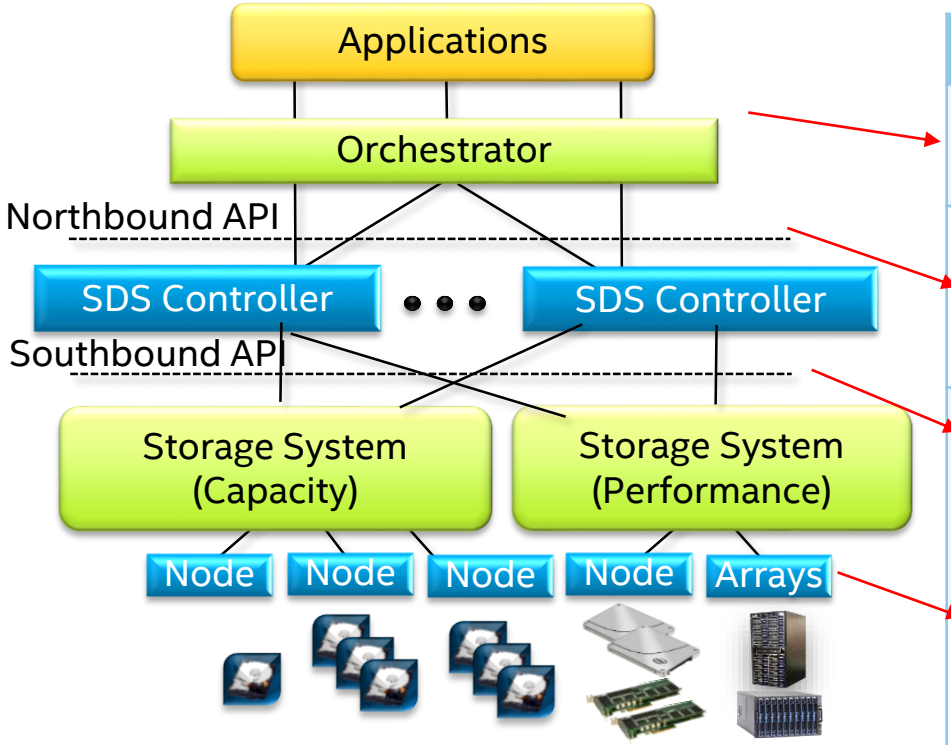
Data Services

Standards exist, but they are not focused on SDS, not organized together, and are not complete



Industry wide focus needed to develop standards by either enhancing or developing new standards (e.g., SNIA, OASIS, DMTF)

SDS Gaps: Standards Current State



Standard	Gap
OASIS TOSCA	Applications provide storage requirements using SLOs
IETF	Network focus - storage requirements (e.g. policies) not comprehended
CDMI	Very good capability discovery for objects – need block/file extensions and granular capabilities (e.g. erasure codes).
SMI-S	Appliance focus - requires changes for distributed storage use

Standards: Application to Orchestration & Controller (SLOs)

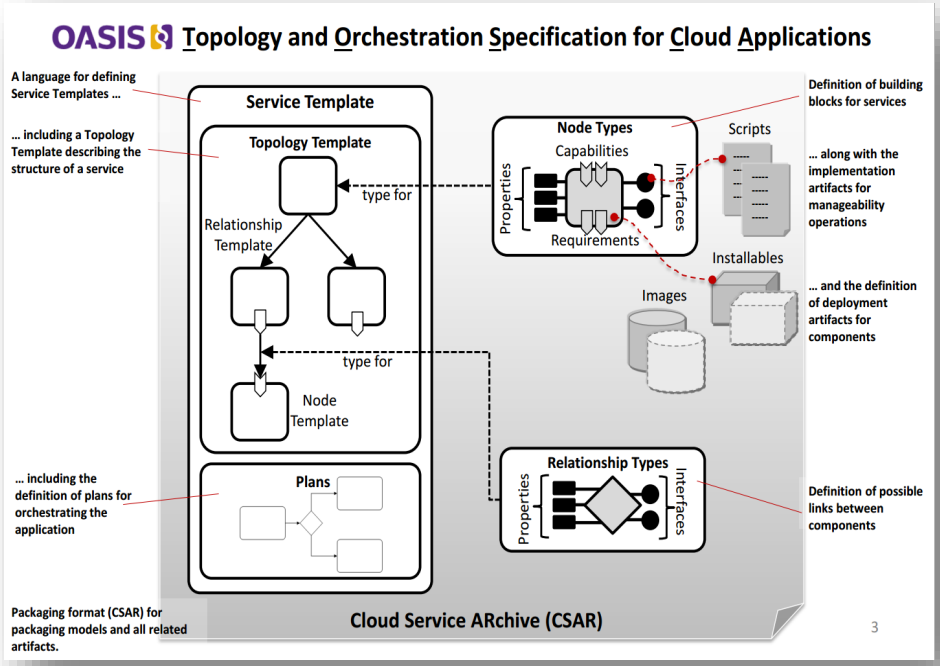
Wikipedia Definitions

- **Service Level Agreement (SLA)** - A service-level agreement (SLA) is a **part of a service contract** where a service is formally defined. In practice, the term SLA is sometimes used to refer to the contracted delivery time (of the service or performance). SLA will typically have a technical definition in terms of *mean time between failures* (MTBF), *mean time to repair* or *mean time to recovery* (MTTR)
- **Service Level Objective (SLO)** - A **service level objective** (SLO) is a key element of a service level agreement (SLA) between a service provider and a customer. SLOs are agreed as a **means of measuring the performance** of the Service Provider and are outlined as a way of avoiding disputes between the two parties based on misunderstanding.

Dimension	SLOs (Examples)	Gold	Silver	Bronze
Performance	Latency (ms), Throughput (MB/s or IOPS)	<10ms	<20ms	<30ms
Workload Profile	Sequential v/s random, Read v/s Write, Access pattern (burst, avg, min, max)	50:50 (R:W)	80:20 (R:W)	90:10 (R:W)
Cost	$/GB, $/IOPS	$2/GB	$1/GB	$.5/GB
Capacity	GB or TB	Max 2TB	Max 10TB	Max 2PB
Consistency	Eventual, Strong, Read after write	Strong	Eventual	Eventual
Durability	Replication, Geo protection	Local	Local	Geo
Availability	Up time (e.g., 99.999)	99.99	99.9999	99.99999
Compliance	HIPAA, ISO etc.	HIPAA	HIPAA	HIPAA
Protection	Encryption, Secure Erase	Client, Server	Client, Server	Server

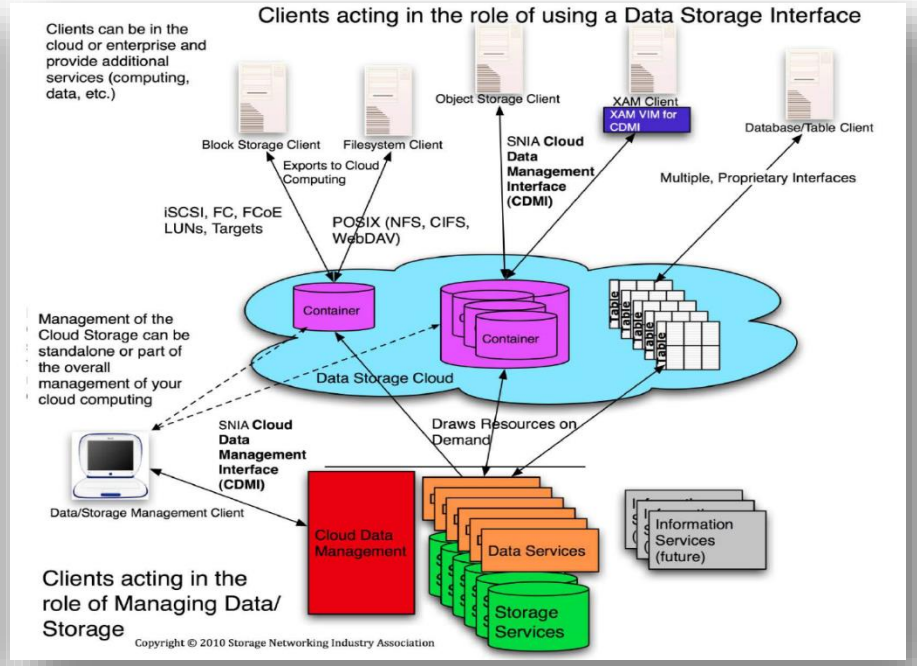
Standards: Application to Orchestration & Controller (TOSCA, CDMI, ?)

