SFC Placement in Edge-Cloud Environments

Estudante
Anselmo Luiz Éden Battisti

Universidade: **UFF**

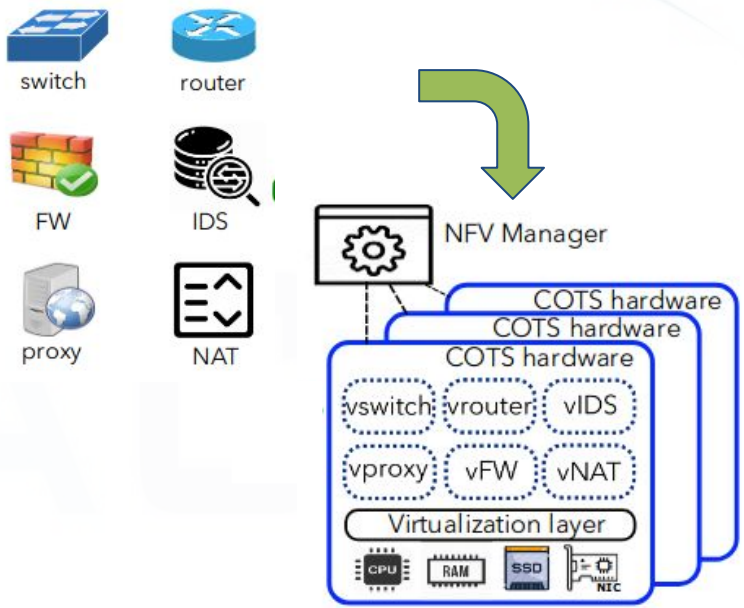
Data Apresentação: **05/09/2023**

Agenda

- NFV Paradigm
- SFC Definition
- EMCO
- Next Steps

NFV Paradigm

- **Trend to virtualize computing and networking resources.**
  - Network core functions, creating the NFV paradigm.
    - The virtualized functions are **VNF.**
- **High-level functions**
  - Video encoders
  - Text to speech



T. Zhang, H. Qiu, L. Linguaglossa, W. Cerroni and P. Giaccone, "NFV Platforms: Taxonomy, Design Choices and Future Challenges," in *IEEE Transactions on Network and Service Management*, vol. 18, no. 1, pp. 30-48, March 2021, doi: 10.1109/TNSM.2020.3045381.

NFV Platform

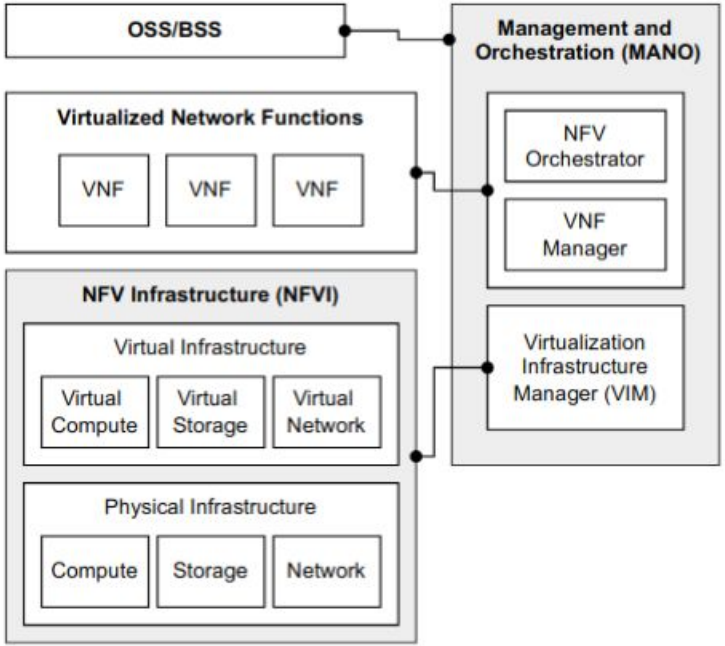
- To execute a VNF, an **NVF Platform** is required.

