OpenStack in Production

Bernd Himmelsbach
VP Cloud Architecture & Engineering, SAP
October, 2016

SAP

Agenda

→ **SAP Figures**

→ **Situation 2014**

→ **OpenStack and SAP Converged Cloud as the „Holy Grail"**

→ **Challenges & Opportunities through OpenStack**

→ **Solution approach**

Agenda

➔ **SAP Figures**

➔ Situation 2014

➔ OpenStack and SAP Converged Cloud as the „Holy Grail"

➔ Challenges & Opportunities through OpenStack

➔ Solution approach

Some High Level Figures of SAP

➔ **80k+ employees**

➔ **70+ data centers**

➔ **7+ PB RAM capacity**

➔ **100+ PB Storage capacity**

➔ **90+ PB backup capacity**

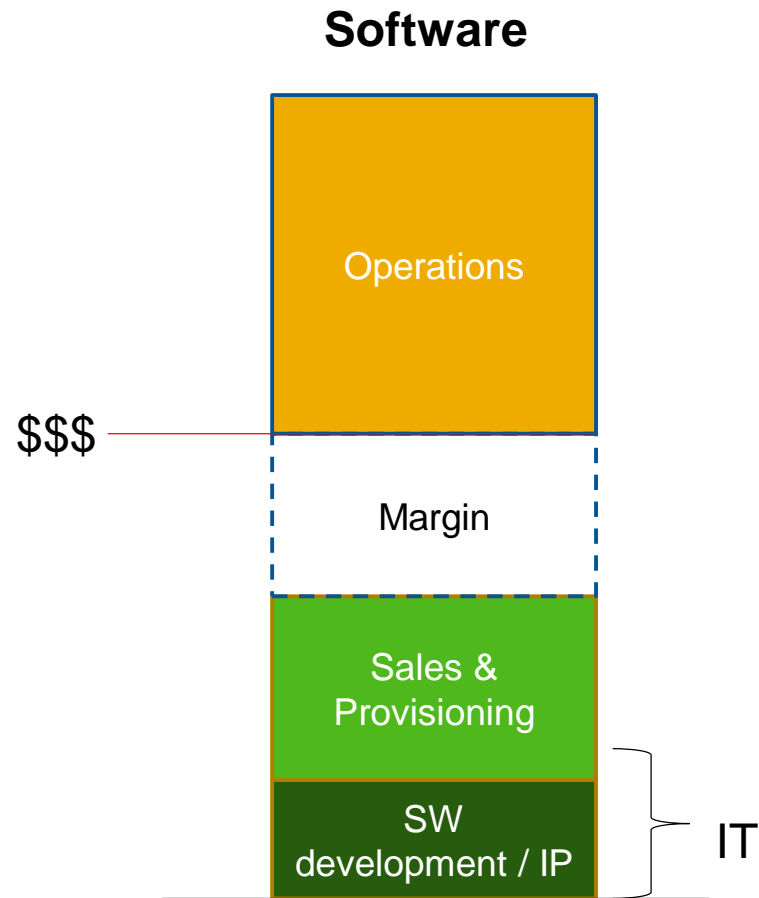➔ **Multiple multi billion USD acquisitions during the last years (successfactors, Ariba, Concur…)**
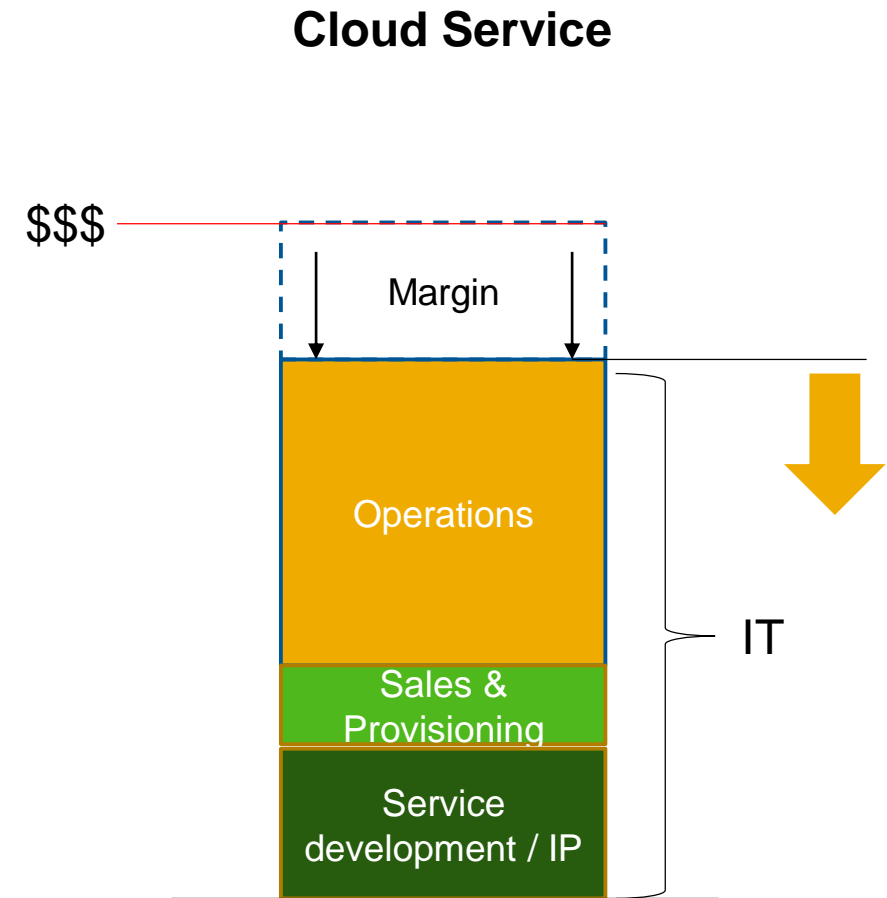
Agenda

➔ **SAP Figures**

➔ **Situation 2014**

➔ **OpenStack and SAP Converged Cloud as the „Holy Grail"**

➔ **Challenges & Opportunities through OpenStack**

➔ **Solution approach**

2014: SAP's Cloud Infrastructure Challenge

Software Provider and Cloud Service Provider have very different cost structures, differ in their core competencies

Software

Operations

$$$

Margin

Sales & Provisioning

SW development / IP

IT

How to increase margin? Sell more licenses!

Cloud Service

$$$

Margin

Operations

Sales & Provisioning

Service development / IP

IT

How to increase margin? Run a competitive IT!

