StarlingX Project Overview

Learn, Try, Get Involved!

Let Me Introduce StarlingX

- Top-level Open Infrastructure Foundation project
- Software stack providing critical infrastructure and management services for distributed cloud applications
- Frequent releases
  - https://opendev.org/starlingx
  - https://mirror.starlingx.windriver.com/mirror/starlingx/release/
- Growing community
  - Inviting users, operators and developers to try out the software and participate in the community

Project Overview

What Is Driving Edge Computing?

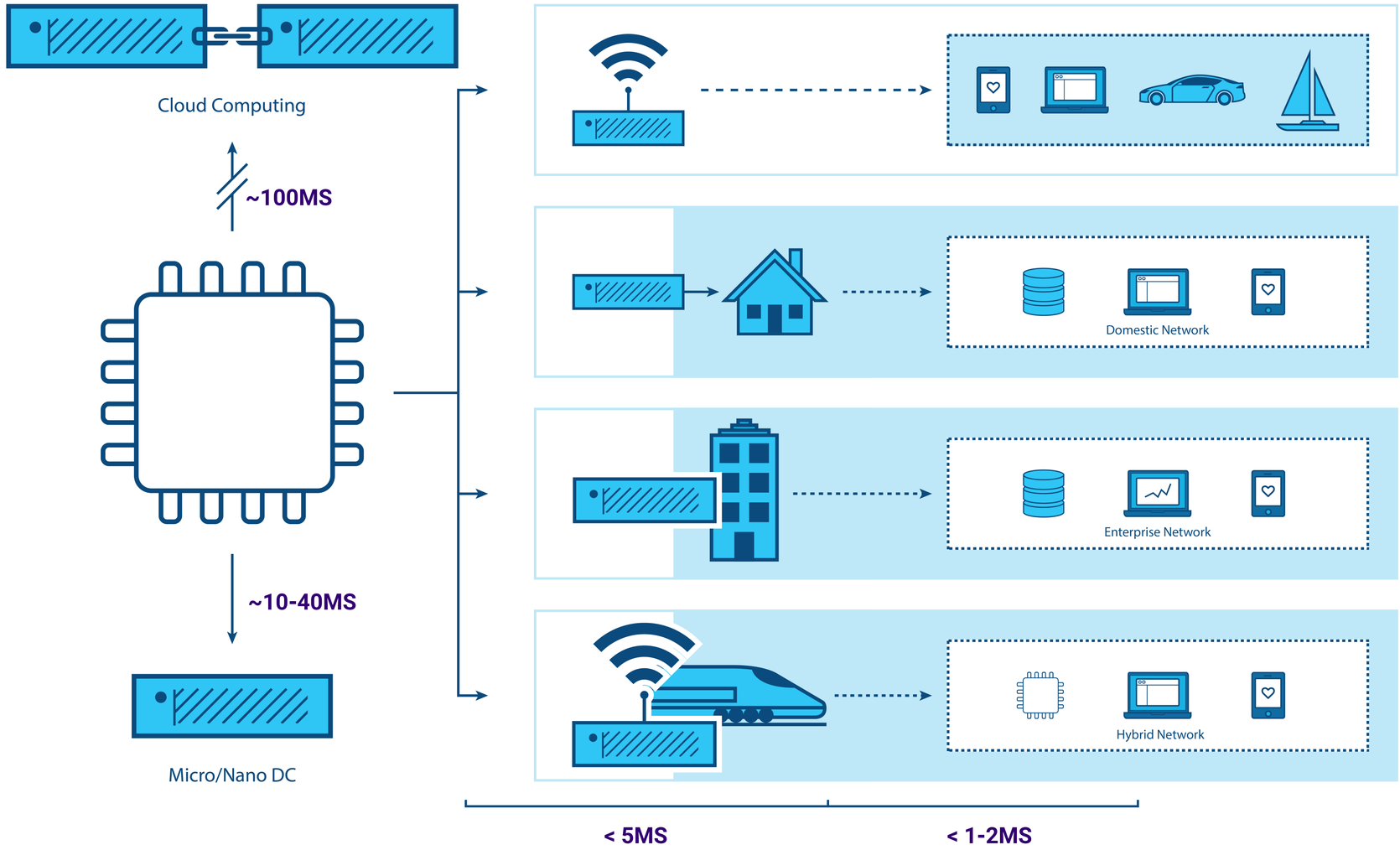
A. Latency

B. Bandwidth

C. Security

D. Connectivity

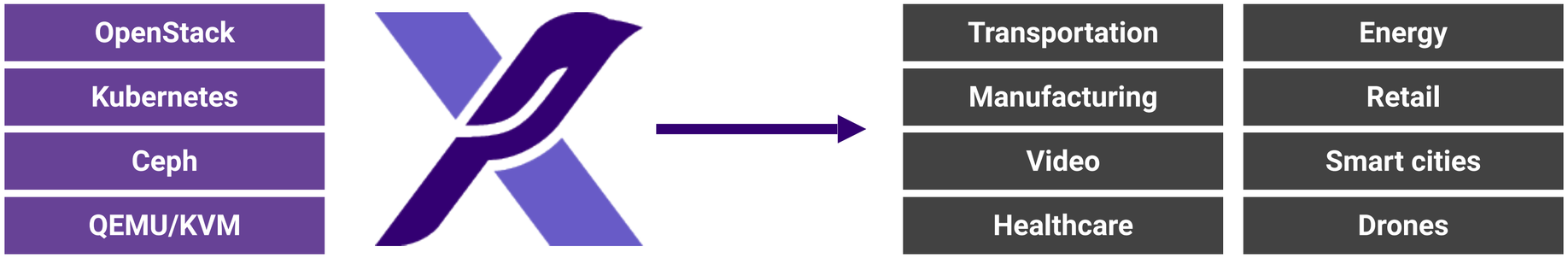
“WHERE” MATTERS



Use Case Frontiers

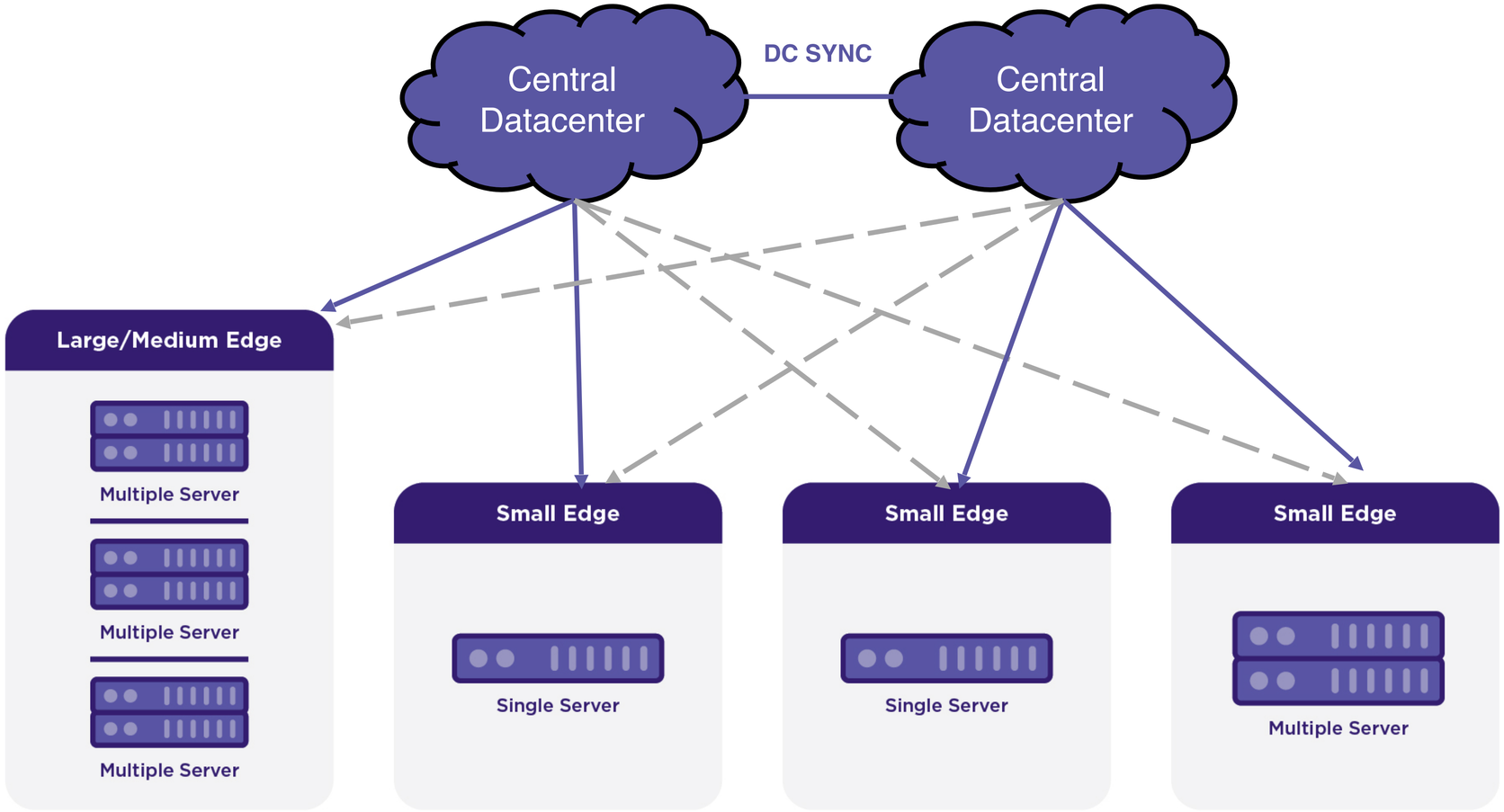
Re-Configure Proven Cloud Technologies for Distributed Compute