Open Source MANO

ONAP
OPEN NETWORK AUTOMATION PLATFORM

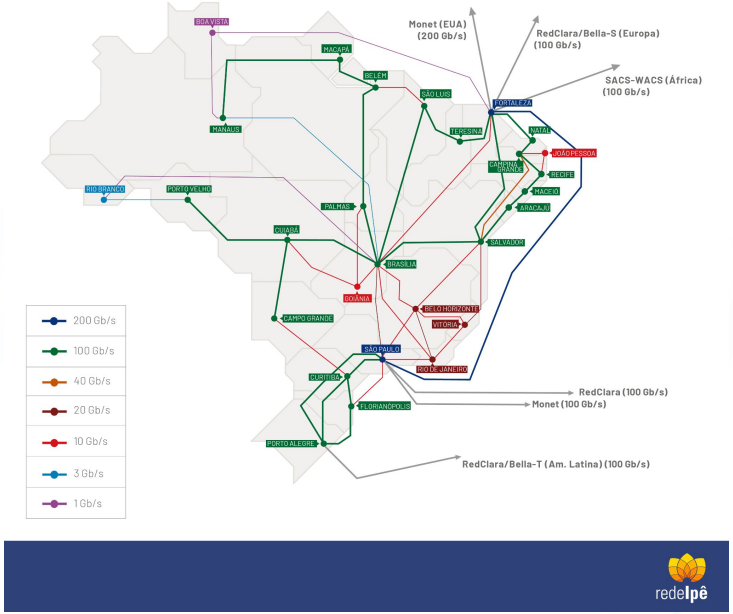
EMCO

- The **VIM** provides interfaces that enable the **NFV Orchestrator** and **VNF Manager** to execute VNFs in the **NFVI**.



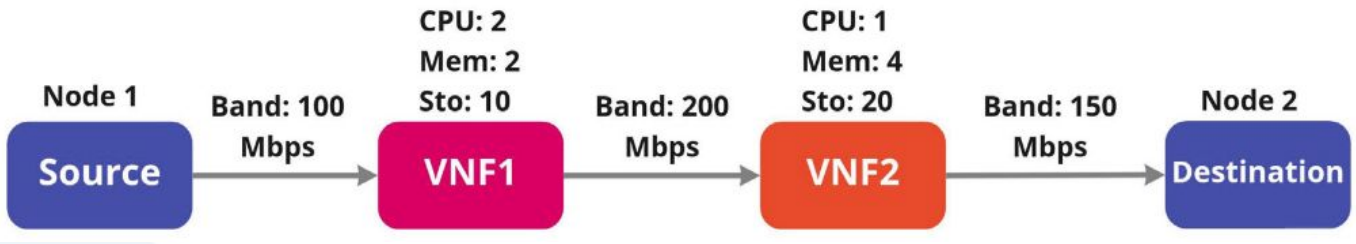
VNF Placement Problem

- **NFV paradigm**, the **VNF Placement Problem** arise.
  - This problem is **NP-Hard** => requiring **good heuristics**.
- **Decides which computational node** will be used to **execute the VNF**.



