IEEE Future NETWORKS

Enabling 5G and Beyond

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Edge Automation Platform

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10-year Vision

Edge will become the Key service delivery vehicle for systems and applications rather than cloud, which would mean ubiquitous thin clients have access to all the processing power edge can offer

- Micro Data Centers will spawn over different locations
- Distributed Access –
  - Edge Agnostic
  - Access Agnostic
  - Latency, Bandwidth and Coverage are three salient features
- Always available- Resilient Fault Tolerant platforms
- Leverage AI functionalities to facilitate the automation in Edge infrastructure operation and dynamic adjustment to improve the target application performance
- Delievery vehicles for the edge using microservices and container deployment

Scope

App Driven Architecture:

- Use 1 or more use cases or Workload (Automated- Connected driving, Edge as a Service, Cloud, Intelligent Edge- audio/video/networking, Automated Manufacturing - IIoT)
- Specify the Best Known Configuration (BKC) to handle both H/W & S/W
- Look at latest Frameworks/Architecture – ONAP, ORAN, MEC , OpenNESS & oneAPI
- Identify common objectives and gaps (for Consider BM & Containers) in microservices based objects
- Define the Refrence Model for Edge, Interfaces, APIs
- Use case flows to formulate KPIs (3GPP, MEC, ORAN etc are defining KPIs)
- Challenges to Achieve the KPIs quotes.
- Automation/Orchestartion tools
- And thoughts for future, opens

Today's Landscape

- ETSI MEC- Is the standard Multi Access Edge Computing Reference Architecture
- OpenStack Edge Group- Is the deployment reference based on Hybrid, VMs and Containers
- LFN ONAP and OPNFV- OPNFV is focused on VMs and ONAP on "OS container" edge platforms
- O-RAN- They are focused on mobile edge services for real time applications
- TIP/TUG-Telecom Infra Project and Telecome users group are focused on migrating VM to container based edge platform deployment
- CNTT - Converged NFV Telecom Taskforce, is working with GSM association and LFN to enable containerised edge deployment
- CNCF- The application of microservices in using "app containers" along with "OS containers" for edge services

Top Needs for 10-year Vision

DRIVER NAME	METRIC (CURRENT STATE)	PROJECTED METRIC 3-YEAR (2022)	PROJECTED METRIC 5-YEAR (2024)	PROJECTED METRIC 10-YEAR (2029)
Standardization of Edge Platform	Evolving (too many ref architecture)	A few winners will emerge	Interoperability between the winners	Edge Services Becomes commoditized
Standardization of appn containers	Docker, Kata, OCI	Common Orchestration Framework	Security Added	Commoditized
Characterization (QoE)	10-20 ms, 1Gbps	5ms, 10 Gbps	1ms, 50 Gbps	100µs, ~100Gbps[DM4]
Security	Cyber Physical Security Service specific security embedded with multi-interface	AI powered security, Slice based and workload based Secuirty	Multi-Layer Multi Modal automation for unified infrastructure and resource dependent security algorithms ?	Personalised decentralised security based on workload, device, interface etc.
Support of Heterogenous Hardware	Multiple vendor platforms in compute, storage and networking with programming options such as P4, SYCL, DPC++	A few parallel programming paradigm will emerge among the existing systems with Bare Metal/Thin real time OS support	Uniform support of heterogenous computing irrespective of operating systems, drivers, debugging tools, etc without a hit on performance	True Cloud native computing using heterogenous hardware, based on workload demand, via automated intelligent orchestration
Hyper Converged Infrastructure(HCI) (common infra for heterogeneous cloud)	Mostly Converged Infrastructure (CI) per cloud and early adoption of HCI	With more managed edge clouds HCI will become the norm.	HCI may lead to more modular with Intelligent Infrastructure elements like GPU. FPGA, SmartNICS	More value adds expected like Vertical Solution Networks with HCI and Intelligent Infrastructure,

