A Holistic Approach to Define Service Chains Using Click-on-OSv on Different NFV Platforms

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Agenda

- Network Function Virtualization
- Service Function Chaining
- A Holistic Approach do Define Service Chains
- Evaluation
- Conclusion

Network Function Virtualization

- Several network functionalities are implemented by a large variety of middleboxes
  - Specific purposes (e.g. firewall, load balancers, proxies, etc.)
  - Match hardware and software from the same manufacturer

- Network Function Virtualization (NFV) allows to replace services traditionally provided using middleboxes by software
  - Software can be executed by virtualization systems on Commercial-Off-The-Shelf (COTS) hardware
  - Decreases costs, increases flexibility to operate and manage network services

Network Function Virtualization

- Virtual Network Function (VNF)
  - Responsible to process a specific network traffic
  - Operates on different layers of the protocol stack

- The European Telecommunications Standards Institute (ETSI) has proposed an architecture for NFV Management & Orchestration (NFV-MANO)
  - Disseminate the use and interoperability of the NFV
  - It provides the functionality required for the provisioning of VNFs and its related operations

Service Function Chaining

- Complex network services can be formed by composing a set of network functions
- Service Function Chaining (SFC)
  - Consists of composing a set of VNFs and routing the traffic through them according to a predefined order (Service Chain)

- The Internet Engineering Task Force (IETF) has proposed an architecture for the SFC
  - SFC: Employs a flow identifier
    - MPLS (Multiprotocol Label Switching)
    - VXLAN (Virtual eXtensible Local Area Network)
    - NSH (Network Service Header)
  - Conventional Routing
    - Decisions are taken on destination IP address

Motivation

- The deploymet of service chains consisting of multiple network functions can be complex, expensive, and time-consuming
- Network operator performs a large number of tasks and services to accomplish service chain composition
  - Laborious task
  - Requires operational experience of the NFV Platform
  - Knowledge of specific data models, describing languages, and their requirements to compose SFCs
- Network operators can get overwhelmed with details of the NFV platform being used
  - Missing the focus on the service composition logic itself
- The efficient composition of service chains still lacks high-level procedures

A Holistic Approach to Define Service Chains

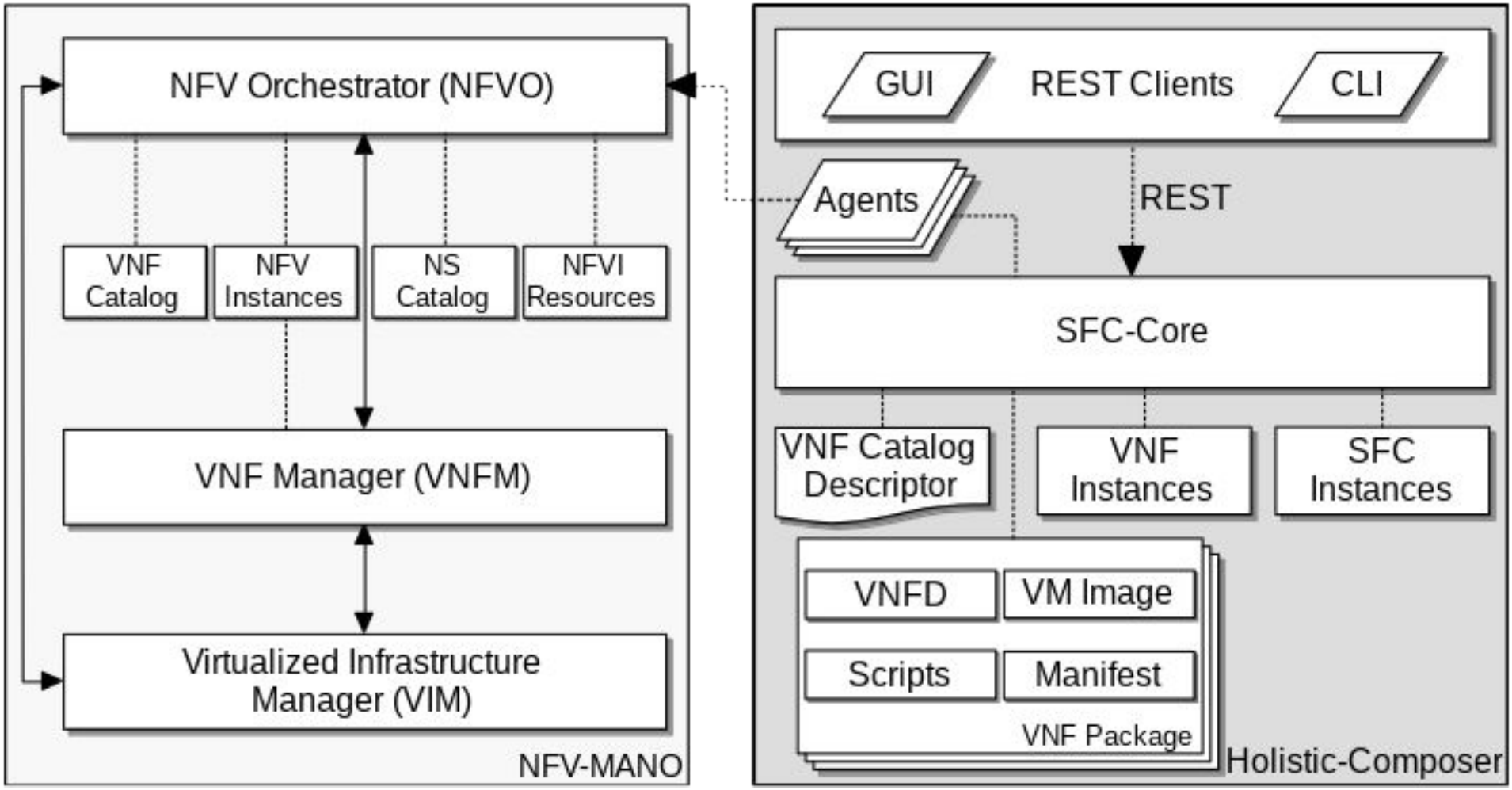
- This work proposes a solution for the definition and lifecycle management of VNF service chains
- A framework architecture is proposed as an extensible solution of the NFV-MANO

