بسمه تعالی

NFV: motivations & history

Seyed Hamed Rastegar

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Outline

1. Traditional networking
    1.1. Purpose-built middle-boxes
    1.2. Challenges of traditional networking
2. NFV-enabled network
    2.1. The idea
    2.2. Motivations and advantages
3. NFV use cases
4. ETSI’s role

1. Traditional networking

Traditional networking

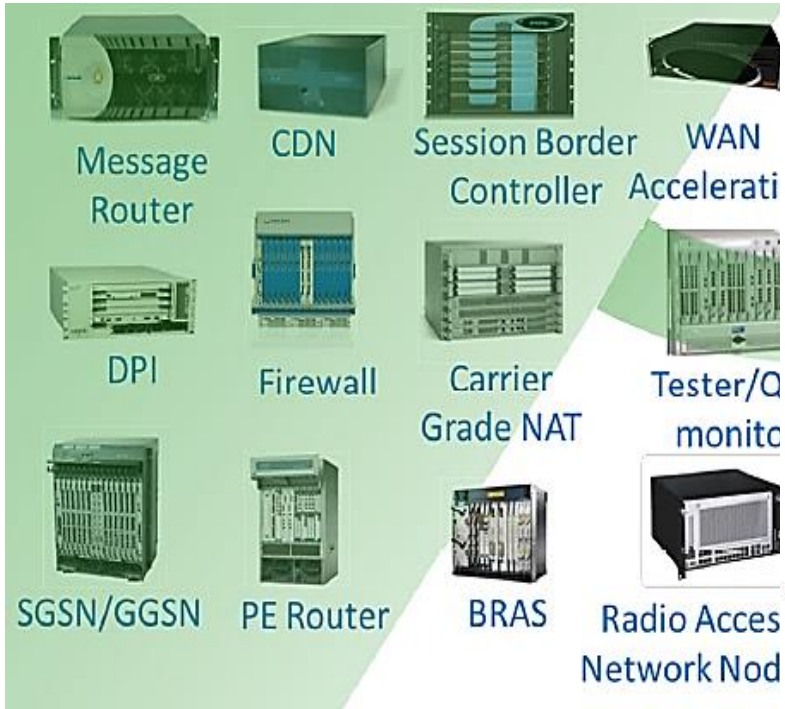
Separate Appliance f

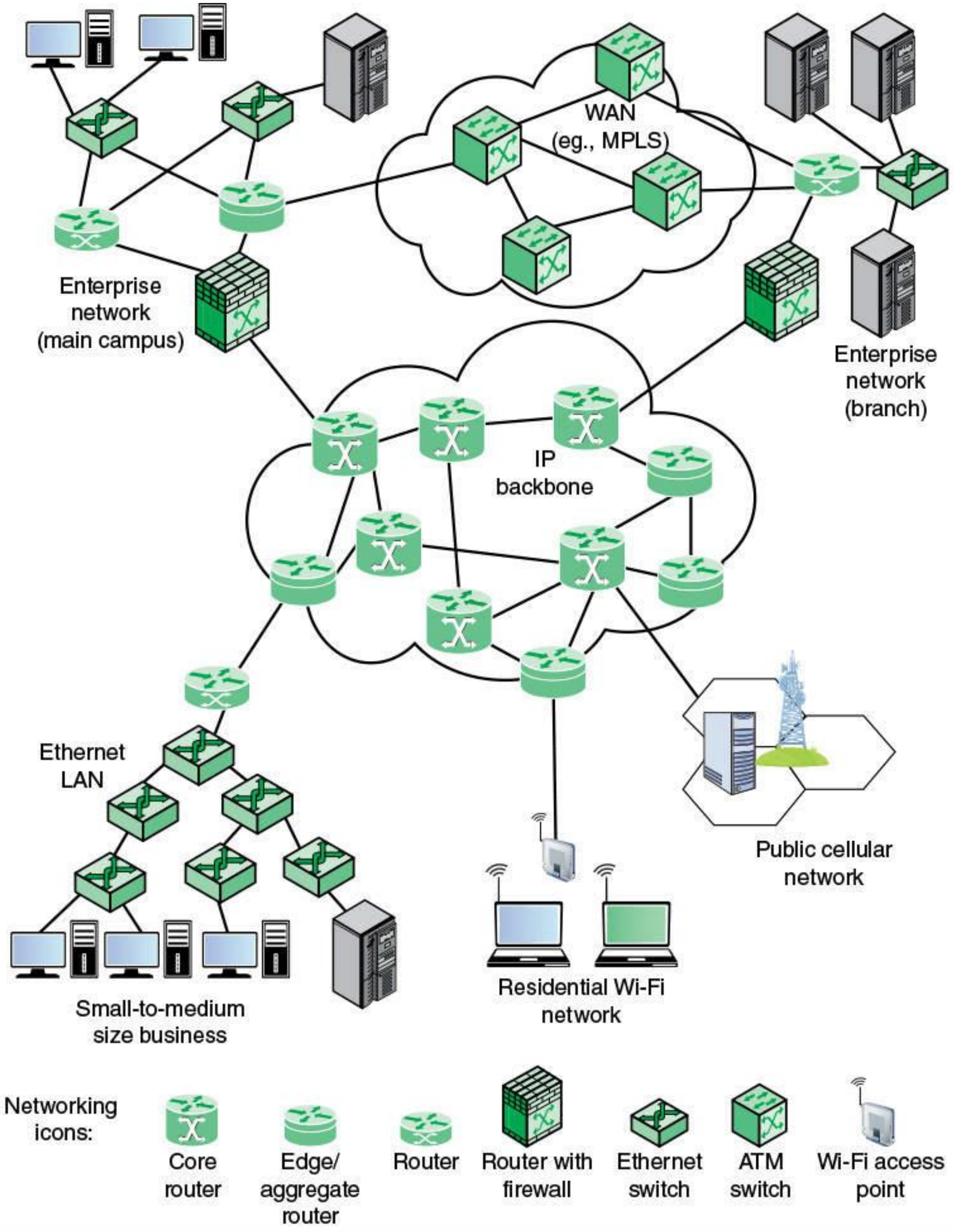
Proprietary Software: Designed t

Proprietary Hardware: Custom

Fixed Network

Limited scalability: Physical Sp



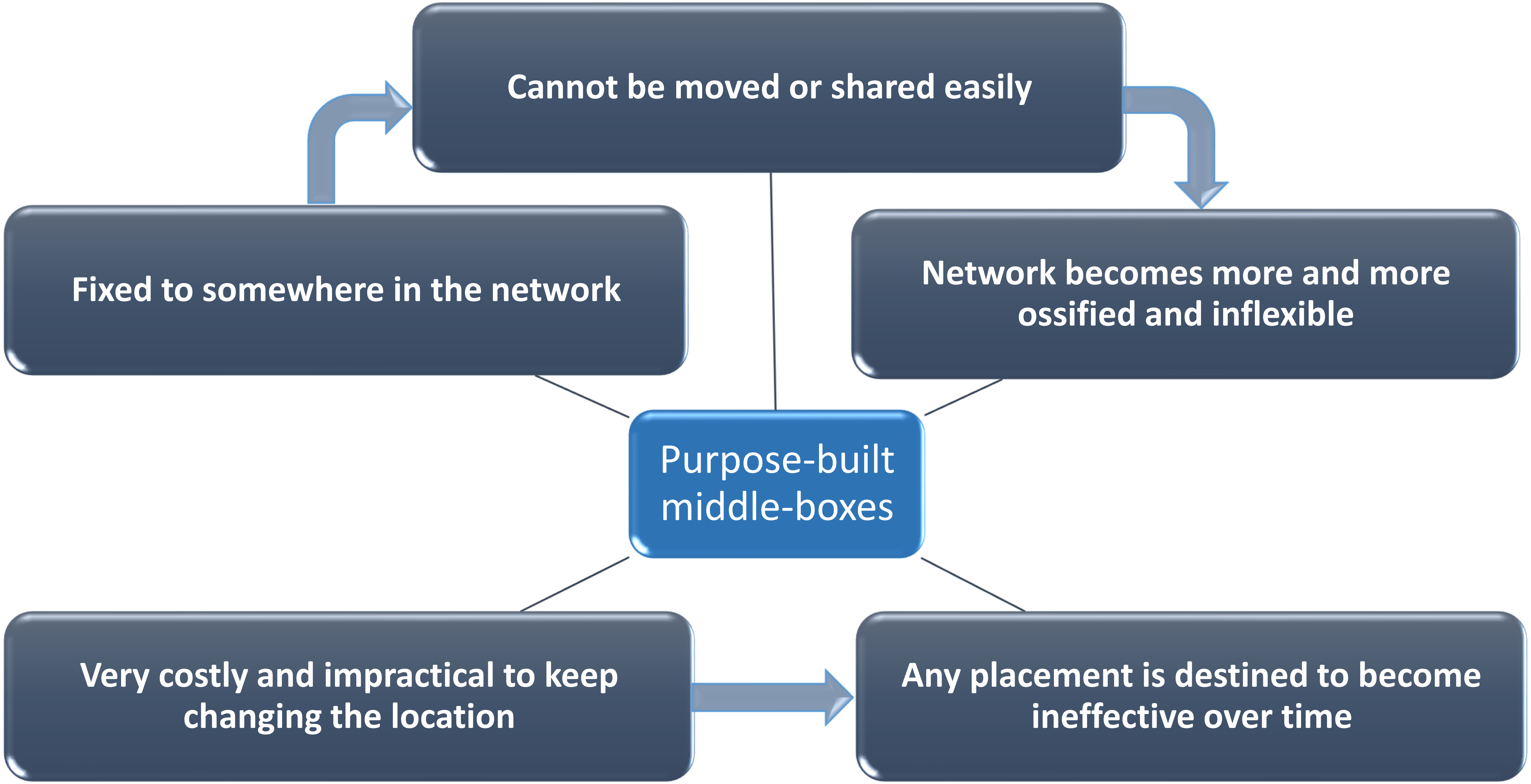


Challenges led by purpose-built middle-boxes

Purpose-built middle-boxes

- Complex process of integrating middle-boxes into network infrastructure
- Requiring a lot of manual work of technically trained person, also a long deployment cycle
- Standalone and closed, so naturally introduce new failures when they crash.
- Diagnosis for the new failures and some mis-configurations would be rather complex.
- New middle-boxes may be incompatible with old protocols which are designed without considering the unpredictable appearance of new middle-boxes
- Reconfiguration or patch procedures are inevitable for making the new middle-boxes work

Challenges led by purpose-built middle-boxes



Challenges of traditional networking

Various physical proprietary devices (middle-boxes) for each function

Strict chaining and/or ordering service components

Requirements for stringent protocol adherence

Heavy dependence on specialized hardware

Long product cycle

Very low service agility

Continuously increasing high data rate requirement by users

More diverse and new (short-lived) services

Constant increase in the number of middle-boxes

Dense deployments of network equipment

High and rapidly changing skills for technicians operating and managing equipment

High CAPEX and OPEX

Need for a dynamic & service-aware

High competition and Customer churn

The increase in CAPEX and OPEX cannot be translated in higher subscription fees

Trying to find dynamic and service-aware networks to…

- Reduce product cycles
- Reduce operating & capital expenses
- Improve service agility

