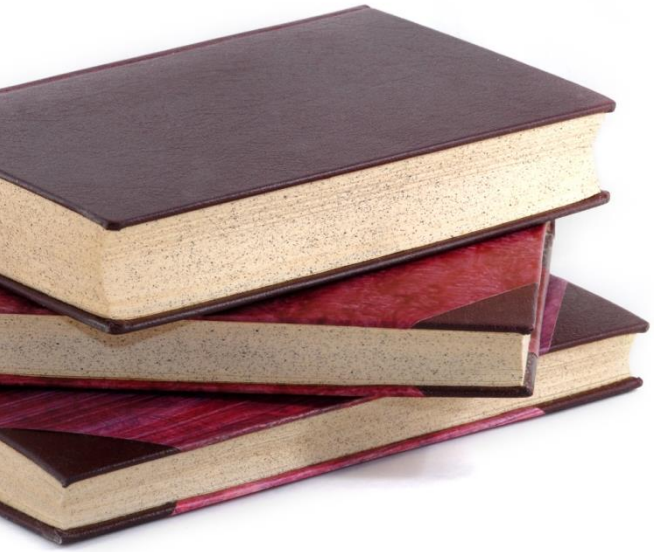
MPSIT

Lecture 9



9 Virtualization

13 decembrie 2016

Outline

- Linux virtualization
- SDN and NFV
- OPNFV
- ODL
- Yocto Project virtualization support

Recap: security

- Security in Linux: Linux security subsystem is helping on kernel security side
- SELinux: LSM (Linux Security Module) developed by NSA for military-level security
- Grsecurity: Role-based access control security enhancement not fully part of Linux kernel
- Yocto Project security: solve CVEs and layers patching
- Meta-security: includes tools for securing, hardening and protecting embedded devices
- Meta-selinux: enables SELinux support and its extensions

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Linux virtualization

- Increases servers utilization
- Decreases energy costs
- Easy to use management system
- Deployment in a couple of minutes
- Flexibility
- Contains a broad range of technologies

What is virtualization?

- The act of creating a virtual version of something
- Involves software
- Includes:
  - Virtual computer,
  - Hardware platforms,
  - Operating systems,
  - Storage devices,
  - Computer network resources.
- We will stop over the network related initiatives
- We will not discuss VMs and hypervisors

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SDN and NFV

- Software Defined Network
- Network Function Virtualization
- Concepts around for more then 20 years
- Lately they started to have possible implementations
- We will discuss more about NFV in this lecture

Keywords definition (1)

- SDN: separates the network's control (brains) and forwarding (muscle) planes and provides a centralized view of the distributed network for more efficient orchestration and automation of network services.
- NFV: focuses on optimizing the network services themselves. NFV decouples the network functions, such as DNS, Caching, etc., from proprietary hardware appliances, so they can run in software to accelerate service innovation and provisioning, particularly within service provider environments.

Keywords definition (2)

- NF: ensures the network can integrate with and support the demands of virtualized architectures, particularly those with multi-tenancy requirements.
- White Box: uses network devices, such as switches and routers, that as based on “generic” merchant silicon networking networking chipset available for anyone to buy, as opposed to proprietary silicon chips designed by and for a single networking vendor.

