IEC Architecture Document

Blueprint overview/Introduction

This document covers both Integrated Edge Cloud Type 1 & 2.

Integrated Edge Cloud(IEC) is an Akraino approved blueprint family and part of Akraino Edge Stack, which intends to develop a fully integrated edge infrastructure solution, and the project is completely focused towards Edge Computing. This open source software stack provides critical infrastructure to enable high performance, reduce latency, improve availability, lower operational overhead, provide scalability, address security needs, and improve fault management. The IEC project will address multiple edge use cases and industry, not just Telco Industry. IEC intends to develop solution and support of carrier, provider, and the IoT networks.

Use Case

The first use case of IEC is SDN Enabled Broadband Access(SEBA) on arm, in the future more use cases would be added with the provisional plan, such as AR/VR, Edge AI, vCDN, Autonomous Vehicles, and so on.

Where on the Edge

Business Drivers

The Integrated Edge Cloud (IEC) will enable new functionalities and business models on the network edge. The benefits of running applications on the network edge are - Better latencies for end users - Less load on network since more data can be processed locally - Fully utilize the computation power of the edge devices.

Overall Architecture

Currently, the chosen operating system(OS) is Ubuntu 16.04 and/or 18.04. The infrastructure orchestration of IEC is based on Kubernetes, which is a production-grade container orchestration with rich running eco-system. The current container network interface(CNI) solution chosen for Kubernetes is project Calico, which is a high performance, scalable, policy enabled and widely used container networking solution with rather easy installation and arm64 support. In the future, Contiv/VPP or OVN-Kubernetes would also be candidates for Kubernetes networking.

The high level design of IEC architecture uses containerized networking environment:

The edge applications run as containers with container orchestration engine and high performance networking support;

The integrated edge cloud platform provides management interface and programming interface to deploy/manage edge applications quickly and conveniently

The platform supports the applications of IoT gateway, SD-WAN, edge AI and etc.

Under the current architecture, 2 kinds of use cases are supported:

Telco/enterprise Edge cloud – for example, MEC or branch office data center…

Telco/enterprise remote edge locations – edge platform with limited resources, for example, SD-WAN, IoT gateway…

The IEC reference stack architecture is given with the following figure:

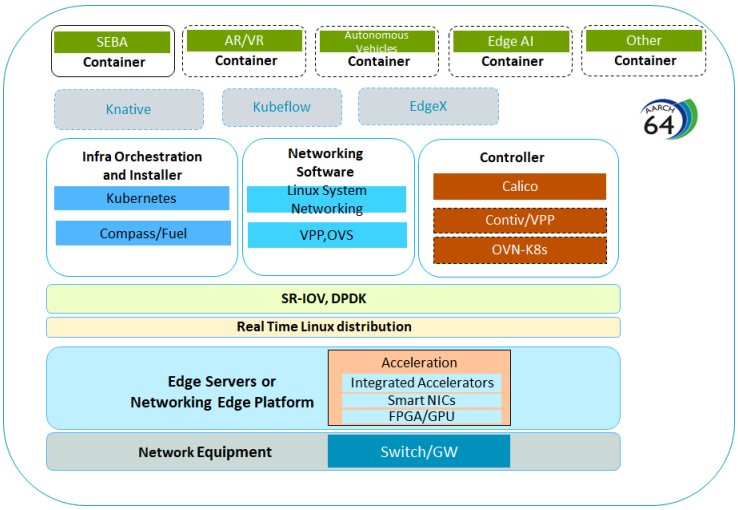


Fig 1 IEC Reference Stack

Currently, IEC provides the following functions under its reference architecture:

- The IEC supported hardware are edge servers mainly based on arm64, such as Huawei Taishan, Marvell ThunderX, Ampere Arm64 servers; at the far edge, the supported edge end devices would be Marvell MACCHIATObin Double Shot or other arm based boxes/devices. The desired network connections are above 10Gbit/s which may satisfy most current IEC applications requirement.
- The installation scripts which deploys Kubernetes cluster, Calico CNI, Helm/Tiller and related verifying Kubernetes applications/services with 1 master and 2 slave nodes. The scripts can be run from the jumpserver, or with manual installation from the servers on which it run. The installation methods is introduced in IEC Blueprints Installation Overview.
- Currently IEC uses project Calico as the main container networking solution which provides high performance, rich network policy, widely supported from Linux system and easy installation. In the future, Contiv/VPP and OVN-Kubernetes can be used as a high performance substitute since those 2 solutions can support DPDK enabled high speed interface access.
- IEC support Akraino CI/CD requests: IEC Daily jobs (scheduled to run recurrently) deploy IEC using one of the agreed installers; run testing suites; collect logs and publish them.
- Currently IEC suppors the SDN Enabled Broadband Access(SEBA) as its first use case. The installation scripts for SEBA on arm and its related source repositories are developed and/or integrated in IEC source code repo. We had ported SEBA components to arm64 servers with Helm chart installation support
- Until now IEC has 3 approved types: Type 1, Type 2 and Type 3 as its supported running types, and other types: Type 3 and Type 5 are under review. IEC is still enriching its use cases with the progress of developing.

Platform Architecture

The IEC project is for openness, which intends to develop a fully integrated edge infrastructure solution, it provides a reference implementation for hardware and software to help users build their projects.