Agenda

➔ **SAP Figures**

➔ **Situation 2014**

➔ **OpenStack and SAP Converged Cloud as the „Holy Grail"**

➔ **Challenges & Opportunities through OpenStack**

➔ **Solution approach**

OpenStack End Users

OpenStack Dashboard — Horizon, Horizon Database

OpenStack Object Store — swift-proxy, account, container, object, account DB, container DB, object store

OpenStack Image Service — glance-api, glance-registry, glance database

OpenStack Compute — nova-api (OS, EC2, Admin), nova-console, nova-cert/objectstore, nova-compute, hypervisor, nova database, Queue, nova-consoleauth, nova-scheduler, nova-network, nova-volume, network provider, volume provider (iSCSI, etc)

OpenStack Block Storage Service — cinder-api, cinder-volume, cinder database, cinder-scheduler

OpenStack Network Service — quantum-server, quantum agent(s), Queue, quantum plugin(s), quantum database

OpenStack Identity Service — keystone (service & admin APIs), token backend (kvs, memcache, etc.), catalog backend (kvs, sql, etc.), policy backend (rules, custom), identity backend (kvs, pam, sql, ldap, etc.)
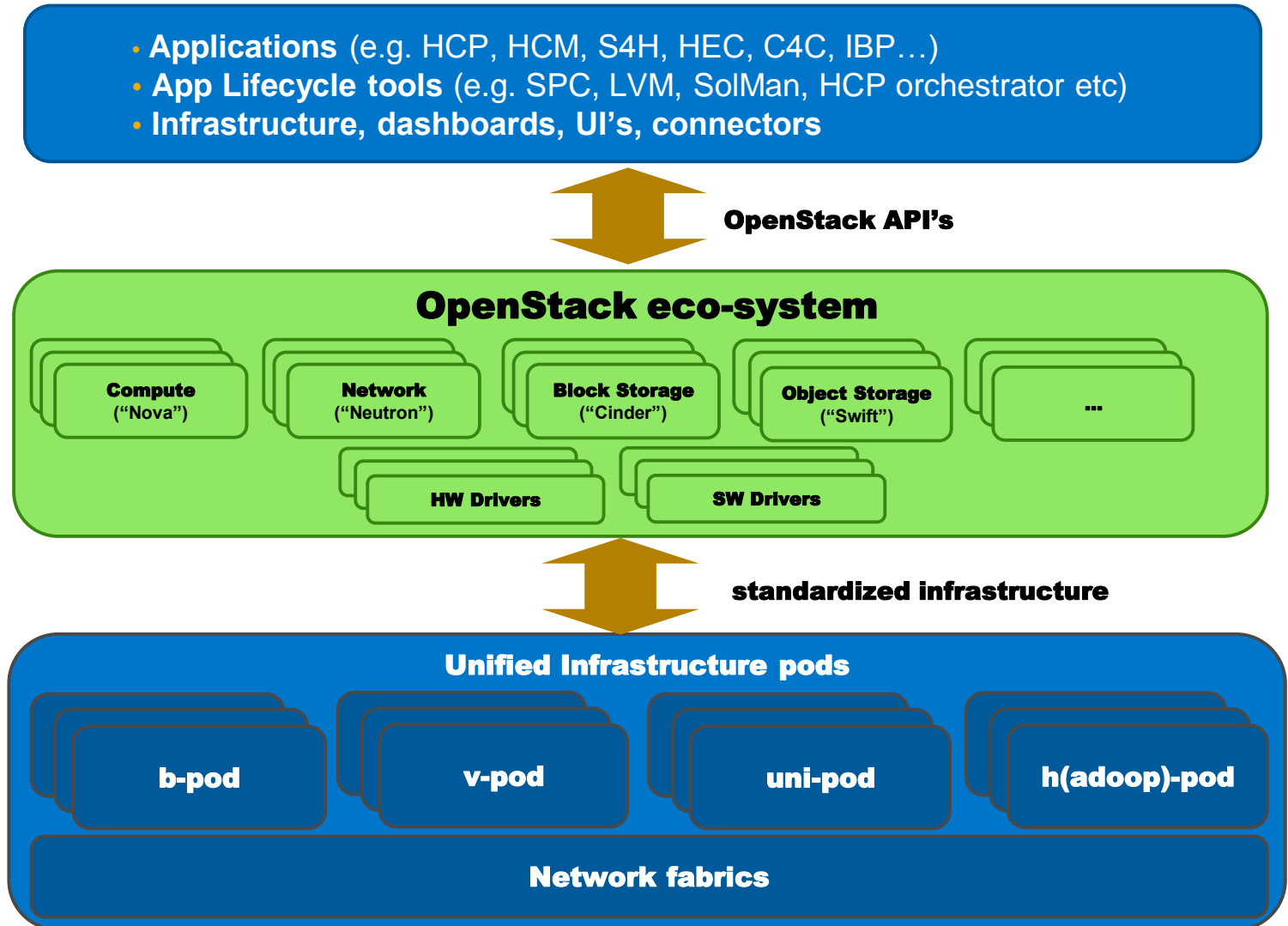
http://ken.pepple.info

What means convergence in SAP's Converged Cloud?

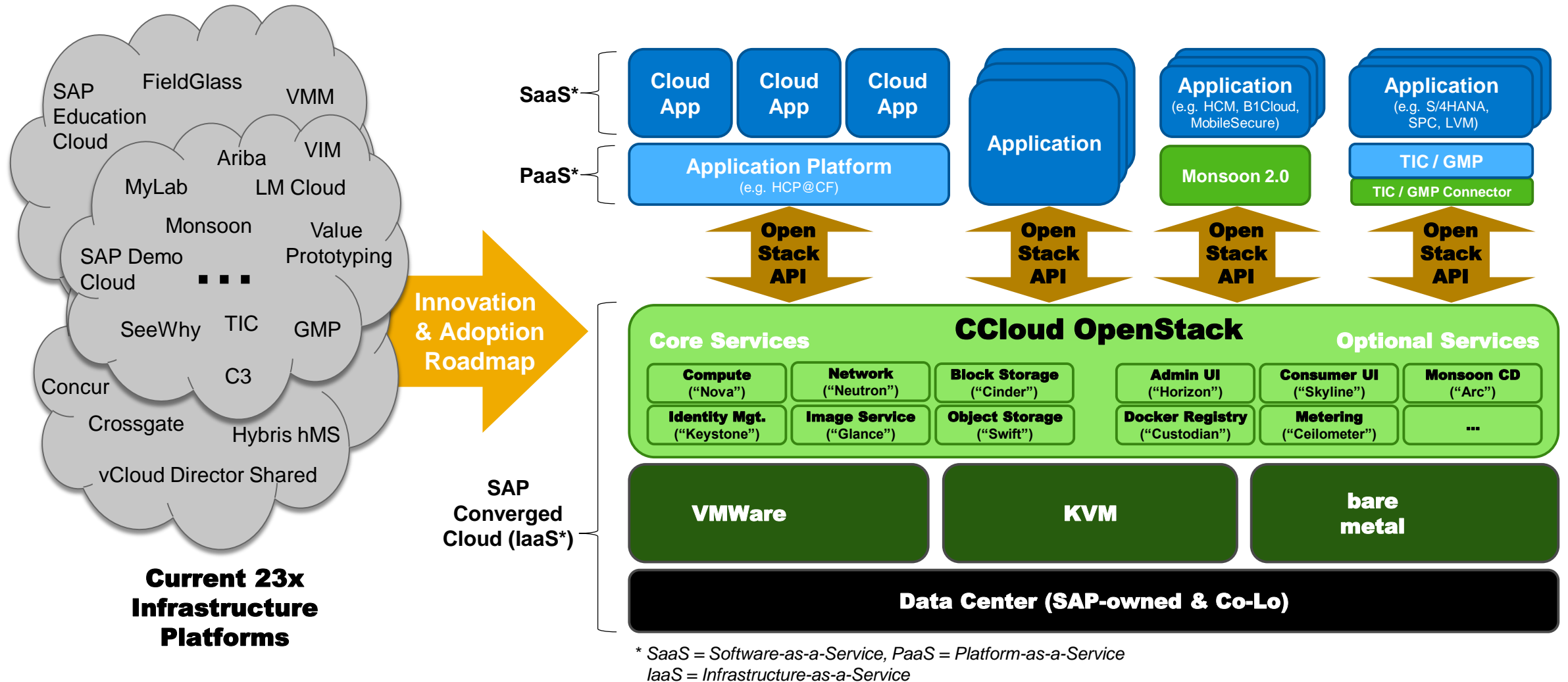→ **We converge „northbound" around OpenStack API's**