Commonalities

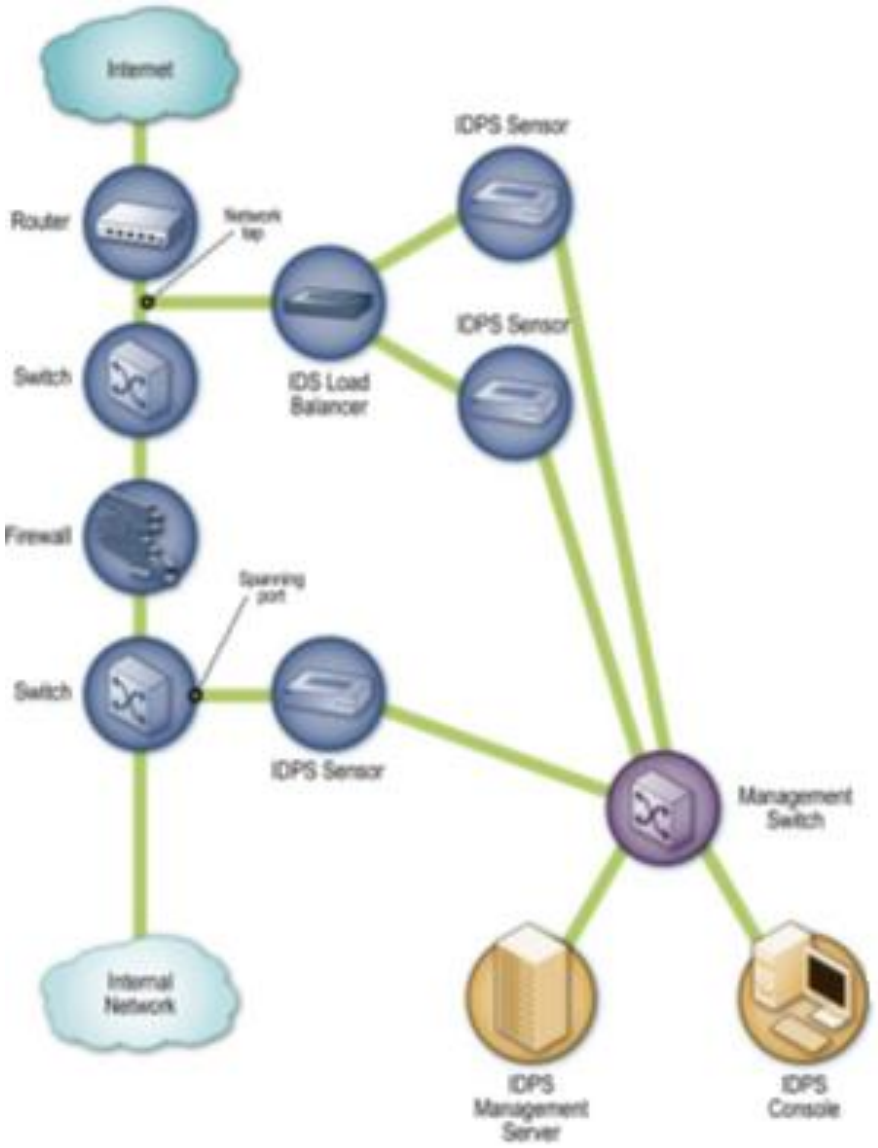
- Move functionality to software
- Use commodity servers and switches over proprietary appliances
- Leverage application program interfaces (APIs)
- Support more efficient orchestration, virtualization, and automation of network services

NFV

- Virtualizes entire categories of network node functions into interconnected blocks
- Creates communication services
- Different from known virtualization techniques
- Uses Virtual Network Functions (VNF) which can be contained in one or more virtual machines
- Execute different processes and software components
- Available on servers, switches or cloud infrastructure

NFV examples

- Load balancers
- Intrusion detection devices
- Firewalls
- ...



Game changes

- In 2013 a SDN and OpenFlow white paper emerged
- Published by ETSI (European Telecommunications Standards Institute)
- This accelerated the NFV progress
- Progresses are taking part inside ETSI ISG (Industry Specification Group for) NFV
  - Develop requirements and architecture for virtualization
  - Various functions from telecom are getting standardized

Benefits of NFV

- Reduce the need to purchase purpose-built hardware and support pay-as-you-grow models to eliminate wasteful over-provisioning
- Reduce space, power and cooling requirements of equipment and simplify the roll out and management of network services
- Accelerate time-to-market
- Deliver agility and flexibility

