

Network Softwarization and Virtualization

Agile Development and Operations for Software Networks

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Network Softwarization Promises & Agenda

It's all about money.....

1. Capex Reduction
2. Opex Reduction
3. Flexibility and faster/increased service revenues

Agenda:

1. Network Sharing to **reduce CAPEX and OPEX**
 - RAN Virtualization and Sharing
 - 5G Network Architecture and virtualization
2. DevOps – a methodology to make SDN management more agile and cost effective
 - **Enabling new service** opportunities and **revenues**

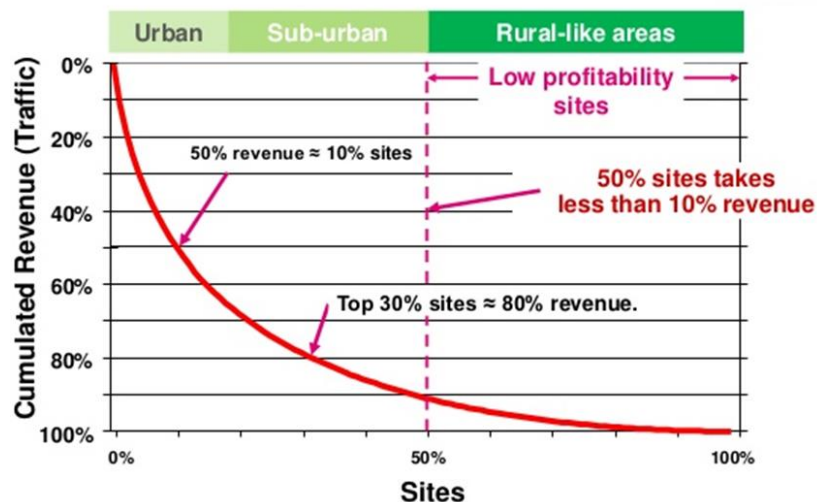
Network Sharing for Capex and OPEX reduction