- Orchestrate system-wide
  - Deploy and manage remote clouds, share configurations
- Simplify deployment to geographically dispersed, remote regions



Scaling from Core to Edge

- Geographically distributed multi-region deployment,
- Geo-Redundant Central Datacenters,
- Central Datacenter providing Orchestration and Synchronization Services,
- Geographically distributed remote sites of various sizes



StarlingX Use Case Examples

- On-premises clouds for
  - Industrial Automation
  - Hospitals
  - Transportation and Rail
- Central Office clouds for
  - Open RAN & vRAN
  - Local data centers
  - uCPE
  - Multi-Access Edge Computing (MEC)
- IIoT and VCS (Vehicle Cloud Services) clouds for
  - Smart cities
  - Autonomous vehicles with V2X (Vehicle-to-Any) communication models

StarlingX Technology

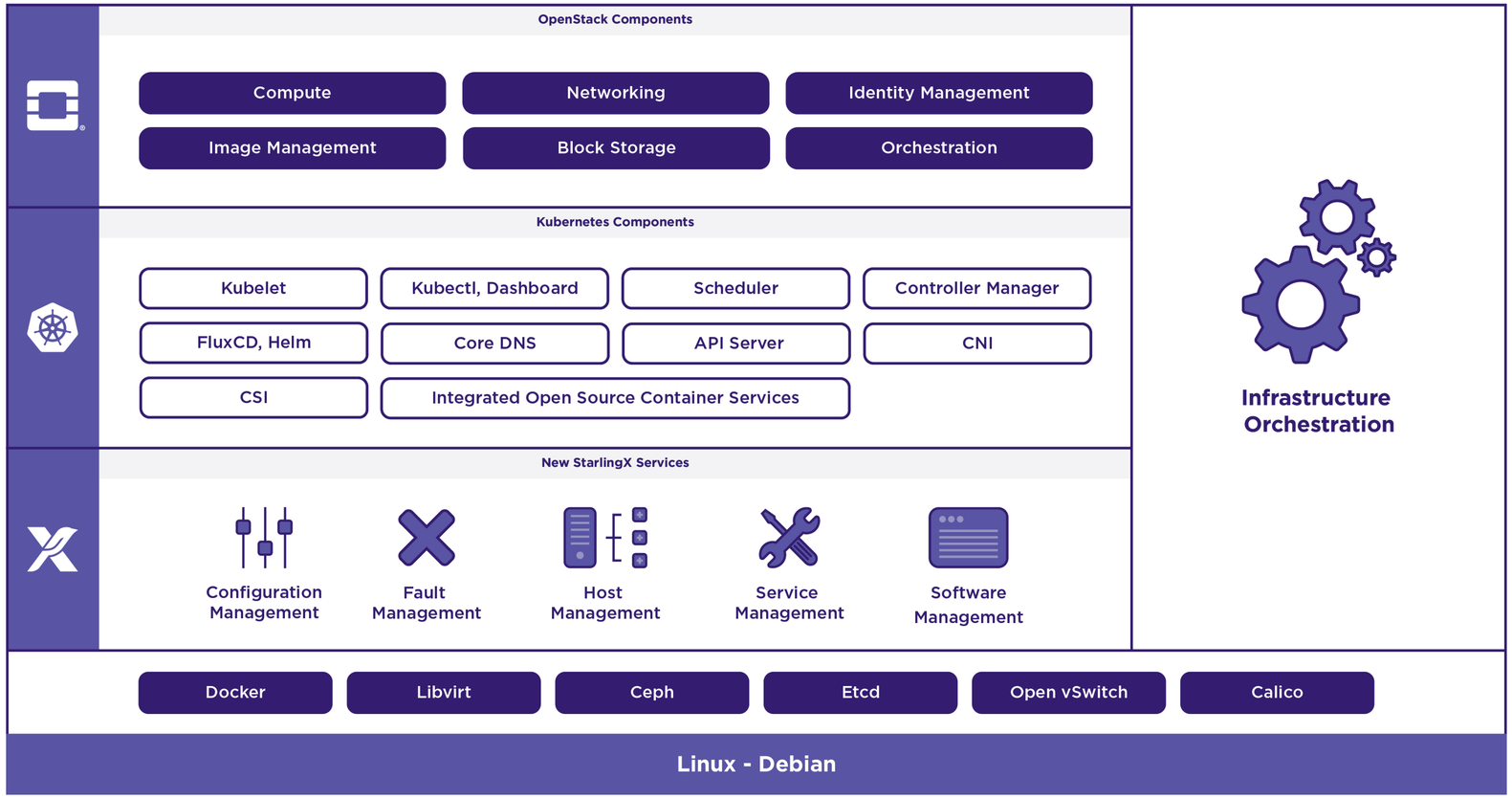
StarlingX – Edge Virtualization Platform

StarlingX provides a **deployment-ready**, **scalable**, **highly reliable** Edge infrastructure software platform

Services from the StarlingX virtualization platform focus on

- **Easy deployment**
- **Low touch manageability**
- **Rapid response to events**
- **Fast recovery**

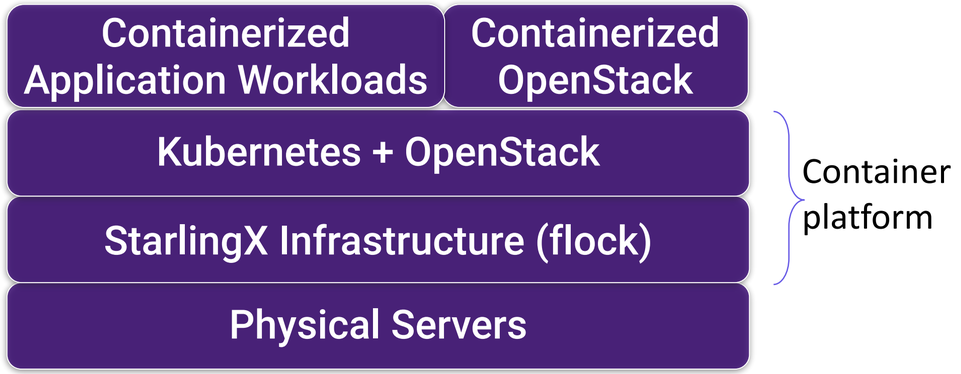
A complete edge orchestration platform for bare metal, VM and container workloads



There are more OpenStack and Kubernetes components used than represented in this diagram.