Service Centric
Service Templates



Source: https://wiki.openstack.org/w/images/a/a1/TOSCA_in_Heat_-_20130415.pdf

Storage Centric
e.g. Data System metadata

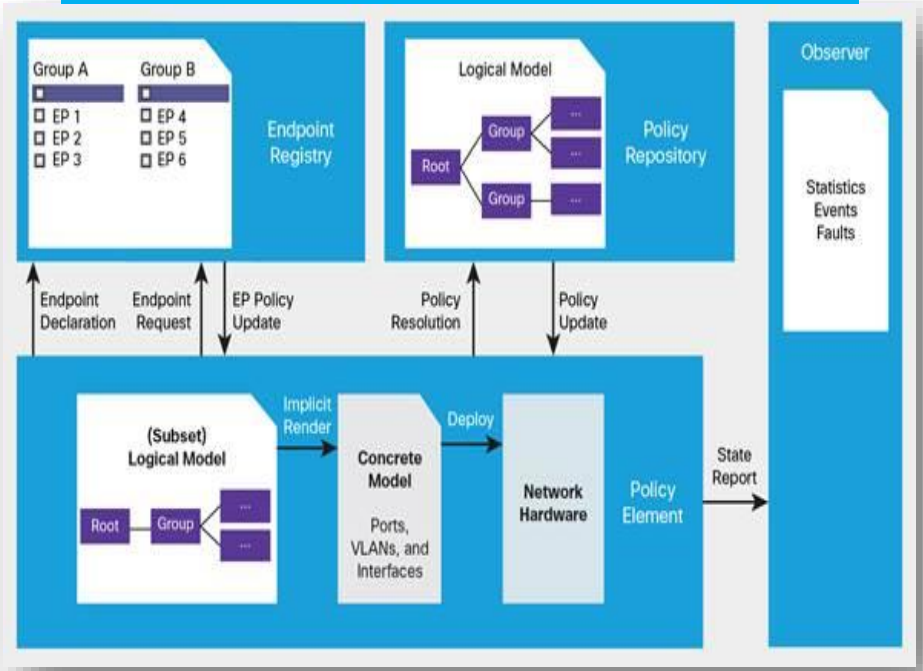


Source: 2011 SNIA Tutorial (Interoperable Cloud Storage with the CDMI Standard)

Need standard way of expressing application requirements using SLOs – work with OASIS, SNIA, IETF to create SLO standards

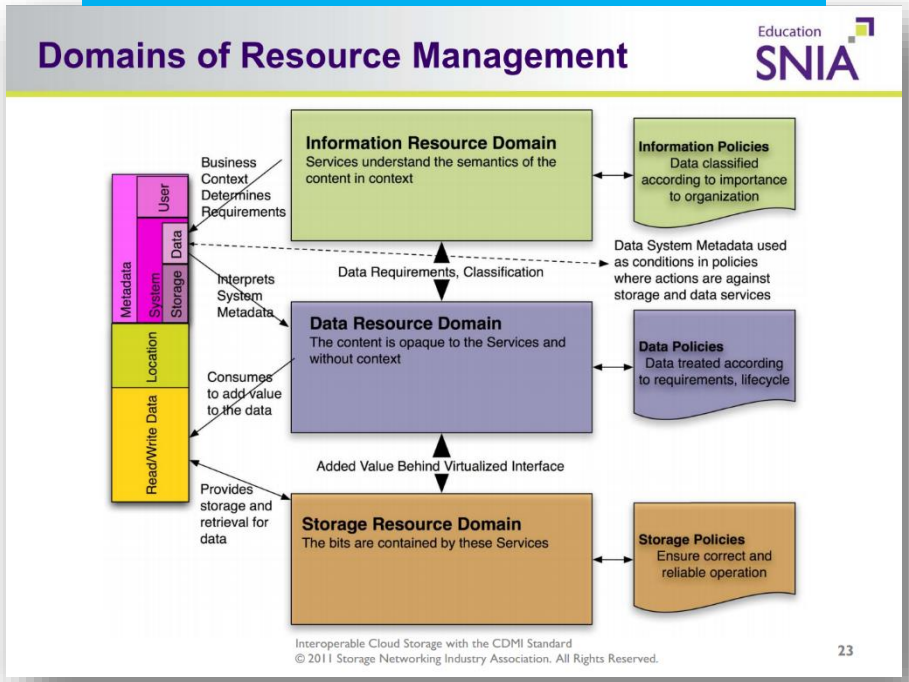
Standards: Storage Resource Management

Cisco OpFlex (IETF informational RFC)
Network Policy



Source: http://www.cisco.com/c/en/us/solutions/collateral/data-center-virtualization/application-centric-infrastructure/white-paper-c11-731302.html

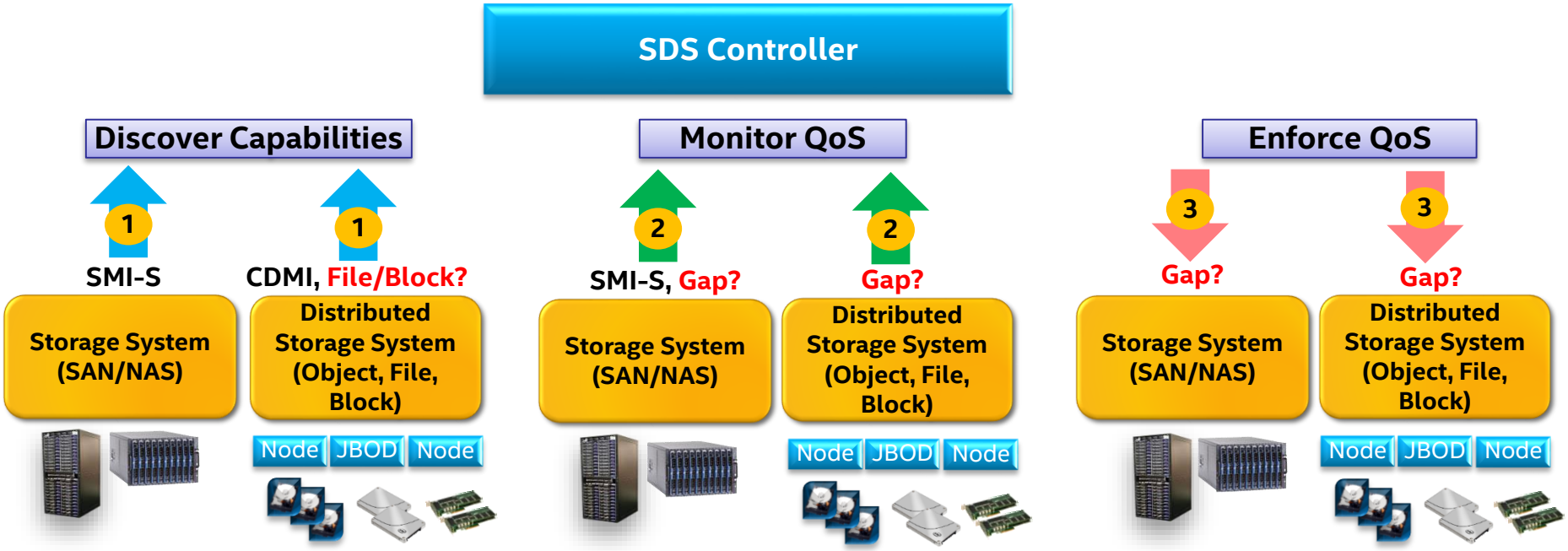
SNIA Resource Management Model
Storage Policy



Source: 2011 SNIA Tutorial (Interoperable Cloud Storage with the CDMI Standard)

One policy framework is desirable in a data center for all resources (compute, network, storage). Need to incorporate storage requirements and policies in emerging standard discussions in IETF.