- Holistic
  - Defines a generic API for the composition of SFCs leveraging particular details of different NFV orchestrators

A Holistic Approach to Define Service Chains

- Main goals
  - Enable the composition and management of SFCs on different NFV Platforms
  - Allow the use of the framework on several final applications and on different NFV platforms which are MANO-compliant
  - Reduce the complexity of NFV platforms to define and manage service chains
    - Network operators do not need specific knowledge
  - Simplify the SFC composition
    - Network operator just informs the sequence of VNFs

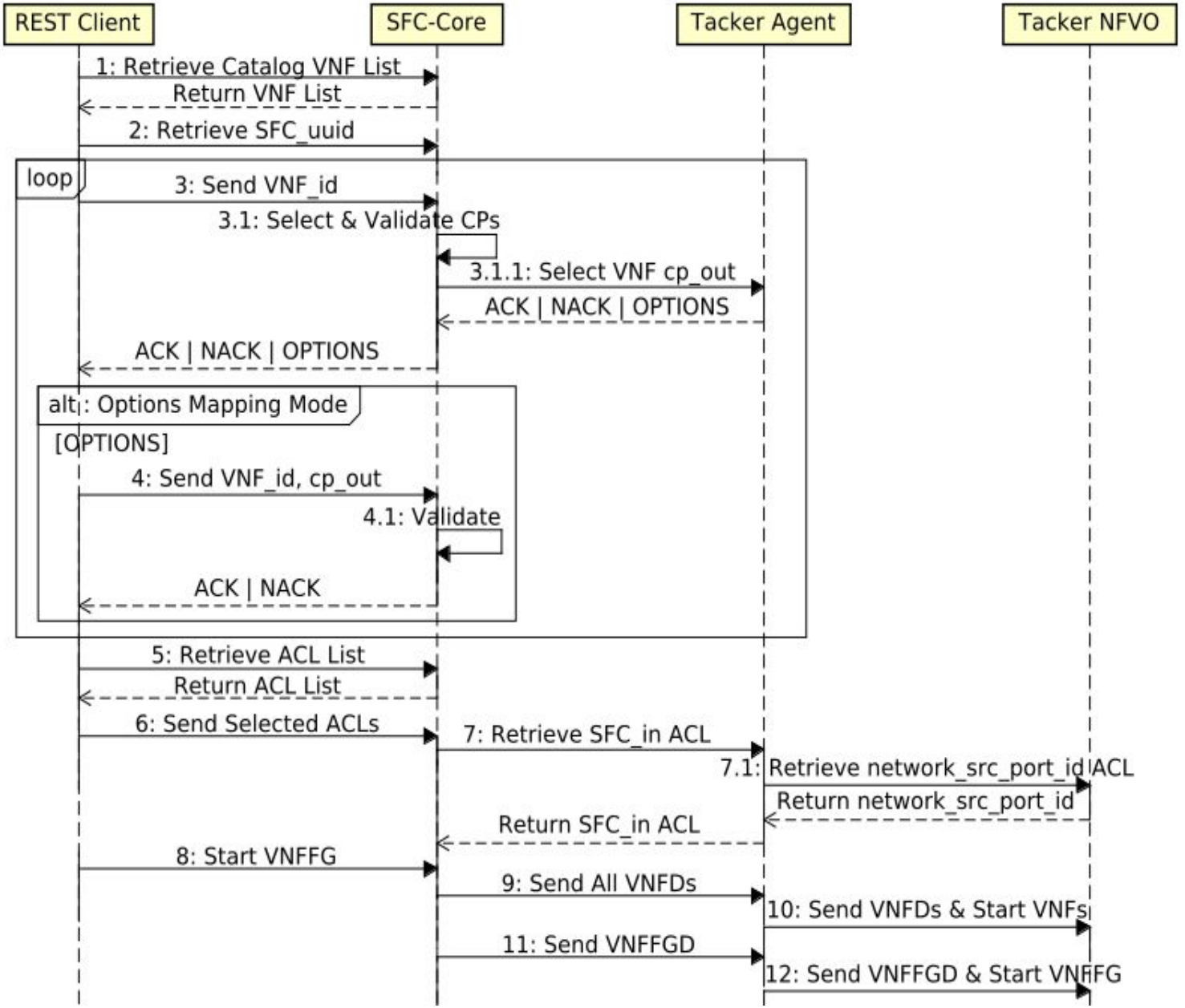
The Proposed Architecture



NFV Enablers

- OpenStack
  - Platform used to control Cloud Computing infrastructure resourses
  - NFV Context: Used in physical resource virtualization for VNFs and network services (VIM)
- Click-on-OSv
  - Enables the execution of network functions built with the Click Modular Router on the OSv unikernel
  - Allows creating high-performance and minimalist VNFs
  - Runs on: Xen, KVM, VMware and VirtualBox
- Tacker
  - Official OpenStack project to develop generic VNFM and NFVO
  - Based on the ETSI NFV-MANO architecture

Service Chain Composition



Prototype Implementation

- Architecture components implemented in Python
- *Flask* library to provide a REST interface
- *Requests* library
  - Communication Agent (Tacker)
  - Client Application (CLI)
- Implementation of an *Element Management* (EM) for the Click-on-OSv
  - Provides FCAPS (*Fault, Configuration, Accounting, Performance and Security*) functionalities through a REST API
- Prototype also allows composing SFCs using traditional VNFs (e.g. Linux)

