Multi-PoP Network Slice Deployment: A Feasibility Study

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Introduction

The 5G Networks are expected to support:

- Variety of vertical industries
  - manufacturing, automotive, healthcare, energy, and media & entertainment
- Services with diverse requirements
  - in terms of bandwidth, low-delay, reliability, etc.

Plethora of IoT and Mobile devices

- massive traffic volumes

Introduction

- Network Slice is seen as a key enabler for meeting the diverse network service requirements, which stem from the transition to 5G.

- Network slicing can be defined as group of subsets of physical or virtual (network, compute, storage) resources that span across multiple operators that are independently controlled, managed and orchestrated.

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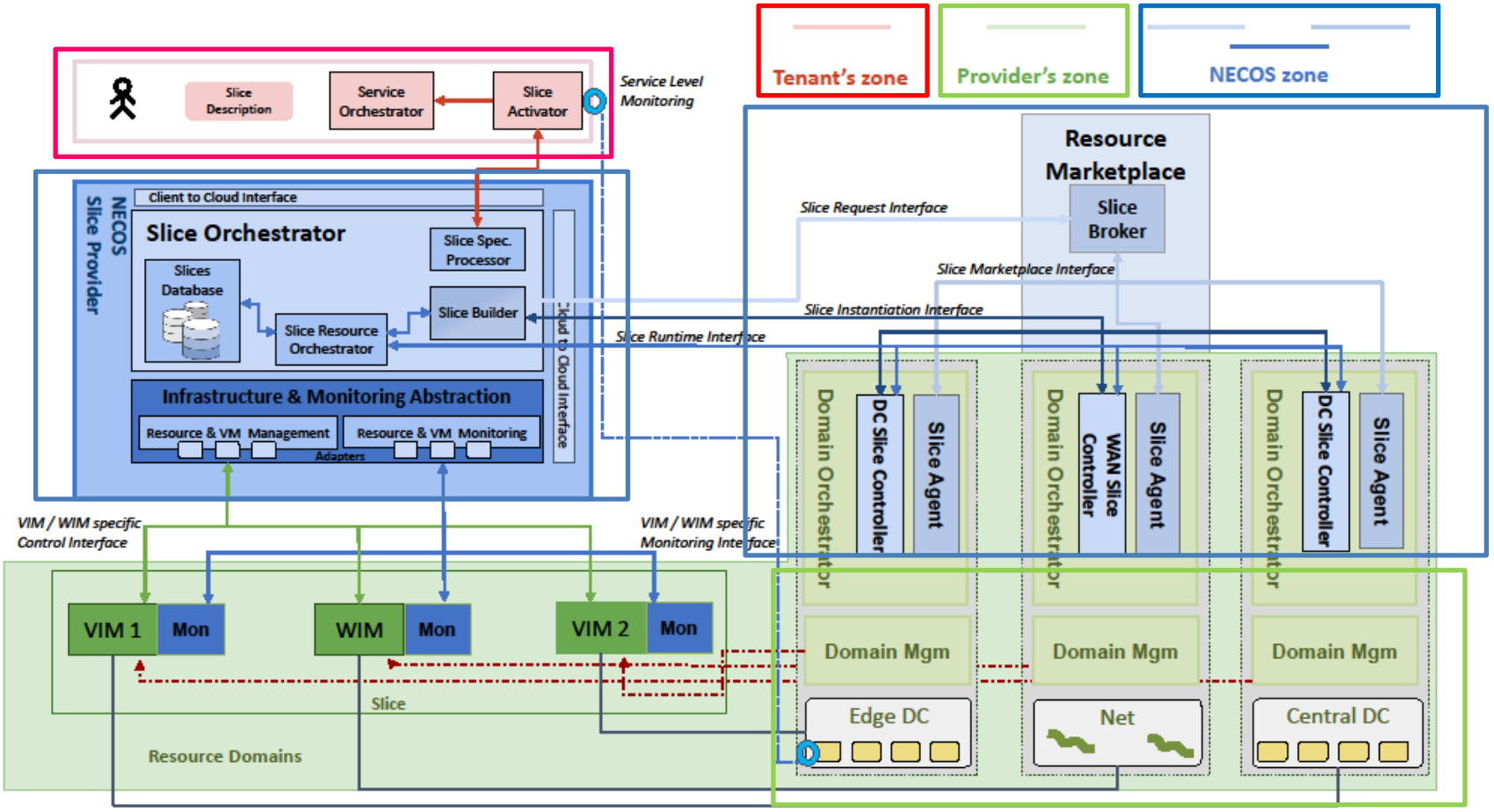
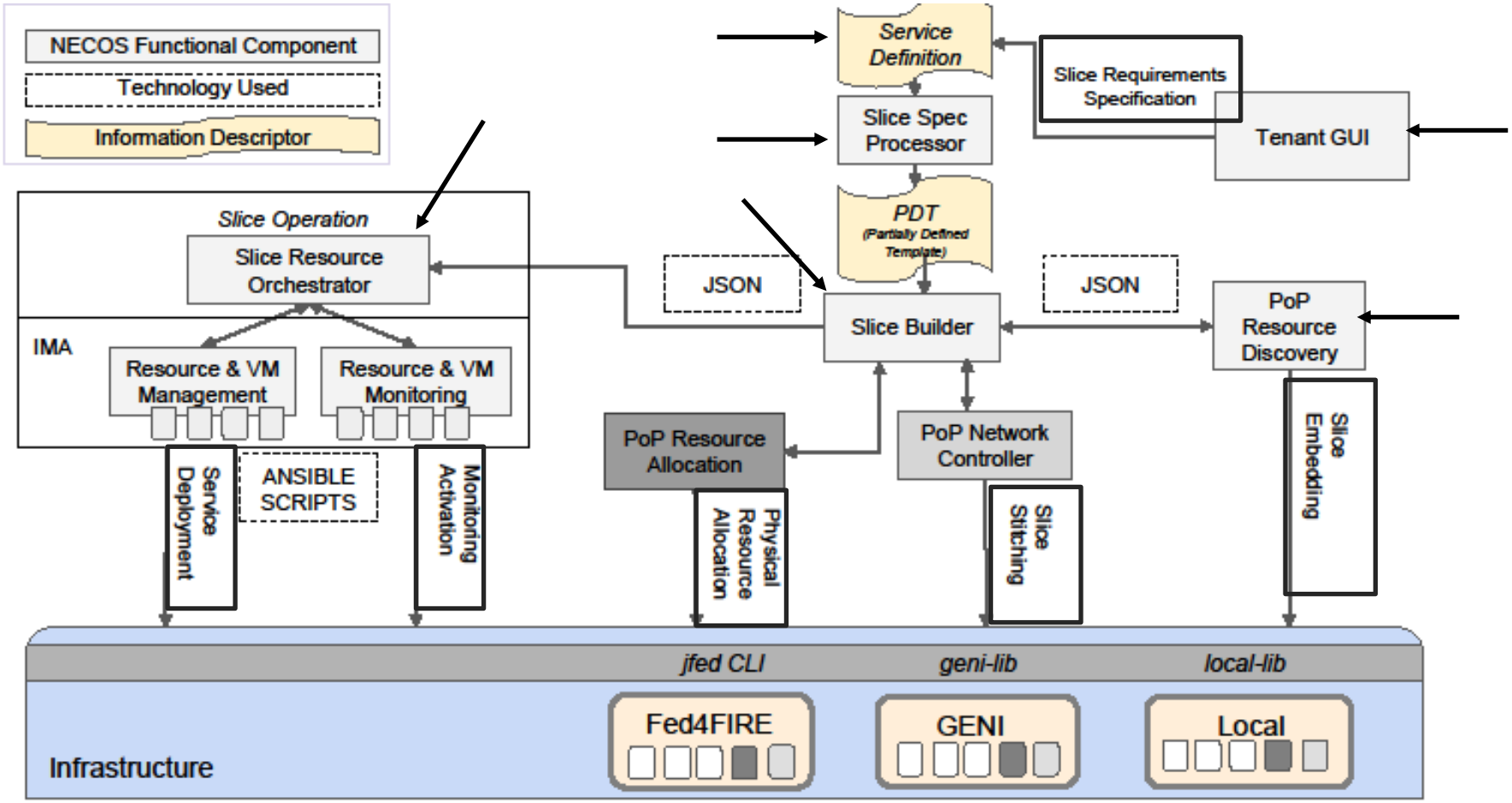
Outline

- Overview of the NECOS Architecture
- Deployment workflow and steps of multi-PoP slice
- Implementation Details
- Experimental Evaluation
- Summary & Future Work

