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Open Source Private 5G on Standard Servers:

An End-to-End O-RAN Blueprint on OpenNebula

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Hello, FOSDEM!

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Alfonso Carrillo Aspiazu | **Principal Edge Solutions Architect** at OpenNebula Systems

- **Alfonso Carrillo Aspiazu is the Principal Architect for Edge Solutions at OpenNebula Systems. With over 20 years of experience, he is an expert telecom and edge virtualization.**
- **He currently participates in the EU IPCEI-CIS ONEnextgen project ecosystem, is the Technical Account Manager for Telco projects, and actively participates in various national and European projects.**

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1 Motivation & Goal

Private 5G without proprietary boxes

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- ✓ Proprietary “black box” baseline
- ✓ Open-source maturity (srsRAN + Open5GS)
- ✓ Thesis: orchestration + EPA makes telco-grade behavior

What you'll see in 18 minutes

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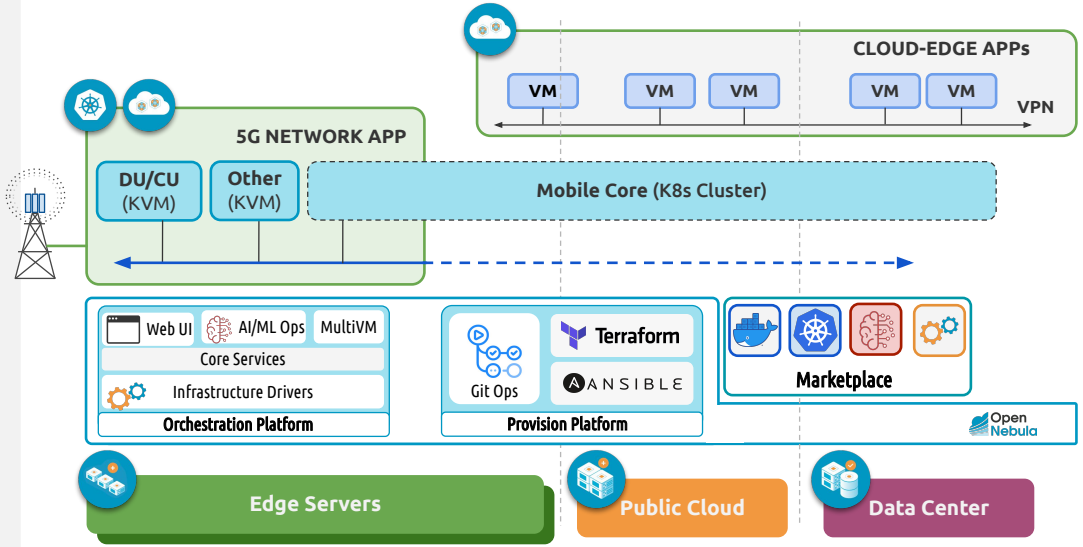
- ✔ End-to-end blueprint on OpenNebula
- ✔ srsRAN (CU/DU) + Open5GS (5GC)
- ✔ EPA pillars: SR-IOV/PT, CPU pinning/NUMA, PTP host→guest
- ✔ Automation + Marketplace appliances

2 End-to-end Reference Architecture

Reference Architecture

https://support.opennebula.pro/hc/en-us/article_attachments/26384607794973

- ✔ Edge node(s) + OpenNebula
- ✔ Telco appliances:
  - Open5GS Core VM
  - srsRAN CU/DU VM(s)
- ✔ Traffic flow: RAN → Core



Where performance is won or lost

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- ✓ EI/O determinism
- ✓ TCPU/NUMA determinism
- ✓ Time determinism

