A Multi-domain Experimentation Environment for 5G Media Verticals

Polychronis Valsamas, Ilias Sakellariou
Sophia Petridou, Lefteris Mamatas

Department of Applied Informatics
University of Macedonia
Thessaloniki, Greece
{xvalsama, iliass, spetrido, emamatas}@uom.edu.gr
Objectives

- Large-scale experimentation of service and resource elasticity utilizing the FED4FIRE test-beds
  - E2E network slicing over multiple, geographically distributed providers with heterogeneous physical and virtual resources
  - Dynamic resource discovery and allocation of DC/NET resources residing at both FED4FIRE and local test-beds
  - Experimentation with modular media service orchestration mechanisms, e.g., content caching
Platform’s architecture

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Slicing for Content Distribution

The Content Distribution Service

- Benchmark tools
- Load Balancer
- Service Orchestrator

UOM test-bed

Network Tunnel (stitching)

FED4FIRE test-beds (VWall2), CLUtah, UOM

Web Servers Cluster

slice part
slice:
  id: TouristicCDN_sliced
  ...  
**slice-constraints:**
  geographic: ['GREECE', 'USA']
  dc-slice-parts: 2
  net-slice-parts: 1
  ...  
service:
  - **service-function:**
    vdu:
      id: benchmarking_clients
      ...  
    - **service-function:**
      service-element-type: vdu
      vdu:
        id: web_server_VMs
        description: 'webserver cluster for CDN'
        flavor:
          vcpu-count: 1
          memory-mb: 128
          storage-mb: 100
      ...  
    - **service-link:**
      service-element-type: link
      link:
        name: orc-to-wsc
        type: MULTIPLEXED
      ...  

- service-function:
  # defining web server cluster VDU
  vdu: ...
  epa-attributes:
    host-epa:
      cpu-model: 'single 3GHz'
      cpu-arch: X86_64
      cpu-vendor: Dell
      cpu-number: 1
      storage-gb: 292
      memory-mb: 4096
      host-range: [2, 5] # define host-count and max-host-count and remove
      host-count: undefined
      max-host-count: undefined
      allocate-hosts: True
      type: 'pc3000' # normally undefined and to be defined by the slice agent
  os-properties:
    architecture: x86_64
    type: linux
    image-type: EMULAB

Extended Attributes

Operating System Specifications
- **service-function:**
  
  # defining web server cluster VDU

  vdu: ...

  epa-attributes:
  
  host-epa: ...

  hypervisor-epa:
  
  type: XEN
  
  version: '4.5'

  VIM-epa:
  
  name: cdn-xen-vim
  
  type: XEN-SERVER
  
  version: '7.5'
  
  on-demand: true

  vsswitch-epa:
  
  type: openvswitch
  
  acceleration: PREFERRED
  
  offload: PREFERRED

**Hypervisor Specification**

**VIM Specification**

**Virtual Switch Specification**
YAML input

```
- service-function:
  # defining web server cluster VDU
  vdu: ...
    epa-attributes: ...
  monitoring-parameters:
    tool: collectd
    measurements_db_ip: undefined
    measurements_db_port: undefined
  metrics:
    - metric:
        name: CPU_UTILIZATION
        granularity-secs: 10
    - metric:
        name: MEMORY_ALLOCATION
        granularity-secs: 10
    - metric:
        name: BANDWIDTH_UTILIZATION
        granularity-secs: 10
```
E2E slicing: abstract view

east-end dc-slice part always part of the UOM test-bed

west-end dc-slice part different test-beds: VWall2, CLUtah, UOM
Heterogeneous hardware resources

**Clients’ connection time**

**Clients’ download time**

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Heterogeneous virtualization resources

**Clients’ connection time**

**Network throughput**
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Resources satisfying memory criteria

Resources satisfying CPU criteria
Resource discovery over FED4FIRE

Resources satisfying disk storage criteria
low-end resources

Resources satisfying bandwidth criteria

Slice Resource Controller

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Modular service orchestration

Performance of the placement algorithms

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Conclusions

- **5G-CDN platform**: a novel experimentation facility for *large-scale, multi-domain* E2E slicing for media content delivery
  - handle heterogeneous physical and virtual resources
  - enable automation in respect to dynamic resource discovery and service-aware E2E slice establishment
  - abstract test-bed control approaches, multiple virtualization technologies (e.g., VIMs) and resource specifications (i.e., applying uniform representation of resources)
  - refine a high-level service definition to lower-level slice specifications, while supporting modular CDN service orchestration

- We are currently working on investigating *alternative media service aspects*, e.g., augmented reality scenarios, interactive services and streaming approaches.
Merci pour votre attention!

Dr. Sophia Petridou,

Department of Applied Informatics
University of Macedonia
Thessaloniki, Greece
spetrido@uom.edu.gr