2. Toward NFV-based network

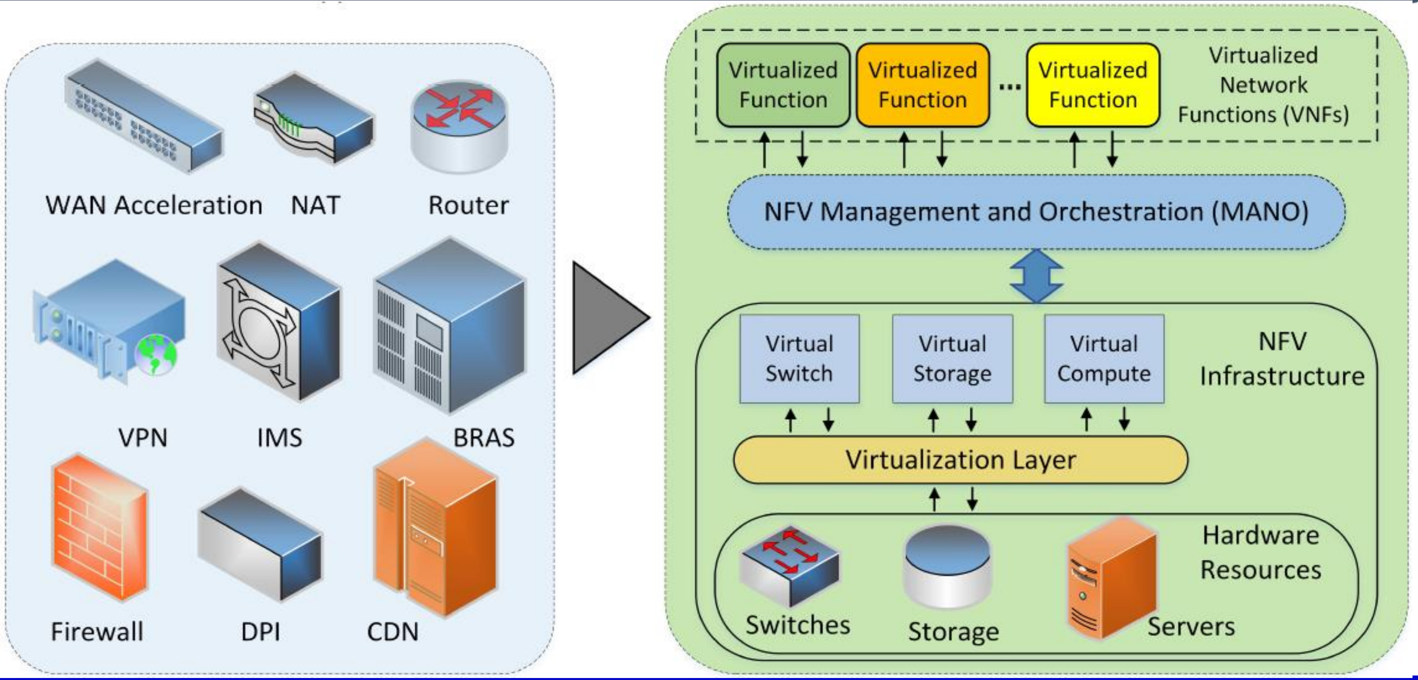
Separating functionality from hardware

Commercial-Off-The-Shelf (COTS) network equipment

Providing far more capacities with less cost

Satisfy the needs of general use rather than customized purposes

Separate network functions from the purpose-built devices and implementing them as software on standard COTS hardware



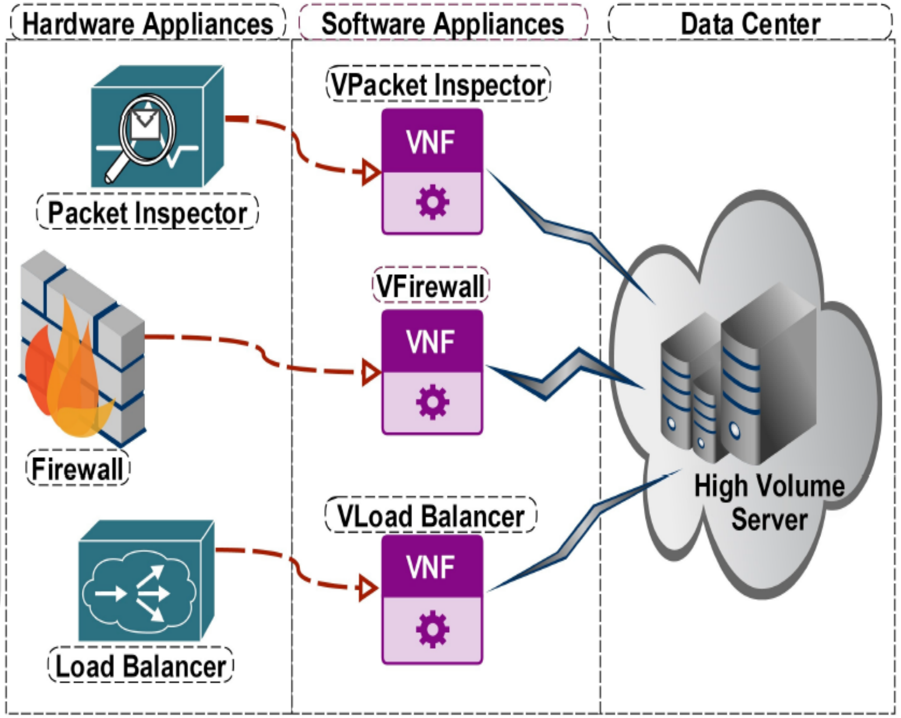
NFV motivation and advantages

A virtualization technology offering a new way to design, deploy and manage networking services.