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EPA for Telco Workloads

EPA #1: SR-IOV & PCI passthrough

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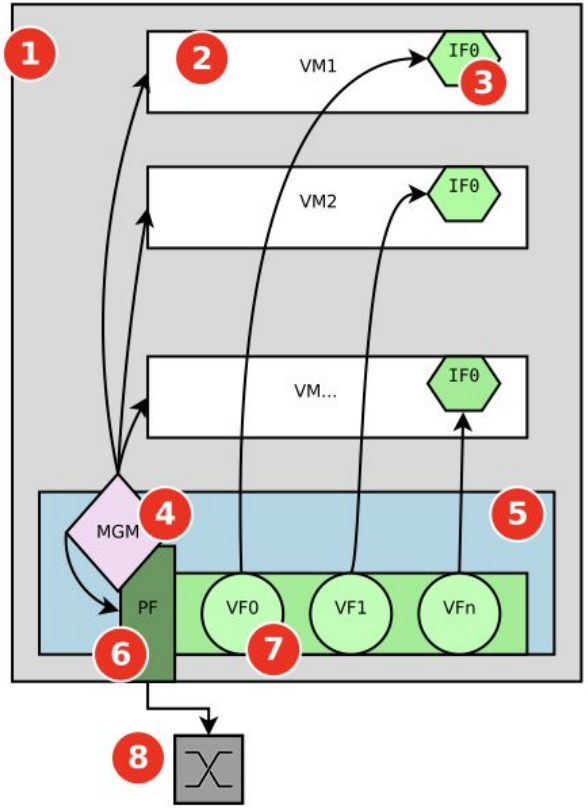
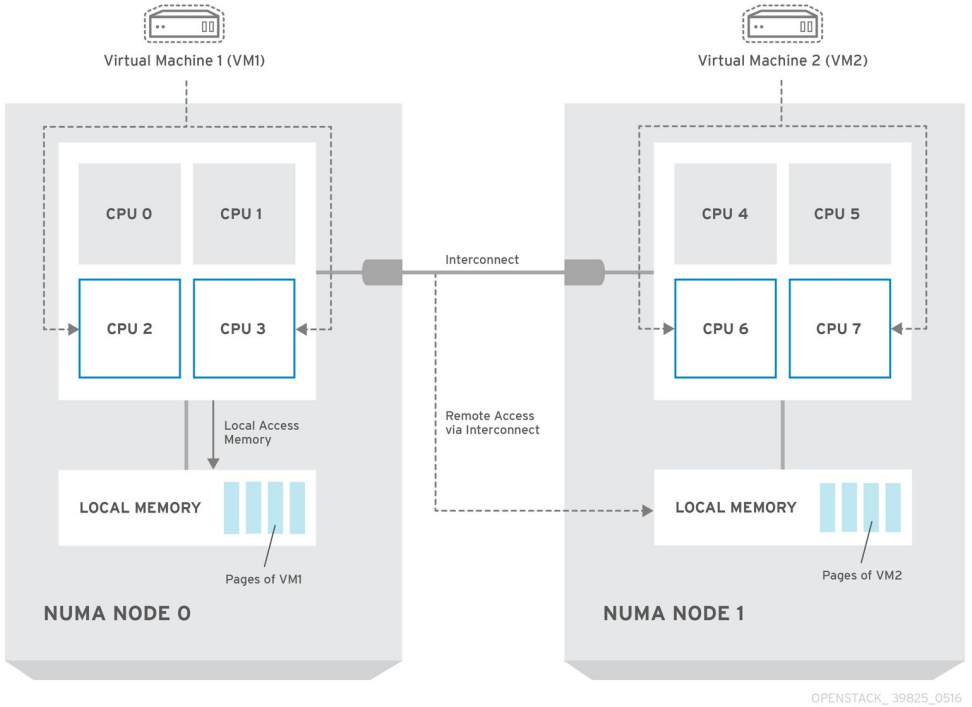
- VF vs passthrough: when/why
- Pitfalls:
  - IOMMU/VT-d,
  - drivers/firmware,
  - IRQ/queues



EPA #2: CPU pinning & NUMA awareness

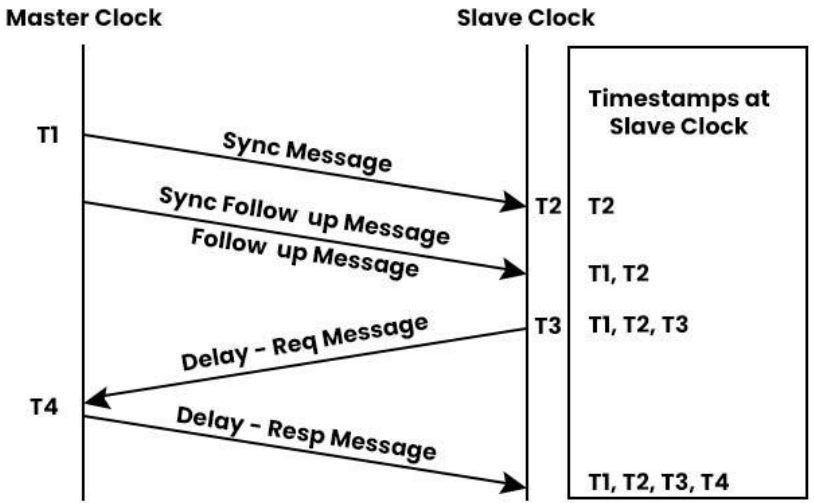
- vCPU pinning for determinism
- NUMA alignment: CPU + memory + NIC locality
- Pitfalls: oversubscription, SMT, affinity drift

- **Visual:** RedHat



EPA #3: PTP host → guest

- Host PTP discipline → guest time propagation
- Pitfalls: NTP/PTP conflicts, unstable GM/holdover, “close enough”



Why platform beats black box: multi-tenancy & neutral hosting

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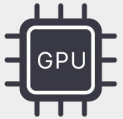
- ✔ EPA enables hard isolation
- ✔ Multi-tenant edge hosting model
- ✔ Neutral hosting for multiple tenants
- ✔ Co-located services: AI inference / analytics / caching



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Blueprint Automation & Verified Appliances

Blueprint: making a 5G-ready edge node

- BIOS: VT-d/IOMMU, SR-IOV
- OS/kernel: isolation, hugepages (if used), VF provisioning
- PTP: host setup + validation
- OpenNebula: templates for pinning/NUMA + SR-IOV/PT profiles

Marketplace appliances & instantiation flow

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- ★ **Verified appliances: Open5GS Core, srsRAN CU/DU**
- ★ **Launch sequence: attach → verify → start core → start RAN → validate**

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Beyond 5G: Multi-Tenancy, Neutral Hosting & AI Inference at the Edge

Takeaways

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- **EPA is mandatory for telco-grade stability**
- **Blueprinting makes deployments reproducible**
- **Deterministic edge → multi-tenancy / neutral hosting / AI inference**

OpenNebula @ FOSDEM 2026

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AI Plumbers :

OneAI: An Open-Source Framework for Managing AI Models at Scale.

Network :

Building an Open Source Private 5G Network: A Practical Blueprint.

Virtualization & Cloud Infrastructure :

How I Turned a Raspberry Pi into an Open-Source Edge Cloud with OpenNebula.

Arming Cloud Computing Continuum: Hunting vulnerabilities in open source hybrid clouds.

Find our Booth in LEVEL 1 of BUILDING K

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Thank You!

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ONEnextgen

> OpenNebula.io/IPCEI-CIS

IPCEI-CIS

Next-Generation European Platform for the Datacenter-Cloud-Edge Continuum

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Plan de Recuperación, Transformación y Resiliencia

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