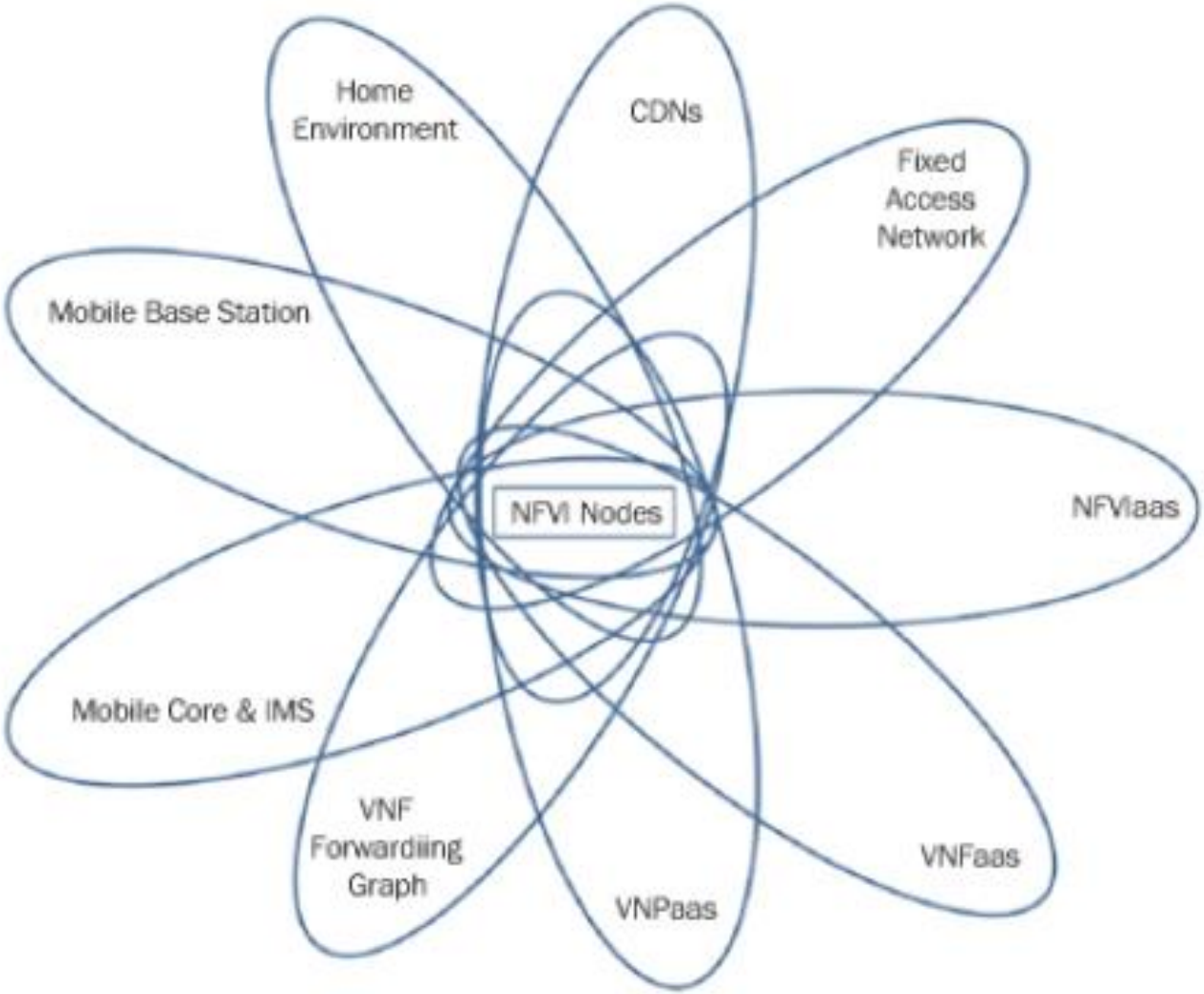
ETSI NFV (1)

- NFV Infrastructure (NFVI) – described in the following NFV ISG documents:
  - NFV Infrastructure Overview,
  - NFV Compute
  - NFV Hypervisor Domain
  - NFV Infrastructure Network Domain
- NFV Management and Orchestration(MANO) – responsible for the decoupling of compute, networking and storing components
- NFV Software Architecture – related to virtualization of the network functions, transition from hardware to software implementation is based on patterns