→ **We converge around the OpenStack software eco-system:**
   integration of HW & Software components through OpenStack drivers and OpenStack modules

→ **We converge „southbound" around standardized hardware pods**

- **Applications** (e.g. HCP, HCM, S4H, HEC, C4C, IBP...)
- **App Lifecycle tools** (e.g. SPC, LVM, SolMan, HCP orchestrator etc)
- **Infrastructure, dashboards, UI's, connectors**

↕ **OpenStack API's**

OpenStack eco-system

| Compute ("Nova") | Network ("Neutron") | Block Storage ("Cinder") | Object Storage ("Swift") | ... |

HW Drivers   SW Drivers

↕ **standardized infrastructure**

Unified Infrastructure pods

| b-pod | v-pod | uni-pod | h(adoop)-pod |

Network fabrics

SAP Converged Cloud "Markitecture" Picture

Current 23x Infrastructure Platforms (cloud): SAP Education Cloud, FieldGlass, VMM, VIM, Ariba, MyLab, LM Cloud, Monsoon, Value Prototyping, SAP Demo Cloud, SeeWhy, TIC, GMP, C3, Concur, Crossgate, Hybris hMS, vCloud Director Shared

Innovation & Adoption Roadmap

SaaS*: Cloud App, Cloud App, Cloud App | Application | Application (e.g. HCM, B1Cloud, MobileSecure) | Application (e.g. S/4HANA, SPC, LVM)

PaaS*: Application Platform (e.g. HCP@CF) | Monsoon 2.0 | TIC / GMP — TIC / GMP Connector

Open Stack API (x4)

SAP Converged Cloud (IaaS*)

CCloud OpenStack

Core Services
- Compute ("Nova")
- Network ("Neutron")
- Block Storage ("Cinder")
- Identity Mgt. ("Keystone")
- Image Service ("Glance")
- Object Storage ("Swift")

Optional Services
- Admin UI ("Horizon")
- Consumer UI ("Skyline")
- Monsoon CD ("Arc")
- Docker Registry ("Custodian")
- Metering ("Ceilometer")
- ...

VMWare | KVM | bare metal

Data Center (SAP-owned & Co-Lo)

* SaaS = Software-as-a-Service, PaaS = Platform-as-a-Service
IaaS = Infrastructure-as-a-Service

Agenda

➔ SAP Figures

➔ Situation 2014

➔ OpenStack and SAP Converged Cloud as the „Holy Grail"

➔ **Challenges & Opportunities through OpenStack**

➔ Solution approach

Challenges & Opportunities

Different payloads:

➔ SAP Enterprise Applications

➔ SAP Cloud native Applications (e.g. cloud foundry based)

Different maturity of OpenStack Projects

Multi hyper visor (KVM & VMware & bare metal) support in one L2 network

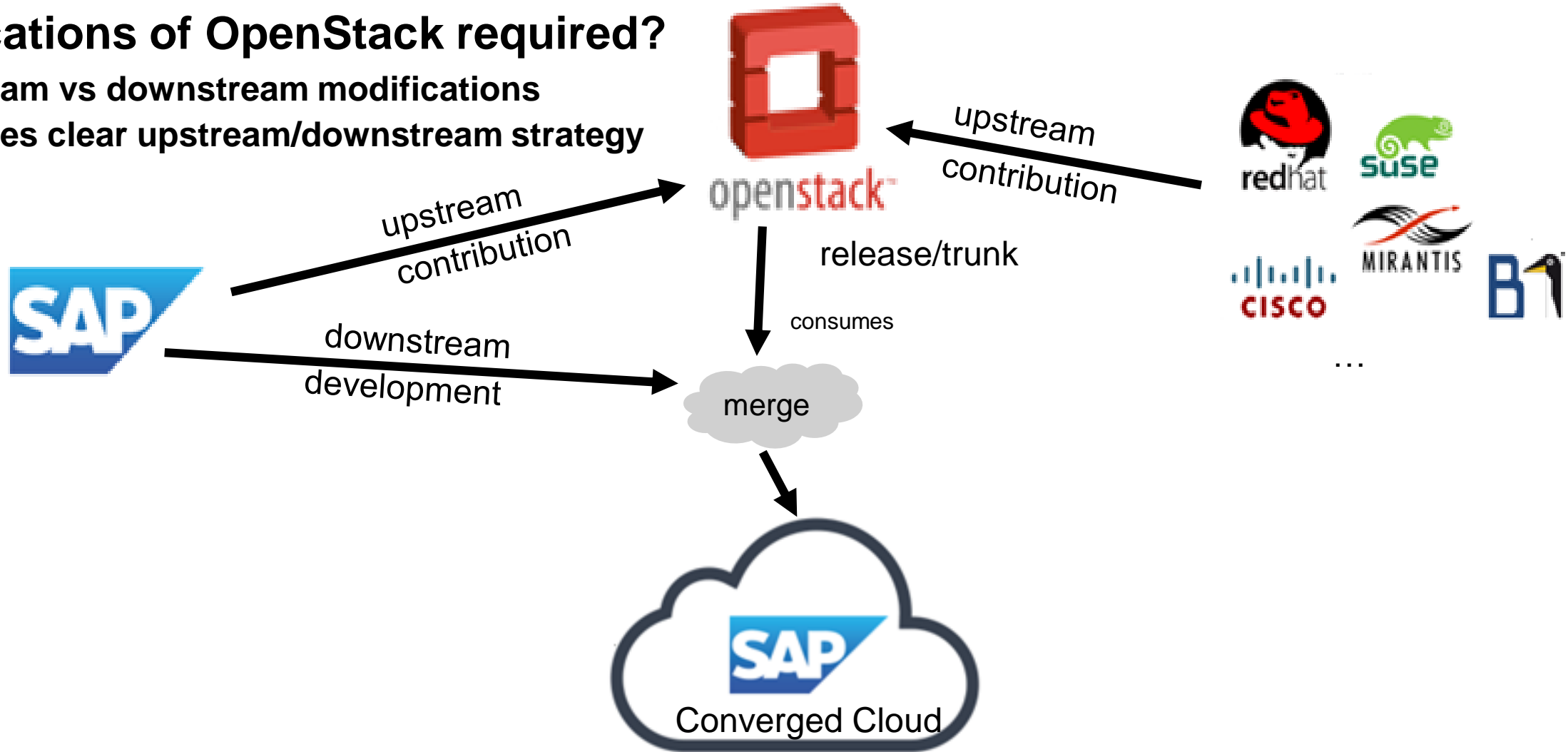➔ Vendor neutral Software Defined Network solutions?