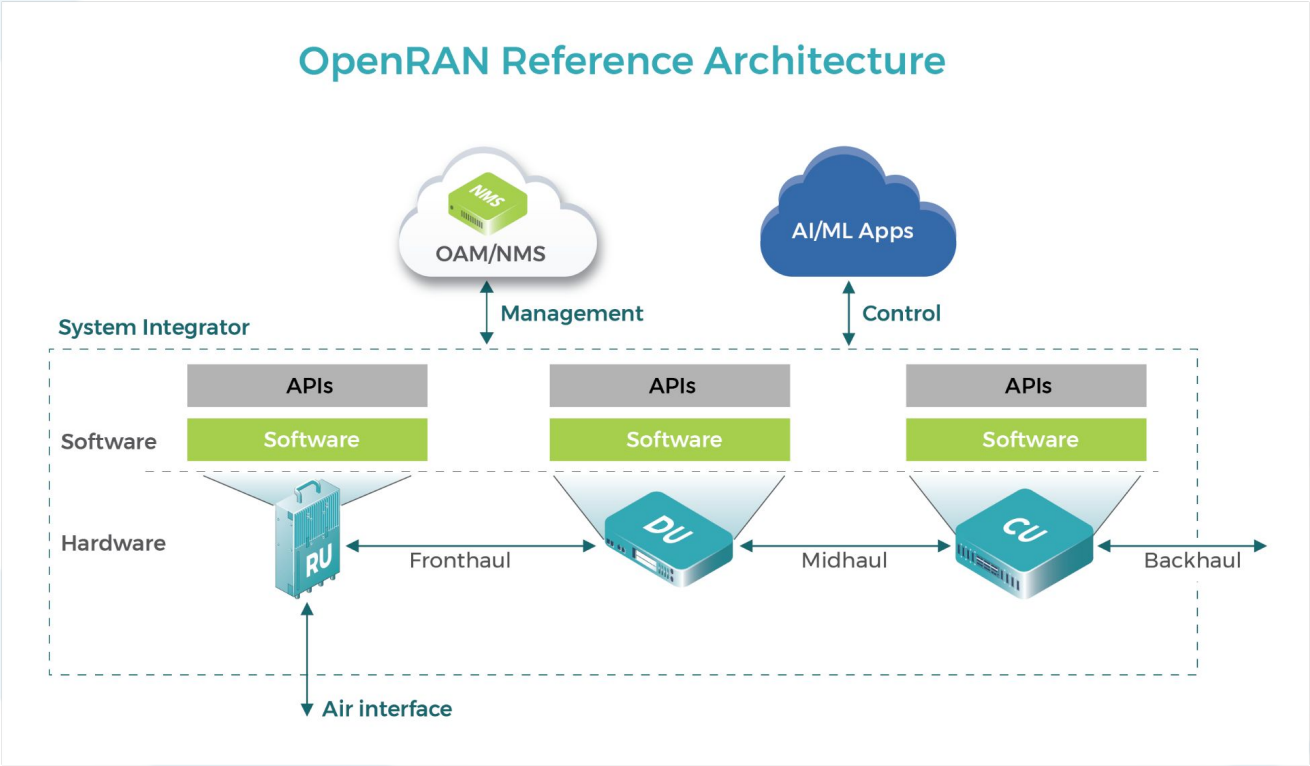
SFC Definition

- Virtualizing **VNFs individually is insufficient in some scenarios**.
  - These scenarios have created the SFC concept.
- The SFC is **a chain of multiple VNFs** with an **SLA**.



Santos, GL, Endo, PT, Sadok, D, Kelner, J. SPIDER: An availability-aware framework for the service function chain placement in distributed scenarios. Softw Pract Exper. 2022; 1- 25. doi:10.1002/spe.31544