The NECOS Architecture



Deployment workflow



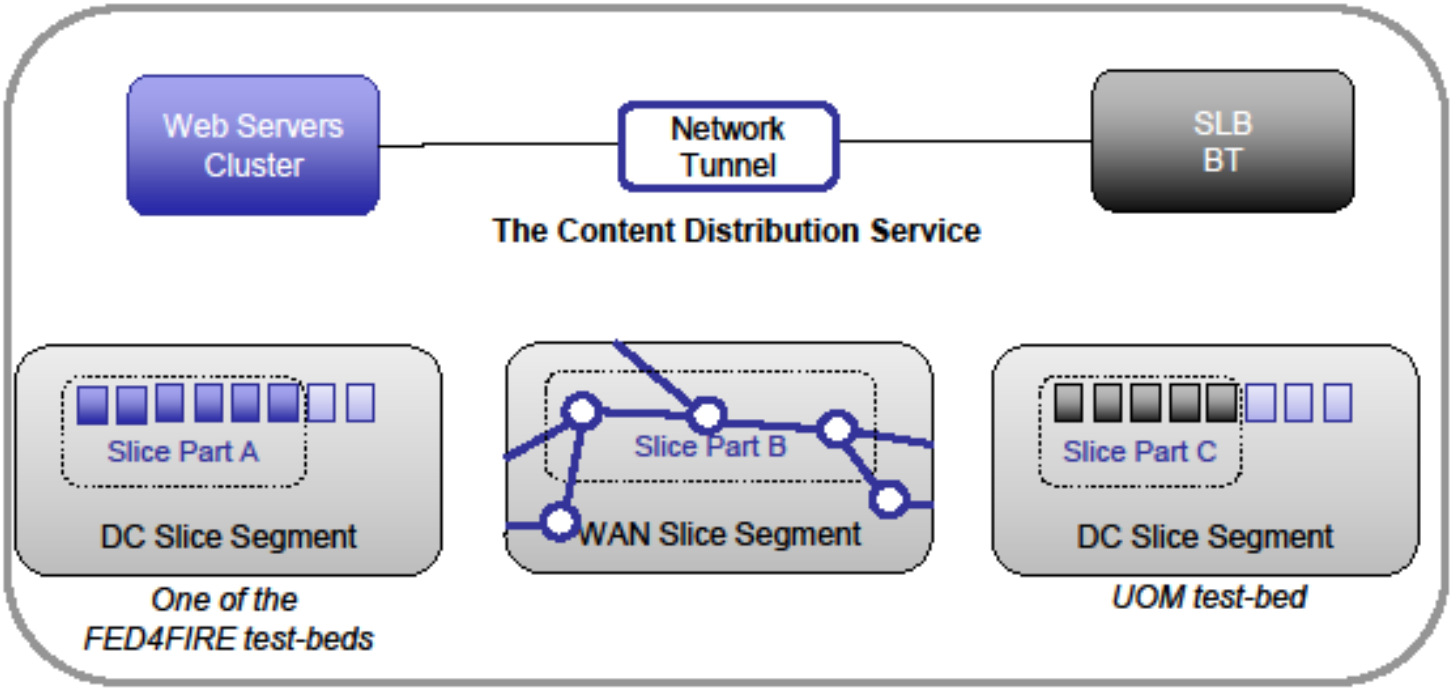
Slice deployment operation steps

- Slice Requirements Specification
  - Tenant defines the slice requirements
- Slice Embedding
  - dynamically discovers physical resources that match the expressed demands
- Physical Resource Allocation
  - allocation and booting up of physical servers and network devices in the different slice-segments
- Slice Stitching
  - stitches the slice segments
- Service Deployment
  - Boot up and configure specific servers
- Monitoring Activation
  - configuration of the requested monitoring capabilities from the Tenant

Content Distribution Service over the NECOS platform

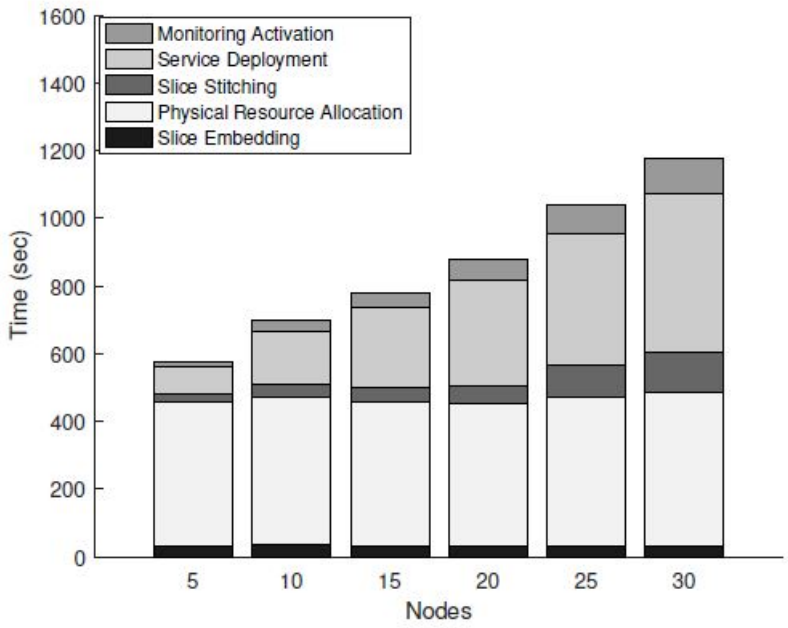
We demonstrate in a **geographically distributed** setting:

- **slice creation** and **service deployment** following the tenant's specifications
- real-time **discovery** and **allocation** of DC/WAN resources
- autonomous **service deployment** and **monitoring** in the allocated slice

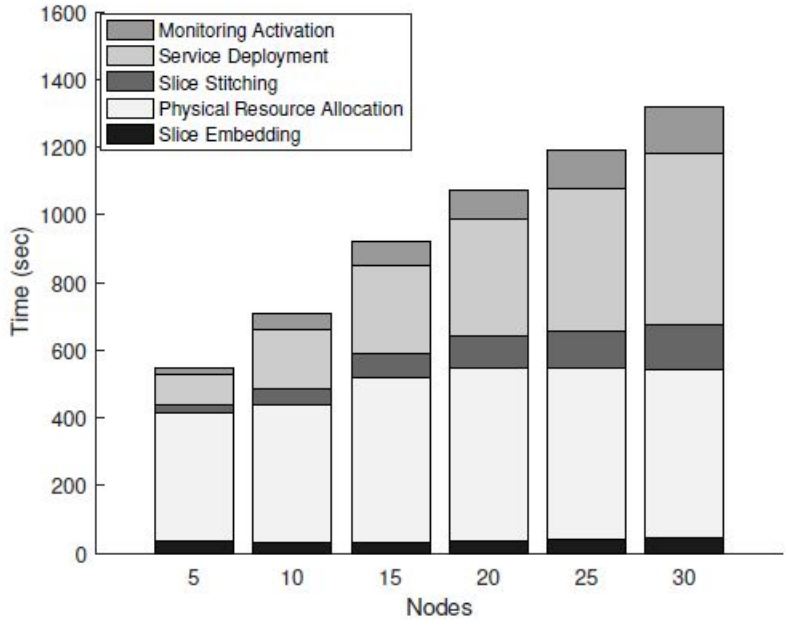


The testbeds are accessible through the novel FED4FIRE experimentation facilities

Experimental Evaluation



(a) Core cloud nodes



(b) Edge cloud nodes

Conclusions

- We conduct a feasibility study of Network Slice instantiation across multiple PoP based on NECOS architecture
- We carried out real experiments utilizing real measurements on the resource availability of variety of open-access test-beds.
- Experiment results indicated that Network Slice instantiation is feasible

Future Work

The Multi-PoP slice deployment approach faces interesting challenging issues, including:

- **Scalability**:
  - Resource requests handled can involve a large number of parallel slices/resources
- **Performance:**
  - Number of messages exchanged, trade-offs, time to respond, etc.
  - Reduce the slice instantiation delay (i.e., slice instantiation tasks run in parallel)
  - Investigate more advanced slice embedding mechanisms
- **Heterogeneity**:
  - Resource discovery coping with a diverse range of server specifications.

Q&A

http://swn.uom.gr/storage/app/media/videos/2019/Multi-PoP%20Network%20Slice%20Deployment%20A%20Feasibility%20Study.mp4

Related Work

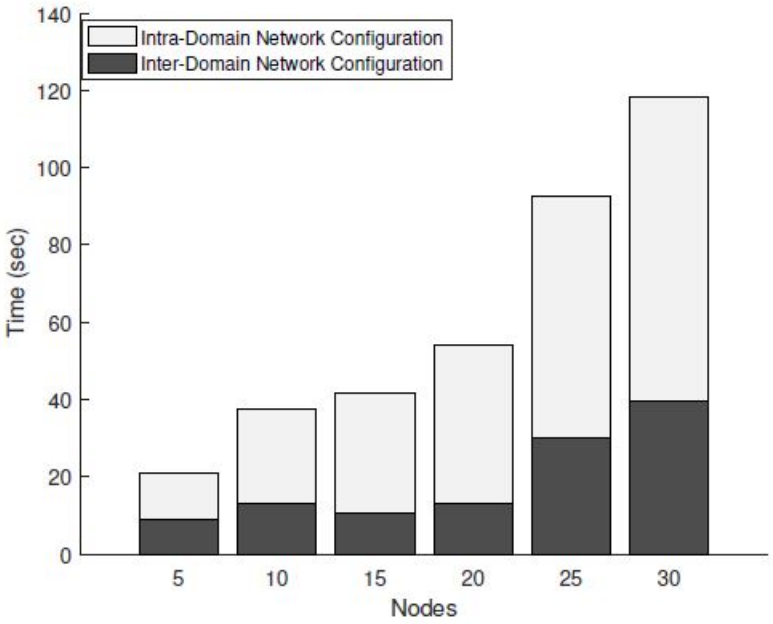
[1] X. Foukas, G. Patounas, A. Elmokashfi, and M. K. Marina, “Network slicing in 5G: Survey and challenges,” IEEE Commun. Mag., vol. 55, no. 5, pp. 94–100, May 2017.