Motivation



Telecom industry should invest \$1.7 Trillion in mobile infrastructure by 2020

Sharing increases free cash flow, up to 20% for a typical European operator

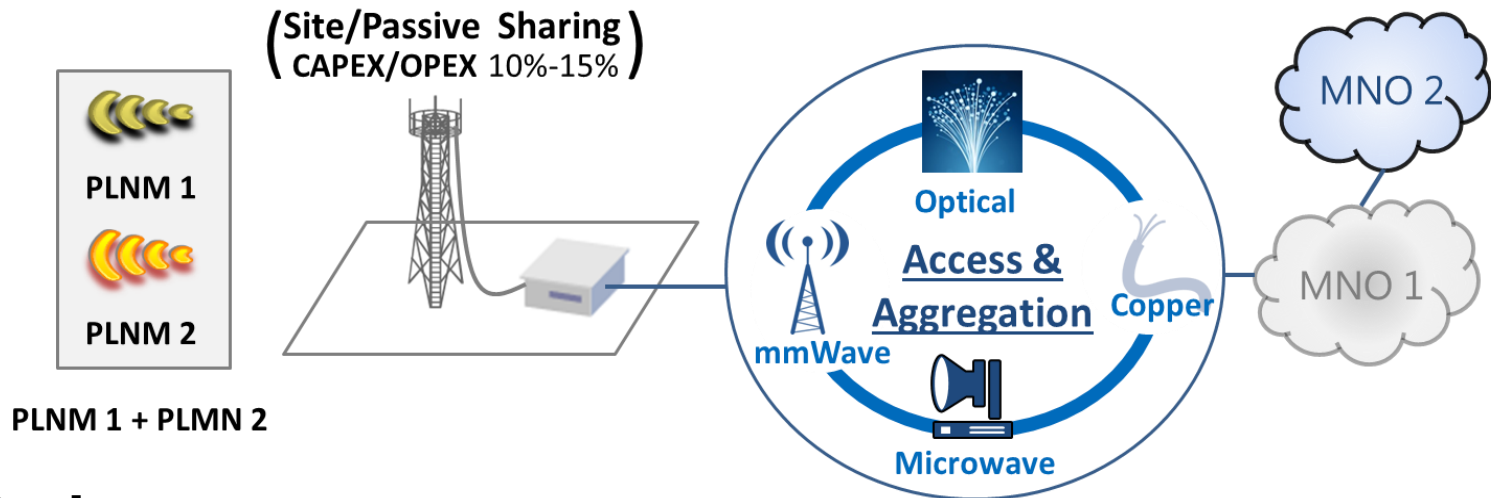


MNO to share masts/sites to min environmental impact

Speed-up market timing

CAPEX/OPEX saving of network sharing

	Radio Access Network (Spectrum and Active Sharing)	Mobile Backhaul (Transport)	Core Network (Evolved Packet Core)
CAPEX	25%-40%	10%-20%	15%-30%
OPEX	20%-30%	10%-15%	20%-25%



Capex Savings

- **Less equipment** (& cables) through **sharing** (slicing, multi-tenancy, multi-service)
- **Cheaper equipment** through virtualization with **HW commoditization**

Opex Savings

- Traffic **demand based scale up and scale down** options (energy reduction, **better resource utilization**, efficient allocation of network functions)
- Flexible and **smooth network evolution** via network programmability

Towards RAN Slicing

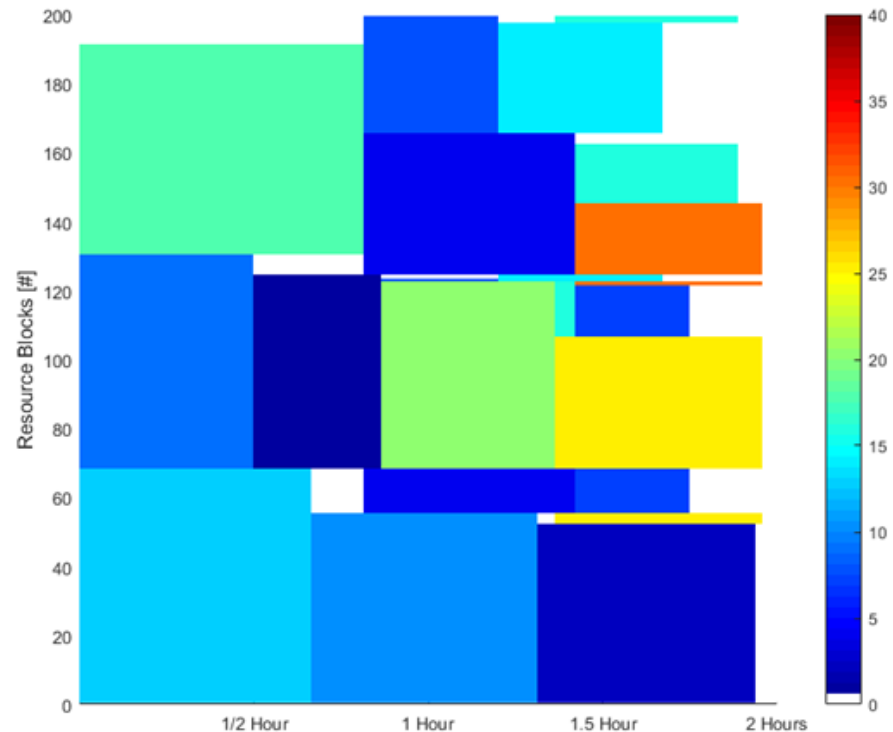
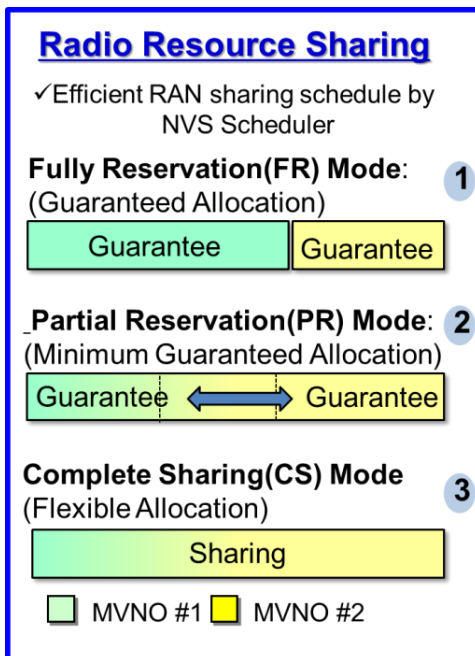
RAN slicing of big interest to Network operators to support:

- efficient sharing of network infrastructure and spectrum
- multiple virtual NW services in low utilization areas
- targeted network service for diverging requirements from verticals

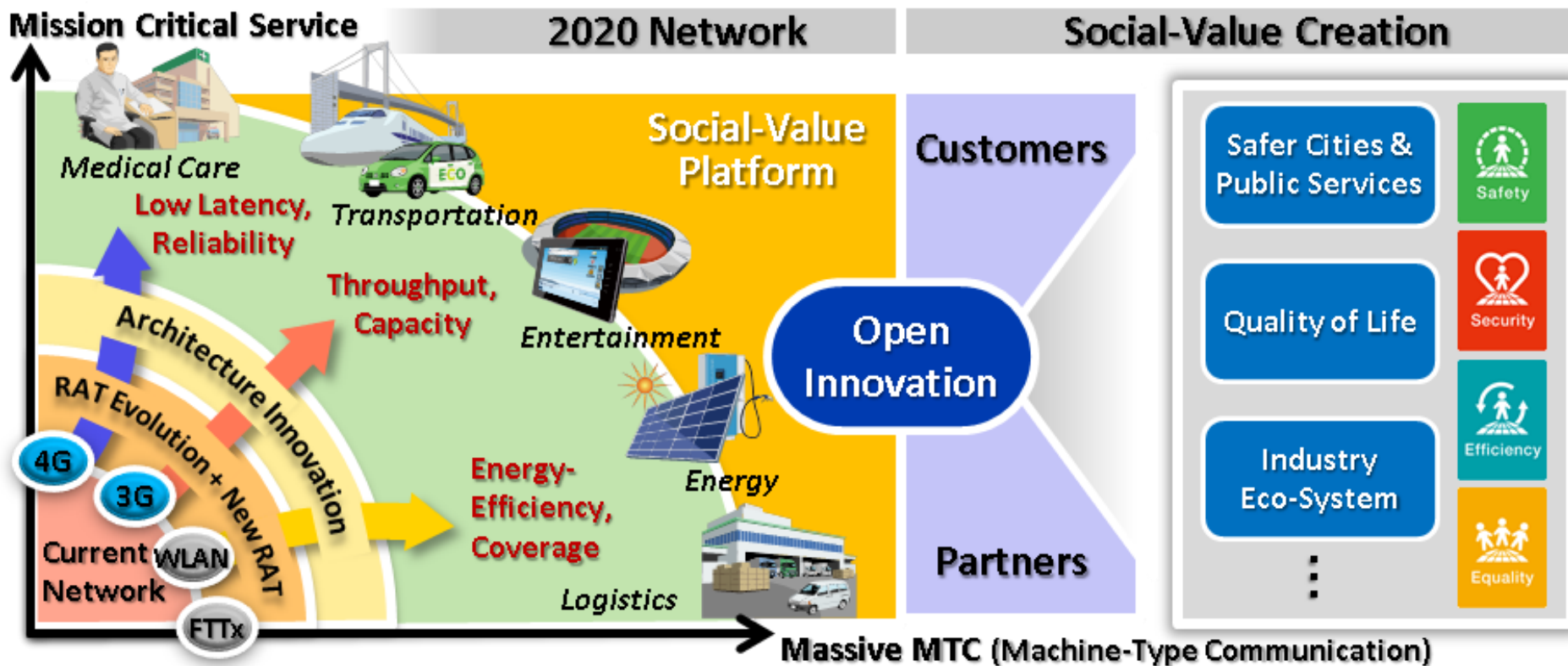
RAN Resource sharing providing

- configurable shares per tenant - customization per tenant

Problem: bandwidth reservation/allocation



NEC's 2020 Network Vision Toward 5G

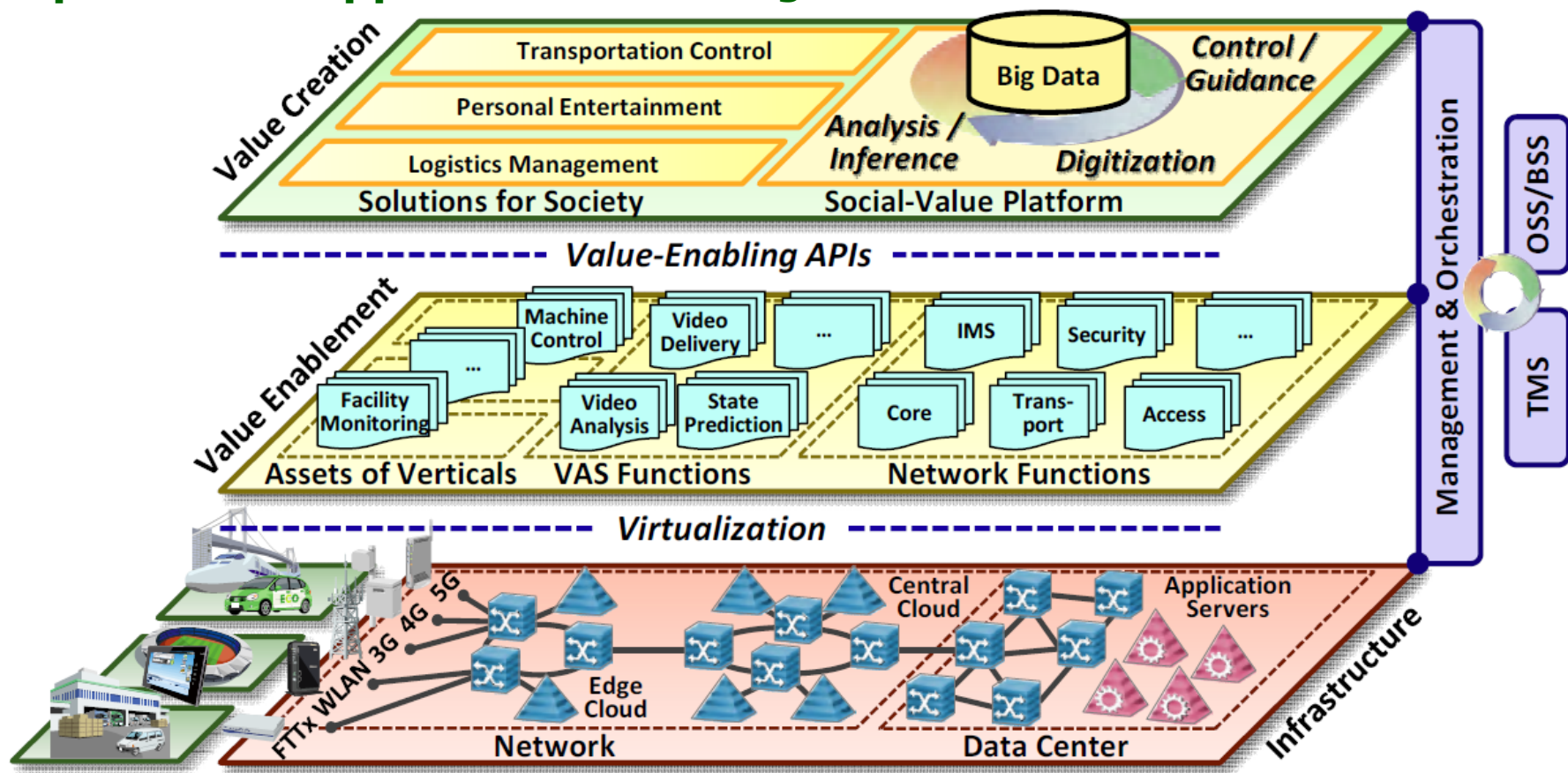


- Different **industry verticals require network services with widely diverging characteristics** in terms of
 - throughput, delay, reliability, coverage, # and types of nodes, etc
- **Dynamic and cost efficient provisioning** of network services **requires virtualization** of network functions

5G Architecture Overview

Network platform to fulfill the **requirements for 5G networks**

- High flexibility & rich functions based on NW virtualization & programmability
- Independency between HW and SW enables expandability of network functions
- **Flexible and heterogeneous set of NW services and functions requires new approaches to management and orchestration**



DevOps – a new SDN management paradigm

Flexibility and faster/increased service revenues

Why DevOps?