Organization and Operations readiness

➔ History of Operations teams with VMware preferences

➔ "Cylinders of Excellence" style setup of Operations Organization

Agenda

➔ **SAP Figures**

➔ **Situation 2014**

➔ **OpenStack and SAP Converged Cloud as the „Holy Grail"**

➔ **Challenges & Opportunities through OpenStack**

➔ **Solution approach**

Recap: Challenges & Opportunities

Different payloads:

➔ SAP Enterprise Applications

➔ SAP Cloud native Applications (e.g. cloud foundry based)

Different maturity of OpenStack Projects

Multi hyper visor (KVM & VMware) support in one L2 network

➔ Vendor neutral Software Defined Network solutions?

Organization and Operations readiness

➔ Preference of Operations towards VMware

Solution Approach for:
Different payloads (Cloud Native vs Enterprise Applications)

OpenStack API's
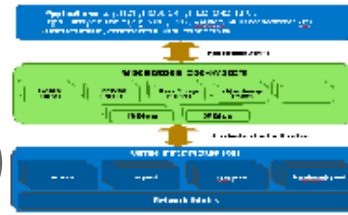
Why trunk and why a distro?

→ **Distro approach enables cloud native &
private cloud deployment support for HCP
IE use cases :**

Partner or even customer can use a defined distro to
deploy and operate infrastructure for HCP IE in non SAP
data center

→ **Trunk approach supports flexibility
required to support specifics for Enterprise
payloads like S4H, HEC**

Bare metal, VMware, NFSaas (Manila) etc. support
missing in existing Distros
SAP needs to influence Community by active
contributions and cooperation with partners to get SAP
requirements introduced to OpenStack

HCP IE: HANA Cloud Platform Industry Edition
HEC: HANA Enterprise Cloud
S4H: SAP Suite for HANA
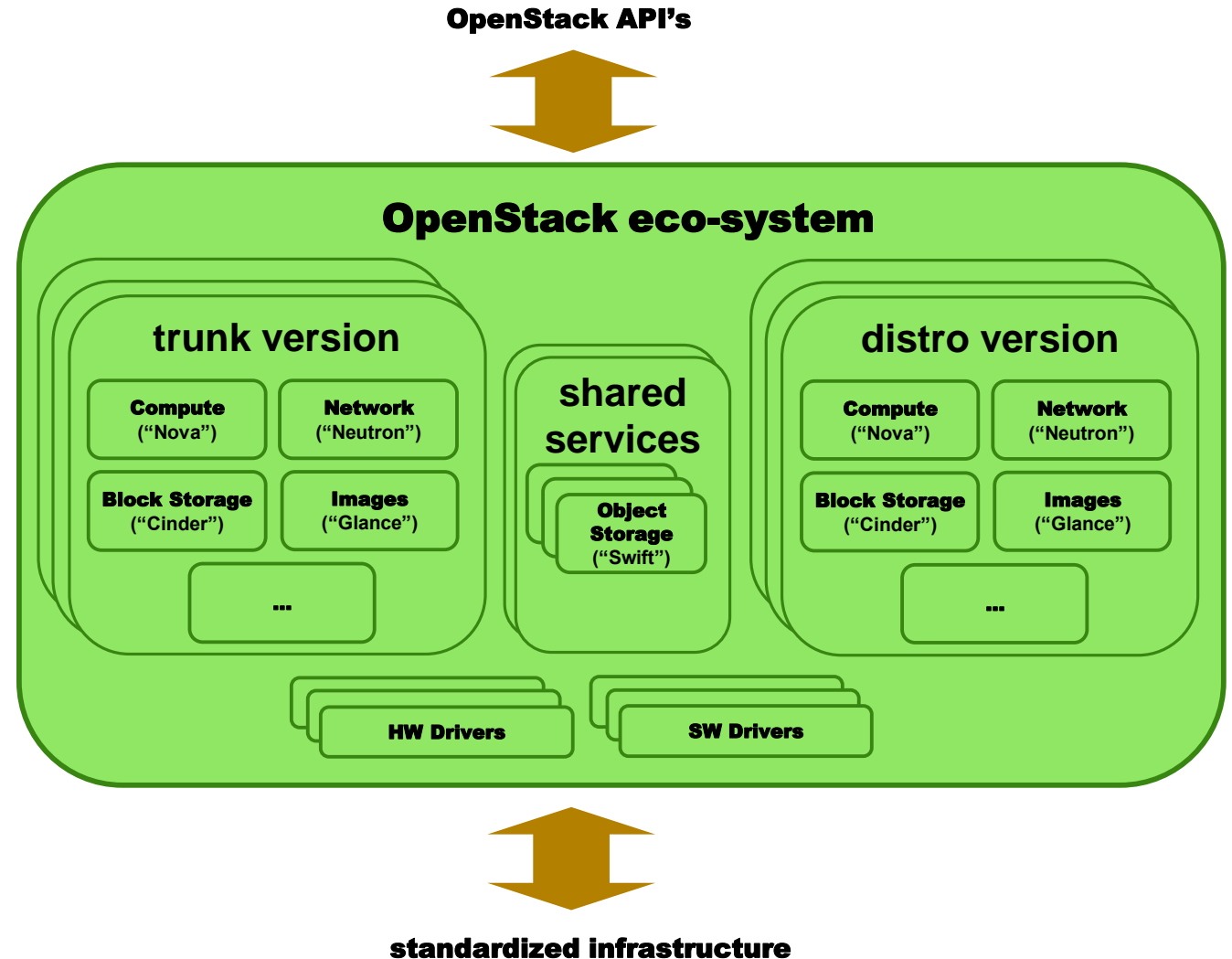
OpenStack eco-system

trunk version

| Compute ("Nova") | Network ("Neutron") |
| Block Storage ("Cinder") | Images ("Glance") |

...

shared services

Object Storage ("Swift")

distro version

| Compute ("Nova") | Network ("Neutron") |
| Block Storage ("Cinder") | Images ("Glance") |

...

HW Drivers   SW Drivers

standardized infrastructure

Recap: Challenges & Opportunities

Different payloads:
- ➜ SAP Enterprise Applications
- ➜ SAP Cloud native Applications (e.g. cloud foundry based)

Different maturity of OpenStack Projects

Multi hyper visor (KVM & VMware & bare metal) support in one L2 network
- ➜ Vendor neutral Software Defined Network solutions?

Organization and Operations readiness
- ➜ Preference of Operations towards VMware

Solution Approach for:
Different maturity of OpenStack Projects

modifications of OpenStack required?