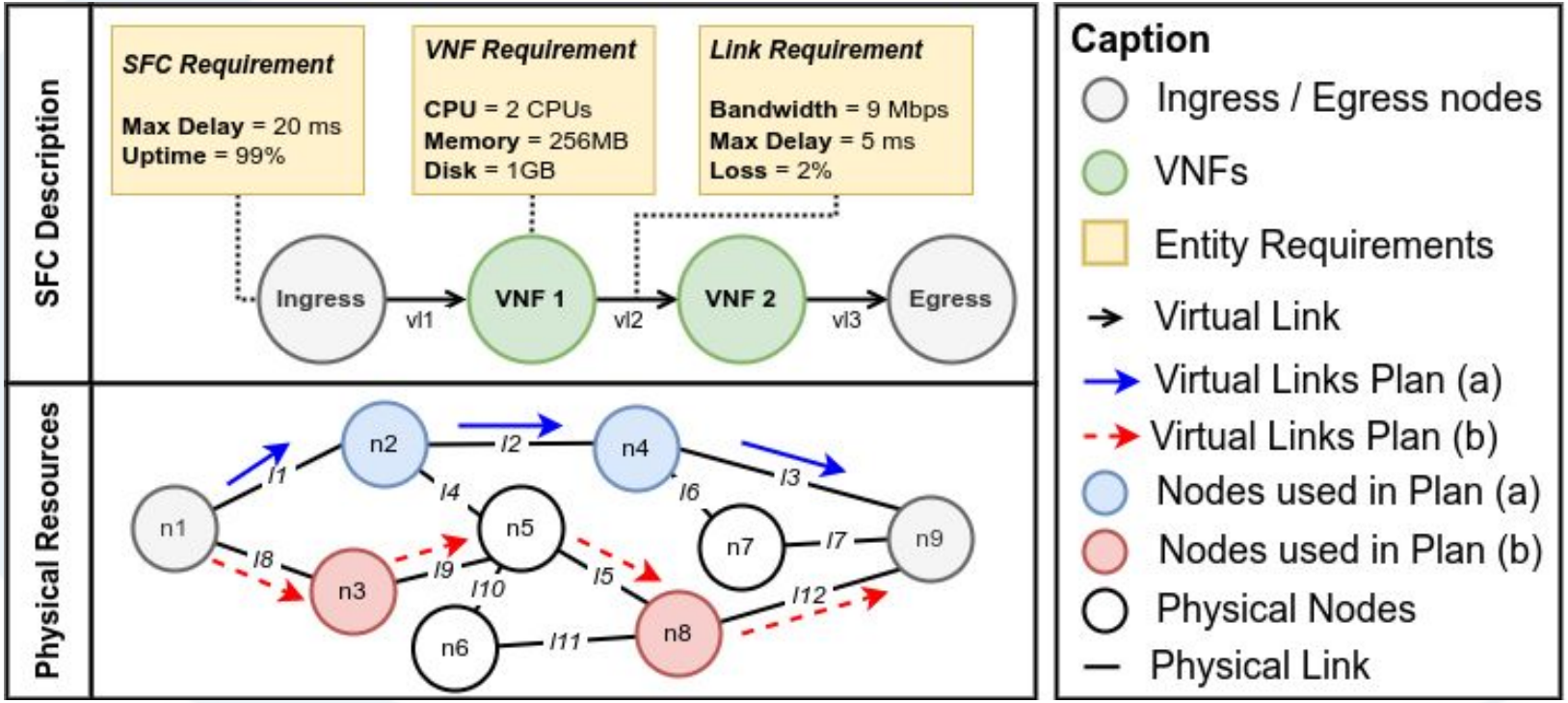
SFC Use Case Example



SFC Placement Problem

- Now the **SFC Placement Problem has emerged**.
- New challenges must be addressed
  - **Where to execute each VNF** of the requested SFC
  - The **networking connectivity** creation to **enable the flow across all the VNFs**.
- Solved using multiple technologies
  - Integer Linear Programming
  - Tabu search
  - Game Theory

SFC Placement Problem



Goal

- Create new methods to solve the SFC Placement Problem in distributed environments.

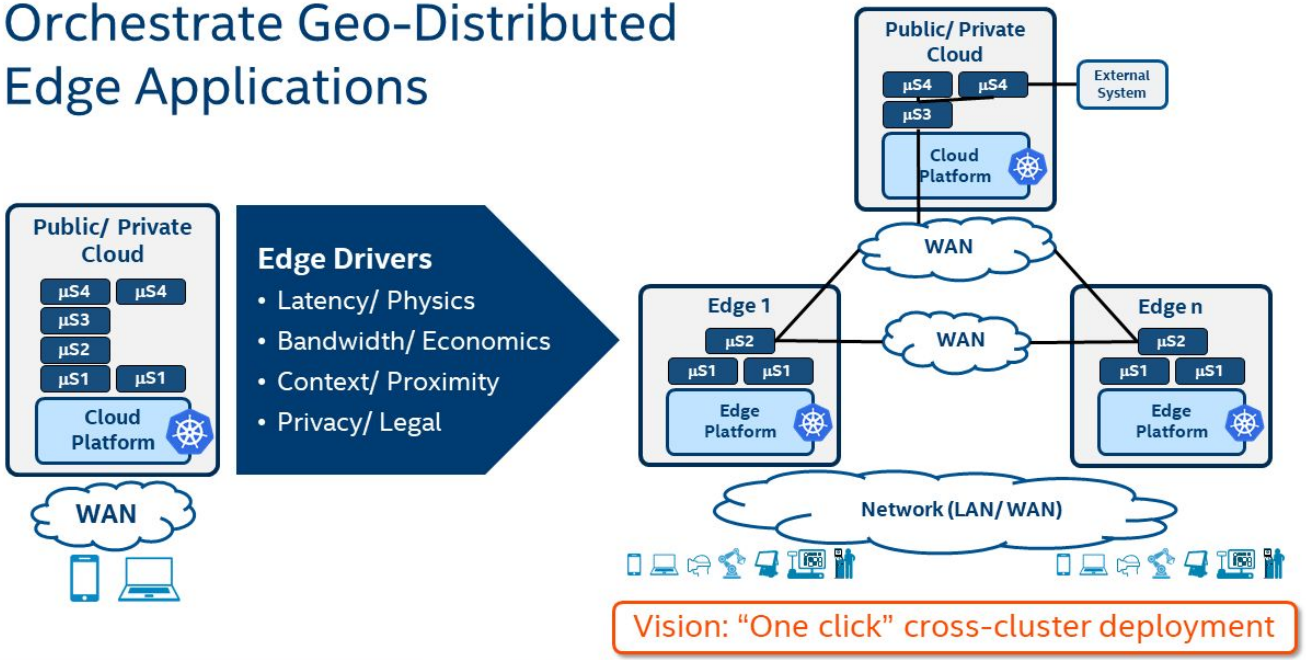
What is EMCO?