Prototype Evaluation

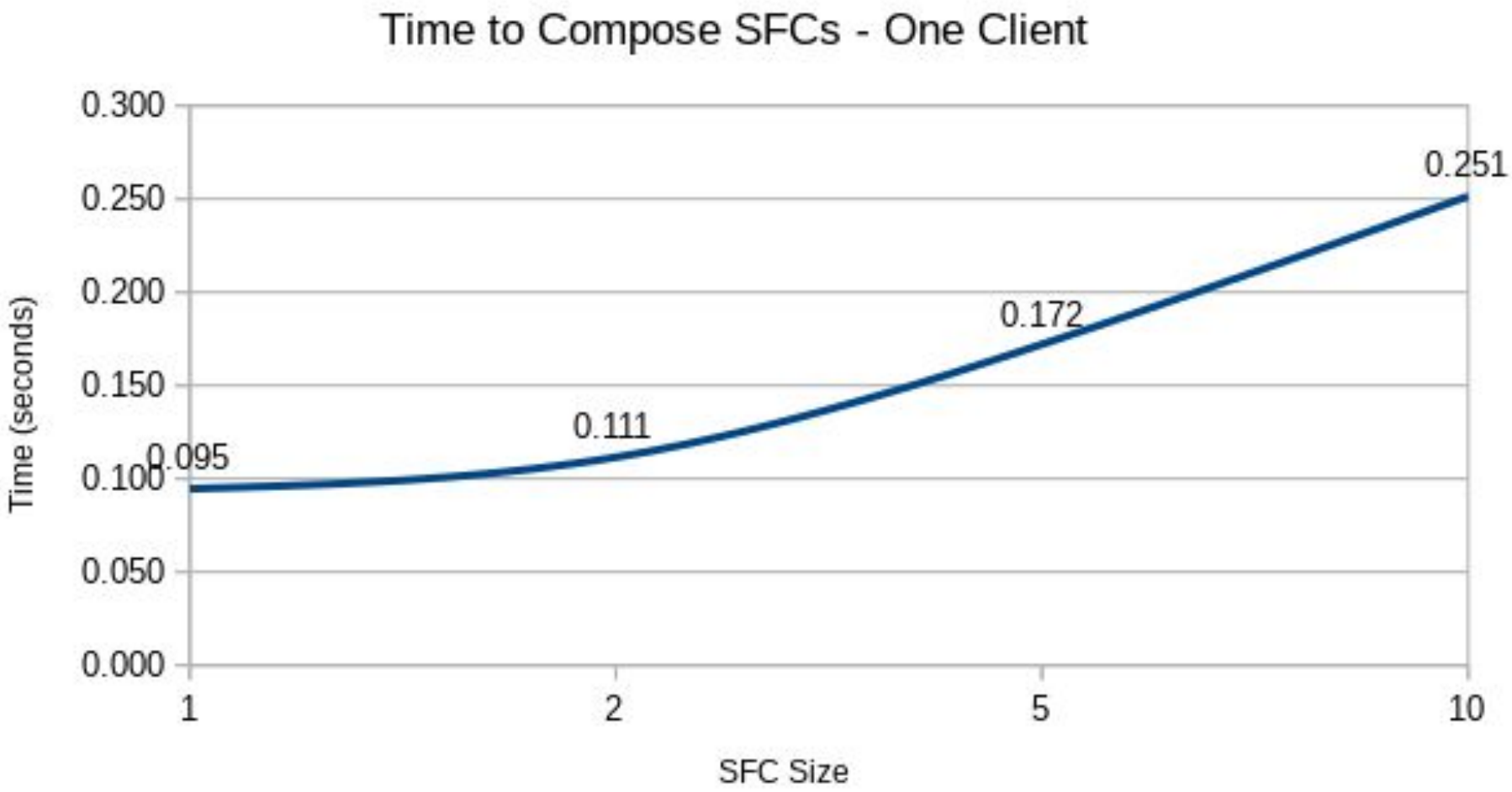
- We are particulary interested on the time it takes to compose SFCs in different execution scenarios
- The experiments were executed on a machine with:
  - Intel(R) Core(TM) i7-6700HQ CPU with 4 cores up to 3.5 GHz
  - 12 GiB of DDR4 RAM at 2133 MHz
  - Linux Ubuntu 16.04.3 running on kernel 4.13.0-37-generic x86_64
  - Apache HTTP Server 2.4.18 with the *mod_wsgi* adapter *libapache2-mod-wsgi-py3*
  - *memcached* daemon 1.4.25
  - MongoDB 2.6.10
- Apache was configured to have 4 processes listening for incoming requests to the SFC-Core

