Akraino & Starlingx: a technical overview
Agenda

- Why Edge Computing?
- What’s Edge Computing?
- Akraino and its Building Blocks
- StarlingX and its Technical Overview
- Collaboration in Akraino Community
Emerging technologies in IoT and networks are demanding lower latency and accelerated processing at the edge.

<table>
<thead>
<tr>
<th>NFV Edge Infrastructure</th>
<th>Wireless (vRAN,vEPC)</th>
<th>Wireline (PON)</th>
<th>uCPE (SD-WAN)</th>
<th>IP Enterprise Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autonomous Devices</td>
<td>Drones</td>
<td>Autonomous Vehicles</td>
<td>Industry Robots</td>
<td>Medical</td>
</tr>
<tr>
<td>Immersive Experiences</td>
<td>Virtual Reality</td>
<td>Augmented Reality</td>
<td>360 Video</td>
<td>Wearable Cognitive Assistance</td>
</tr>
<tr>
<td>IoT &amp; Analytics</td>
<td>Industrial Sensors</td>
<td>Home Devices</td>
<td>Retail</td>
<td>Healthcare</td>
</tr>
</tbody>
</table>

- On-Demand NFV
- Hardware Acceleration
- A.I.
- Microservices
- 5G
Why Edge computing?

Emerging technologies are demanding lower latency and accelerated processing at the edge.

**Edge Cloud**
Performs data processing at the edge of the network, near data sources

- Low Latency: < 20ms
- Optimal

**Central Cloud**
Highly centralized computing resources of cloud service providers

- High Latency: ~25 – 200ms
- Not Optimal
Edge computing

- Extensions Beyond Cloud Computing and Data Centers
- Close to Users and Data Sources, Edge Sides
- Converged Platform of Networks, Compute, Storage and Applications
- Real-Time, Optimized, Data Localization, Intelligence, Security and Privacy
- High Performance and Low Latency
- Large-Scale but Small-Size
- Zero Touch Provisioning and Automation, Remote Management, Autonomous Devices
- Self-Healing, Easy Upgrading, and Long Life Power Supplier
What is akraino?
Everything about edge – akraino is the edge stack

- Development of Edge Applications
  - Develop Edge applications and create an app/VNF ecosystem

- Development of Edge Middleware and API
  - Development of Edge API, Middleware, SDKs
  - Cross Platform Interoperability (3rd party clouds)

- Fully Integrated Open Edge Stack
  - Fully integrated, working Edge blueprints
  - Edge Stack Life Cycle – CI/CD & Tooling
  - Upstream collaboration
New edge requires end-to-end automation & interworking

Services
- Cloud Services
- Residential Services
- Enterprise Services
- IOT Services
- AI Services

Software & Automation
- Cloud Automation
- Network Automation
- IOT Automation

Infrastructure
- Enterprise
- Software Defined Data Centers (SDDC)

Data Centers
- Carrier Network
- Cloud Network

Public/Hybrid
- Cloud Service Providers
- Cloud Hosting Providers
- Private Cloud Providers
- Web Service Providers
The new edge requirements for akraino project

Akraino Edge Stack is the first open source collaborative community project exclusively focused on integrated distributed cloud edge platform.

Edge Challenges

- **Large Scale**
  - >1000 Locations

- **Need Simple Operations**
  - Zero-touch provisioning
  - Zero-touch operations
  - Zero-touch lifecycle

- **Low Cost**
  - Start-up, Build, Run

- **Multiple Edge Use Cases**
  - Faster innovation but with right integration

Solution

Akraino Edge Stack integrates multiple open sources to supply holistic Edge Platform, Edge Application, and Developer APIs ecosystem.
LF Announcement March 2018

- First Open Source Project at Edge gathers momentum, complements other standards & consortiums
- Edge now an integral part of Open Source Software Ecosystem

The Linux Foundation Announces Expanded Industry Commitment to Akraino Edge Stack
Akraino building blocks

- Akraino GUI
  - Dashboard
  - Admin GUI
- Akraino Workflow
  - Platform Workflows
  - Camunda
- Edge Application and APIs
  - APIs
  - Applications & VNFs
  - Edge APIs
  - Any Edge Applications
  - Edge Cloud(s) Integration APIs
- Edge Application and Orchestration
  - Lightweight Edge App Orchestration
  - Community - TBD
- NFV Orchestration
  - NFV & Domain Specific Orchestrator
  - ONAP
- Edge Platform Software
  - Infra Orchestration
  - Storage
  - Network Control Plane
  - Network Data Plane
  - Operation System
  - OpenStack
  - Kubernetes
  - SDN
  - Calico
  - SR-IOV
  - Linux Flavor
  - OVS-DPDK
  - Thin Linux
- Network Edge
  - Cruiser
  - Tricycle
  - Unicycle
- Customer Edge
  - Satellite
  - Rover
  - Community

Source: AT&T
What is starlingx?