➔ **Upstream vs downstream modifications**

➔ **Requires clear upstream/downstream strategy**

upstream contribution

upstream contribution

release/trunk

consumes

downstream development

merge

Converged Cloud

…

Upstream first

Upstream first

- The paradigm means any change for a open source project should be aligned with the community

- Feature implementation must follow the process and rely on the release cycle

- Effects:
  - Solutions must be vendor independent
  - Accepted changes are maintained by the community
  - Code will be supported by distros later on

Deliver in time

- Our stakeholders have tough timelines and therefore demanding our infrastructure features are delivered in time

- Some components are missing functionality

- Upstreaming takes time

- Does not mean downstream only (upstreaming can be decoupled but can be risky)

Downstream only → cumulates technical debt

Franken-Cloud

Business Requirements

downstream development

$$$

Technical Debt Can Make OpenStack Fail

$$

$

OpenStack Trunk

Liberty

Mitaka
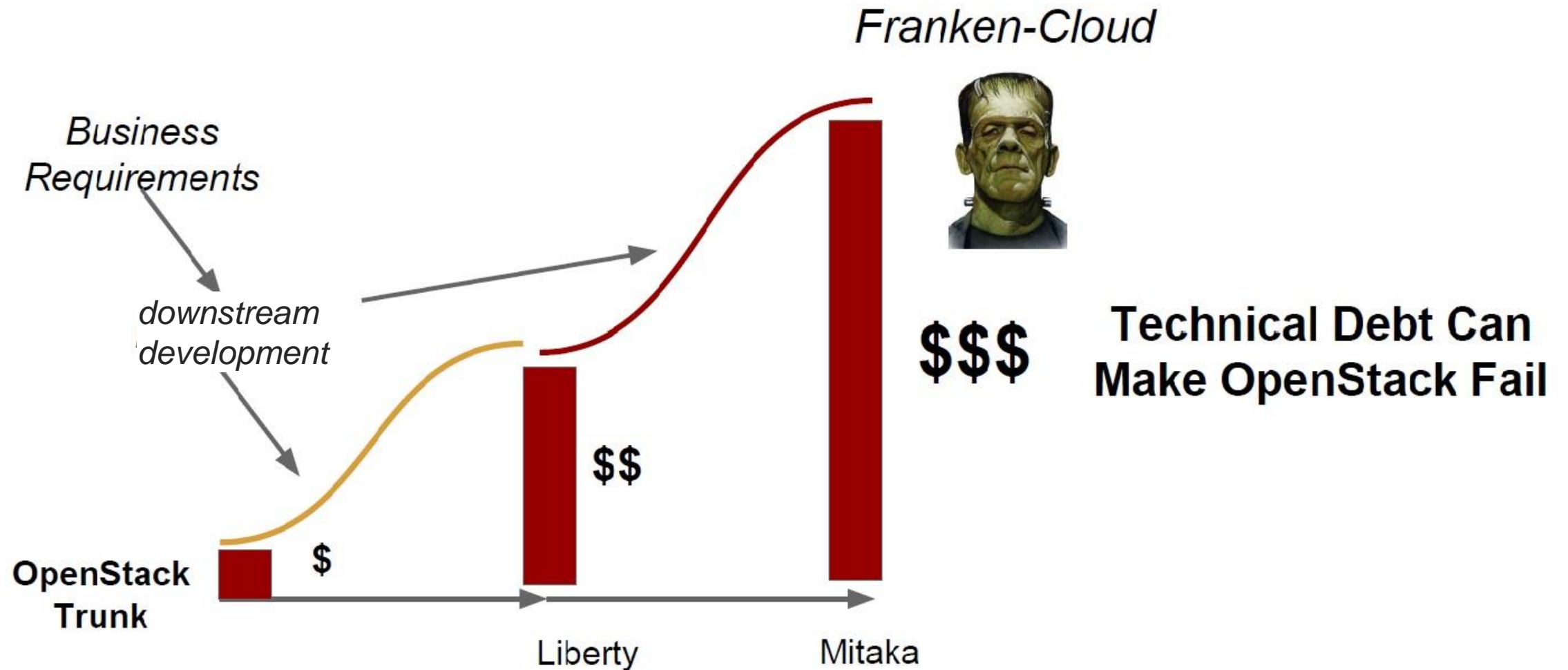
Upstream Development Impact

upstream development:

→ **pay down tech debt + innovate upstream OpenStack**
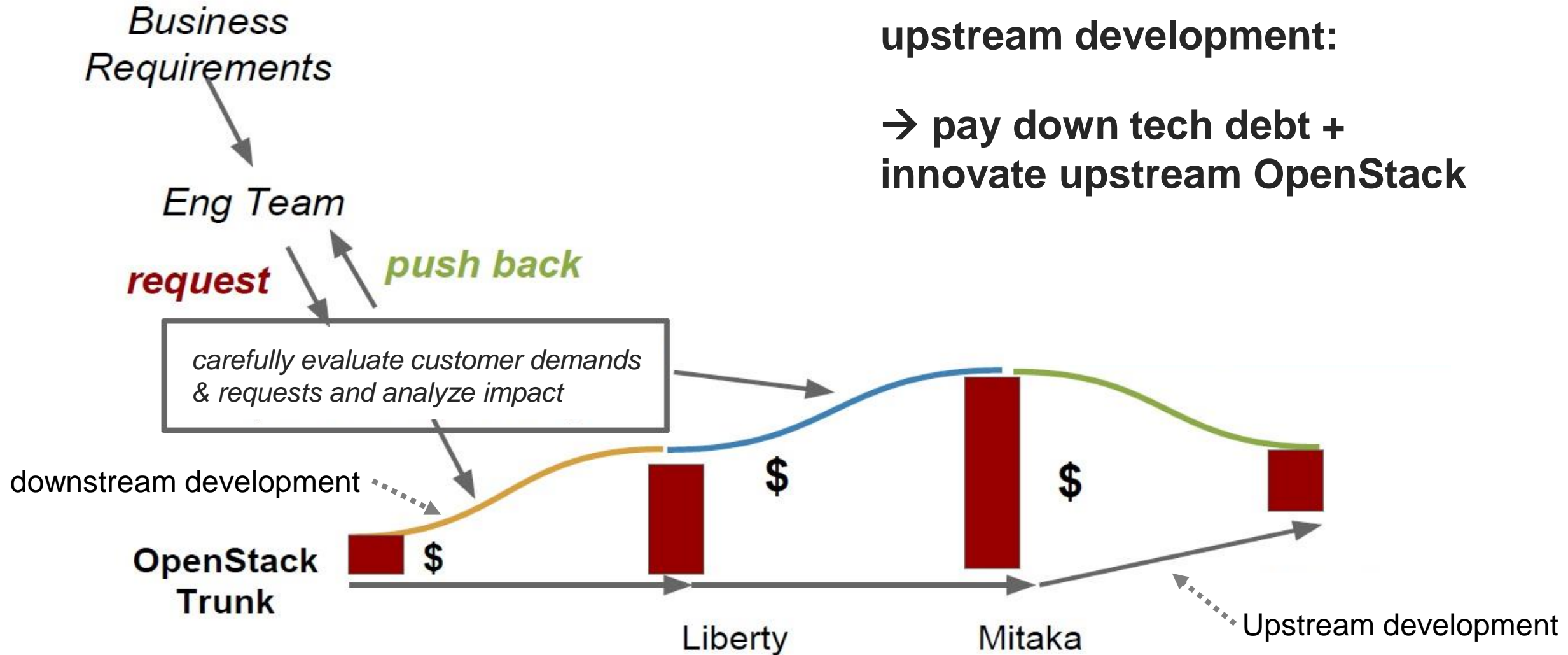
Upstream first vs Downstream first depends on Impact levels

A change can have the following impact levels:

1. **Impact level: high**
   - API change (= the API version will be increased)
   - DB schema changes (= DB migration need to be done)
   - RPC changes
   - core changes
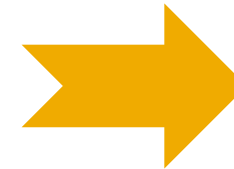
   ➤ Should be always upstream first

2. **Impact level: medium**
   - vendor driver change (not in core repository)
   - plugin change (an external hosted plugin)
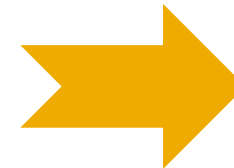
   ➤ Upstream first preferred
   Downstream possible

3. **Impact level: low**
   - An external module that uses OpenStack APIs only
   - A monitoring script
   - 3rd party integration that is SAP specific (like AD integration)
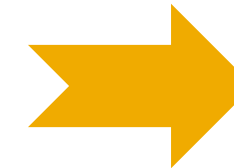
   ➤ Typically done downstream

The higher the impact level the higher the risk to be incompatible to vanilla OpenStack in case of downstream solution.