Standards: SDS Controller to Storage System



SDS Controller enables granular monitoring and QoS enforcement of storage data types (virtual volume, shares, containers) – need standards to address these gaps.

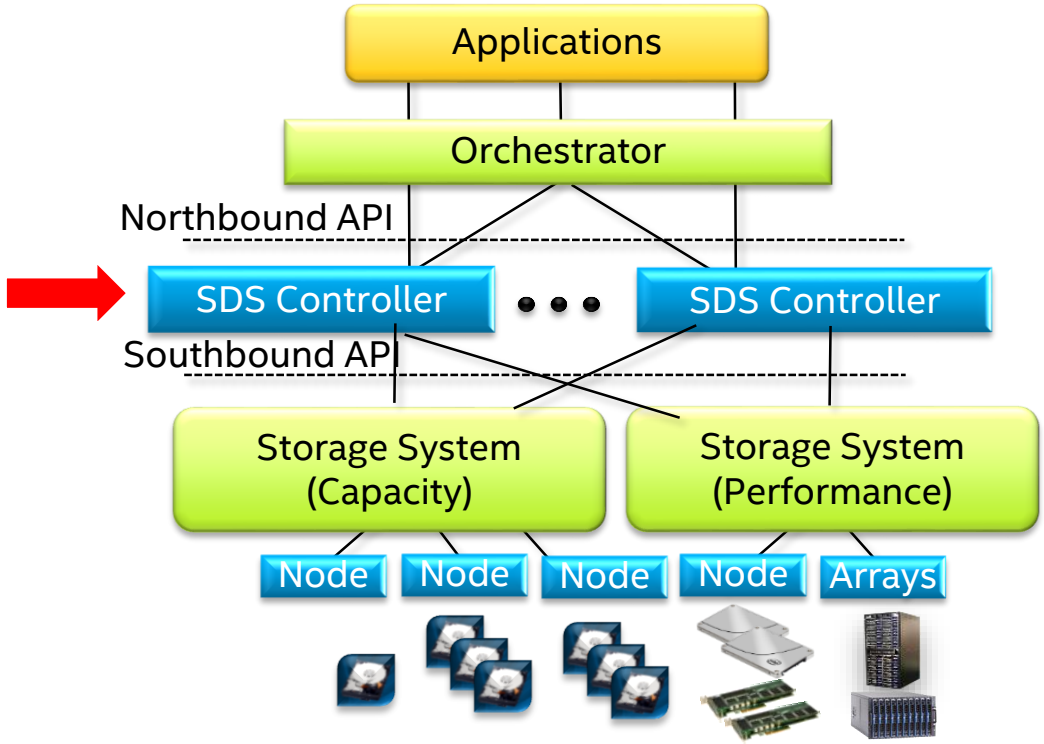
SDS Gaps: Open SDS Controller

Clear Standards

SDS Controller

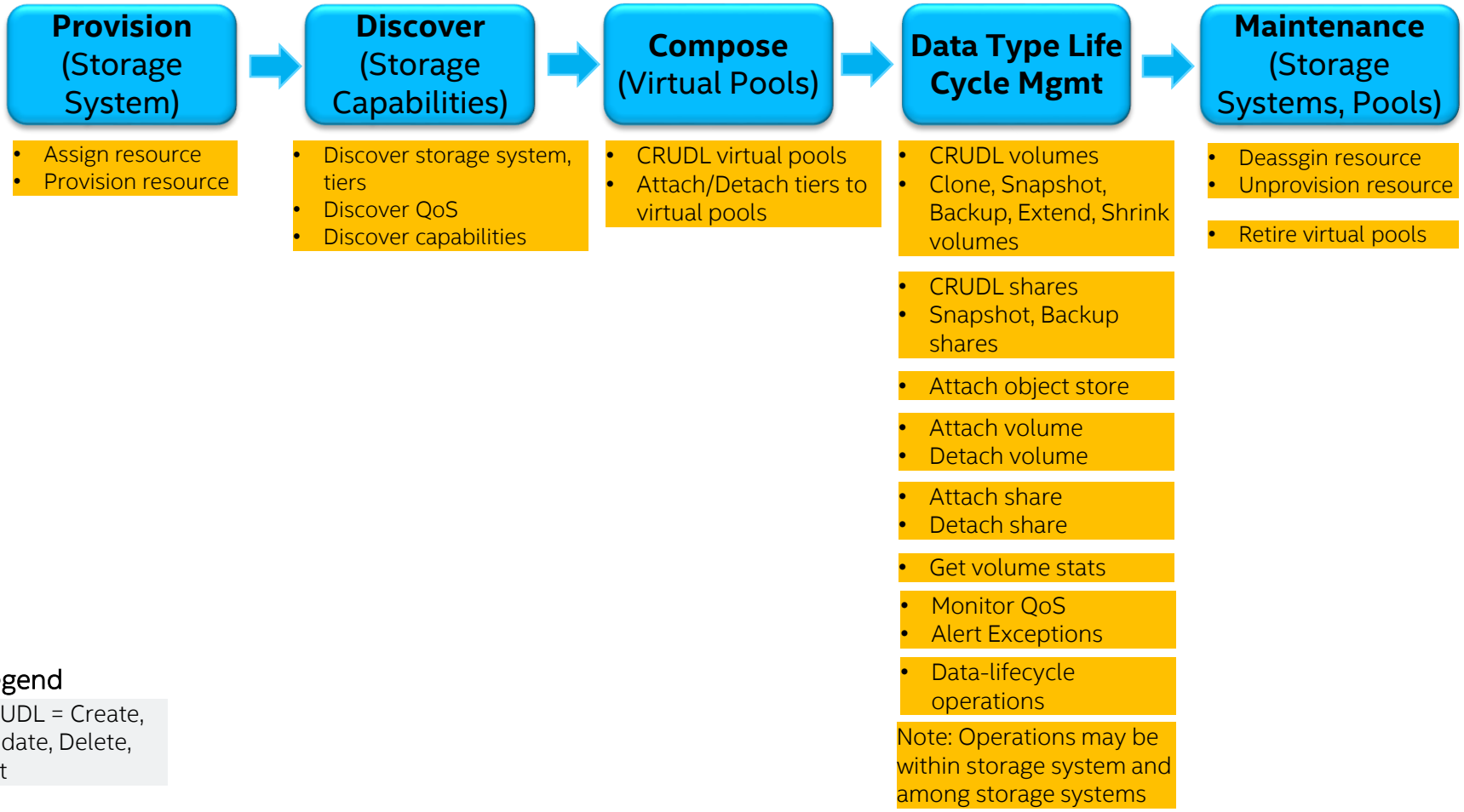
Data Services

Open SDS Controller does not exist

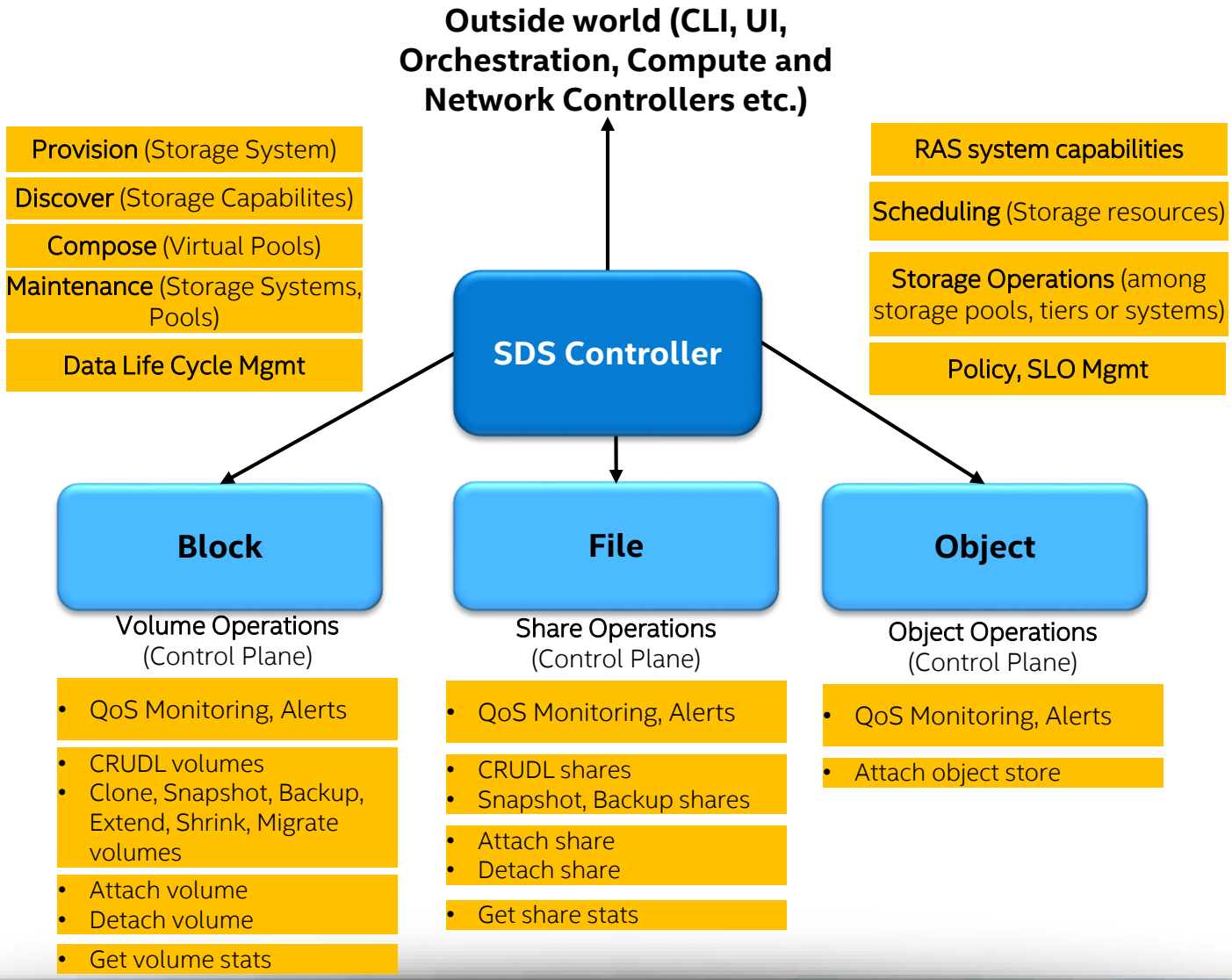


Open, federated "control plane" with pluggable architecture is needed for ecosystem innovation