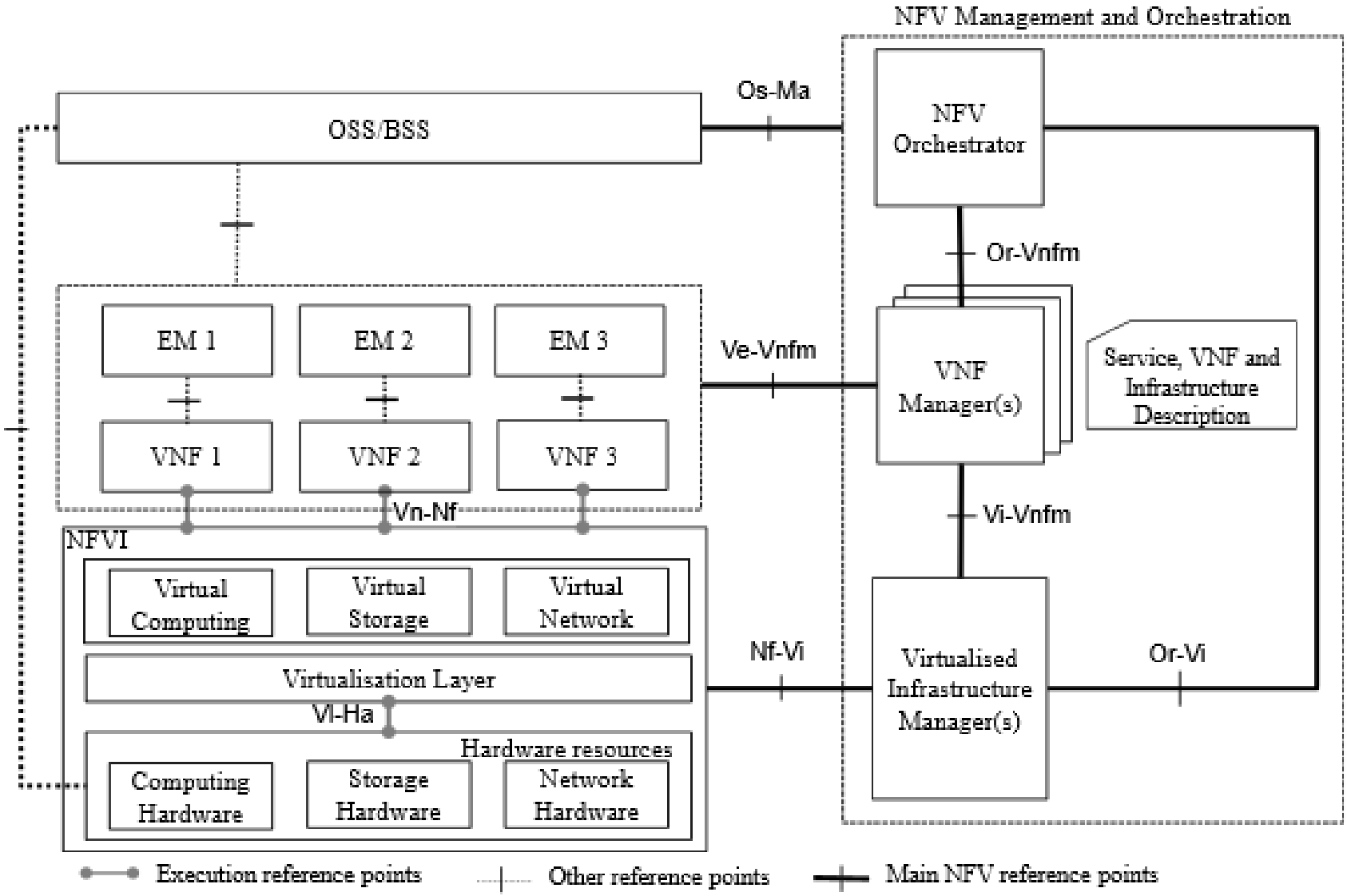
ETSI NFV (2)

- NFV Reliability and Availability – identifies various problems and indicates the best practices used in designing resilient NFV systems
- NFV Performance and Portability – explains how to apply the best practices related to performance and portability in a general VNF deployment
- NFV Security – concerned about and also dependent on the security of networking and cloud computing, which makes it critical for NFV to assure security. The Security Expert Group focuses on those concerns.