Recap: Challenges & Opportunities

Different payloads:

➔ SAP Enterprise Applications

➔ SAP Cloud native Applications (e.g. cloud foundry based)

Different maturity of OpenStack Projects

Multi hyper visor (KVM & VMware & bare metal) support in one L2 network

➔ Vendor neutral Software Defined Network solutions?

Organization and Operations readiness

➔ Preference of Operations towards VMware

Solution Approach for:
Multi hyper visor (KVM & Vmware & bare metal) support in one L2 network

Objective:

→ **avoid vendor lock in by vendor specific/proprietary Software Defined Storage solution**

Approach: Hierarchical Port Binding

http://specs.openstack.org/openstack/neutron-specs/specs/kilo/ml2-hierarchical-port-binding.html

Additional advantages:

→ **Eases the operations model transition**

- → from network, storage & compute silos to interdisciplinary cloud admins
- → end devices do still speak vLAN while 4k vLAN deadlock/limitation in network fabric is eliminated
- → Allows separation of data and control plane

Recap: Challenges & Opportunities

Different payloads:

➔ SAP Enterprise Applications

➔ SAP Cloud native Applications (e.g. cloud foundry based)

Different maturity of OpenStack Projects

Multi hyper visor (KVM & VMware & bare metal) support in one L2 network

➔ Vendor neutral Software Defined Network solutions?

Organization and Operations readiness

➔ Preference of Operations towards VMware

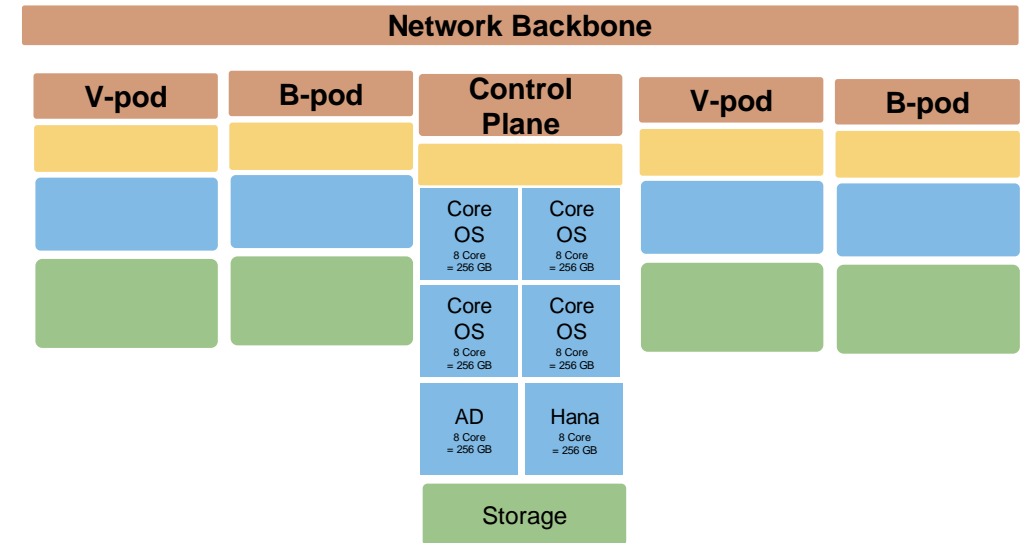# Approach to address Operations Challenges (1/3)

Pre-manufactured Pods

- Well defined BOM and procedure for pre-manufactured hardware commissioning (Pods)
- Addresses: time to delivery and quality in build-up

Clearly separate control and data planes

- Independent SLOs & Scalability
- Existing model to operate vendor gear and hypervisors (data path)

Run openstack as pure control plane

- Automatic, self healing, self supervising, immutable system (control)
- Target: Very limited extra operations

Network Backbone

| V-pod | B-pod | Control Plane | V-pod | B-pod |

Core OS 8 Core = 256 GB
Core OS 8 Core = 256 GB
Core OS 8 Core = 256 GB
Core OS 8 Core = 256 GB
AD 8 Core = 256 GB
Hana 8 Core = 256 GB
Storage

L3 networking
L2 networking
storage   compute
control plance (openstack services)
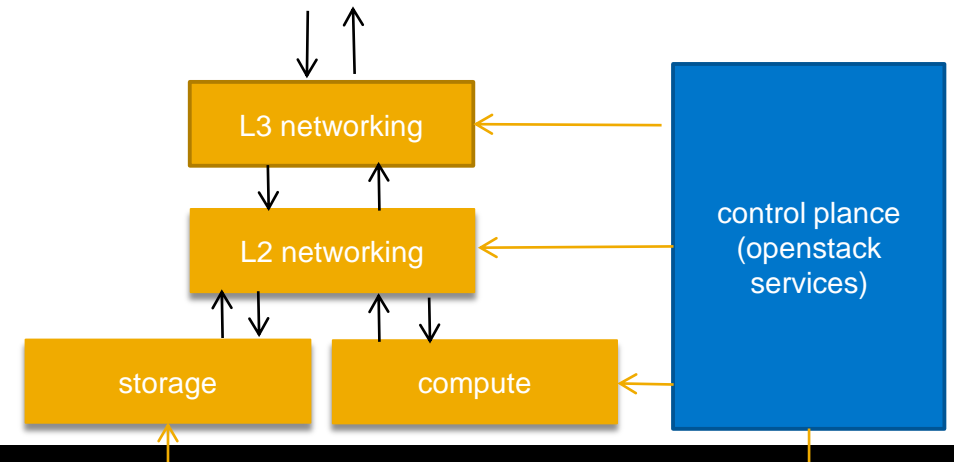
Approach to address Operations Challenges (2/3): Containerized OpenStack on Kubernetes

- Everything containerized on Kubernetes

- Constant releases with low touch operations.

  - OS patching via CoreOS auto-update.

- No downtime in data path due upgrades on OpenStack.

- Automatic, Self-healing, Consistent and Immutable.