- EMCO (Edge Multi-Cluster Orchestrator) is a universal **control plane** and **application orchestrator** for Kubernetes**.**

- EMCO's main objective is to automate the deployment of applications and services across **multiple clusters**.
  - It acts as a central orchestrator that can manage edge services and network functions across **geographically distributed edge clusters from different third parties**.

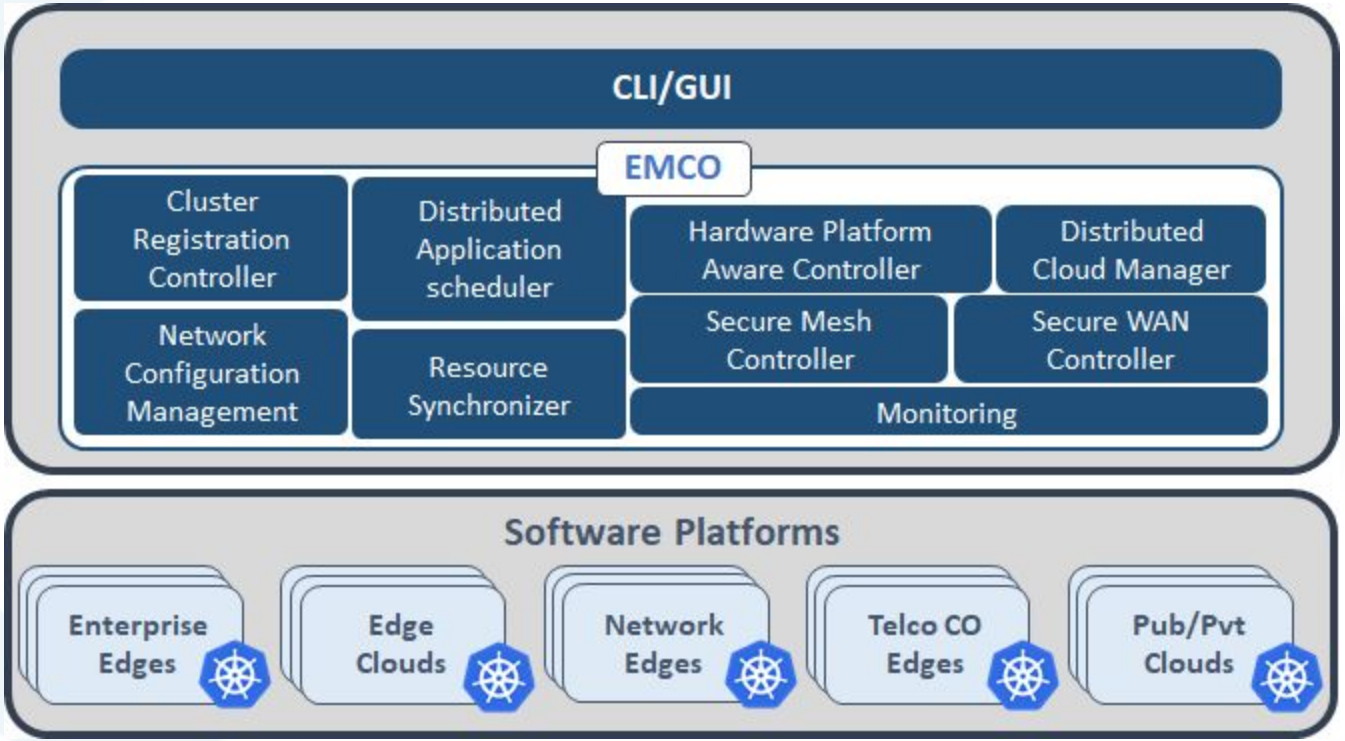
What is EMCO?

Orchestrate Geo-Distributed Edge Applications



Vision: "One click" cross-cluster deployment

What is EMCO?