NFVI usecases



ETSI ISG NFV architecture



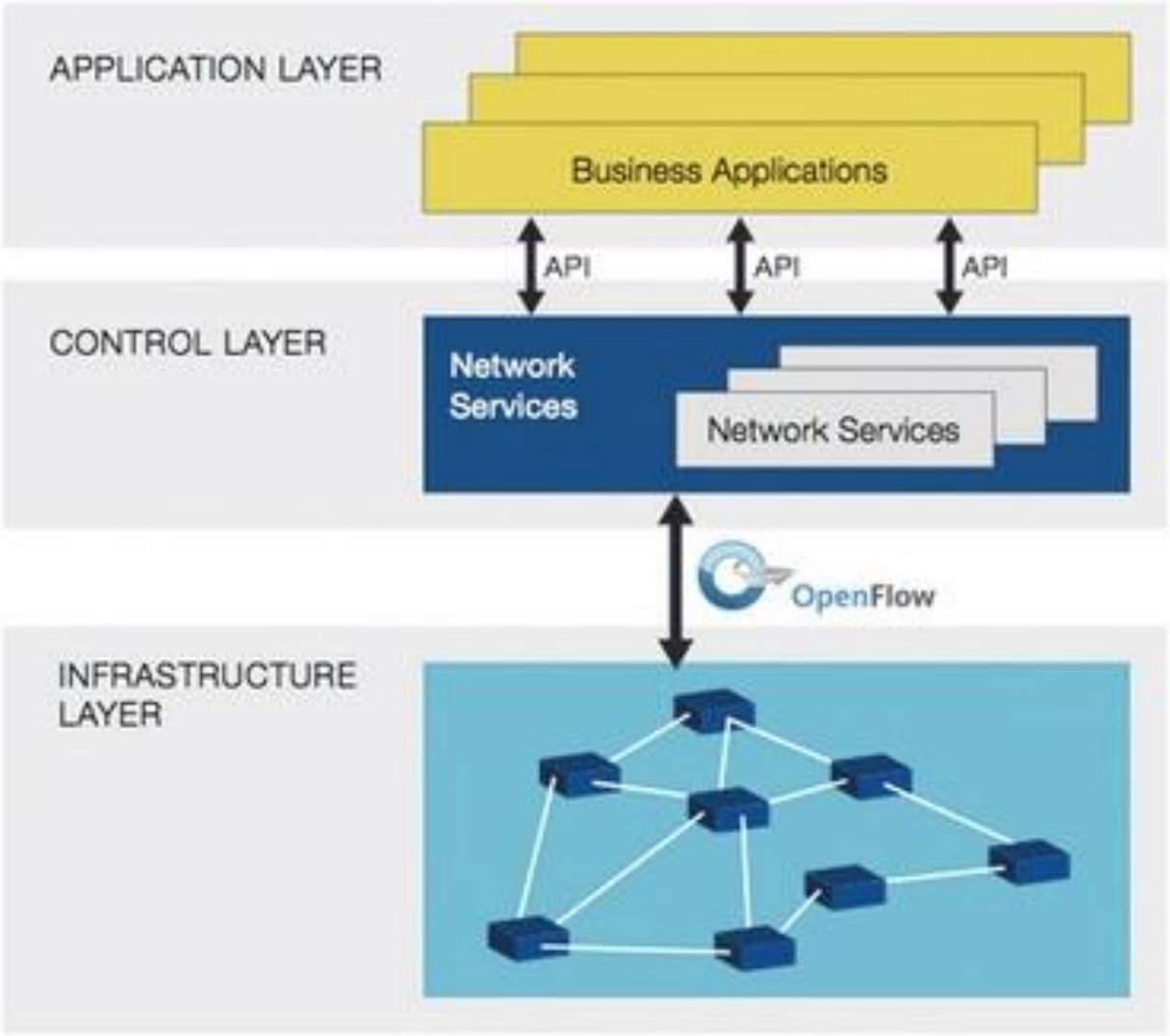
SDN

- Possibility to manage various services using the abstraction of available functionalities
- System is decouple into:
  - Control plane (sent network traffic)
  - Data plane (forwarded traffic)
- The decisions are taken based on network traffic
- OpenFlow is the mechanism used for communication between the two planes
- Other components can replace OpenFlow

How does SDN work?

- Direct programming: control and data plane are decoupled, control plane directly programmable
- Programmatically configuration: permitted management, configuration, and optimization of resources though programs
- Agility: abstraction between components permits adjustment of control flows
- Central management: Logical components could be centered on the control plane
- Open standards and vendor neutrality: open source standards that simplify SDN design and operations

SDN framework



Benefits of SDN

- Directly programmable
- Centralized Management
- SDN potentially limits the need to purchase purpose-built, ASIC-based networking hardware, and instead supports pay-as-you-grow models
- SDN enables algorithmic control of the network of network elements making it easier to design, deploy, manage and scale networks
- Deliver agility and flexibility
- Enable innovation

Why SDN and NFV

- Mutually beneficial but not dependent on one another, SDN makes NFV more compelling and vice-versa
- It enables innovation by enabling organization to create new types of applications, services and business models
- Offer new services: new revenue generating ones
- Reduce CapEX: allow network function to run on off-the-shelf hardware
- Reduce OpEX: support automation and algorithm control through programmability of network elements
- Deliver agility and flexibility