Main idea is the decoupling of physical network equipment from the functions running on them.

- e.g. a firewall - can be dispatched to a TSP as an instance of plain software.

Allows for the consolidation of many network equipment types onto high volume servers, switches and storage (in data centers, distributed network nodes and at end user premises).



A given service can be decomposed into a set of Virtual Network Functions (VNFs).

VNFs can be implemented in software running on one or more industry standard physical servers.

VNFs may be relocated and instantiated at different network locations without necessarily requiring the purchase and installation of new hardware.

- e.g., aimed at introduction of a service targeting customers in a given geographical location.

NFV motivation and advantages

Network function migration

Traditional

- Migration of the whole object
- Time-consuming
- Energy-wasting

More efficient way which can save migration time and energy greatly.

NFV enabled network

- NFV enables a more efficient way for migration
- The traditional network function migration problem is equal to the VNF migration problem in the context of NFV
- Migration of the stateful information, while the other parts of the VNF can be remotely instantiated on the node after migration

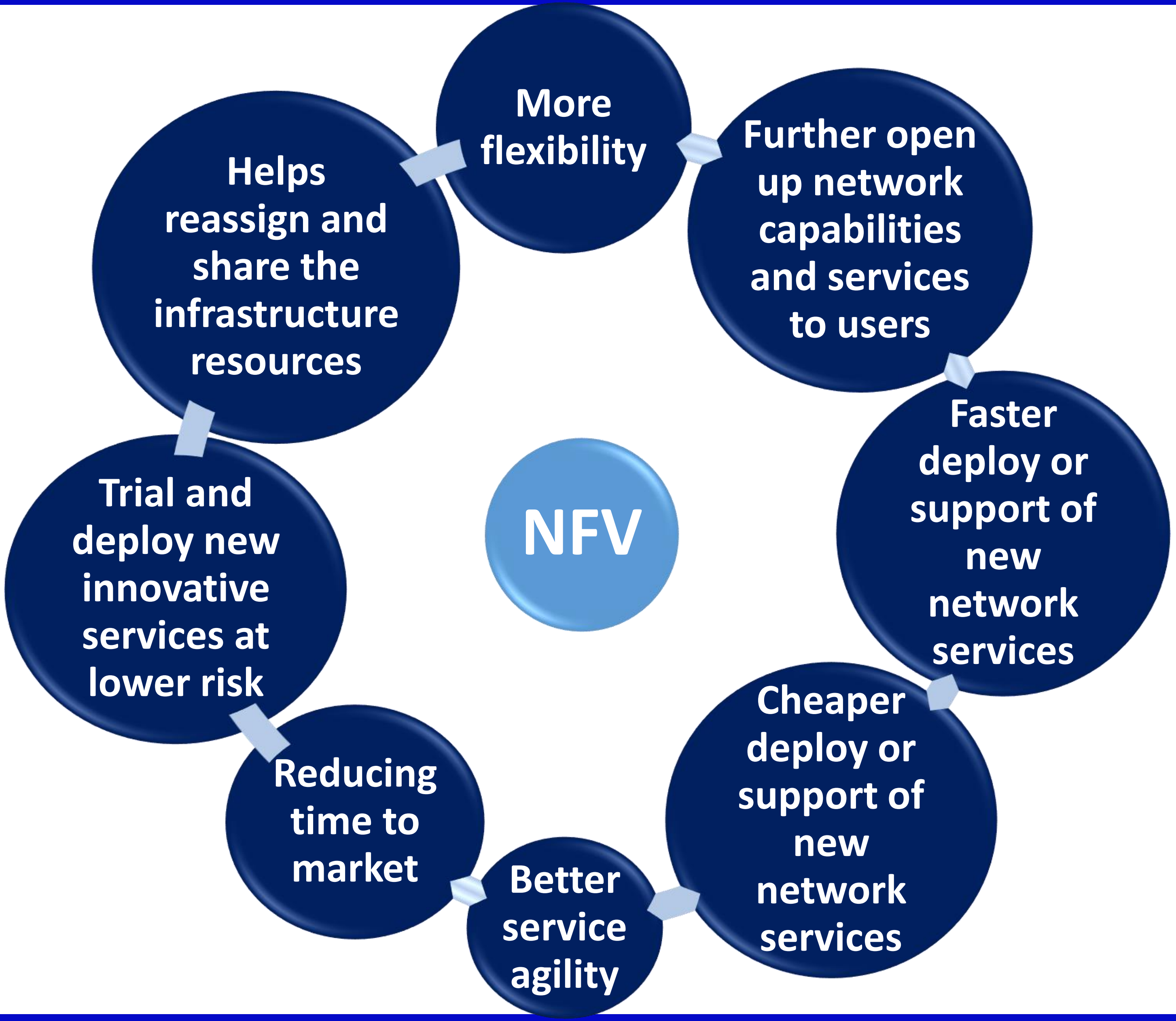
NFV motivation and advantages

Network service provisioning

traditional	NFV
Network element is a composition of integrated hardware and software entities.	The development and the maintenance of software and hardware accelerates in an independent way.
Resource allocation is done coarsely in a static way.	Resource allocation can be adjusted to the actual demands of traffic in a more dynamic way and with finer granularity.