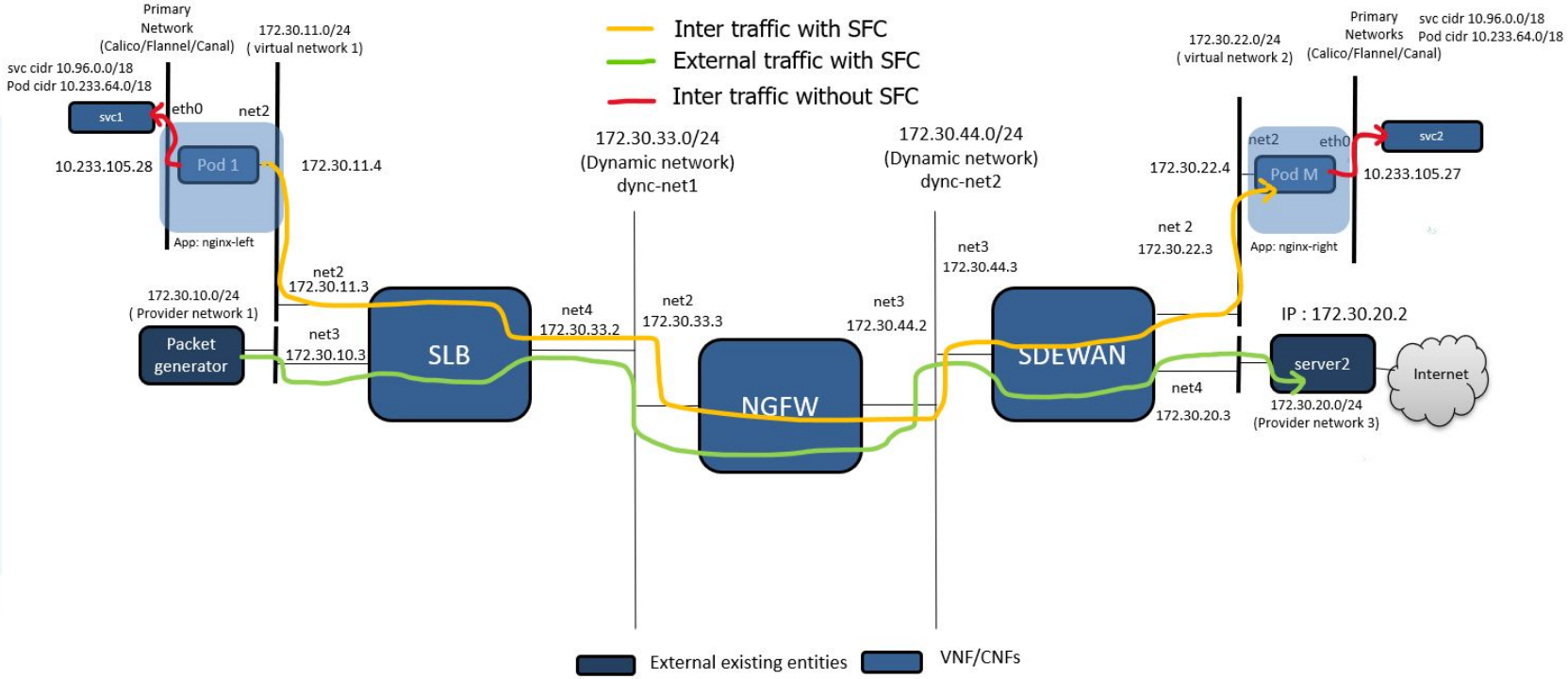

CLI/GUI
EMCO
Cluster Registration Controller
Distributed Application scheduler
Hardware Platform Aware Controller
Distributed Cloud Manager
Network Configuration Management
Resource Synchronizer
Secure Mesh Controller
Secure WAN Controller
Monitoring
Software Platforms
Enterprise Edges
Edge Clouds
Network Edges
Telco CO Edges
Pub/Pvt Clouds

Composite Application

- The composite application is a combination of multiple applications that work together.
  - Each application in the composite application is a Helm chart. Through the use of placement intents, EMCO allows different applications in the composite application to be deployed (and replicated as necessary) to different sets of clusters.

- **SFCs** can be designed as EMCO composite applications.

Composite Application



https://github.com/akraino-edge-stack/icn-nodus/tree/master/demo/calico-nodus-secondary-sfc-setup-II

EMCO - SFC Management

- SFC controller
  - The Service Function Chaining action controller provides intents that can be used to create a Service Function Chain from a number of the apps in the deployment intent group.

- SFC Client controller
  - The SFC Client controller is used to attach components of a composite application to an SFC that has been deployed on the edge cluster(s).

Next Steps

- Implement inside the EMCO SFC Controller the source code of our algorithm to solve the SFC Placement problem in distributed environments.

openRAN BRASIL

Laboratório MídiaCom

Instituto de Computação

Universidade Federal Fluminense

Contatos

Anselmo Luiz Éden Battisti
anselmo@midiacom.uff.br