StarlingX Evolution

- A hardened cloud-native platform integrating OpenStack and Kubernetes on dedicated physical servers
- Containerized OpenStack services based on the latest release
- Closely aligned with the current OpenStack code base
  - The StarlingX and OpenStack communities are working together on Edge related enhancements
- Kubernetes-based edge sites for containerized workloads



StarlingX Distributed Cloud Platform

Infrastructure Orchestration

Hosted Container Workloads

Container | Container | Container

Containerized OpenStack for VM Workloads

openstack. | KVM

Kubernetes | Docker Registry | FluxCD | Helm

Distributed Edge Cloud

Host Management

Fault Management

Software Management

Configuration Management

Service Management

IPMI Redfish | HTTP HTTPS | Apache | Horizon | CEPH | Keystone | ETCD | Docker | Calico | PostgreSQL

Standard or Low Latency Linux - Debian

StarlingX – Deployment Models

- Scalable deployment models
  - Standalone clouds support up to 200 k8s workers
  - Distributed cloud configuration supports up to 1,000 sub-clouds
    - Each sub-cloud supports up to 200 k8s workers

- Minimize infrastructure footprint / overhead
  - Standard (Controllers + Workers) Configuration
    - Support 2-server controller/master solution
    - On worker nodes, only 1 core required for StarlingX platform services
  - All-In-One (AIO) Configurations (i.e. AIO-Simplex and AIO-Duplex)
    - AIO servers require only 2 cores to run StarlingX platform services

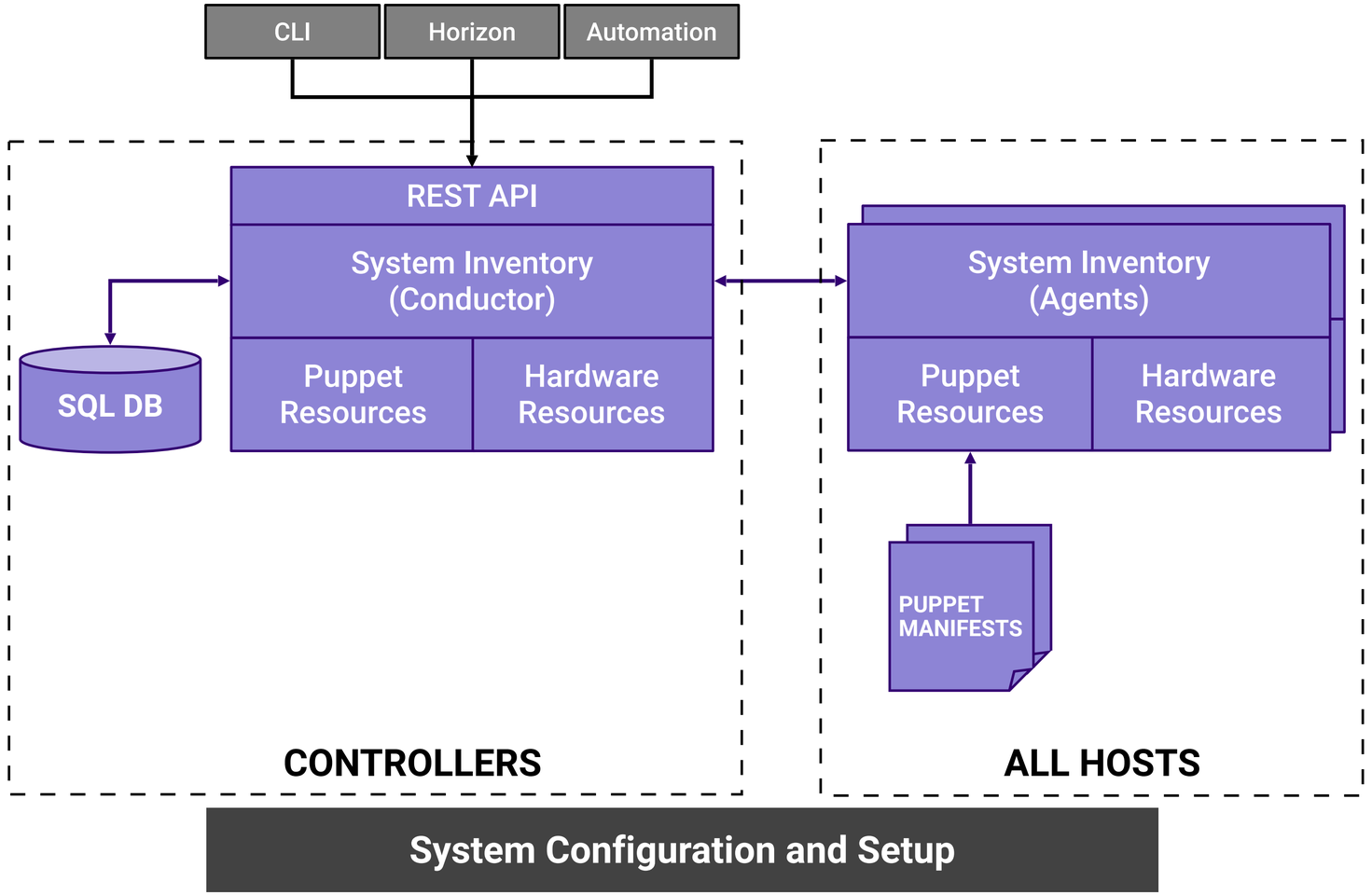
- Storage
  - Integrated CEPH for one & two node solutions
  - Co-located CEPH on master nodes for small frame level deployments
  - Dedicated CEPH storage nodes for larger configurations

STARLINGX

Infrastructure Management
“The Flock”

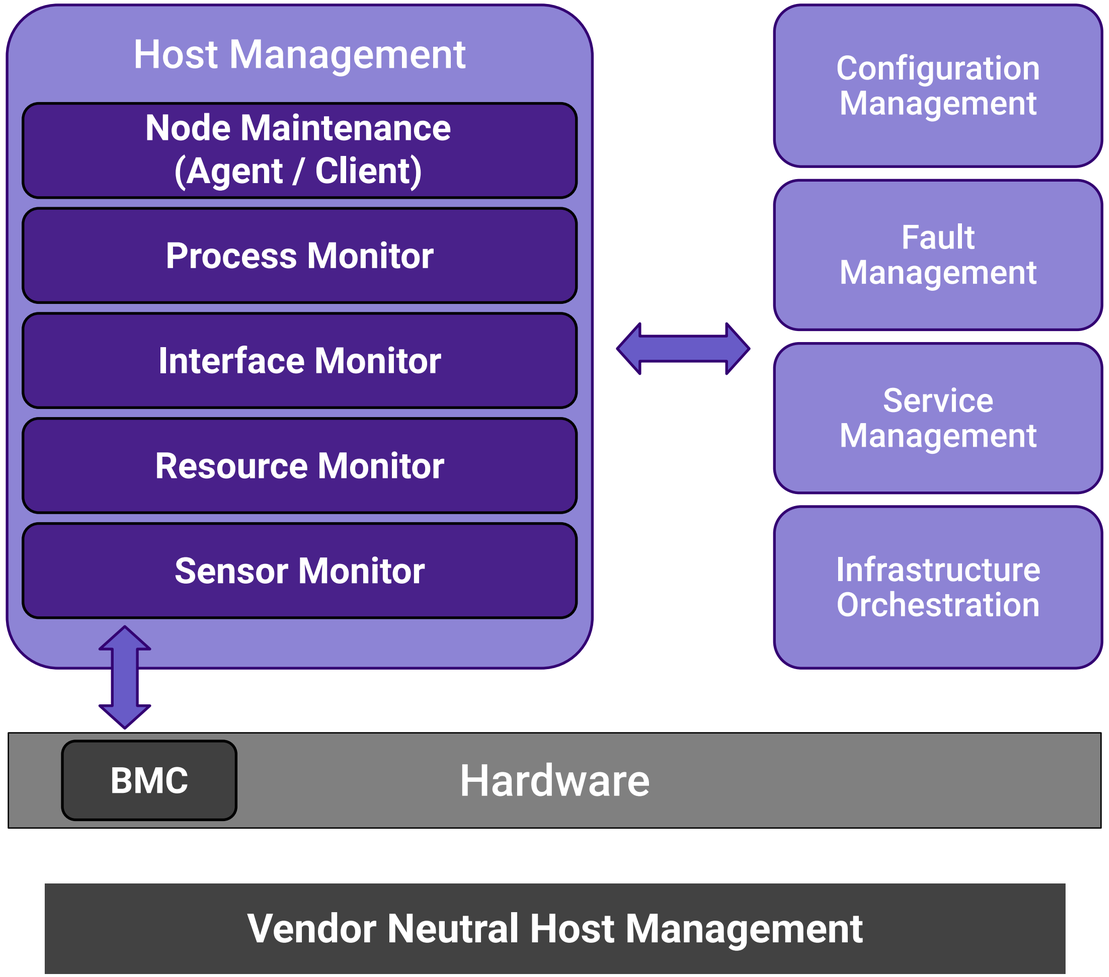
Configuration Management

- Manages installation
  - Auto-discover new nodes
  - Manage installation parameters (i.e. console, root disks)
  - Bulk provisioning of nodes through XML file
- Nodal Configuration
  - Node role, role profiles
  - Core, memory (including huge page) assignments
  - Network Interfaces and storage assignments
- Inventory Discovery
  - CPU/cores, SMT, processors, memory, huge pages
  - Storage, ports
  - GPUs, storage, Crypto/compression H/W