Software instantiation and deployment are mostly done manually.	Software instantiation and deployment can be automated as long as the related COTS hardware is ready at specific N-PoPs.
Services are provided by ordering/chaining various middle-boxes in a particular sequence.	Services can be provided by orchestrating different VNFs, that is, placing VNFs (instead of middle-boxes) on the optimal N-PoPs and chaining them in a particular sequence.

N-PoP: Network Point of Presence

Summary of NFV motivation and advantages



3. NFV Use Cases

NFV Use Cases

- **Use Case #1**: Network Function Virtualization Infrastructure as a Service (NFVIaaS)
  - NFVIaaS: NaaS + IaaS
- **Use Case #2**: VNF Forwarding Graphs
- **Use Case #3**: Virtualization of Mobile Core Network and IMS
- **Use Case #4**: Virtualization of Mobile base station
- **Use Case #5**: Virtualization of the Home Environment
- **Use Case #6**: Virtual Content Delivery Network (vCDN) – Fulfilment
- **Use Case #7**: Fixed Access Network Functions Virtualization
- **Use Case #8**: Crypto as a Service (CaaS)

@ETSI GR NFV 001 V1.2.1 (2017-05): Network Functions Virtualization (NFV);Use Cases

NFV Use Cases

- ❖ **Use Case #9**: Network Slicing
- ❖ **Use Case #10**: Virtualization of Internet of Things (IoT)
- ❖ **Use Case #11**: Rapid Service Deployment
- ❖ **Use Case #12**: DevOps/CI/CD
  - ❖ **DevOp:** software development (**Dev**) and information-technology operations (**Ops**)
  - ❖ Continuous Integration, Continuous Delivery, (**CI**/**CD**)
- ❖ **Use Case #13**: A/B testing
- ❖ **Use Case #14**: VNF composition across multiple administrative domains
- ❖ **Use Case #15**: Security as a Service (SecaaS)