What is reported below is a list of hardware that IEC community have tested over time in lab trials, mainly on the Arm machine. If you need to understand the hardware requirements of the x86 server, you can refer to the following link:

https://guide.opencord.org/cord-6.1/prereqs/hardware.html#bom-examples

Build Of Materials (BOM) / Hardware requirements

Generic Hardware Guidelines

Compute Machines: By observing the actual memory utilization of ThunderX2, it is found that if IEC is deployed on a single node, at least 15G of memory and 62G disk is required; This kind of hardware condition is very harsh for embedded devices. For more realistic deployments, we suggest using at least three machines (preferably all the same). The characteristics of these machines depends several factors. At the very minimum, each machine should have a 4 cores CPU, 32GB of RAM, and 60G of disk capacity.

Network: The machine have to download a large quantity of software from different sources on the Internet, so it`s need to be able to reach Internet. For whatever server use, it should have at the very minimum a 1G network interface for management. 40G NIC is required if performance testing is required.

Optics and Cabling: Some hardware may be picky about the optics. Both optics and cable models tested by the community are provided below.

Recommended Hardware

Following is a list of hardware that people from the IEC community have tested over time in lab trials.

Please attention: Until now, there has been no performance testing of the IEC, which is our follow-up work.

Device 1

Quantity	Category	Brand	Model	P/N
1	Compute	Cavium	ThunderX2	ThunderX2
4	Memory	Micron Technology	9ASF1G72PZ-2G6D1	9ASF1G72PZ-2G6D1 8GB*4
1	Management switch (L2 with VLAN support)	*	*	*
1	Network interface card(for mgmt)	Intel	10-Gigabit X540-AT2	10-Gigabit X540-AT2
1	Network interface card(for data)	Intel	XL710 40 GbE	XL710 40 GbE
2	SFP(for mgmt)	Intel	FTLX8571D3BCV-IT	INTEL FTLX8571D3BCV-IT Finisar 10GB s 850nm Multimode SFP SR Transceiver
	Fabric switch	N/A	N/A	N/A

Device 2

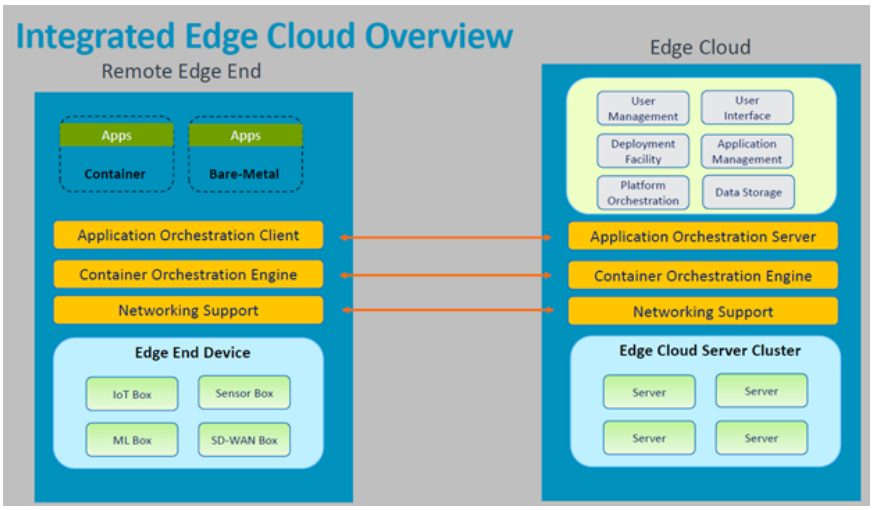
Quantity	Category	Brand	Model	P/N
1	Compute	Ampere	eMAG server	eMAG server
8	Memory	Samsung	M393A4K40CB2-CTD	M393A4K40CB2-CTD 32GB*8
1	Management switch (L2 with VLAN support)	*	*	*
1	Network interface card(for mgmt)	Mellanox	MT27710 Family	ConnectX-4 Lx
1	Network interface card(for data)	Intel	XL710 40 GbE	XL710 40 GbE
2	SFP(for mgmt)	Intel	FTLX8571D3BCV-IT	INTEL FTLX8571D3BCV-IT Finisar 10GB s 850nm Multimode SFP SR Transceiver
	Fabric switch	N/A	N/A	N/A

Device 3

Quantity	Category	Brand	Model	P/N
2	Compute	Marvell	Marvell ARMADA 8040	MACCHIATObin Double Shot
1	Memory	System memory	Marvell ARMADA 8040	DDR4 DIMM slot with optional ECC and single/dual chip select support 16GB
1	Management switch (L2 with VLAN support)	*	*	*
1	Network interface card(for mgmt)	Marvell	Marvell ARMADA 8040	Dual 10GbE (1/2.5/10GbE) via copper or SFP 2.5GbE (1/2.5GbE) via SFP 1GbE via copper
2	SFP(for mgmt)	Cisco	Passive Direct Attach Copper Twinax Cable	SFP-H10GB-CU3M Compatible 10G SFP+
	Fabric switch	N/A	N/A	N/A

Software Platform Architecture

The IEC reference software platform architecture is given with the following figure:



Platform Software	Version
docker	18.06.1-ce
kubelet	v1.13.0
kubeadm	v1.13.0
kubectl	v1.13.0
calico	v3.3.2
etcd	v3.3.9-arm64

APIs

APIs with reference to Architecture and Modules

High Level definition of APIs are stated here, assuming Full definition APIs are in the API documentation

Hardware and Software Management

Licensing

- GNU/common license