[2] F. S. D. Silva, M. O. O. Lemos, A. Medeiros, A. V. Neto et al., “NECOS project: Towards lightweight slicing of cloud federated infrastructures,” in 4th IEEE Conf. on Network Softwarization and Workshops, June 2018, pp. 406–414.

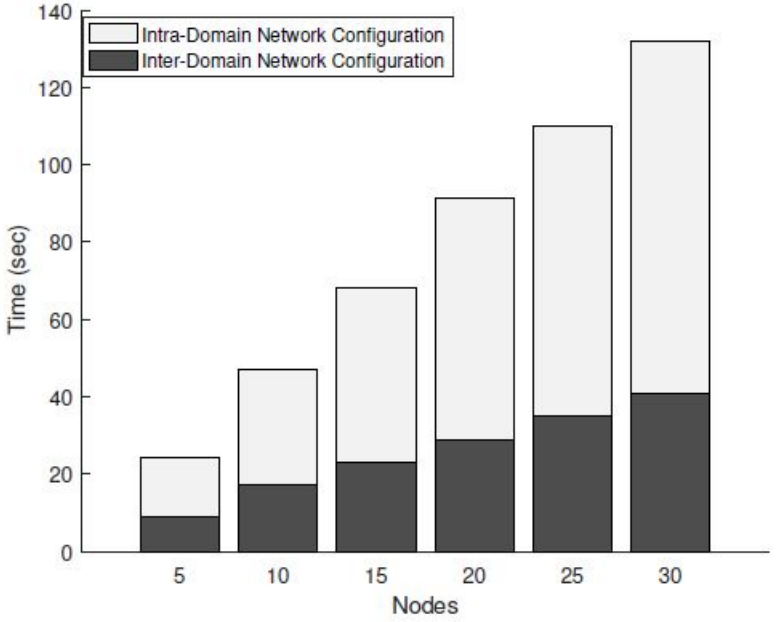
[3] H. Zhang, N. Liu, X. Chu, K. Long et al., “Network slicing based 5g and future mobile networks: Mobility, resource management, and challenges,” IEEE Communications Magazine, vol. 55, no. 8, pp. 138–145, Aug 2017.

[4] L. A. Freitas, V. G. Braga, S. L. Correa, L. Mamatas et al., “Slicing and allocation of transformable resources for the deployment of multiple virtualized infrastructure managers (VIMs),” in 4th IEEE Conf. on Network Softwarization and Workshops, June 2018, pp. 424–432.

Experimental Evaluation



(a) Core cloud nodes



(b) Edge cloud nodes

YAML example

```
slice:
  id: TouristicCDN_sliced
  ...
  slice-constraints:
    geographic:
    dc-slice-parts:
    net-slice-parts:
   ...
  service:
    - service-function:
        vdu:
          id:
          ...
    - service-function:
        service-element-type: vdu
        vdu:
          id:
          epa-attributes:
            host-epa:
              cpu-model: 'single 3GHz'
              cpu-arch: X86_64
              cpu-vendor: Dell
              cpu-number: 1
              storage-gb: 256
             ....
    - service-link:
        service-element-type: link
        link:
          name:
          type: ...
```

```
slice:
    # definition of DC slice parts
    - dc-slice-part:
        name: dc-slice1
        vdus: …
    - dc-slice-part:
        name: dc-slice2
        vdus: …
        …
    - …
# definition of WAN slice parts
    - net-slice-part:
        name: external_ip_slice1-to-external_ip_slice2
        links:
          - dc-part1: dc-slice1
          - dc-part2: dc-slice2
        type: interconnect
```

Slice Geographic Constraints

Service Descriptions

Service Specific Resource Flavor Constraints

Extended Attributes

Marketplace components and interactions