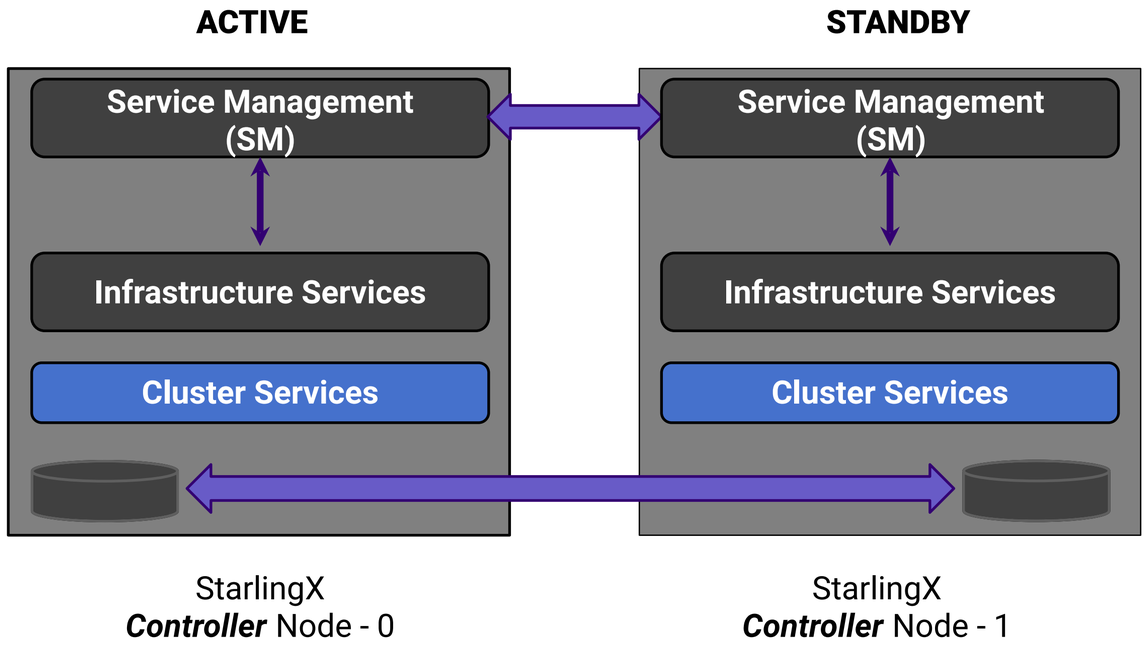
Host Management

- Full life-cycle management of the host
- Detects and automatically handles host failures and initiates recovery
- Monitoring and fault reporting for
  - Cluster connectivity, critical process failures
  - Resource utilization thresholds, interface states
  - H/W fault / sensors, host watchdog
  - Activity progress reporting
- Interfaces with board management (BMC)
  - For out of band reset
  - Power-on/off
  - H/W sensor monitoring



Service Management

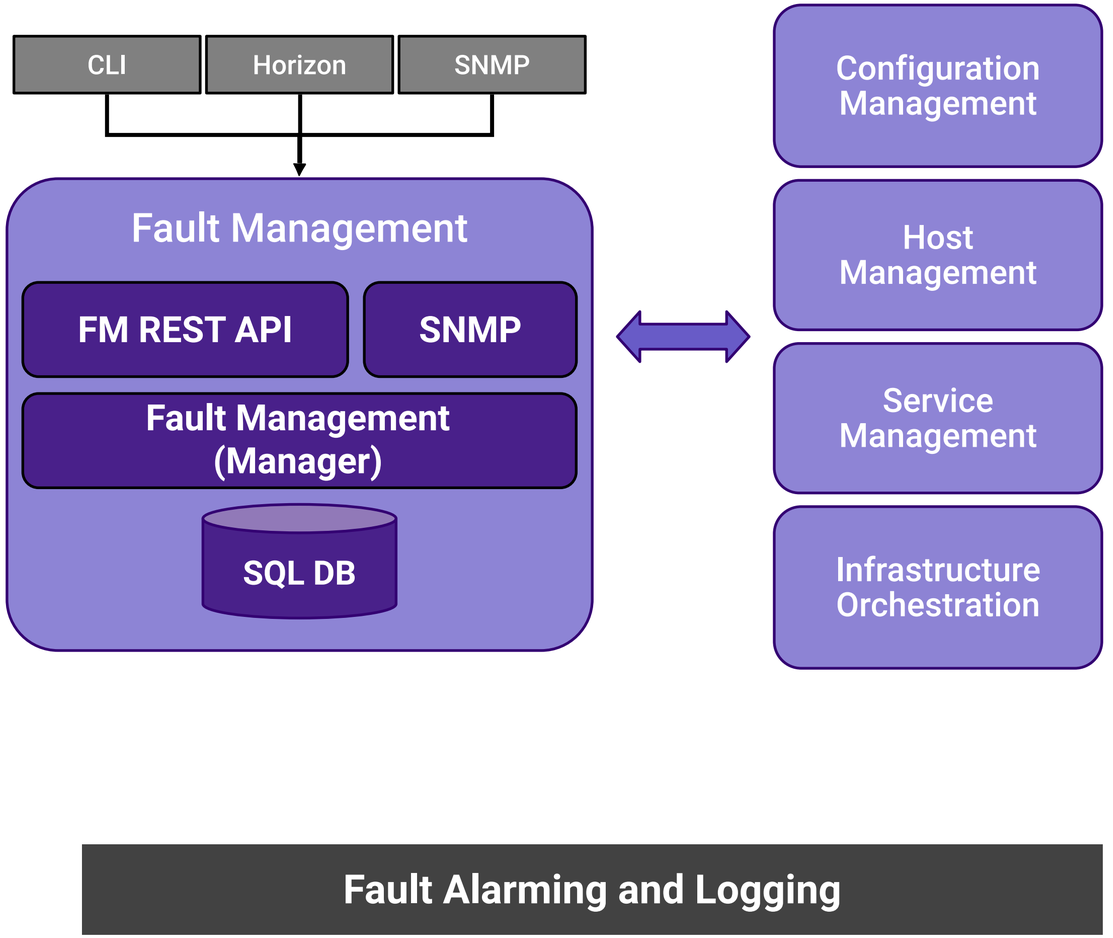
- High availability manager
  - Redundancy model can be N+M or N across multiple nodes
  - Currently 1+1 HA Controller Cluster
- Uses multiple messaging paths to avoid split-brain communication failures
  - Up to 3 independent communication paths
  - LAG can also be configured for multi-link protection of each path
  - Messages are authenticated using HMAC SHA-512 if configured / enabled on an interface-by-interface basis
- Active or passive monitoring of services
- Allows for specifying the impact of a service failure