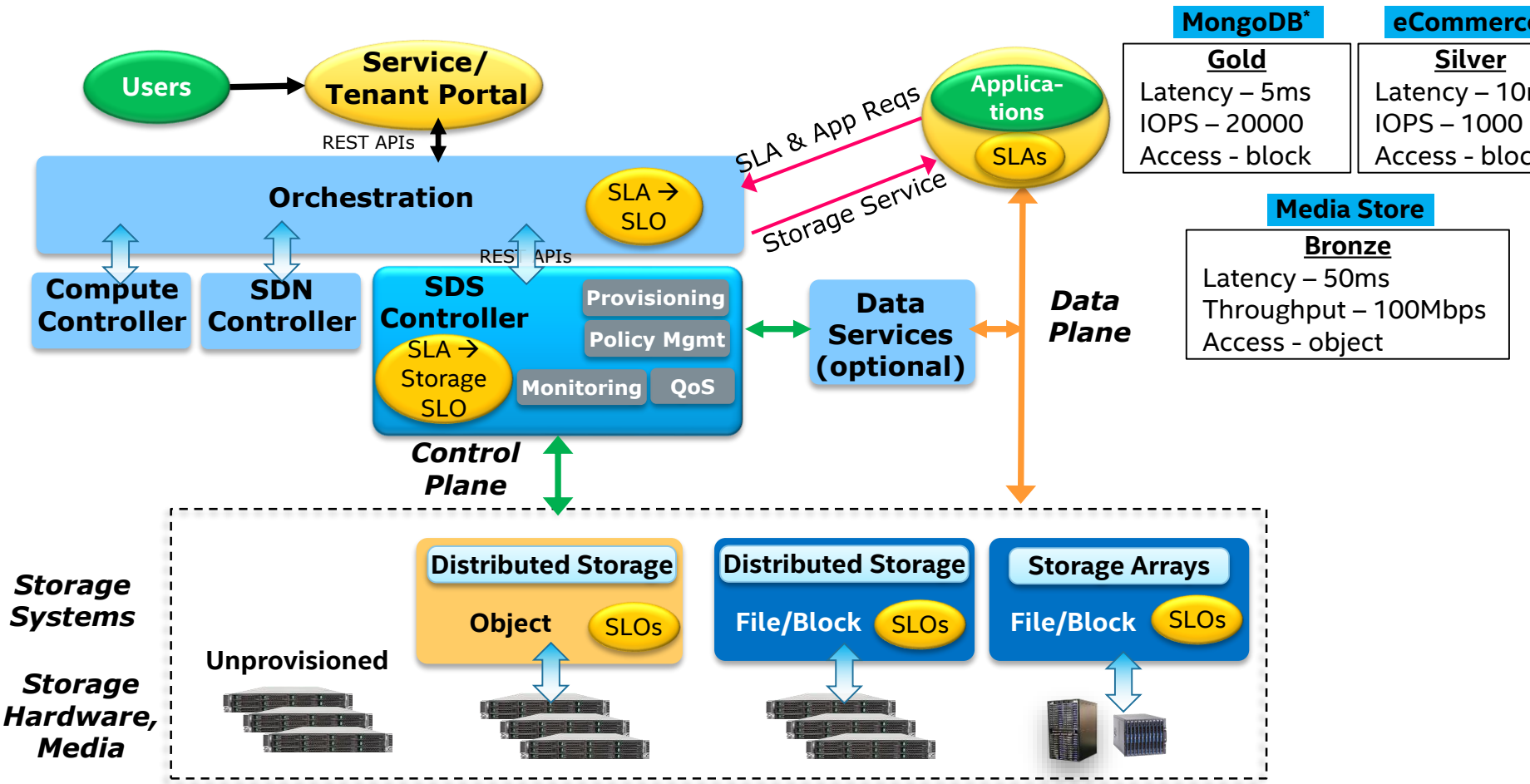
SDS Requirements



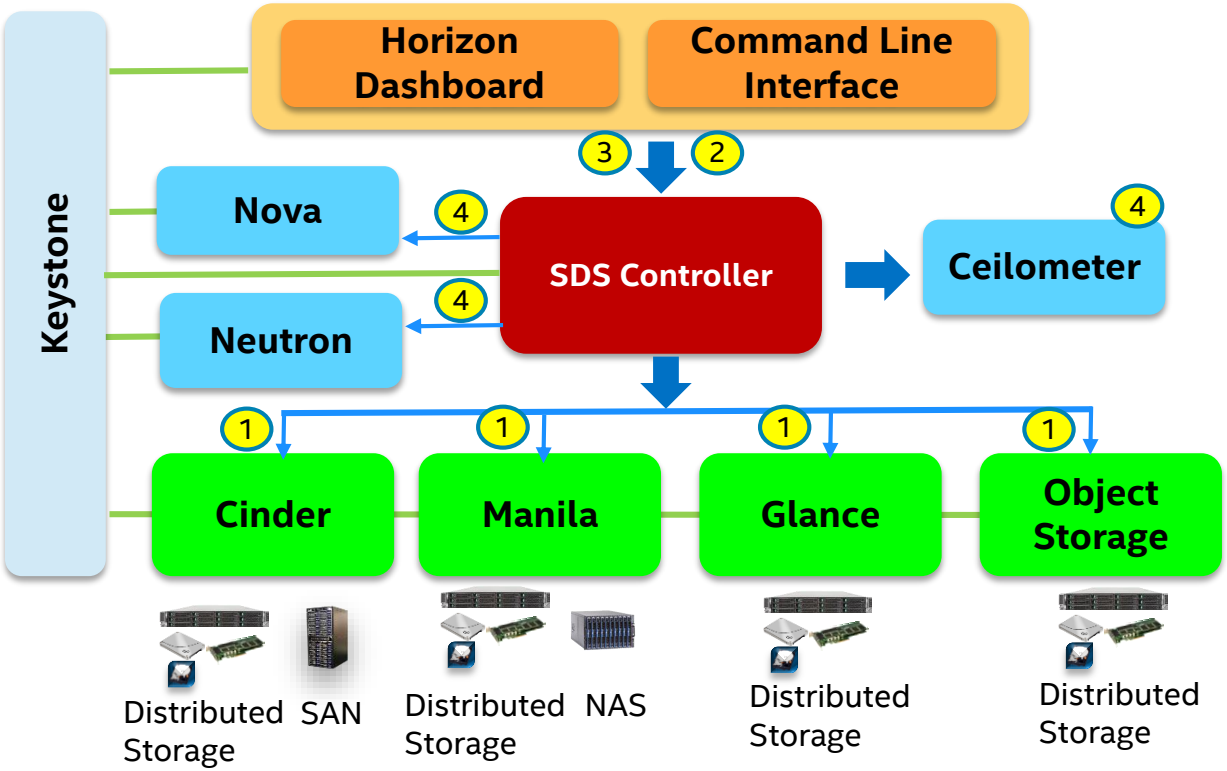
SDS Functional Partitioning



SDS Controller Reference Architecture



Open Source SDS Controller - Prototype



Develop key requirements by working with ecosystem and finalize open source enabling plans in 2H'14

1. SDS controller discovers storage systems and capabilities (e.g., perf, capacity, tiers, etc.)
2. Admin composes storage pools (e.g., gold, silver, bronze)
3. Application requests storage service using SLOs.

   Controller allocates storage volume from pool that can best service the request.
4. Storage gets assigned to Nova or App in VM.

   Controller works with compute, network to set QoS.

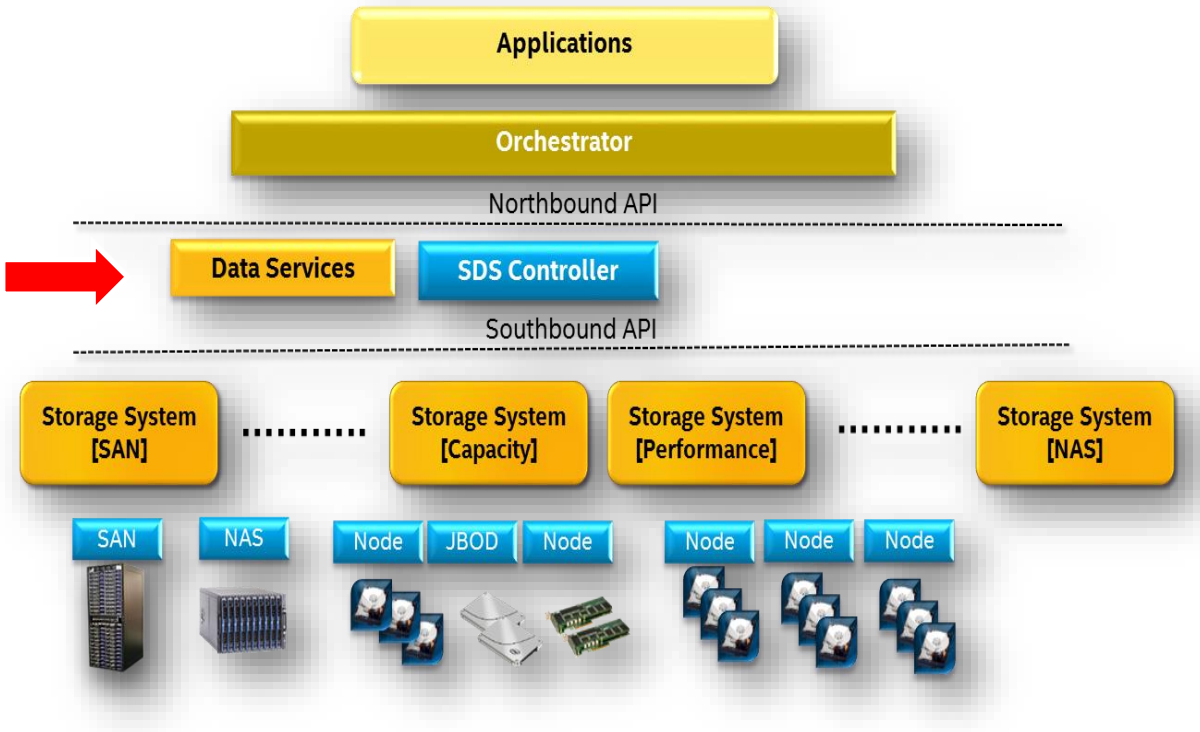