- Scales non linearly across multiple regions – do once, repeat
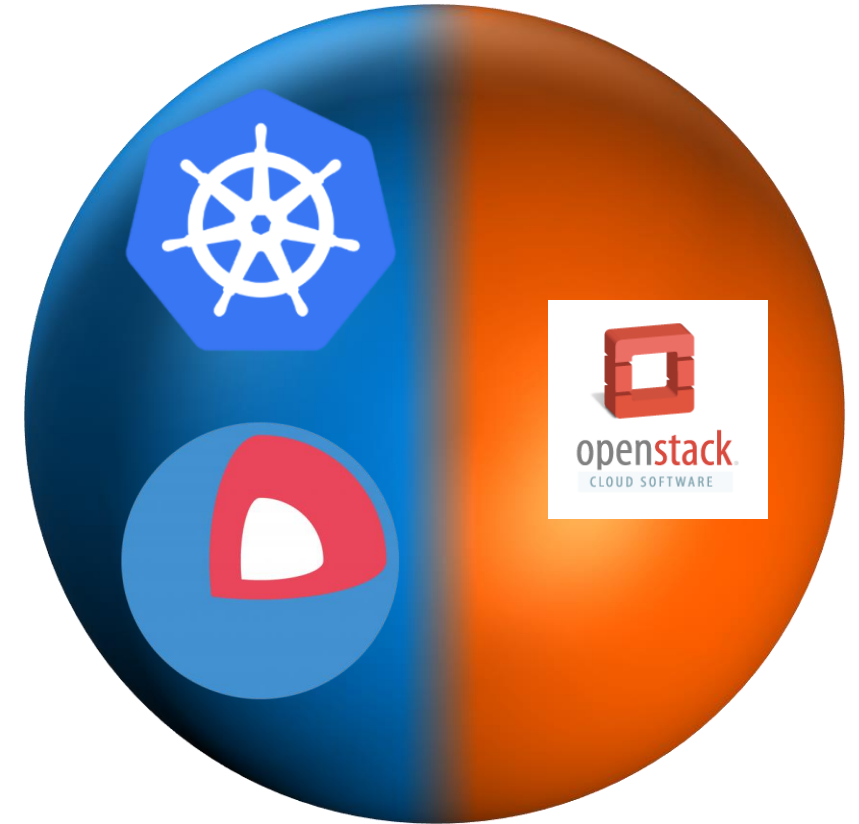
# Approach to address Operations Challenges (3/3): Embedded Analytics

- Self contained monitoring and analytics per region for control plane

- Automatic: traditional ops "key action" is replacing/patching/adding hardware and vendor gear, the rest is automatic. (not yet, but step by step)

→ Kubernetes /healthz for OpenStack

→ Prometheus middleware for OpenStack

→ Sentry middleware for OpenStack

→ Monasca, alerting and logging for OpenStack and Prometheus.

→ SAP Hana for pay per use & long term analytics.

Prometheus — An open-source service monitoring system and time series database.

Sentry

openstack   Monasca

SAP
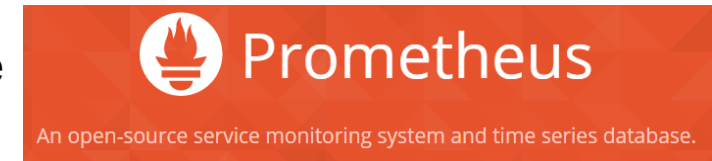
Embedded Analytics
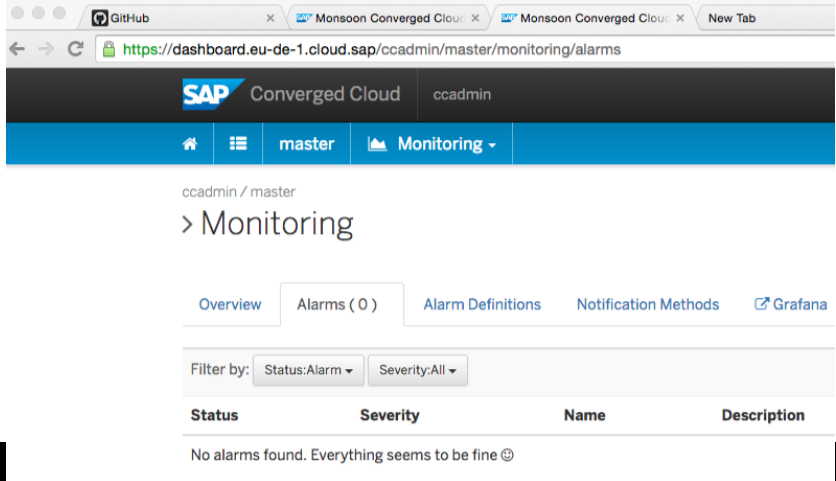# Metric everything, Error reporting, Alerting

API Availability & uptime
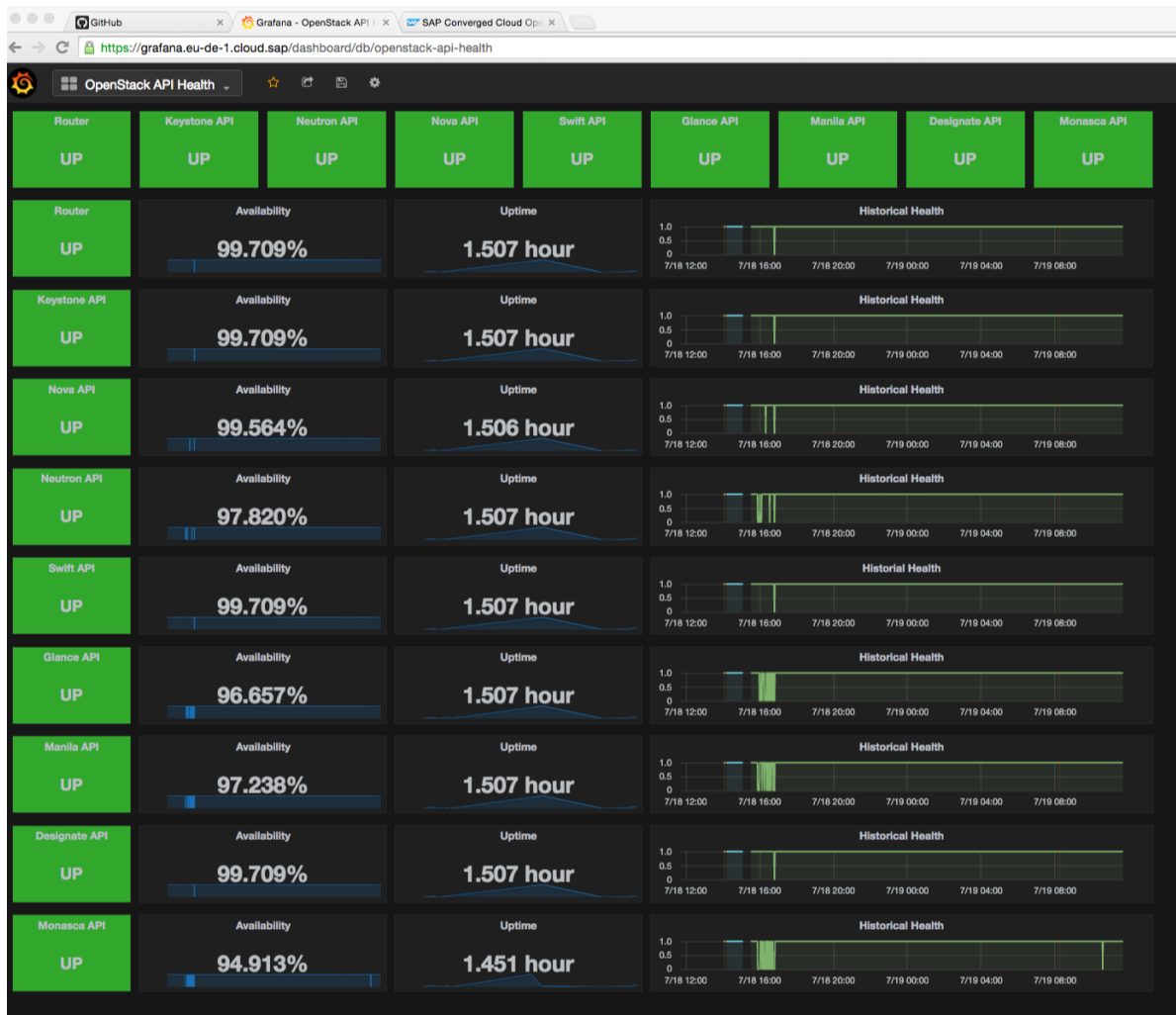
Error reporting
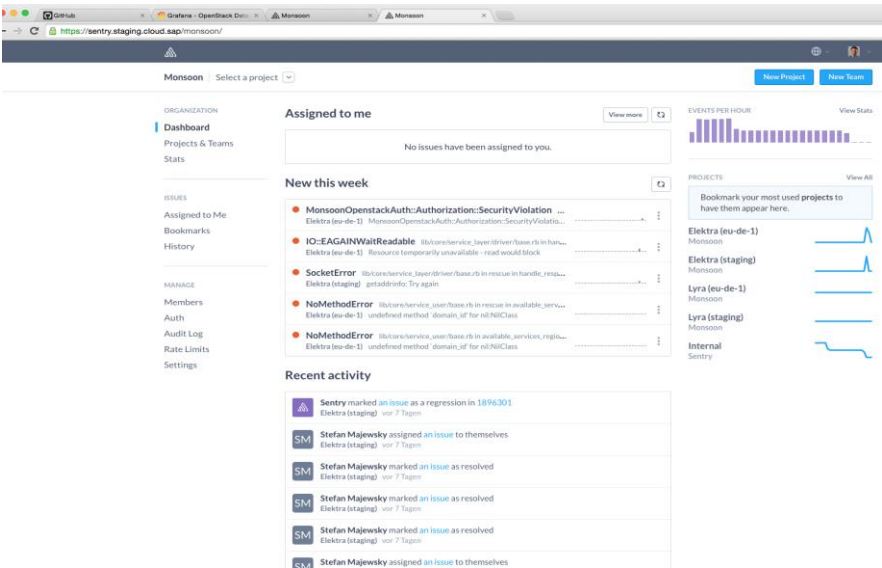
Alert Management as a Service