High Availability for Critical Infrastructure

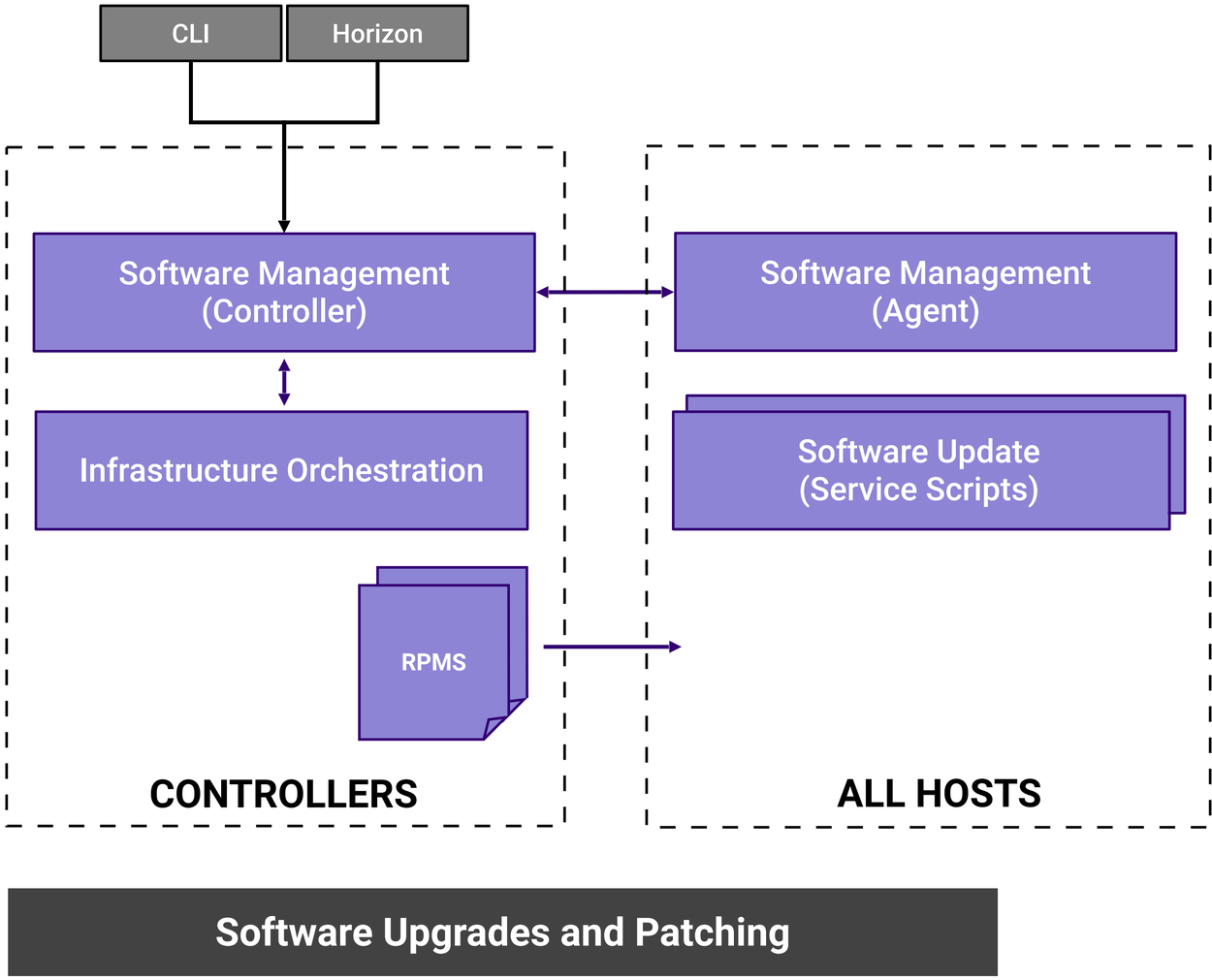
Fault Management

- Framework for infrastructure services via API
  - Set, clear and query customer alarms
  - Generate customer logs for significant events
- Maintains an Active Alarm List
- Provides REST API to query alarms and events
- Support for alarm suppression
- Operator alarms
  - On platform nodes and resources
  - On hosted virtual resources
- Operator logs - Event List
  - Logging of set/clear of alarms
  - Related to platform nodes and resources
  - Related to hosted virtual resources



Software Management - in progress

- Automated deploy of software updates for security and/or new functionality
- Integrated end-to-end rolling upgrade solution
  - Automated, low number of steps
  - No additional hardware required for upgrade
  - Rolling upgrade across nodes
- In-service and reboot required patches supported
  - Reboot required for kernel replacement etc.
  - VM live migration is used for patches that require reboot
- Manages upgrades of all software
  - Host OS changes
  - New / upgraded StarlingX service software
  - New / upgraded OpenStack software