SDS Gaps: Data Services

Clear Standards

SDS Controller

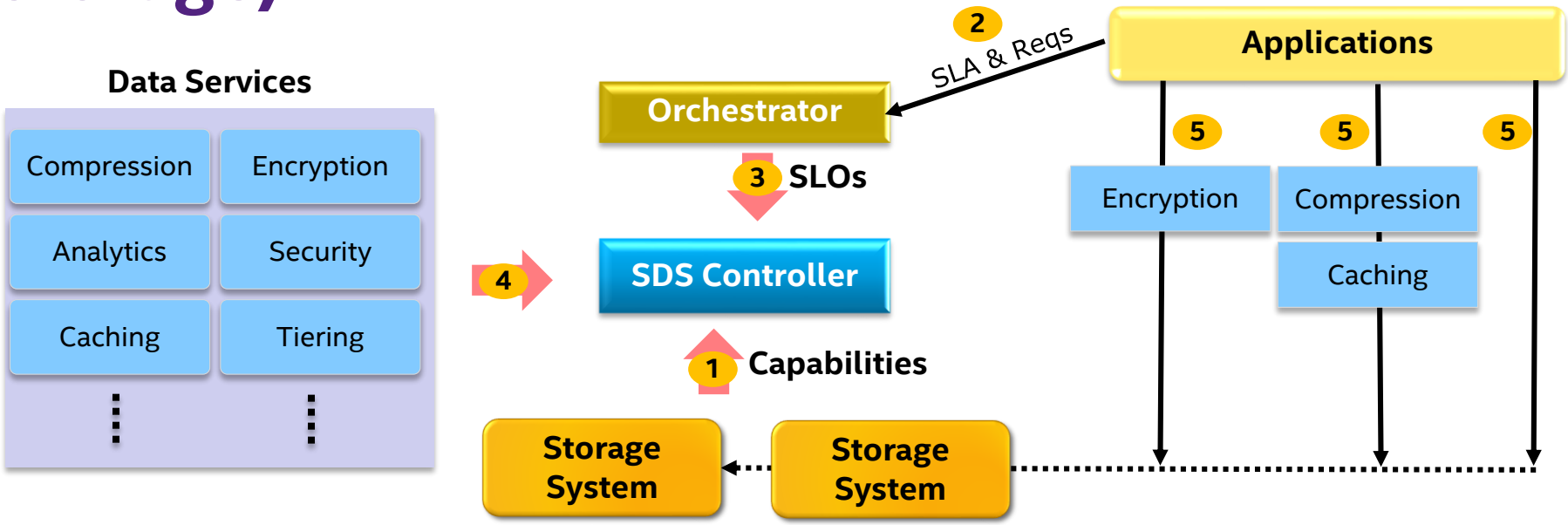
Data Services

Need a framework for vendor innovation



Data Services framework definition and standards needed for ecosystem innovation

SDS Gaps: Data Services (An app store for storage)



- Data Services are set of storage capabilities that manipulate data without much contextual interpretation
- Data Services can be deployed as virtual services or purpose built appliances
- SDS controller dynamically composes an end to end storage service by intelligently chaining data services and storage systems to meet application requirements. Can be extended to Network functions too (e.g. WAN acceleration for geo replication).