- StarlingX is a new project being hosted by the OpenStack Foundation
- Formed with seed code from the Wind River Titanium Cloud portfolio
- Project will provide a fully integrated OpenStack platform with focus on high availability, Quality of Service, performance and low latency needed for industrial and telco use cases
- Aligned with the OpenStack Foundation Edge Working Group and the Linux Foundation Akraino Edge Stack
Starlingx addresses edge gaps
Based on Wind river titanium cloud

Proven, Integrated virtualization platform saves Time-To-Market
Delivered latency, resiliency and performance for Edge use cases
Streamlined installation, commissioning and maintenance
End-to-End security and Ultra-low latency for Edge applications
100% compatible with open industry and de facto standards
Full support for multi-layer HW and SW decoupling
High level project structure

Upstream Projects
- Kubernetes
- Ceph
- ovsdpdk
- CentOS
- OpenStack

Integration Project
- Host Management
- Configuration Management
- Service Management
- Fault Management
- Software Management
- Infrastructure Orchestration

Extensions
Starlingx architecture details

**OSS/BSS**

**Service Orchestration (i.e. ONAP)**

**Control Node**
- Virtualization Infrastructure Manager (VIM)
  - Infrastructure Orchestration
  - Configuration Management
  - Fault Management
- Service Management

**Compute Nodes**
- Neutron Agent
- Nova Compute
- ovsdpdk
- SRIOV networking
- KVM – Real time
- Linux

**Storage Node**
- Carrier Grade Storage Cluster
  - Centralized, Local, or SAN

**Edge Applications**
- VM
  - IOT
- VM
  - CPE
- K8S
  - Others

**StarlingX Edge Node(s)**
Scalability for all edge use case deployment models

Minimum-Footprint Edge Solution
Single server

Highly-Available Edge Solution
Two servers

1:1 protected pair of servers

Multi-Rack Solution
4-100 servers
Addressing the challenges of industrial edge
Reliability, management, performance, scalability, security, open standards

- Integrated software platform for on-premise critical infrastructure applications
- Addresses all the key challenges for industrial-grade virtualization and security

<table>
<thead>
<tr>
<th>Physical Devices</th>
<th>Virtualized Applications (Level 1-3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCS</td>
<td>Virtual Machine PLC</td>
</tr>
<tr>
<td>Analyzer</td>
<td>Virtual Machine DCS</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Virtual Machine HIS</td>
</tr>
<tr>
<td>Safety Systems</td>
<td>Virtual Machine Other</td>
</tr>
<tr>
<td>Wireless Gateway</td>
<td></td>
</tr>
<tr>
<td>PLC</td>
<td></td>
</tr>
</tbody>
</table>

Standard Servers
Industrial-Grade Networking

StarlingX Software
Control Node(s)
Compute Node(s)
Storage Node(s)
Key capabilities for edge stack

StarlingX New Features

- Titanium Cloud SM + REST API
- Process Monitoring
- Standalone Titanium Cloud FM including Horizon Extensions
- S/W Repository Management
- S/W Patching
- S/W Upgrade
- Backup and Restore

Upstream
OpenStack* w/ Titanium Cloud Extensions

- Bare metal install and node management
- H/W maintenance
- VIM
- VIM helper components: nova-api proxy, guest API infrastructure
- System Configuration frontend
- System Configuration backend
- Hieradata management
- Manifest apply
Directional vision for akraino

- Combining OpenStack* with components from Wind River® Titanium Cloud with new extensions to support k8s with Docker* runtime
- Keystone runs as a shared service on the platform with Ceph for persistent storage
- Kubernetes* applications deployed by Helm
  - OpenStack is containerized
  - Calico used for container networking backend
- Retains Wind River Titanium Cloud installation mechanism for bare metal installation
- Deployment for Intel seed will use Puppet for bare metal and Helm for OpenStack and Containerized Apps
- Lifecycle for Intel seed will use existing Wind River Titanium Cloud services for bare metal and K8s for remaining
Distributed cloud incubation project