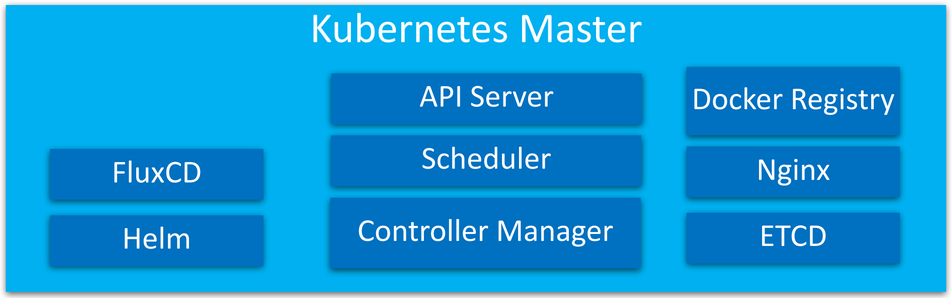
STARLINGX

Container Platform

Kubernetes Cluster Software Components

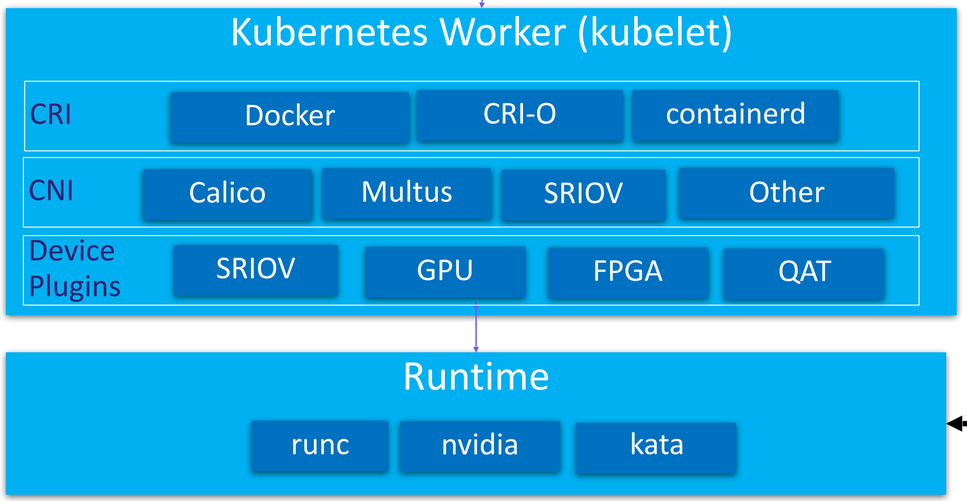
STARLINGX

Control Plane



- Full infrastructure and cluster orchestration
- Security and Policy

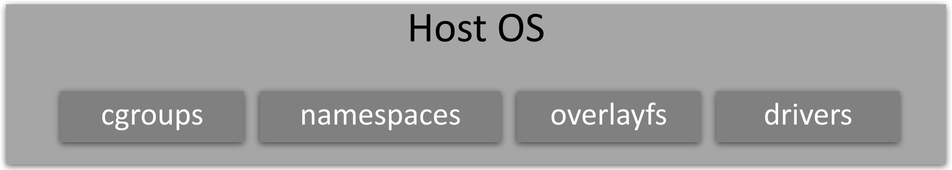
Worker Nodes



Application Containers

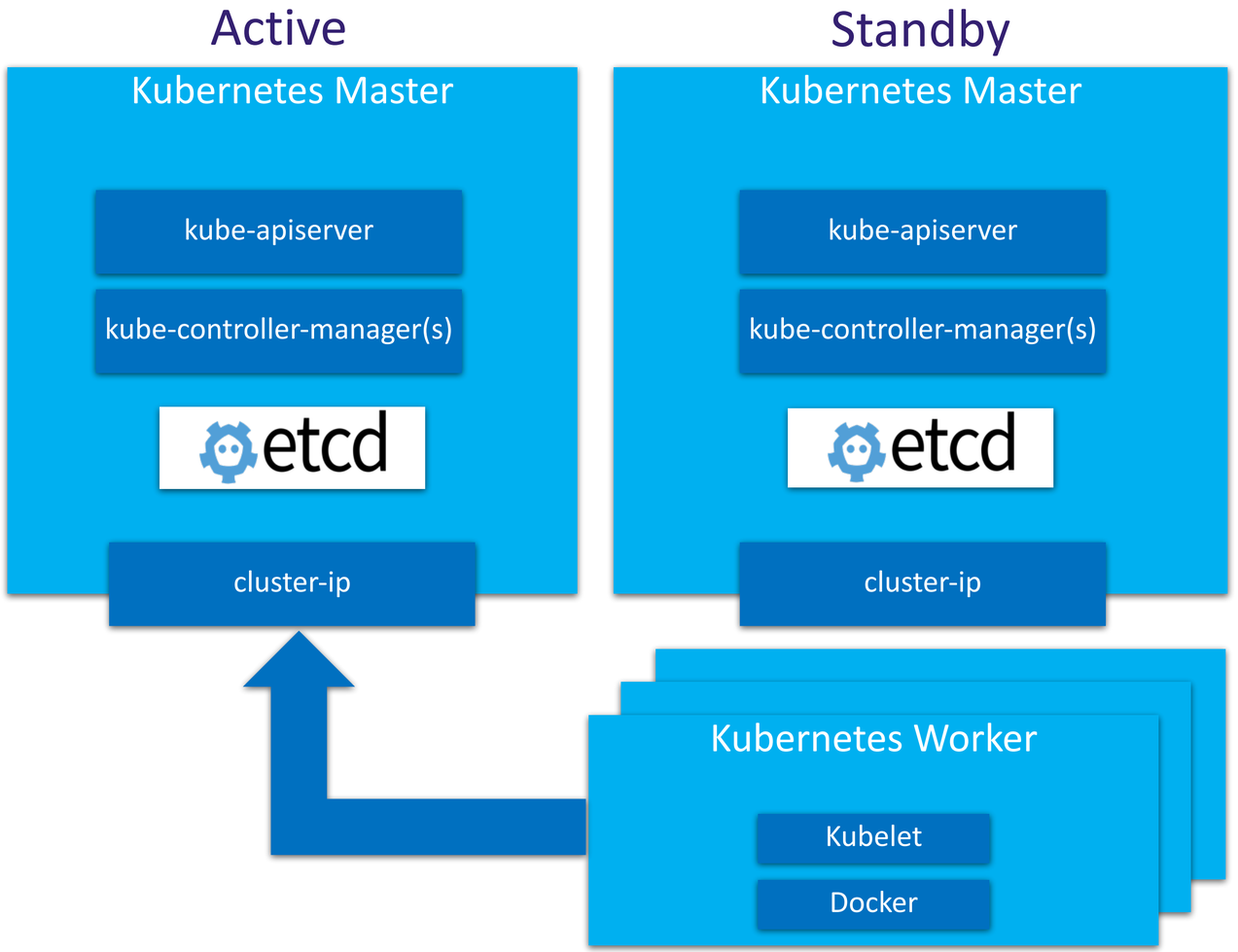
- Flexible ecosystem of base OS
- Evolution to other container runtimes
- Kernel and Accelerated networking

Host Abstraction



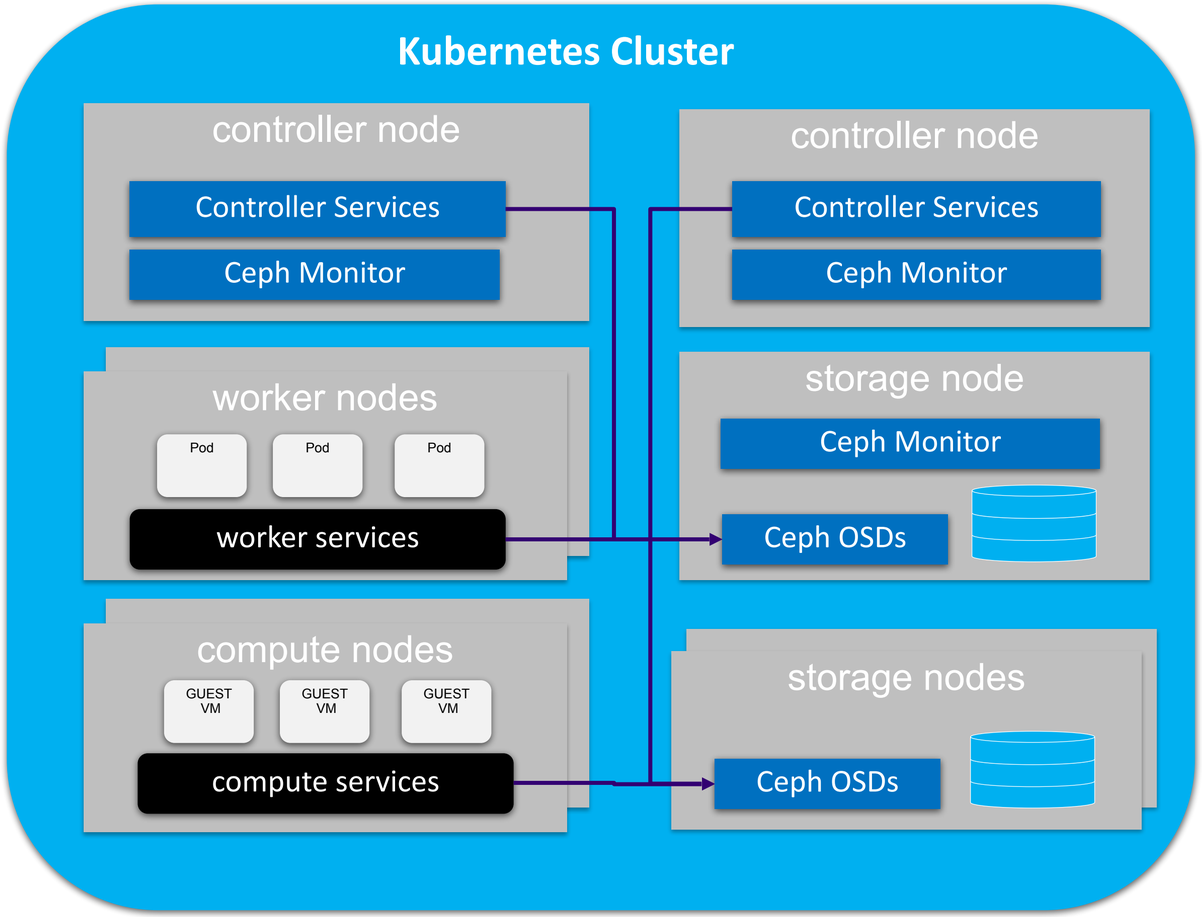
Kubernetes Deployment Architecture

- Kubernetes deployed in a highly available configuration
  - Deployed in a 1:1 service model
  - All-in-One Simplex/Duplex deployments supported using same service management
- Requests directed to active instances via cluster floating IP address
- DRBD backed file system for redundant persistent storage
- Service availability and activity managed by Service Management (SM)
  - Handles HA sparing of individual services
  - Actively monitors host, service and network availability
  - Mitigates split-brain scenarios