1. SDS controller discovers storage systems, capabilities
2. Application provides requirements using SLAs
3. Orchestrator provides SLOs to SDS controller
4. SDS controller composes storage resources and passes information to application
5. Application uses end point information for data path communication

Data Services concept is similar to Service Chaining in Network Function Virtualization

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Summary

- Software Defined Storage is needed to address tomorrow's challenges
  - Data needs are growing at a rate unsustainable with today's infrastructure and labor costs
  - Traditional storage silos drives management complexity and inefficient
- SDS is a framework aimed at serving the needs of emerging storage requirements. But there are gaps -
  - Industry wide focus is needed to create standards for application and storage system interoperability
  - Open, federated SDS controller that provisions, monitors, provides SLA adherence is needed
  - Data Services framework definition and standards needed for ecosystem innovation
- SNIA has critical role in creating SDS framework and defining SDS storage standards by working with other standard bodies

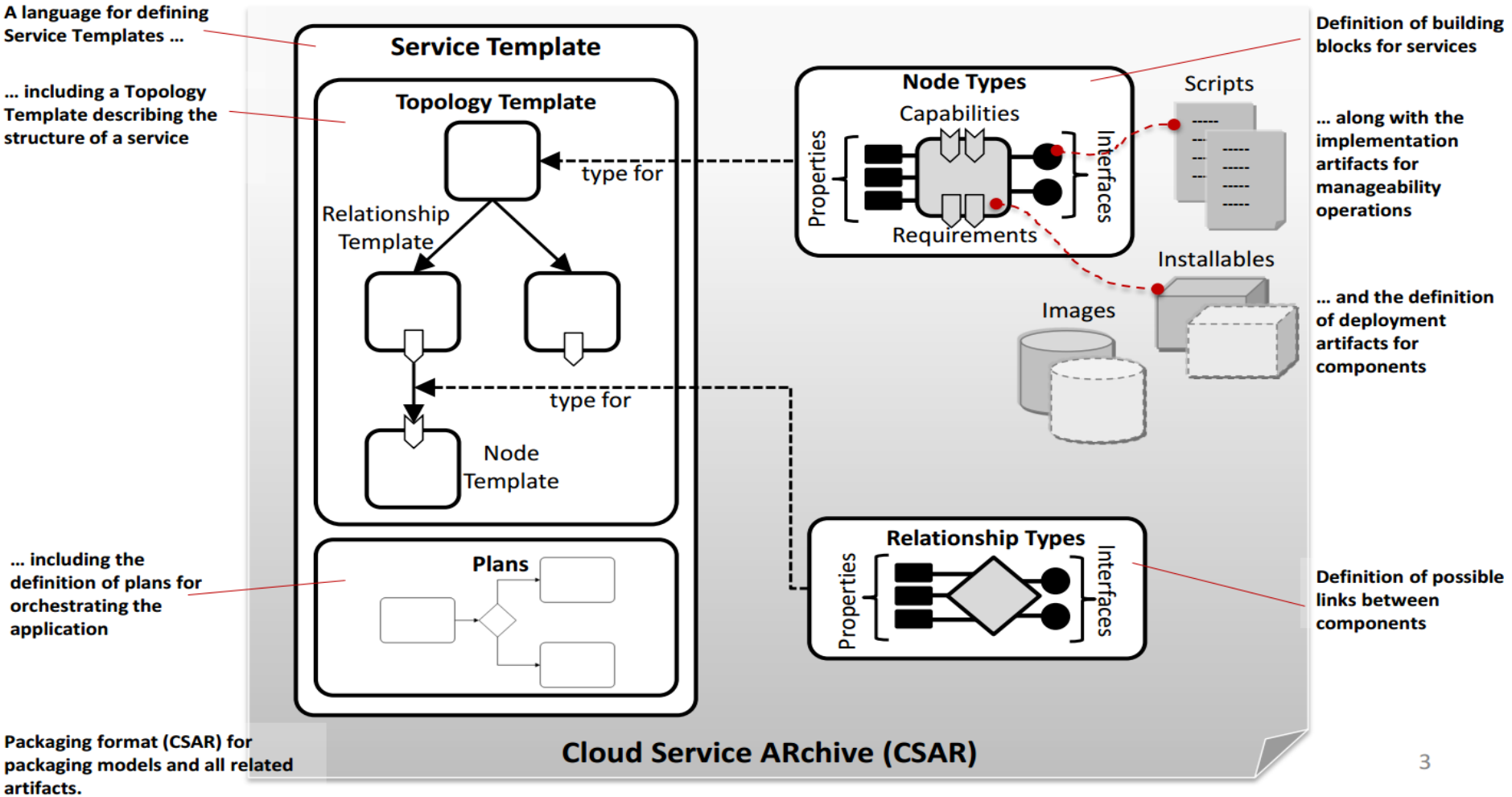
Call to Action

- Contribute to Opensource SDS controller development
- Engage with SNIA to address SDS standards gaps
  - Develop cohesive Software Defined Storage Model with framework and standards in SNIA
- Pilot SDS solutions in 1H'15 (based on open source controller)
- Innovate storage offerings with Open source framework and Data Services

Backup Slides

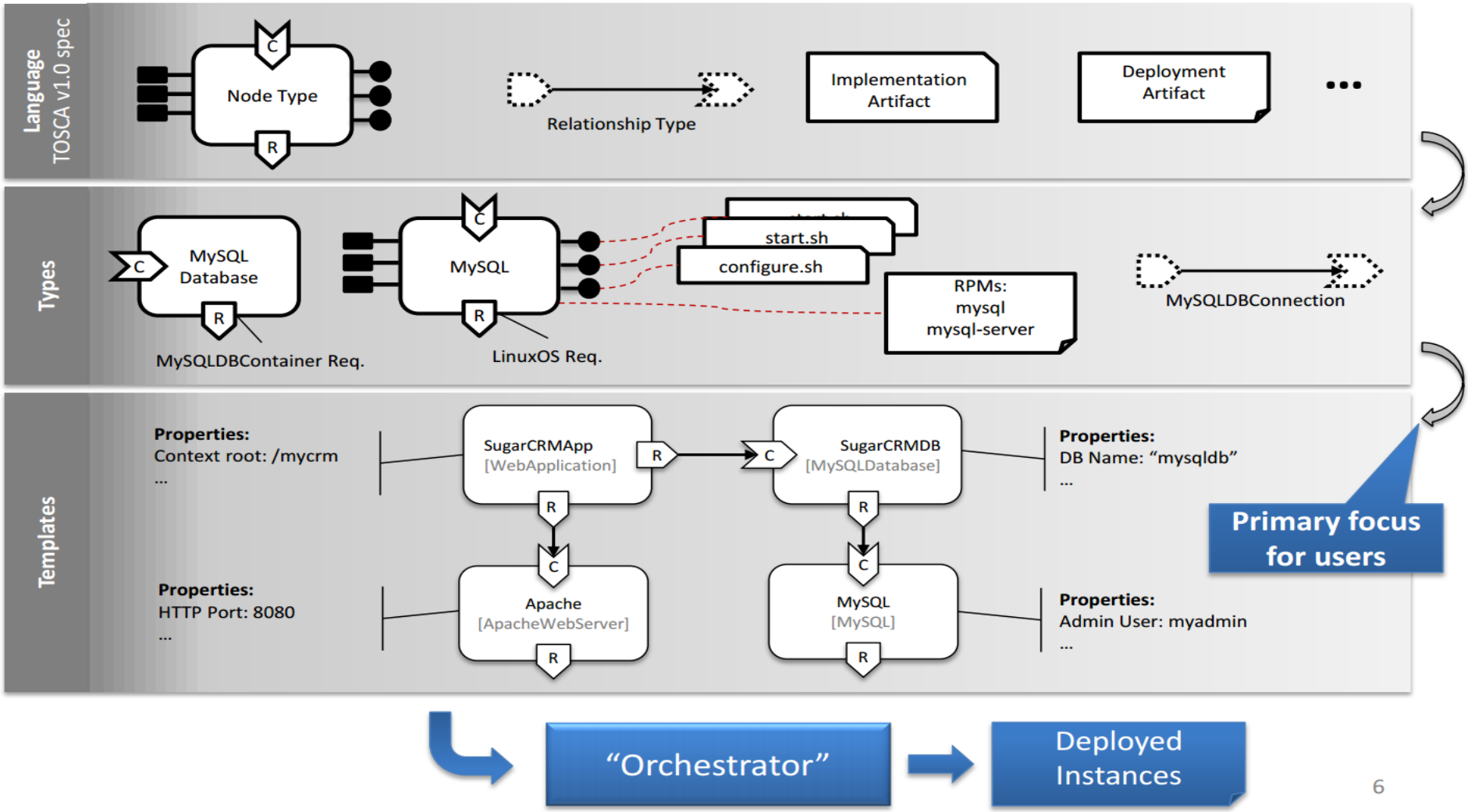
What is TOSCA?