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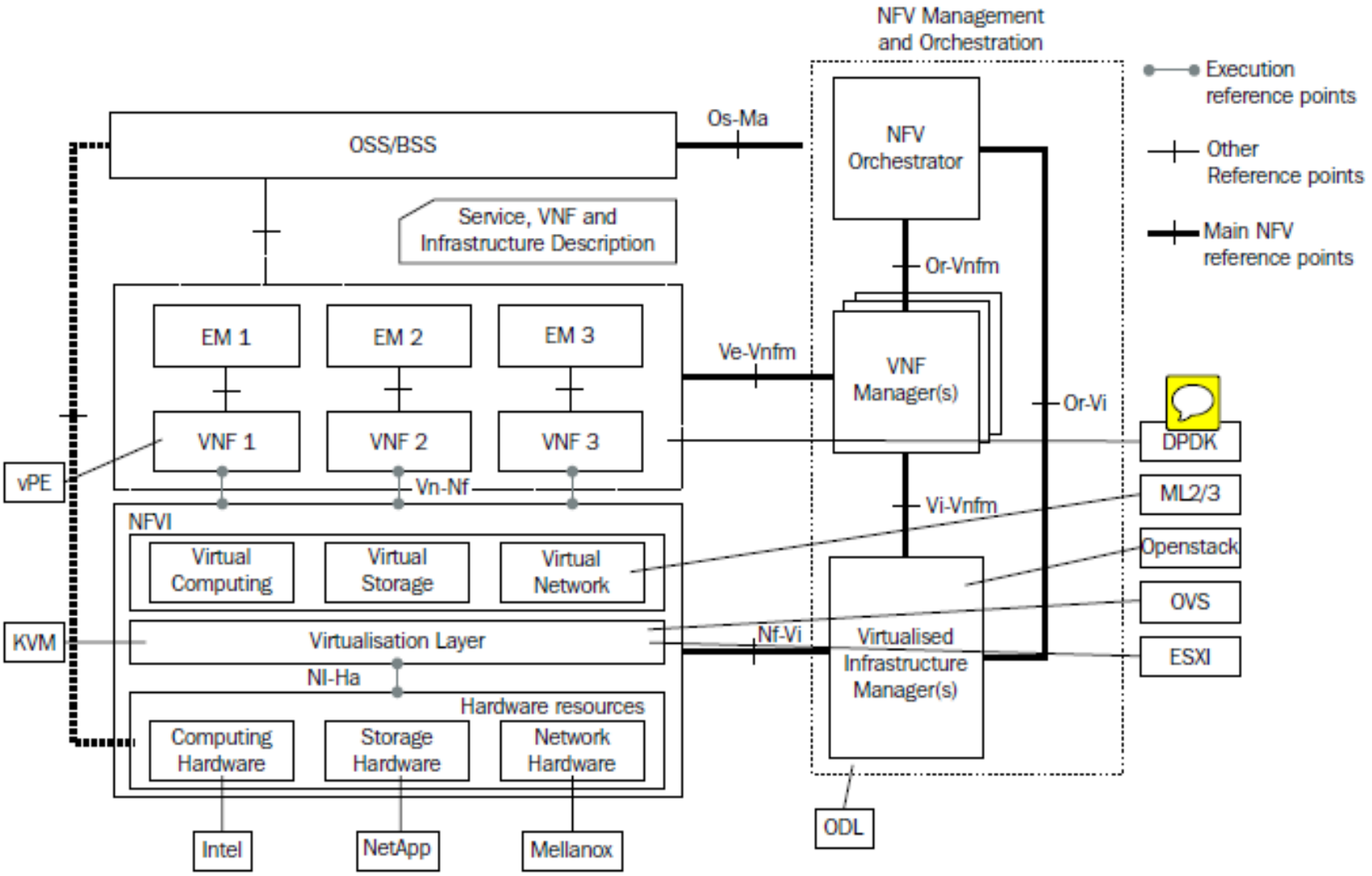
OPNFV

- Open Platform for NFV
- Open source reference platform for NFV
- Provides among different blocks and projects:
  - Consistency
  - Interoperability
  - Performance
- Works closely with a variety of open source projects and ETSI workgroups

OPNFV structure



OPNFV goals and objectives

- OPNFV put industry leaders together to hone/sharpen NFV capabilities
- Provide consistency and interoperability
- Provide proactive cooperation of end users to validate OPNFV's strides to address community needs
- Form an open environment for NFV products founded on open standards and open source software
- Contribute and engage in open source projects that will be influenced in the OPNFV reference platform

OPNFV qualities and use-cases

- A common mechanism is needed for the life-cycle management of VNFs, which include deployment, instantiation, configuration, start and stop, upgrade/downgrade, and final decommissioning
- A consistent mechanism is used to specify and interconnect VNFs, VNFCs, and PNFs; these are independent of the physical network infrastructure, network overlays, and so on, that is, a virtual link
- A common mechanism is used to dynamically instantiate new VNF instances or decommission sufficient ones to meet the current performance, scale, and network bandwidth needs
- A mechanism is used to detect faults and failure in the NFVI, VIM, and other components of an infrastructure as well as recover from these failures
- A mechanism is used to source/sink traffic from/to a physical network function to/from a virtual network function
- NFVI as a Service is used to host different VNF instances from different vendors on the same infrastructure