Recommended reads

Running and building an IaaS is not only a technical challenge

It is also a cultural and conceptual one
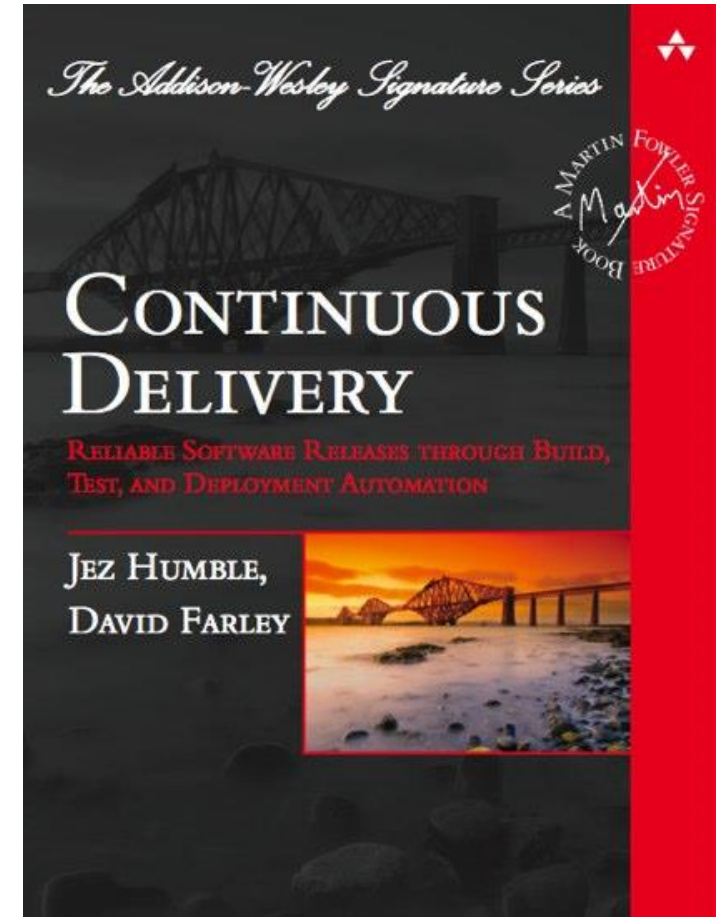
Learning the patterns people out there use… is a important

Vision & Cultural Change – "we are all developers"

New on boards to Team → Read the book
- <u>Automate everything</u>, especially testing & deployment
- <u>Version control everything</u>

**Get it in action**
- Provide trust
- Provide cover

Vision & Cultural Change – "we are all operators"

New on boards to Team → Read the book

"Google's SREs have done our industry an enormous service by writing up the principles and patterns – architectural and cultural – that enable their teams to combine continuous delivery with world-class reliability at ludicrous scale. You owe it to yourself and your organization to read this book and try out these ideas for yourself"

- Jez Humble, author of "Continuous Delivery"

Site Reliability Engineering

HOW GOOGLE RUNS PRODUCTION SYSTEMS
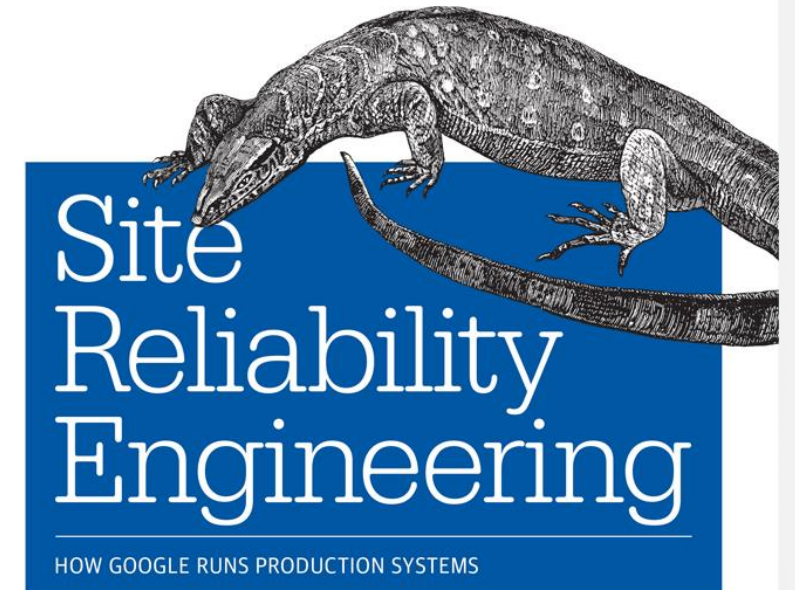
Edited by Betsy Beyer, Chris Jones,
Jennifer Petoff & Niall Murphy

Key Takeaways

Key Takeaways

➔ **Vendor Neutrality through OpenStack**

➔ **Trunk and Distro approach are valid approaches, depending on the use case**

➔ **No way around collaboration with and contribution to the community**

➔ **Clear up- & downstream strategy required**

➔ **From Silo Admins/Operators to Cloud Admins/Operators**

➔ **From internal development to community development**

Thank you for your time and attention…

Q&A

Thank You!