Need #1, Standard Interfaces

Near-term Challenges: 2020-2023	*Description*
Multiple Edges	Far Edge (Device, On Prem), Radio Edge, Near edge (Provider/network edge), Network Core
Multiple Standards	*MEC, CNTT, O-RAN*
MEC	MEC is not acceptable to Industry as hard to deploy. Radio API over MEC is relatively mature
CNTT	Multiple CNTT architectures which are still evolving, RA1 is matures, RA2 is still evolving
O-RAN	Multiple splits e.g. 7.2, 8, etc. Different standards apply to different use cases due to optimisation
Variety of Workload Requirements	Standards need to meet the requirements of different workloads HCI, AI/ML workloads and these may differ as per the geo requirements as well e.g. 5G Asia , EU, NA
Mid-term Challenges: 2024-2025	*Mapping between workload type and defining configurations to enable the functions required to execute certain popular use cases.*
Interoperability	Interoperability challenges amongst the emerging workloads
Long-term Challenges: 2026-2030	*New Market shifts in the Edge and last mile delivery due to availability of 5G & Fiber to the premise*
Integration of new technology	Emergence of newer Quantum computing shifting the edge application platforms

Need #2, Automation and Orchestration of Edge Platform

Near-term Challenges: 2020-2023	*Can the devices and platforms being used for Edge be programmed automatically?*
Device	Evolving devices for Edge (V2X, IIoT, Edge as a service etc)
Shared data	In Memory or shared memory processes e.g; GRPC
Device Discovery	Make the resources seen by an automated orchestration and scheduling framework so resource allocation can be effective
Monitoring	Health of devices, Bandwidth allocation and Utilisation, Performance indicators such as Latency and RTT (Round Trip Time)
Management	Various solutions to Solution Provisioning and Life Cycle Management including automation exist, e.g. Puppet, Ansible Playbook, OpenStack, Kubernetes, however none of them meet the needs of end-to-end automation for edge
Mid-term Challenges: 2024-2025	*Workloads, devices and standards will evolve based on Edge adoption*
Remote Provisioning and Management	Distributed deployment of edges means remote provisioning and management becomes more important as edge becomes more and more distributed
Long-term Challenges: 2026-2030	*Automating recognition of new types of devices and access technology*
Unknown devices and access technology will appear	EAP platforms should be able to handle any new type of devices and technologies as they become available instead of being reactive and adding support after the appearance, e.g. Quantum and related technology.

Need #3, Edge Automation Platform

Near-term Challenges: 2020-2023	*Description*
Cyber Physical Security	Addressing security for infrastructure & service heterogeneity; Hardware & Software adaptation for application specific security settings.
Security by design	Application specific security embedded with multi-interface involvement.
More challenges	Add more rows for each challenge
Mid-term Challenges: 2024-2025	*Description*
Multi-Layer Multi Modal automation requirement	Within a unified infrastructure usage, sensitivity and resource demand (and availability) dependent security algorithms
Long-term Challenges: 2026-2030	*Description*
AI powered centralized and decentralized accessibility	Within a unified infrastructure usage, sensitivity and resource demand (and availability), location & time dependent security.

Need #4 Support of Heterogeneous Platforms

Near-term Challenges: 2020-2023	*Description*
Multi vendor edge devices	Multiple vendor platforms in compute, storage and networking with programming options such as P4, SYCL, DPC++
Interoperabilty	Edge Apps and systems running on devices from multiple vendors should be able to interoperate
Management and Orchestration of Data Plane	Management of devices (which will be combination of number of system on a chip, connected with THz links) to be controlled from edge platforms
Mid-term Challenges: 2024-2025	*Description*
Just in time Compilation	workloads can run on available hardware and code can be compiled for that hardware at run time based on avaialbilty, even in a cloud native environment
Performance	Support of heterogenous platform should not effect performance
Long-term Challenges: 2026-2030	*Description*
Support of Tera Hetz Devices	Plug and play with THz link with local specrum management from edge supporting Clock detection and sycnhroniztion for Device discovery and plugin to system

Stakeholders

- Telco (MNO/MVNO)
- Cloud Providers
- Infrastructure providers
- Consumers
- Equipment Providers
- Government/Cities
- App developers
- Education

Working Group Team

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Get involved!

Please reach out to any of the EAP members or email 5GRM-eap@ieee.org

QUESTIONS?