TOMORROW
starts here.

Cisco Connect
NfV koncepce a případy využití

TECH-SDN-SP

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Obsah přednášky

- Co je NfV, standardizace
- Použitelnost NfV
- Cisco a NfV
- Případy využití NfV + demo
Network Functions Virtualisation
Enablers, benefits and applications

NfV = Transition of network infrastructure services to run on virtualised compute platforms
Using cloud technology to provide network functionality

- **Enablers**
  - Hypervisor and cloud computing technology
  - Improving x86 h/w performance
  - Optimised packet processing and coding techniques
  - Network industry standardising on Ethernet
  - SDN based orchestration

- **Value Proposition**
  - Shorter innovation cycle
  - Improved service agility
  - Reduction in CAPEX and OPEX

- **Applications**
  - Potentially all network functions
Network Functions Virtualisation: Terminology

- **Network Function (NF):** A functional building block within a network infrastructure, which has well-defined external interfaces and a well-defined functional behaviour. In practical terms, a Network Function is today often a network node or physical appliance.

- **Virtualised Network Function (VNF):** An implementation of an NF that can be deployed on a Network Function Virtualisation Infrastructure (NFVI).

- **NFV Infrastructure (NFVI):** The NFV-Infrastructure is the totality of all hardware and software components which build up the environment in which VNFs are deployed. The NFV-Infrastructure can span across several locations.

- **NFV Orchestrator (NFVO):** The NFV Orchestrator is in charge of the network wide orchestration and management of NFV (infrastructure and software) resources, and realizing NFV service topology on the NFVI.

- **NF Forwarding Graph:** A graph of logical links connecting NF nodes for the purpose of describing traffic flow between these network function.

- **VNF Component (VNFC):** Subcomponent of a VNF executing in a discrete VM*

Source NFV terminology document: [http://www.etsi.org/deliver/etsi_gs/NFV/001_099/003/01.01.01_60(gs_NFV003v010101p.pdf](http://www.etsi.org/deliver/etsi_gs/NFV/001_099/003/01.01.01_60(gs_NFV003v010101p.pdf)] * Not formally defined in the terminology document
ETSI NfV architektura a organizace

S/W Architecture

NFVI

Virtual Computing
Virtual Storage
Virtual Network

Infrastructure

Computing Hardware
Storage Hardware
Network Hardware

Virtualisation Layer

Hardware resources

VNF 1
VNF 2
VNF 3

Virtualised Infrastructure Manager(s)

Orchestrator

Management and Operations

Main NfV reference points

Other reference points

Execution reference points

OSS/BSS

Technical Steering Committee

Reliability and Availability

Expert Groups

Performance and portability

Security

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NfV Infrastructure Group

- **Role**: Infrastructure to support VNFs

- **Hypervisor domain**
  - Virtual Machine technology

- **Compute domain**
  - h/w on which VNFs execute
  - CPUs – x86 and ARM
  - Network Interface Cards
  - Accelerators
  - Storage

- **Infrastructure Network domain**
  - Real and virtual infrastructure network
  - N/W virtual partitioning technology
**NFV-MANO Group**

- **Role:** Management framework of VNFs and NFVI

- **NfV Orchestrator**
  Life cycle management of n/w services  
  Across entire operators domain (multiple sites)

- **VNF Manager**
  Lifecycle management of VNFs  
  Associated NFVI resources

- **Virtualised Infrastructure Manager**
  Management of the NFVI components  
  Specialist VIMs permitted (e.g. compute and n/w)

- **E/NMS:** FCAPs for VNFs

- **OSS/BSS:** linkage to legacy systems

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**Simplified Diagram:**

- **OSS/BSS**
- **NfV Orchestrator (NFVO)**
- **E/NMS**
- **VNF Manager (VNFM)**
- **Virtualised Infrastructure Manager (VIM)**
- **VNF**
- **NFVI**
Role: Structure of VNFs and interfaces

VNF Designs
- Single or multiple components (VNFCs)
- VNFC parallel or non parallel
- VNFC → Stateful, stateless, external state
- Load balancing
- Scaling models → auto, on-demand, manual
- Reuse

Description of VNF Characteristics
- Defining VNF properties
- Descriptor (VNFD) attributes
Použitelnost NfV
The “Service Provider” landscape

**Wireless**
- 2G 3G
- LTE
- SecGW
- WiFi
- Small Cell
- HNB-GW

**Wireline**
- FTTx
- PON
- xDSL
- CMTS
- HFC
- Biz CPE
- Res CPE

**Metro and Access**
- RNC
- SGSN
- GGSN
- SGW
- PGW
- MME
- eWAG
- ePDG
- WLC
- BNG

**Gateways**
- BGCF
- MGCF
- I-CSCF
- CSCF
- ENUM
- HLR
- BGP
- AAA
- DNS

**Subsystem and Network Control**
- Voice/IMS
- Video
- Network
- User plane
- Core Network
- DC Network
- Service Provider Services
- OSS/BSS/NMS/EMS
- Security GWs
- FW
- DPI