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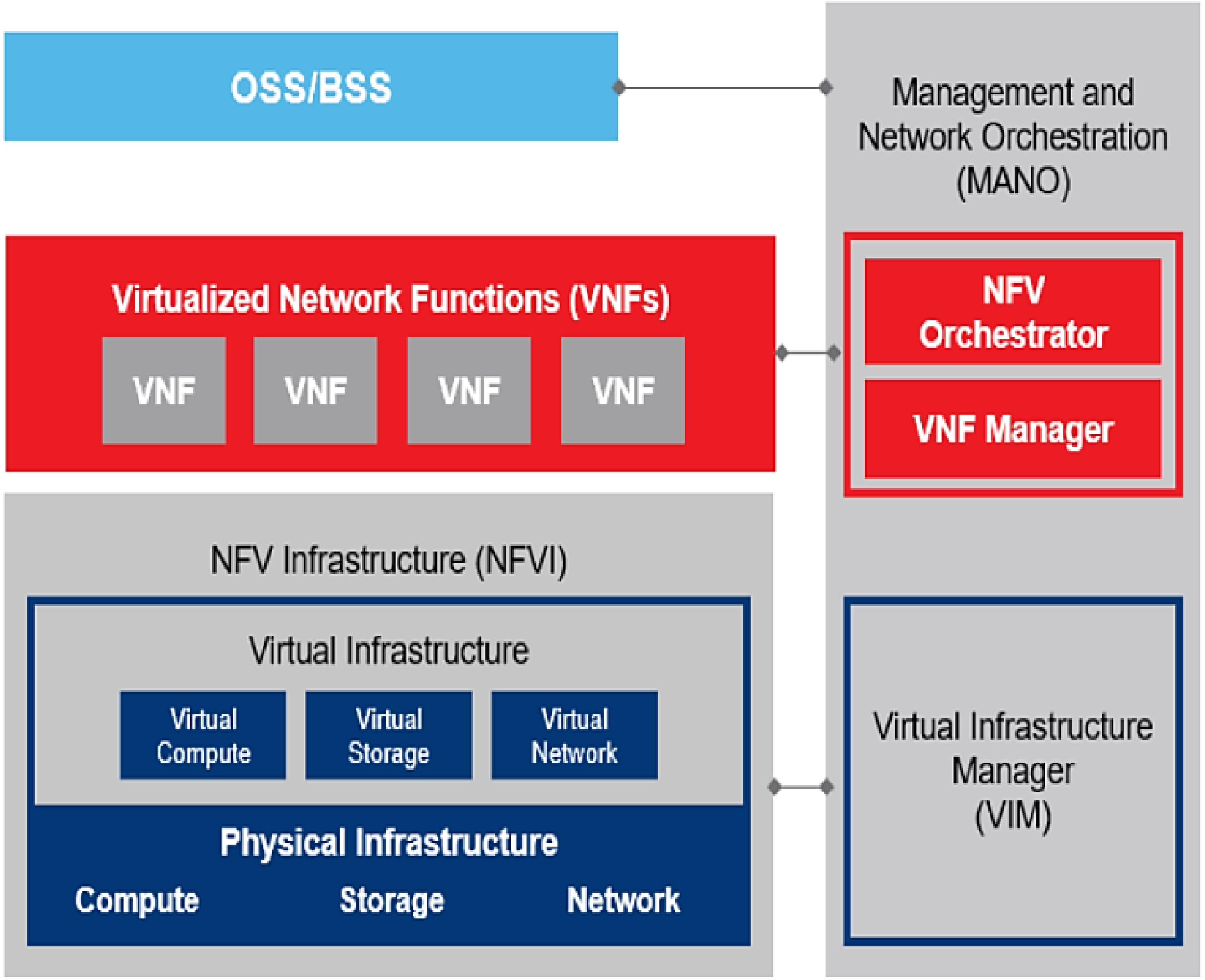
4. ETSI's Role

Emergence of NFV

These efforts did not form a standard, but they fundamentally contributed to appearance of NFV

Under such background, the concept of NFV appeared in the white paper co-authored by over twenty of the world's largest TOs in October 2012

In November 2012 seven of operators (AT&T, BT, Deutsche Telekom, Orange, Telecom Italia, Telefonica and Verizon) selected ETSI to be the home of Industry Specification Group for NFV



ETSI’s role in developing NFV

Membership of ETSI has grown to over 245 individual companies including 37 of world’s major service providers, representatives from both telecoms and IT vendors

In phase 1 of ETSI’s work specifications of NFV are described and include:

infrastructure overview

Security, trust, resilience and service quality metrics

descriptions of compute, hypervisor and network domains of the infrastructure

Management and Orchestration (MANO)

updated architectural framework

Formation of ETSI and its goal

The ETSI NFV ISG currently has four working groups and two expert groups:

1. Infrastructure Architecture,
2. Management and Orchestration,
3. Software Architecture,
4. Reliability & Availability,
5. Security,
6. Performance & Portability.