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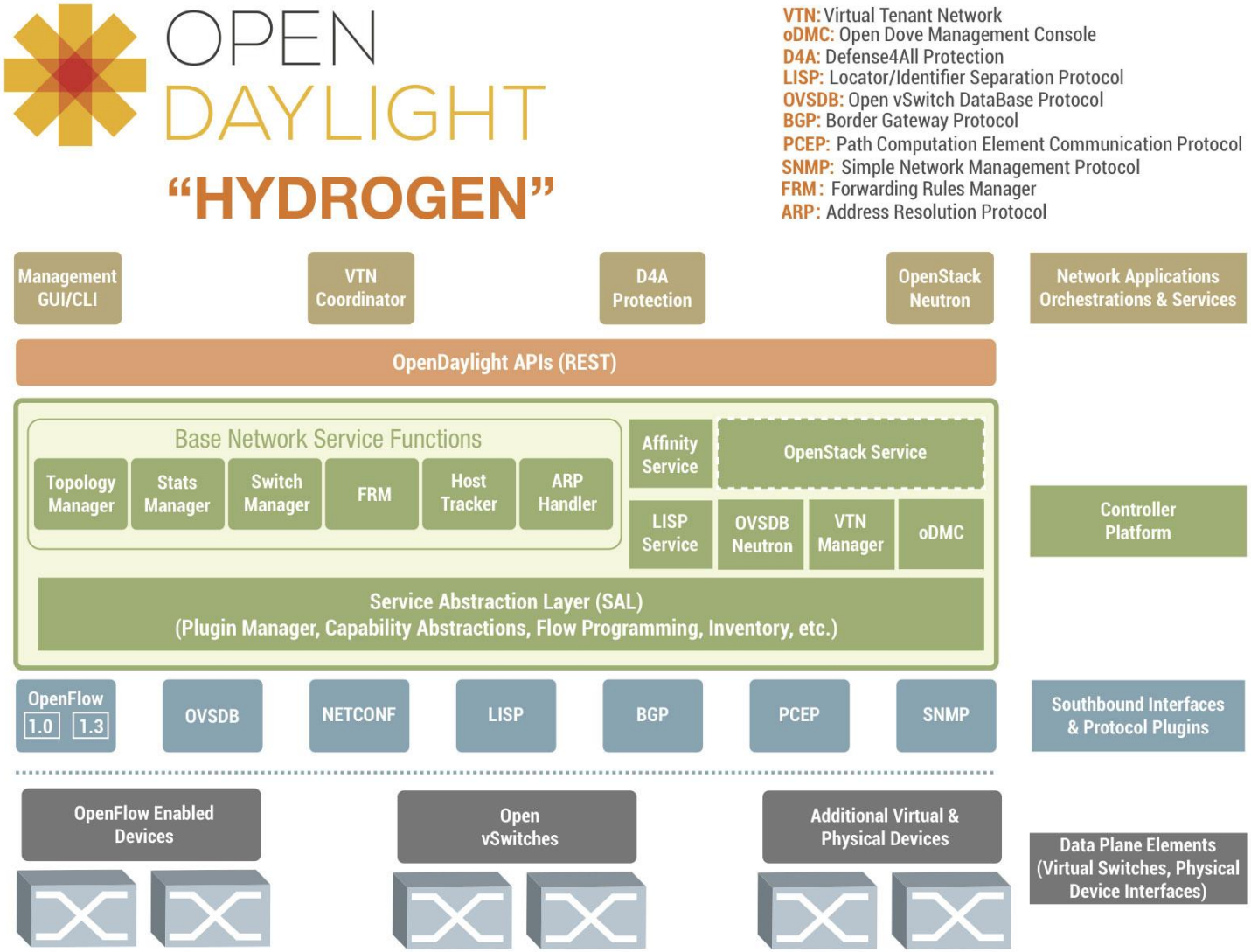
ODL

- OpenDaylight Project
- Announced in April 2013
- Open source SDN project hosted by the Linux Foundation
- Advances SDN adoption and creates basis for a strong network function virtualization (NFV)
- Community-led and industry supported open source SDN framework

ODL aim and purpose

- Offer a functional SDN platform that gives users directly deployed SDN without the need for other components
- Contributors and vendors can deliver add-ons and other pieces that will offer more value to OpenDaylight
- Licensed under Eclipse Public License (EPL), does not run only on Linux, can also be chosen for Java-based projects
- EPL license allows OpenDaylight to increase its compatibility with the expansive environment of libraries and third-party components that already have been released under the EPL license

ODL technical overview



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Yocto Project virtualization support

- Revolves around meta-virtualization layer
- Tries to simplify the way collaborative benchmarking and researching is done with tools, such as KVM/LxC virtualization, combined with advanced core isolation and other techniques
- Integration and contribution to projects, such as OpenFlow, OpenvSwitch, LxC, dmtcp, CRIU and others, which can be used with other components, such as OpenStack or Carrier Graded Linux.