Today's issues in network configuration & deployment

Manual Efforts	Long Wait Times	Unproductive Work
<ul style="list-style-type: none">• Deployments require human intervention• Relying on custom undocumented scripts• Environment configuration on an „as needed“ basis• Relying on spreadsheets, meetings conference calls, etc for status updates	<ul style="list-style-type: none">• Teams waiting on manual hand-off• Resources are unavailable when needed• Delayed time-to-test• Insufficient notifications• Long outage windows	<ul style="list-style-type: none">• Using static environments• Deploying things that have not been changed• Managing infra-structure and applications separately

Keys to overcome the current situation

- Reduction of human intervention
- Automation of processes
- Reduction of barriers between the different teams and stakeholders
- Incremental and iterative network service deployment

-> **DevOps**

DevOps Aspects

Development and **Operations (DevOps)**

- **Collaboration** and communication of software developers and NW Operators
- Automation of process for software delivery & infrastructure changes

Agile Development

- **Adaptive** planning, evolutionary development, early delivery, and continuous improvement:
⇒ encouraging rapid and flexible response to change

Continuous Integration and Deployment (**CI/CD**)

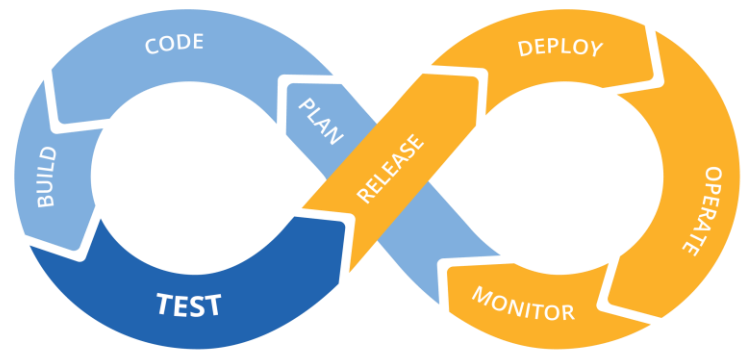
- Merging all developer working copies of code several times a day
- **Automated** testing and rollout of production service

Well established methods in software industry

- Especially for web-services

Imposes several **challenges and opportunities** for telco operators

- Needs collaboration between developers and operators
- + Significant decrease in time-to-market



DevOps Technologies and Benefits

Objective:

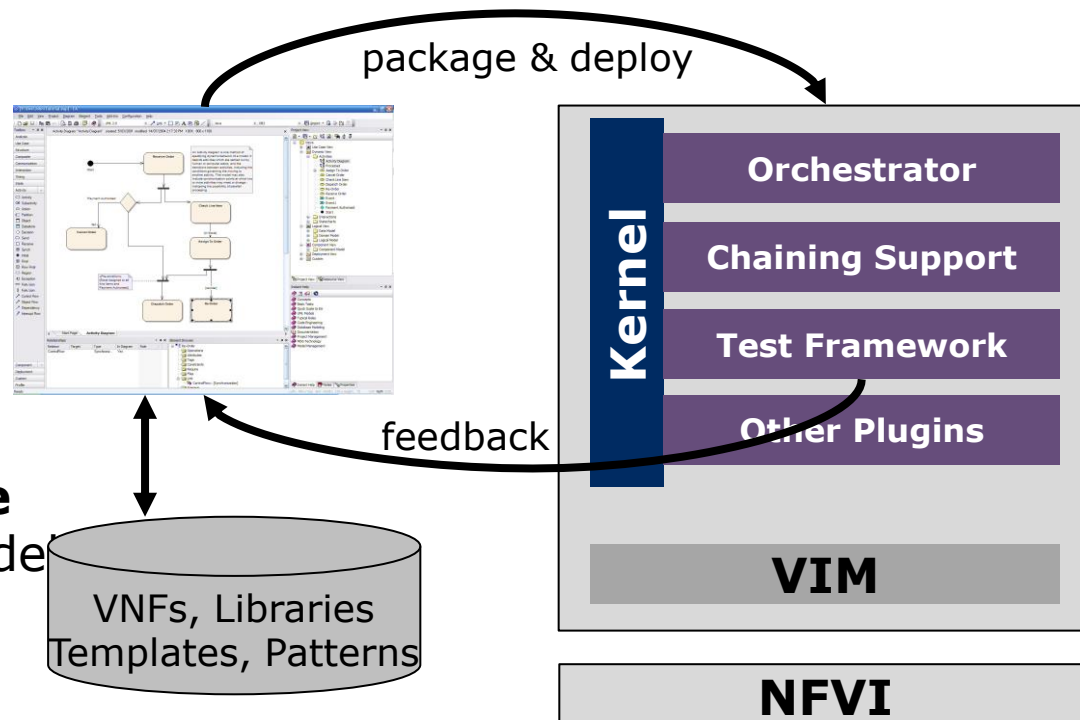
- Provide a consistent set of **methods, tools & platforms for service programming & execution**