Prototype Evaluation

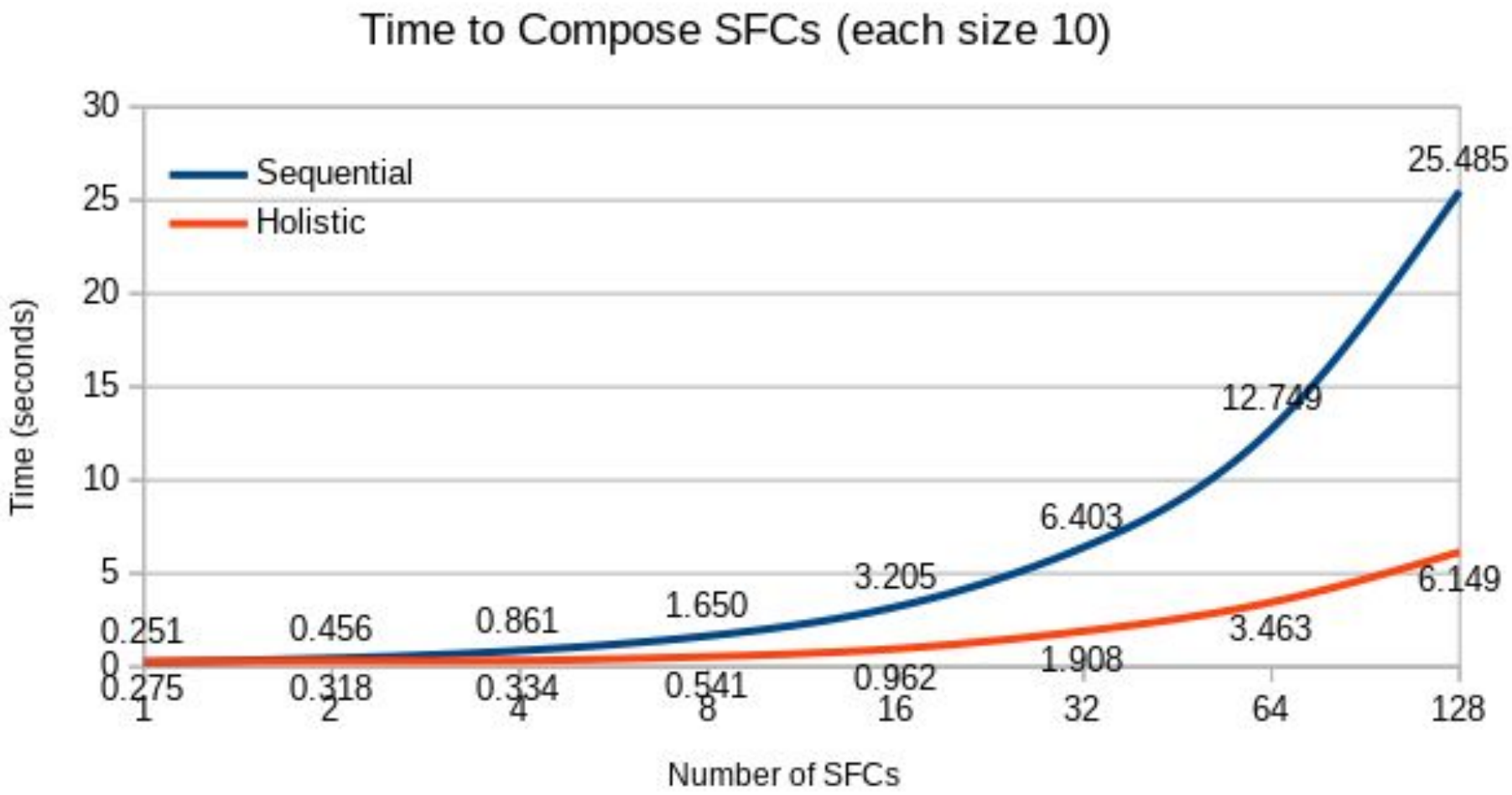
- A REST Client was implemented in order to run SFC composition experiments
- We highlight that:
  - The client application simply sends REST requests to the SFC-Core
  - The SFC-Core has the responsibility of the logic of composing and managing the SFC life cycle
  - The evaluation takes into account only the prototype execution times
- The elapsed time was recorded by the REST Client
  - At the time instants the SFC composition starts and completes