Meta-virtualization packages

- CRIU: Checkpoint/Restore In Userspace
- Docker: automates the method of deploying applications inside Linux containers
- LXC: OS level virtualization by providing isolated containers
- Irqbalance: distributed hardware interrupt system
- Libvirt: connector with the virtualization capabilities available in the Linux kernel
- Xen: hypervisor with a microkernel design
- Open vSwitch: virtual switch for virtual environments

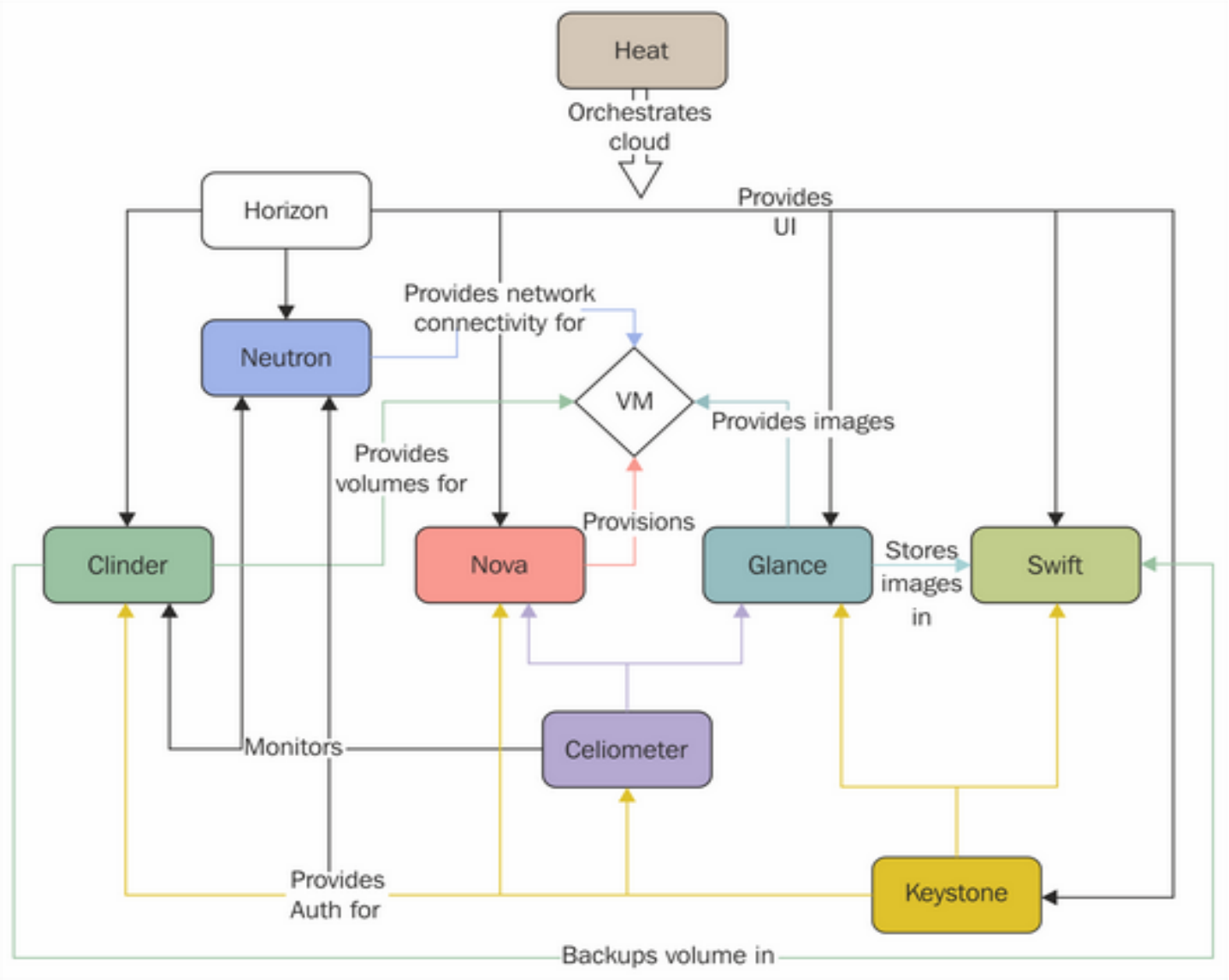
Meta-cloud-services packages (1)

- openLDAP: open source implementation of Lightweight Directory Access Protocol
- SPICE: Simple Protocol for Independent computing environments
- Qpid: messaging tool developed by Apache, understands Advanced Message Queueing Protocol (AMQP)
- RabbitMQ: message broker software components that implements AMQP similar to Qpid and also open source
- Tempest: integration test suite for OpenStack, useful for any OpenStack deployment

Meta-cloud-services packages (2)

- Cyrus-SASL: generic client-server library implementation for Simple Authentication and Security Layer (SASL) authentication
- Puppet: open source configuration management system that allows IT infrastructure to have certain states defined and also enforce these states
- oVirt: virtualization platform that offers a web interface
- OpenStack: multiple projects for management of cloud based data processing, storage and networking resources

OpenStack conceptual architecture



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