IEC Type 4 Blueprint: AR/VR at Edge

ARM, HTC, IBM, MobiledgeX, Visby, Orange, PSU

Wenping Ying, TPL
Integrated Edge Cloud Reference Stack

- **Heterogeneous Architecture**
  - VM, container, bare metal
  - Servers and customized Edge platforms
  - Virtualized NFs and Physical NFs
  - Accelerator interface

- **Resource constraints**
  - Kubernetes
  - SDN Controller for K8s

- **HW Accelerations**
  - Integrated accelerators
  - PCIe/CCIX attached accelerator (Smart NICs...)

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- **Lightweight App orchestration**
  - Knative (serverless)

- **Apps**
  - Bare metal
  - Container

- **Infra Orchestration and Installer**
  - Kubernetes
  - Containerized Compass

- **Networking Software**
  - Linux System Networking
  - VPP, OVS

- **Control**
  - Calico, xConnect, NSM
  - Contiv/VPP
  - OVN-K8s

- **SR-IOV, DPDK**

- **Real Time Linux distribution**

- **Edge Servers or Networking Edge Platform**
  - Integrated Accelerators
  - Smart NICs
  - FPGA/GPU

- **Network Equipment**
  - Switch/GW
Distributed Application Mobility Architecture (MEX)
Cloud VR Vertical Deployment Architecture (VIVE)

1. CP-PC – Client Request VR app (user id, app, location id)
2. CP-PC – ACK (appInst IP, port, user token)
3. SO-RS – start container with APP and user token
4. App + Server RE (SR)
5. PC-SM - PC LCM Requesting starting VR app (app and cell ID/location)
6. SM-PC - ACK (appInst IP and port, user token)
7. CP-CR – init app request (server IP, port, user token)
8. CR-SR – rendering traffic and client pos/IMU feedback

Public Cloud LCM (PC)

Server MEC (SM)

Client HMD

App + Client Rendering Engine (CR)

CApp Registry (CAREG)

Location Registry (LREG)
Scope of Type 4 AR/VR Edge Cloud

- **APP cluster Orchestrator (MEX/VIVE)**
- **Orchestrator (ONAP)**
- **VNFs**
- **VMs**
- **PODs**
- **CI/CD Framework**

**Edge Controllers**
- Physical Provisioning (Ansible?)
- Application Provisioning (K8S or KubeEdge)
- Orchestration (K8S or KubeEdge)
- SDN (OVN or Contiv/VPP)
- Monitoring/Alerting (Prometheus/Grafana)

**Servers**
- High speed networking
- VR/AR
- Storage

**Container/Compute Nodes**
- Servers with SW acceleration (DPDK, SR-IOV)
- Servers with SmartNICs
- Servers with GPU
- Storage Servers
Proposed Generic/Baseline AR/VR Blueprint

GUI
- Dashboard
- Admin GUI
- User GUI (content portal)
- Prometheus

Edge Application and APIs
- Applications
  - VR/AR Apps
  - Adaptive Remote Rendering Runtime
- APIs
  - Developer VR App
  - Developer AR App

Edge Application Orchestration
- Lightweight Edge App Orchestration
  - Kubernetes
  - CRM

Edge Platform Software Components
- Isolation framework
- Docker, VM
- Infra Orchestration
- Kubernetes, Kubefed
- Storage
- Ceph, Calico
- Network Control Plane
- Flannel
- Network Data Plane
- OVS
- Operation System
- Ubuntu, Windows Server

Network Edge
- Multi-node Single cluster
- NC – Multi-node Multi-Cluster

VR/AR - new
Generic/baseline
VR/AR optional Add-ons
Future release
Optional MEX application centric Components
# Cloud VR/AR Blueprint Spec

<table>
<thead>
<tr>
<th>Case Attributes</th>
<th>Description</th>
<th>Informational</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>New Blueprint for VR/AR on the Network Edge</td>
<td></td>
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<tr>
<td><strong>Blueprint Family - Proposed Name</strong></td>
<td>Integrated Edge Cloud (IEC) Type 4</td>
<td></td>
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<tr>
<td><strong>Use Case</strong></td>
<td>Deployment of generic edge end and cloud environment for VR/AR cloud streaming</td>
<td>ref to use case supplementary material</td>
</tr>
<tr>
<td><strong>Blueprint proposed Name</strong></td>
<td>IEC Type 4: Generic AR/VR oriented Edge Stack for Integrated Edge Cloud (IEC) Blueprint Family</td>
<td></td>
</tr>
<tr>
<td><strong>Initial POD Cost (capex)</strong></td>
<td>Leverage IEC Type 1 Blueprint - less than $120k (3 nodes)</td>
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## Scale & Type

- **Generic blueprint PoC:**
  - One master node and up to 5 worker nodes with mixed Linux and optional Windows OS
  - Each server, x86/ARM server with nVidia RTX GPUs (Titan or GeForce TBD)
- **Large scale deployment:**
  - Number of servers, x86/ARM server or deep edge class, is site dependent (footprint)
  - vGPU and federation supported class, e.g. NVIDIA Tesla K80 GPUs;
  - Chelsio T580-CR NIC

## Applications

- **Generic blueprint PoC:** Small scale cloud AR/VR rendering farm with generic SO
  1. High performance premium gaming, 3D/Light-field video for movies, live concerts, events, LBE, etc.
  2. Enterprise applications, including training/education, product design collaboration, manufacturing, maintenance, data analytical etc,

## Power Restrictions

- N/A

## Infrastructure orchestration

- **Docker 18.09.4 or above (19.03 may be needed to run optional windows container with nVidia GPU support)** and K8s 1.14.1 or above- Container Orchestration, VMWare VM
- **OS - Ubuntu 18.04.2, windows server 2019**

## SDN

- Calico and K8s, or or SR-IOV, OVS-DPDK

## Workload Type

- VR and AR applications with adaptive remote/split rendering runtime running inside Containers or VM

## Additional Details

- The test configuration consists of 3 machines connected using ethernet switch: a master and 2 worker nodes, each with TBD processor clocked at TBD GHz, with TBD GB of RAM and Ubuntu operating system for master, windows server 2019 or later for worker. MTU of 1450B is configured (to compensate for GTP tunnel header). Each windows server preconfigures with 2-3 VMs with fixed GPU allocation per VM.
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