OASIS Topology and Orchestration Specification for Cloud Applications



Source: https://wiki.openstack.org/w/images/a/a1/TOSCA_in_Heat_-_20130415.pdf

Using TOSCA to model applications



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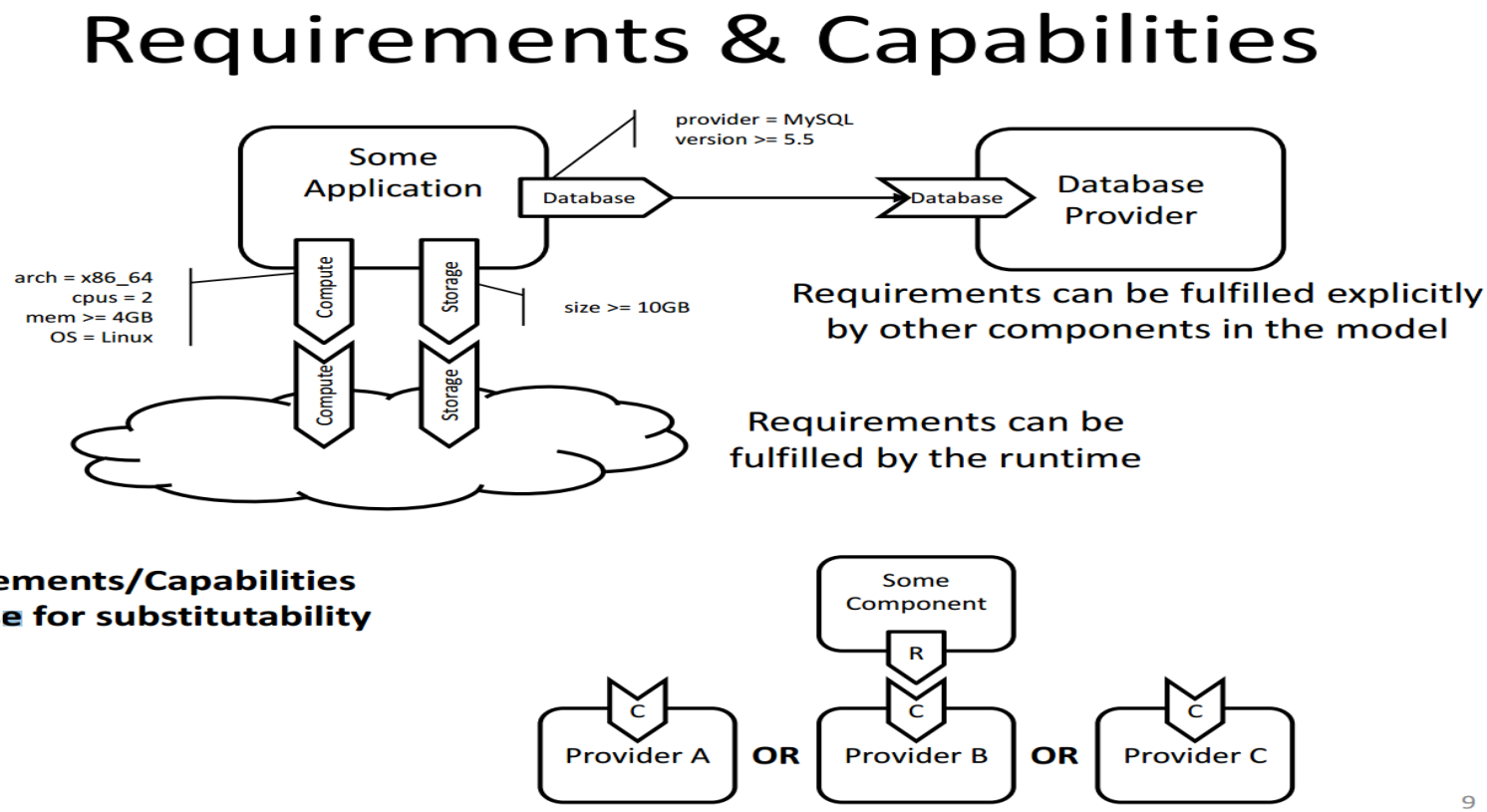
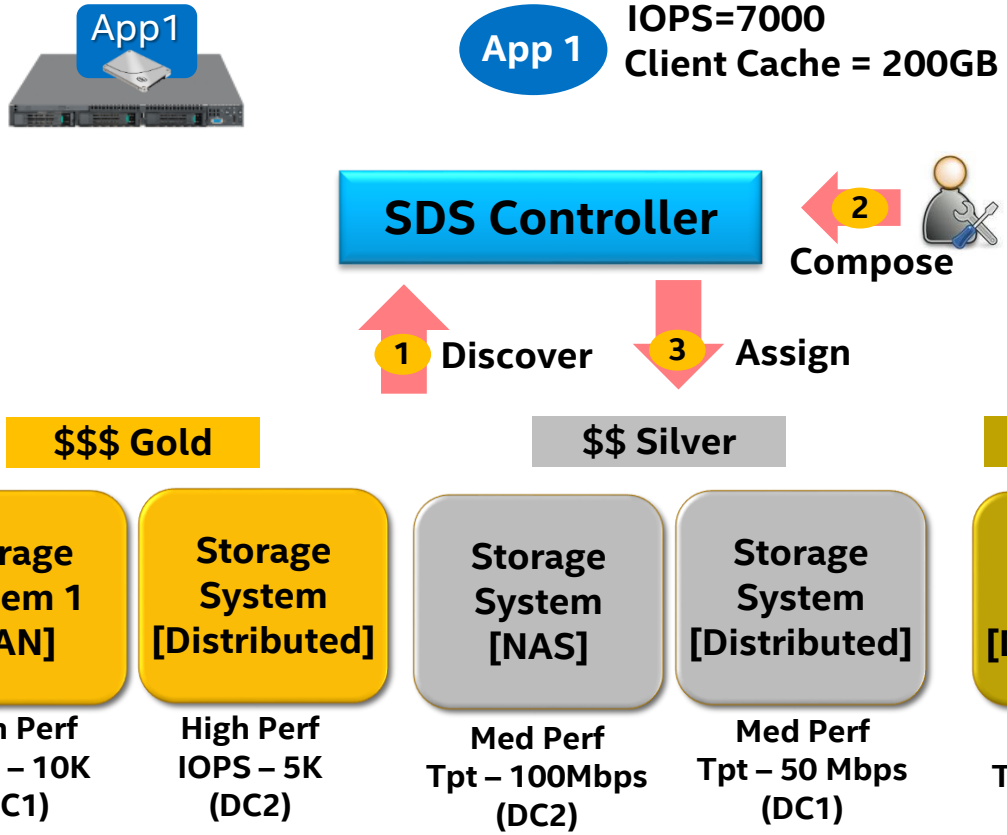
Using TOSCA for SLOs?