All experiments were performed 100 times, averages are

Time a single REST client takes to compose SFCs with sizes 1, 2, 5, and 10 VNFs



Time to compose different numbers of SFCs, each consisting of 10 VNFs



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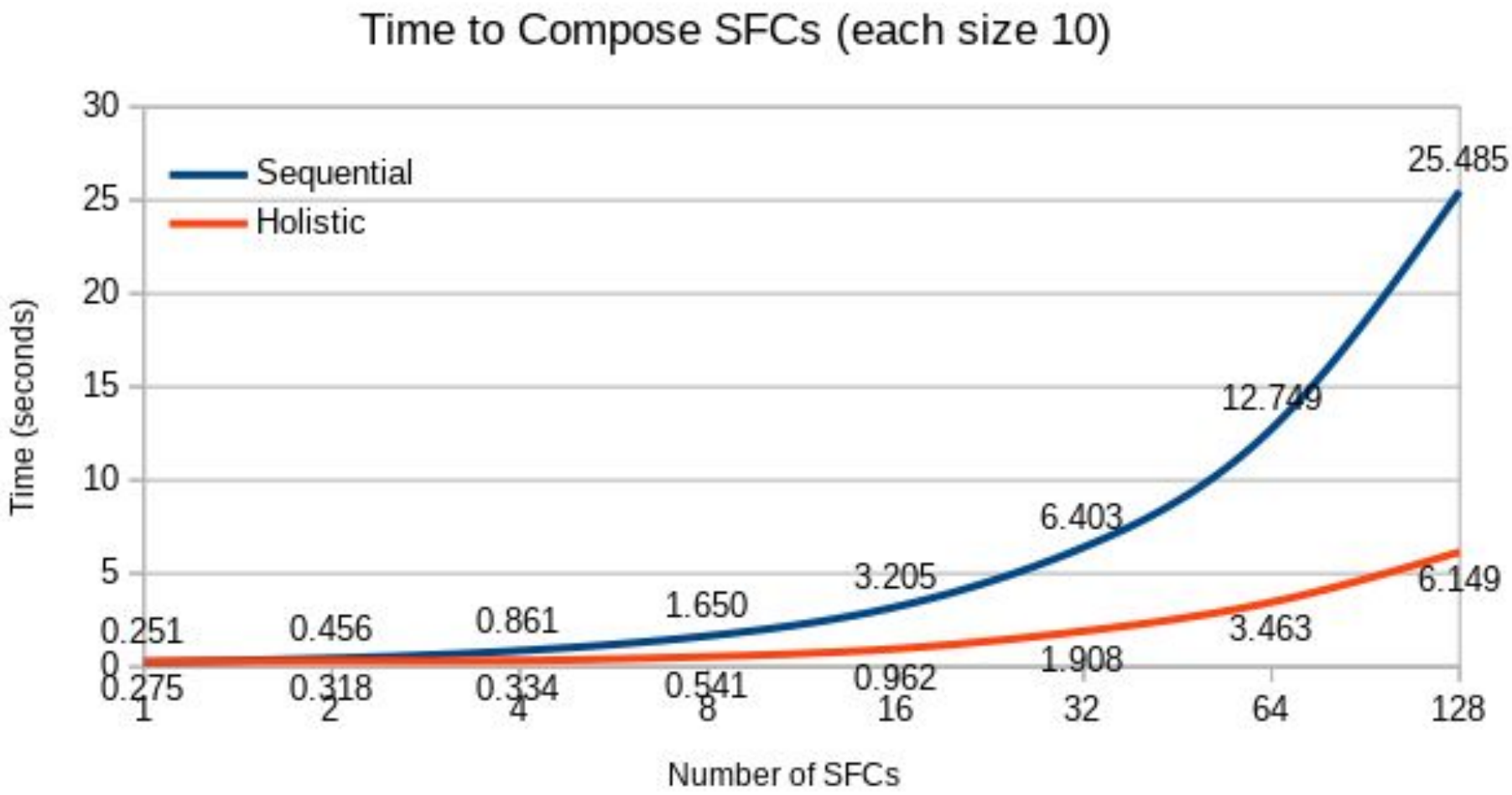

The Holistic approach is around 4.145 times faster than the Sequential approach

Conclusion

- The Holistic-Composer framework simplifies the composition and lifecycle management of SFCs on different NFV platforms
  - Defines generic operations for the composition and lifecycle management of SFCs
- Allows the integration with NFV enablers that do not provide interactive SFC composition functionality
- A prototype was implemented for the composition and lifecycle management of SFCs built with Click-on-OSv running on the OpenStack Tacker
  - Results were presented for multiple SFC compositions done concurrently

Future Work

- We are currently implementing a communication agent for the OSM Orchestrator
- Other orchestrators are also planned, specially those on the edge
- Extending the architecture to allow resource management, in particular SFC elasticity
- Automatic sharing of VNF instances on multiple SFCs

Thank you!

https://github.com/alexandre-huff/holistic-composer

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