Technologies:

- **Service Programming** (language, libraries, templates, compiler, IDE)
- **Service Platform** (deployment, runtime APIs, chaining, orchestration)
- **DevOps** (monitoring, testing, profiling, debugging, iterative service dev)

Benefits:

- **Shorter time-to-market** for new services due to easy-to-use SDK, agile development and reuse of libraries
- **Better service experience** due to iterative DevOps mode
- Flexible SW environment **generating new revenue**



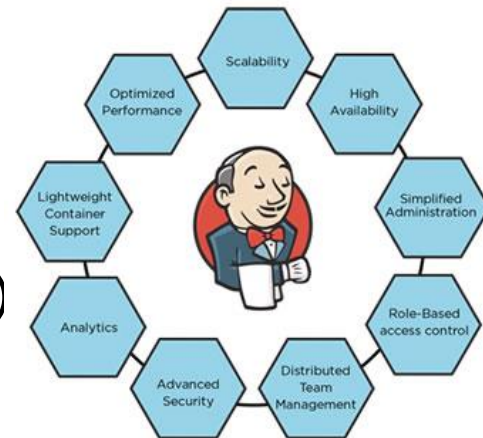
DevOps for Network Function Virtualization

Moving **towards NFV DevOps** requires **new tool support for ...**

- Real-time analytics
- Auto-testing
- Auto-tuning
- Continuous Integration & Delivery pipeline

Continuous Integration & Delivery (CI/CD)

- Auto-deploy & test new and updated NFV services
- Testing & benchmarking of NFV infrastructure elements



Policy-/Constraint-based VNF Deployment

- Fast and resource-efficient deployment of VNFs instantiation, scaling and failover, based on policies for performance and reliability

VNF Auto-Tuning

- Auto-tuning of VNF's deployment parameters, such as number of CPUs and RAM, at deployment-time or during run-time