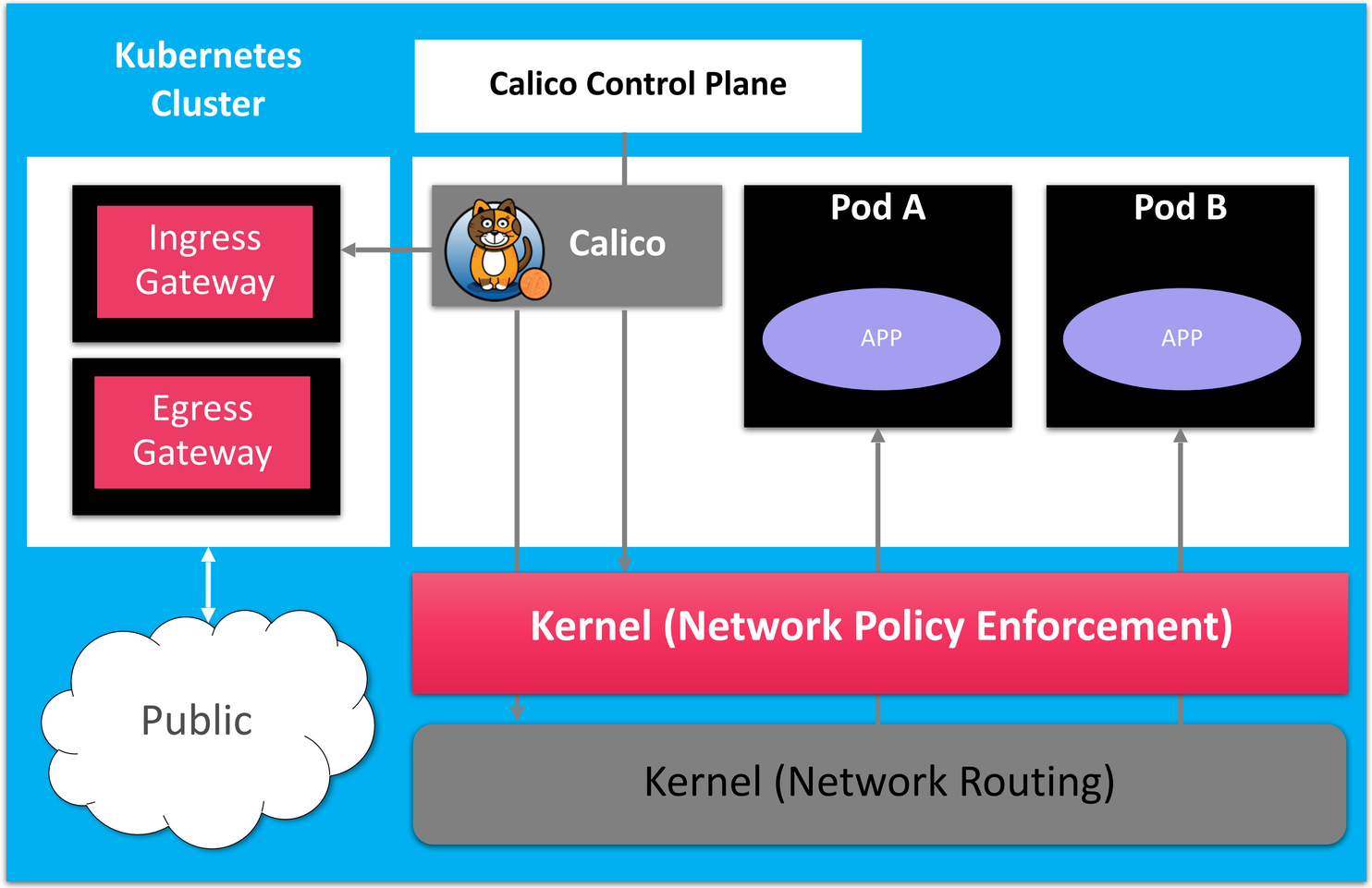
Cluster Persistent Storage

- Ceph uniquely delivers object, block, and file storage in one unified system
- Highly scalable and highly available deployment with distributed Ceph monitors and Object Storage Devices (OSD) for data replication
  - Automatic cluster storage deployment and replication
  - Unified storage solution for all deployments: AIO-SX/DX, Standard, Multi-cloud
  - Fully managed Ceph Cluster Map (hyper-scale)
- Kubernetes persistent storage provided by Ceph's RADOS Block Devices (RBD) provisioner
  - Persistent Volumes (PVs) and Claims (PVCs)
  - Default Storage Class
- Support for Rook to add additional storage backend options
- OpenStack backend storage solution for services: Glance, Cinder, Swift, Nova



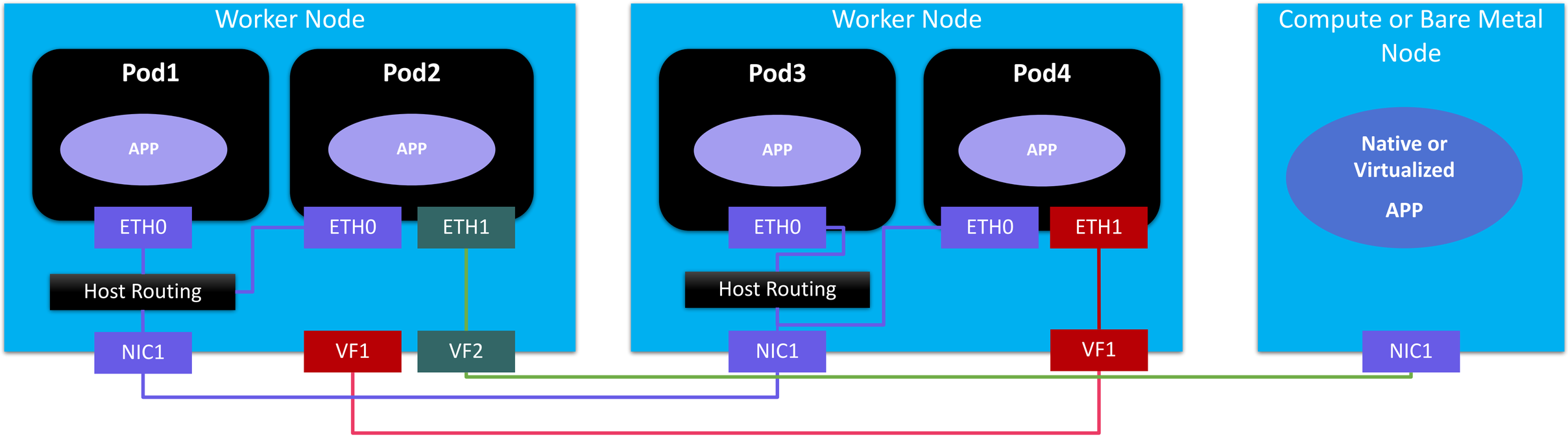
Kubernetes Cluster Networking

- Calico provides a pure L3 fabric solution for interconnecting containers
- Calico leverages the Linux kernel for routing and policy enforcement
- Calico leverages Border Gateway Protocol (BGP) for control plane
- Calico leverages Open Standards and is a full Open Source network solution
- Calico is highly scalable, and is operator and policy friendly:
  - No overlay, no tunnelling, no VRF tables (no overhead) – pure routing
  - Access Controls enforced through L3/L4 security policies



Kubernetes Accelerated Networking

- Multus, SR-IOV, DPDK
- Kubernetes managed accelerated network devices (via Device and CNI plugins)
- Containers bind the driver to the Virtual Function (VF) or DPDK devices directly
- No host routing or switching is involved for SRIOV and provides the best direct IO

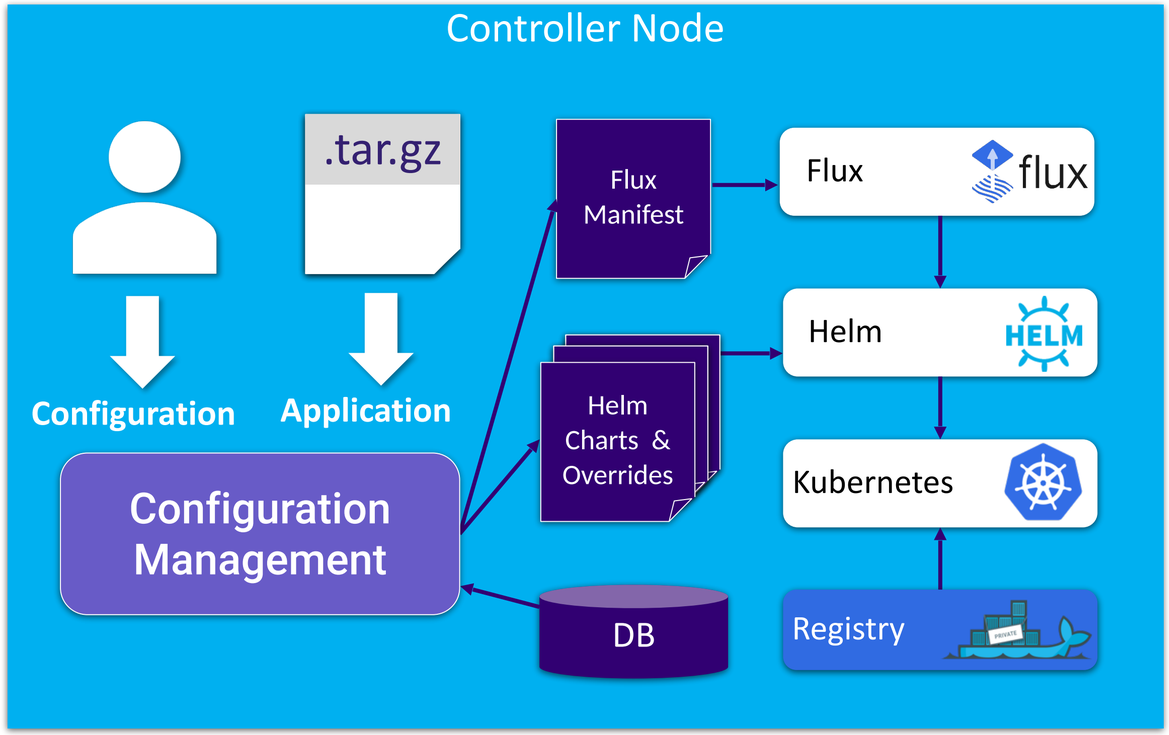


Additional Capabilities

- Local replicated docker image registry
- Integration with OpenStack Keystone
  - Local docker image registry authentication
  - Authentication/authorization of StarlingX REST API
- Huge Page support
  - Enables pods to allocate and consume huge pages from pre-allocated host pool
- Kubernetes CPU manager static policy
  - Enables applications to reserve exclusive CPUs in their pod spec