- Based on OpenStack Regions
  - Central Region (System Controller)
    - Hosting shared services
    - System wide infrastructure orchestration functions
      - Deployment and management of Edge clouds
      - Configuration portal for shared configuration across all Edges (host and OpenStack)
    - Fault aggregation
    - Portal for system wide patch (s/w updates) application
  - Geographically dispersed remote Edge regions
    - Connected to the system controller via L3 network
  - Inter-region communications via REST APIs
  - Edge clouds run a reduced control plane
In flight seed code evolution based on titanium cloud

- K8S management of platform/infrastructure services
  - Docker runtime
  - Calico CNI plugin
  - Ceph as persistent storage backend
  - Helm as the package manager
  - Local docker image registry

- Initial services
  - OpenStack and dependencies (i.e. mariadb, Keystone) leveraging OpenStack Helm
  - Infrastructure orchestration services

- K8S cluster available for end user applications (control plane apps)
Performance features

- Compute node performance profiles
  - Select performance characteristics that match the workload requirements
- Optional RT KVM support
- Housekeeping functions including interrupts offloaded to dedicated CPU(s)
- Huge page backend VM’s (2M or 1G)
- Dedicated and shared VM CPUs
  - Including hybrid model for VM
- High Performance Networking
  - OVS-DPDK
  - SR-IOV
  - PCI-passthrough
- GPU passthrough support

- EPA Features
  - HT placement/scheduler policy support
  - Ability to specify CPU models for VMs to leverage advanced features of CPU architectures
  - NUMA node awareness
    - Specify multiple virtual NUMA nodes and required memory per virtual NUMA node
    - Specify mapping of a virtual NUMA node to a physical NUMA node
    - NUMA affinity (relative to vswitch and/or PCI-PT/SRIOV)
    - Network load balancing across NUMA nodes
  - vcpu scale up/down
    - Nova-api extension with Heat integration
  - RDT cache allocation technology (CAT) support
    - Enable VMs to reserve slice of L3 cache

Delivering Predictable Performance At The Edge
VM’s and bare metal containers as first class citizens
  - Meeting the performance, latency and reliability requirements for the Edge
  - Co-existence in a single deployment

Infrastructure
  - Migration of remaining infrastructure services to containers

Full support for applications
  - Accelerated container networking with SR-IOV and OVS-DPDK
  - Multi-tenancy support for containers
  - Support for additional container runtimes including Kata containers
Vision for future collaboration

- Ubuntu OS support
- Edge deployment simplification enabling zero touch provisioning
- Centralizing infrastructure management of Edge deployments
- Securing the edge
  - Remote attestation
- PTP support – and eventually TSN support
- Identify and work to drive synergies with EdgeX and NEV SDK within Akraino
- Enable 5G use cases at the Edge vRAN
Akraino is complementary
Akraino interfaces with adjacent projects standards, ref arch and ref impl

- Zero Touch Edge Cloud Automation

- Container Orchestration Multi-cloud portability

- IIOT Framework at Edge

- Open Source Software for Creating Private and Public Clouds

- AI Framework Across Projects Networking Analytics/Automation

- Disaggregated Networking Whitebox Operating Systems
## Akraino benefits
enable new business ecosystem & cost savings

<table>
<thead>
<tr>
<th>Users (Enterprises)</th>
<th>New Services</th>
<th>Open Source-Based</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application Developers</td>
<td>New Edge Applications</td>
<td>Global Open Source Collaboration</td>
</tr>
<tr>
<td>Public Cloud Provider</td>
<td>New Cloud Services</td>
<td>More Footprint</td>
</tr>
<tr>
<td>Suppliers</td>
<td>Infrastructure (H/W)</td>
<td>Support as a Service</td>
</tr>
<tr>
<td>Telco Operator</td>
<td>Edge Processing – Reduced Backhaul Traffic</td>
<td>NFV Infrastructure (5G, Etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edge Services (Public Edge Cloud, API, Analytics)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Edge Real Estate</td>
</tr>
</tbody>
</table>
For More Information, Please
Visit www.akraino.org and www.starlingx.io