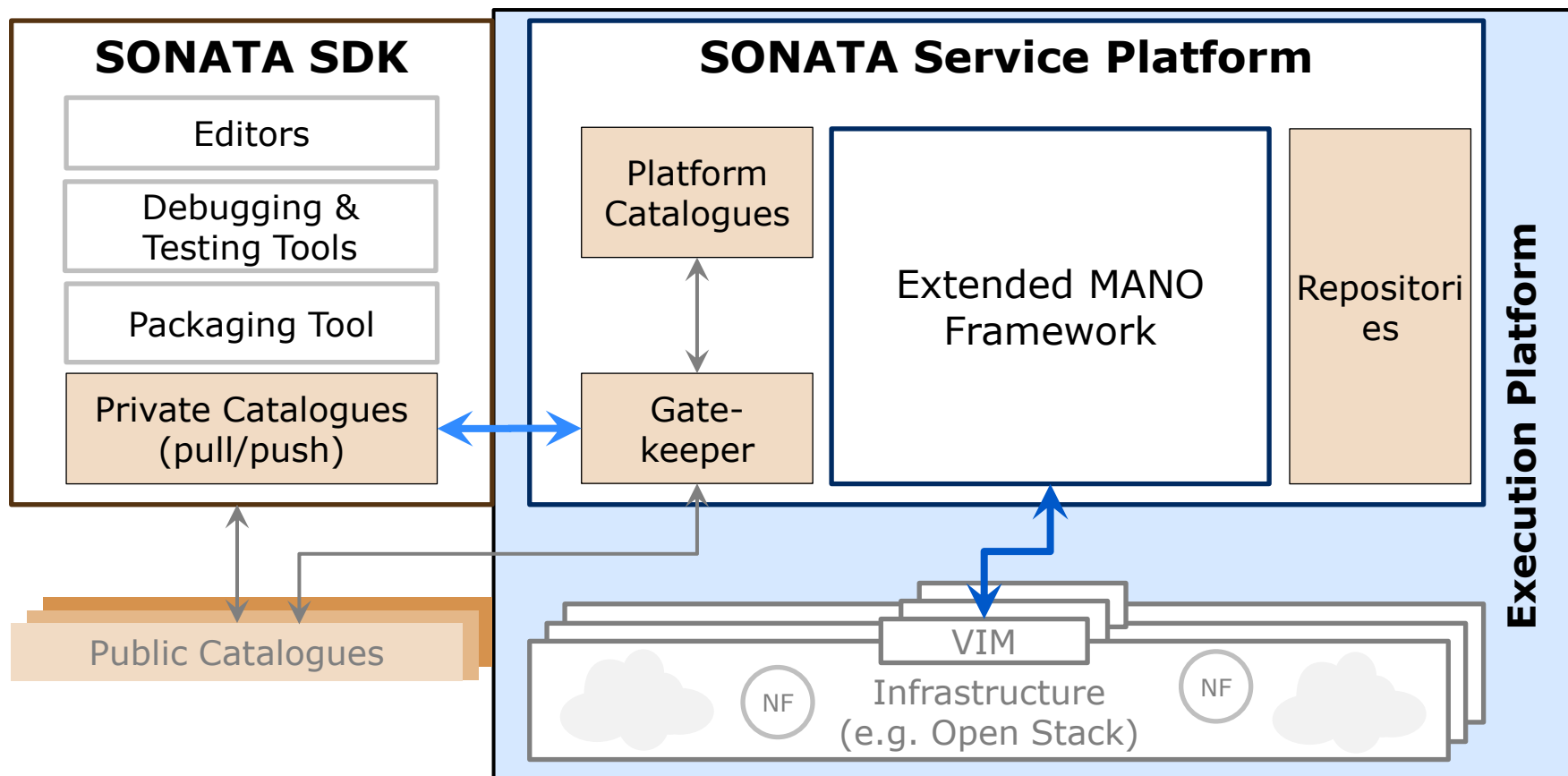
VNF Monitoring and Debugging

- Run-time checking of correct VNF operations based on behavior
- Automatic scaling and healing based on monitoring events

SONATA Approach (SONATA is a EU H2020 Project)

The SONATA Architecture

- Modular and flexible Service Platform based on micro-services
- Close integration between development tools (SDK) and the MANO framework (Service Platform)
 - Ready to build a CI/CD pipeline for NFV



Sonata Results

1

An open source **service platform** with a modular **orchestration** framework that helps network operators optimize resource utilization, increase automation, reduce OPEX and facilitate their NFV transition

2

A **programming model and Service Development Kit (SDK)** that empowers service providers, network equipment vendors and SMEs to develop services based on new or existing network functions, opening the market and reducing time to delivery

3

A set of **DevOps tools and methodology** that helps to connect these stakeholders to a modern, agile workflow that supports the rapid development cycles of software-driven networks, as well as the inter-organizational challenges between them

GitHub



SONATA SW is publicly available under: <https://github.com/sonata-nfv>
SONATA SW Release 2.0 planned for Feb. 2017 (incl. containers, IPv6, etc)

Summary

- Network Softwarization & Virtualization offers great promises to reduce both CAPEX and OPEX in 5th Generation Mobile Networks
- Network and Infrastructure **sharing will sharply decrease CAPEX** for infrastructure providers both in the RAN as well as in the Transport and Core networks
 - Research on network sharing by virtue of virtualization is in full swing, e.g. EU H2020 NORMA and Crosshaul projects
 - Network slicing supporting network requirements from vertical industries is considered to be the economical „saving grace“ of 5G
- The full **benefits of network function virtualization** with significant reduced OPEX can only be reaped when we master the **fast and flexible adaptation of the network services and configuration** to quickly changing loads and requirements
- Applying agile SW development paradigms aka DevOps to a VNFI helps NW operators to **create new service & revenues** faster and more dynamically than in the past (-> EU H2020 SONATA)

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