Application Management

- Helm
  - Helm Charts help you define, install, and upgrade even the most complex Kubernetes application.
  - Template based approach to Kubernetes configuration
  - System and User overrides combined to provide final deployment configuration
- Flux
  - Manages the dependencies between multiple Helm Charts and expression of those relationship
  - Static and default configuration attributes
- Application
  - Curated software bundle of Flux manifest and Helm Charts
  - Application-specific Plugin support for customized behavior (e.g., intelligent helm override defaults based on system configuration)
  - Application lifecycle coordinated by Configuration Management
  - User uploads, applies / removes application with single command operations



STARLINGX

OpenStack

OpenStack Deployment

- OpenStack is deployed as a containerized Kubernetes application
  - OpenStack control plane running in pods
  - OpenStack virtual machines running on hosts
  - Leverages Kubernetes' strengths to manage, scale and update the OpenStack services
- Deployed using Helm (using OpenStack-Helm charts) and FluxCD (StarlingX default orchestrator for deploying Helm charts)
- StarlingX provides application APIs to install and configure the containerized OpenStack application
  - Application tarball contains helm charts and armada manifest for StarlingX
  - Automatic generation of helm configuration values based on system configuration
  - User can easily customize helm configuration of OpenStack Services

Supported OpenStack Services

- Configuration optimized and system validated within StarlingX
- Supported OpenStack services include:
  - Cinder
  - Glance
  - Heat
  - Horizon
  - Keystone
  - Neutron
  - Nova

Day 2 Configuration Changes

- Configuration changes can be applied after the application has been deployed
- Update the helm chart overrides
  - system helm-override-update …
- Reapply the application
  - system application-apply …
- Only charts impacted by the configuration change will be updated

STARLINGX

Distributed Cloud

Distributed Cloud Overview

- Introduced in StarlingX 3.0
- Heterogeneous Distribution of Kubernetes and OpenStack Clouds
- Central Cloud (System Controller)
  - Hosting shared services
  - System-wide infrastructure orchestration functions
    - Install, Orchestrate / Automate Software Patching & Upgrade, and more
  - Highly scalable; up to 1000x remote sites
  - Supporting geo-redundant Central Clouds
- Remote, geographically dispersed sites
  - An autonomous cloud managed by the Central Cloud through REST APIs/L3
  - Scalable from single server to 100s of servers
- In line with the Distributed Control Plane reference architecture model defined by the OpenInfra Edge Computing Group

Distributed Cloud - System Controller

- Supports active / active geo-redundant configuration
- Centrally orchestrated & automated operations on remote sites
  - Install and initial configuration
  - Backup & restore
  - Software patching and upgrades
  - Certificate management
  - Firmware management
- Supports environments with poor / high latency to remote sites
- Health monitoring and management of remote sites
- Synchronized User Authentication & Authorization with Keystone
- Centralized Docker registry for infrastructure and applications
- Centralize Horizon dashboard - single pane of glass
- Configuration portal for shared platform data
  - DNS, NTP/PTP, API Firewall, SNMP, …

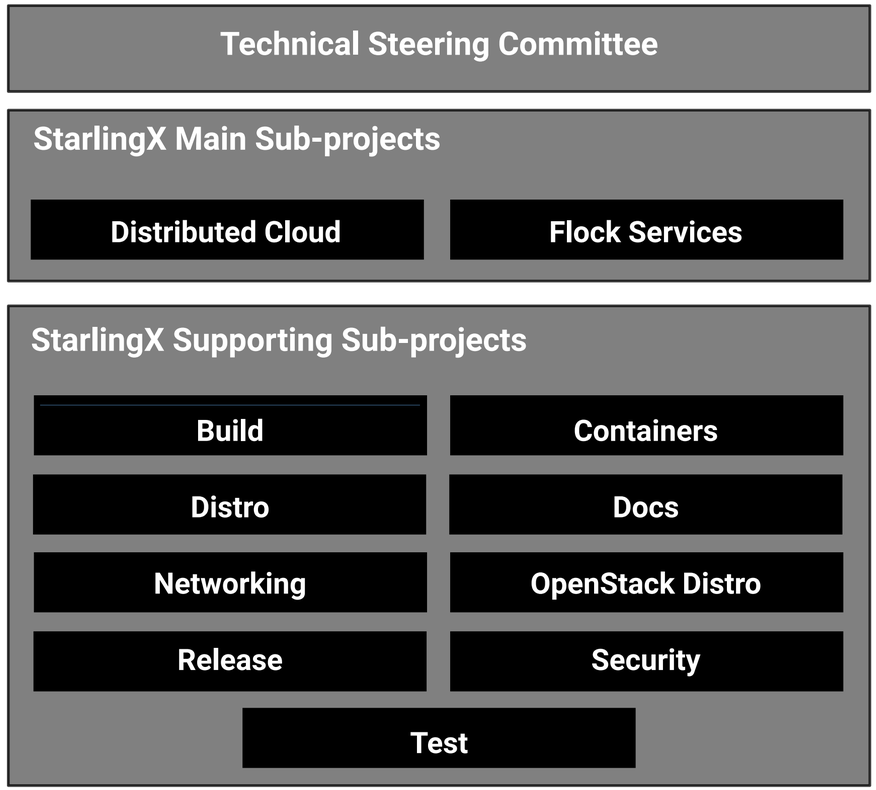
Community and Contributing

Principles

- The StarlingX project follows the “four opens,”
  - Open Community
  - Open Design
  - Open Development
  - Open Source
- Technical decisions will be made by technical contributors and a representative Technical Steering Committee.
- The community is committed to diversity, openness, encouraging new contributors and leaders to rise up.

Sub-project Structure

- Main sub-projects
  - New functionality and services
- Supporting sub-projects
  - Supporting services, test and infrastructure
- Sub-project team structure
  - 1 Technical Lead
  - 1 Project Lead
  - Core Reviewers
  - Contributors



Governance Roles

- Contributor
  - Someone who made a contribution in the past 12 months
    - Code, test or documentation
    - Serving in a leadership role
  - Can run and vote for elected positions
- Core Reviewer
  - Active contributors to a sub-project, appointed by fellow core reviewers
  - Responsible for reviewing changes and specifications
  - Can approve code and documentation changes

Governance Roles

- Technical Lead
  - Per sub-project
  - Core Reviewer with additional duties
  - Helps guiding the technical direction of a sub-project
- Project Lead
  - Sub-project level coordination work
    - Tracks and communicates progress and priorities
  - Sub-project ambassador

Governance Bodies

- Technical Steering Committee (TSC)
  - Responsible for overall project architectural decisions
  - Managing the sub-project life-cycle
  - Making final decisions if sub-project Core Reviewers, Technical Leads or Project Leads disagree
  - The TSC members are selected by the community through an election process

Get Involved

- Code and documentation are available through git
  - https://opendev.org/starlingx
- Apache 2 license
- Chat: Matrix - https://matrix.to/#/#starlingx:opendev.org
- Mailing List for daily discussions
  - https://lists.starlingx.io/mailman3/lists/starlingx-discuss.lists.starlingx.io/

Where to Contribute?

- Bugs are tracked in Launchpad
  - https://bugs.launchpad.net/starlingx
- New ideas are introduced in the specs repository
  - https://opendev.org/starlingx/specs
- Design and implementation work is tracked in StoryBoard
  - https://storyboard.openstack.org/#!/project_group/86
- Further information about sub-teams and processes
  - https://wiki.openstack.org/wiki/StarlingX

Community

- You do not need to be an Individual Member of the Open Infrastructure Foundation in order to contribute, but if you would like to participate in the project's elections or vote in the annual Open Infrastructure Foundation Board of Directors election, you may join: https://openinfra.dev/join/individual/
- If you are contributing on behalf of an employer, they will need to sign a corporate contributor license agreement, which now covers all projects hosted by the Open Infrastructure Foundation (same model such as Apache and CNCF)

Communication

- General room in the StarlingX space on Matrix for online discussions
  - https://matrix.to/#/#starlingx:opendev.org
- Mailing Lists: lists.starlingx.io
- Email: info@starlingx.io
- Weekly meetings:
  - Zoom calls
  - https://wiki.openstack.org/wiki/Starlingx/Meetings
- Twitter handle: @StarlingX

STARLINGX

Thank You!