Source: https://wiki.openstack.org/w/images/a/a1/TOSCA_in_Heat_-_20130415.pdf

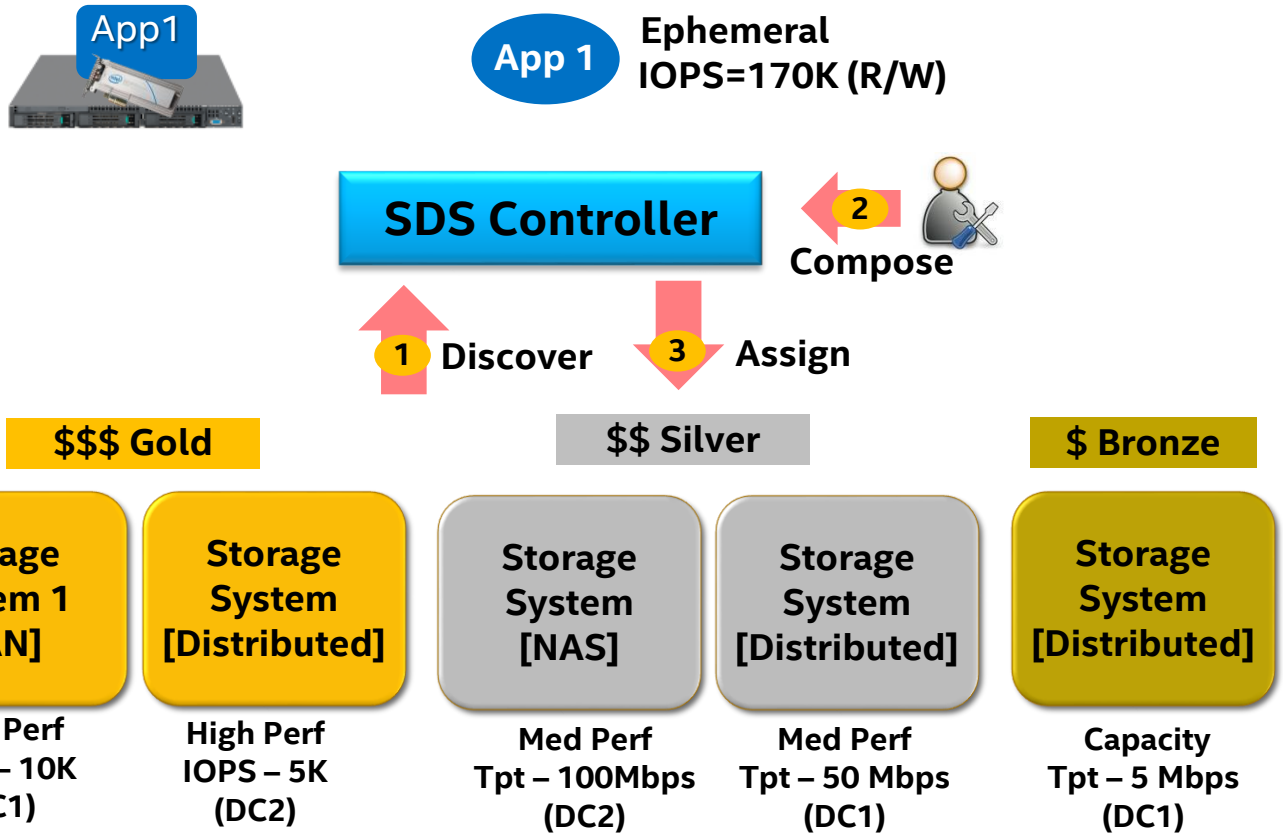
SDS Controller Use Case: Application Assignment (Complex SLOs)

Example: Application provides SLO attributes (performance, client caching)



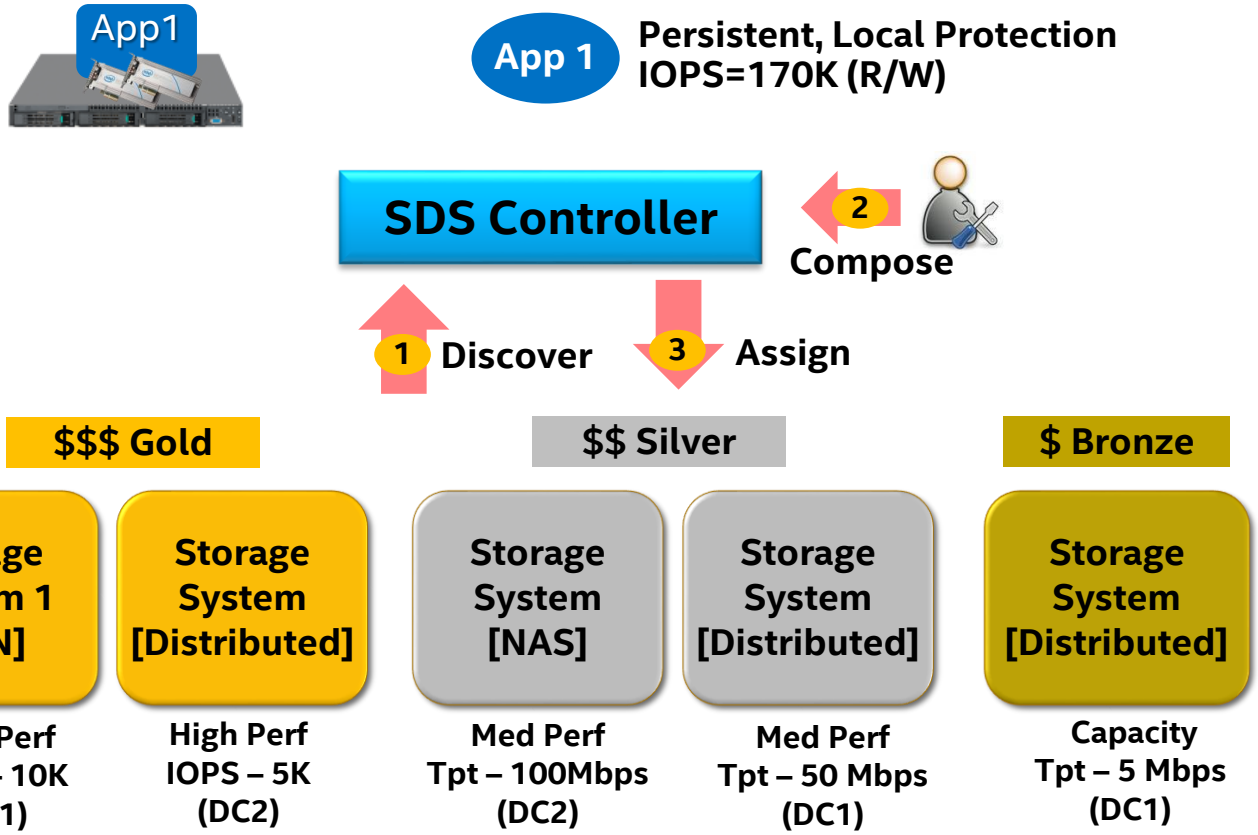
SDS Controller Use Case: Application Assignment (Complex SLOs)

Example: Application provides SLO attributes (ephemeral)



SDS Controller Use Case: Application Assignment (Complex SLOs)

Example: Application provides SLO attributes (ephemeral, local protection)



SDS Controller Use Case: Application Assignment (SLOs & Policies)

Example: Application provides SLO attributes (IOPS, noisy neighbor policy)