**Metro Network**
Network solutions: Requirements

- OSS/BSS, subsystem and N/W control
- Wireless GWs
- Appliances (L4-L7)
- Wireline GWs
- Backbone, Metro and DC switching
- Business CPE
- Home CPE

CPU Reqs

0 10Mbps 100Mbps 1Gbps 10Gbps 100Gbps 1Tbps 10Tbps 100Tbps 1Pbps
Network solutions: Design approaches

- **OSS/BSS, subsystem and N/W control**: Centralized: CPU or SoC
- **Wireless GWs**: Distributed: CPUs + Lots of NPUs
- **Wireline GWs**: Distributed: Lots CPUs + NPUs
- **Appliances (L4-L7)**: Distributed: CPUs + NPUs
- **Backbone, Metro and DC switching**: Centralized: CPU + NPU
- **Business CPE**: Centralized: CPU or SoC
- **Home CPE**: Variable CPU / FPGA / NPU

**CPU Reqs**
- High: 0
- Low: 10Mbps, 100Mbps, 1Gbps, 10Gbps, 100Gbps, 1Tbps, 10Tbps, 100Tbps, 1Pbps
Virtual Network Functions (VNF) – evaluation criteria

- Physical Design Requirements
  - interface count, interface size, system design requirements, specialist N/W functions
- Performance Requirements
  - L1-L3 packet performance, CPU processing, fabric capacity
- Network Architecture
  - Will virtualization fit the network architecture principles of the network
- Elasticity of the service
- Economics
  - Onboarding, CapEX and OpEx
Appeal of virtualized solutions

Active Cisco virtualization efforts

- Business CPE and services
- Consumer Services
- SP applications
- OSS/BSS/NMS/EMS
- IMS
- Network control
- Wireline gateways (BNG/BRAS)
- Mobile Gateways
- User Plane Appliances (GiLAN)
- DC Virtual appliances

Virtualization Opportunities
Some very obvious / many SP and architecture dependent
Cisco’s NfV vision – architectural components

- **Real**: High capacity plumbing and high performance gateways
- **Virtualized**: CPU intensive functions, low – mid range packet processing functions
- **Interaction** required between the real and virtual network functions via orchestration

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Cisco's NfV vision

Virtualised Network Functions (VNFs)

Orchestration (NFVO)

Data Centre

Customer Premises and/or Data Centre

Classification + Redirection Function

Policy Server

PoP

Network Overlays

Compute + Virtualization Technology (NFVI) + Service Chaining

Wide Area Network

Virtualised Network Functions

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NFVI compute - Placement of resources

Customer Premises

CPE

Stand Alone UCS Server

ISR G2 Cloud Connector (UCS)

PoP

IP edge

NGN

Centralised DC

UCS directly connected to ASR9000

Blade or chassis based UCS

VSM running in an ASR9000

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NFVI hypervisor – Cisco’s approach

- ETSI allows virtualized and bare metal solutions
- Cisco approach
  Concentrating on virtualized solutions
  Multi-hypervisor approach for the overall market place
  SP’s running NfV environments → KVM managed by Openstack
NFVI network – Virtual partitions

Physical Infrastructure

Example: Managed Services Virtual Partition

L3 VPN

Internet

vRouter

vLoadbalancer

vWeb Scrubber

IaaS capabilities

Managed Services Functionality
NFVI network – creating the virtual network partitions

Underlay and overlays
Example vPE and VXLAN

Infrastructure partitioning
Example VLANs

Functionality of virtual N/W orchestration controller application dependent on physical infrastructure and virtualization technology
NFVI network – Service Chaining or Forwarding Graphs

- Steer traffic through a one or more service entities
- Critical for non routed data plane services
- Important for control plane services
- Physically/logically directed or carried in packet metadata
NFVI network – Service Chaining or Forwarding Graphs

- Service ordering determined by real or virtual n/w structure
- Virtual Packet Edge (vPE) solution

Service Path information determines Service Chaining

- Service ordering by info in user packet
- 5 drafts submitted by Cisco at Berlin IETF
- New IETF working group “Service Function Chaining (sfc)”
Případy využití NfV
NfV Use Cases

- Virtualized SP and third party applications / appliances
- Virtualized gateways (PE, P-GW, BNG/BRAS)
- Virtual Managed Services
- Virtual Home CPE (→demo)
- Virtualized mobile solutions
- Virtualized video solutions (→demo)
NfV use case: Virtualized SP / 3rd party applications

- Many examples
  OSS/BSS, voice and video solutions, N/W control, video/collaboration solutions, wireless/wifi, security

- NfV transition well underway

- Cisco has a wide range of FCS’d products in this space
  See earlier slide for details

- New solutions coming think and fast
  Ask your SE for the latest status
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NfV use case: Virtualized Edge Gateway

- Cisco complementing existing h/w gateway solutions with virtualized g/w solutions
- vPE, vBNG/BRAS based on Cloud Service Router (CSR1000: IOS-XE 3.13 July 2014)
- Virtual mobile gateways (MME, S/PGW) based on QvPC solutions
- CableLabs have kicked off work on vCMTS
- Virtualized gateways may require architectural changes
  Virtual racking and stacking
NfV Use Case: Managed services

Service appliances in the branch and DC

Virtualised services on the physical router

Virtualised router and services

Virtualized branch services

Virtualized service in DC
NfV use case: Virtual residential gateway

- Quantum Virtual Broadband Node (Q-vBN)
  - L2 domain between home and data centre
  - Virtualized CPE and home services in the cloud
Physical Appliances are complex to design
Mismatched capacities
Diverse resiliency strategies
Incompatible networking

Re-configuration (adding capacity or adding an appliance) is difficult

Hard-wired service chains
NfV use case: Virtual Service Infrastructure

- Simple reconfiguration of service chains via SDN and virtualization tools
  - Improved scaling
  - Elastic services
- GiLAN solution trials: 1HCY2014
Q-vBN
Q-vBN Intro

Broadband Today

- Services

???

- Virtualize Services
- Virtualize Network
- API Exposure

Broadband Tomorrow

- Services
Definice Q-vBN

What is it?
- A low cost software based virtualization system that runs standard broadband CPE code in the cloud

What can it do?
- Allows for services to be written and run in the cloud
- Allows SPs to sell an inexpensive cloud based computing platform directly connected in the home
- Extends the life of the physical CPE in the home
- Allows for per device management in the home
- Allows for test environments for companies to quickly trial new services
Q-vBN pro minimální vCPE aplikace

- No L3 functionality in the gateway
- All L3 functionality in a “cloud gateway”
- Home broadcast domain extended to Cloud GW
- Setup demonstrated at CES
Q-vBN: Rozšíření LAN do Cloudu

- Network design unchanged – no forklift
- Home LAN extended to a Service
  - Storage (NAS) Backup
  - IPv6 as a service/v4
  - Individual device management
  - M2M
Principy řídící vrstvy Q-vBN

- No polling required – RPC and event driven
- External Sets and Gets of data by RPC using HTTP/REST
- Events and asynchronous RPC by XMPP Publish/Subscribe
- A common internal Network Management Protocol built upon JSON formatted messages
- Out of band control plane connection to agents in virtual CPEs for robustness and security
- Control plane has been built to isolate agents from knowledge of their identities. NMP adds/removes JSON addressing envelope as required
- Configuration pushed to agents, not pulled
The basic building block in Q-vBN is a host which supports a number of vCPE instances, a virtual switch and host/vCPE management agents:
Multiple Q-vBNs hosts are combined using ESB architecture:
Závěr

- Poptávka po NfV musí odpovědně zohledňovat růst síťového provozu
- Cisco se plně hlásí k NfV a je aktivní v mnoha oblastech
  - VNFs, NFVIs, orchestrace
- Některé VNFs jsou zřejmé, velké spektrum ale závisí na SP a jeho architektuře
- Realitou jsou hybridní síťová prostředí s custom NFs i Virtualized NFs (VNFs)
- Přehled některých Cisco implementací NfV
Užitečné odkazy

- GS NfV 001 NfV: Use Cases
- GS NfV 002 NfV: Architectural Framework
- GS NfV 003 NfV: Terminology for Main Concepts in NfV
- GS NfV 004 NfV: Virtualisation Requirements
- GS NFV-PER 002 NfV: Proofs of Concepts; Framework
Prosíme, ohodnoťte tuto přednášku

Děkujeme
Demo: NfV

1) vCPE:

- High Speed Message Router
  - Guest Agent
  - Virtual Switch
- Core Network
- Broadband Network
+ $30 =

2) Virtualizované (elastické) CDN:

- Orchestration Engine
  - VM Orchestration
  - SE Orchestration
- VM Create and Configure
- VM Create and Configure Request
- vStreamer Load Updates
- Elasticity Policy
- Load Configure
- HTTP Load Generator
- vStreamer
- Virtual Environment (OpenStack)
- Origin Services
- Streaming Node
- Origin Services
- OpenStack – Compute, Storage, and Network Orchestration
- Hypervisor
- Unified Compute System
- Hypervisor
- Unified Compute System
- Hypervisor
- Unified Compute System
- Network Infrastructure
- Load Updates
- vStreamer Load Updates
- Network Infrastructure
- Load Updates