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Wybrane problemy wirtualizacji funkcji sieciowych NFV

Artur Lasoń

2024

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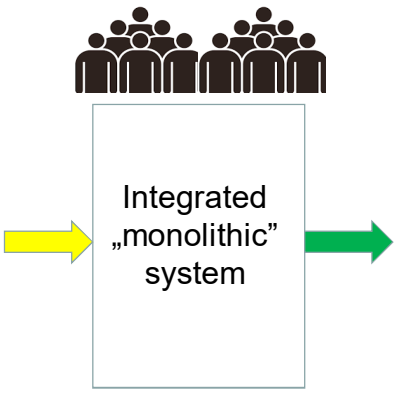

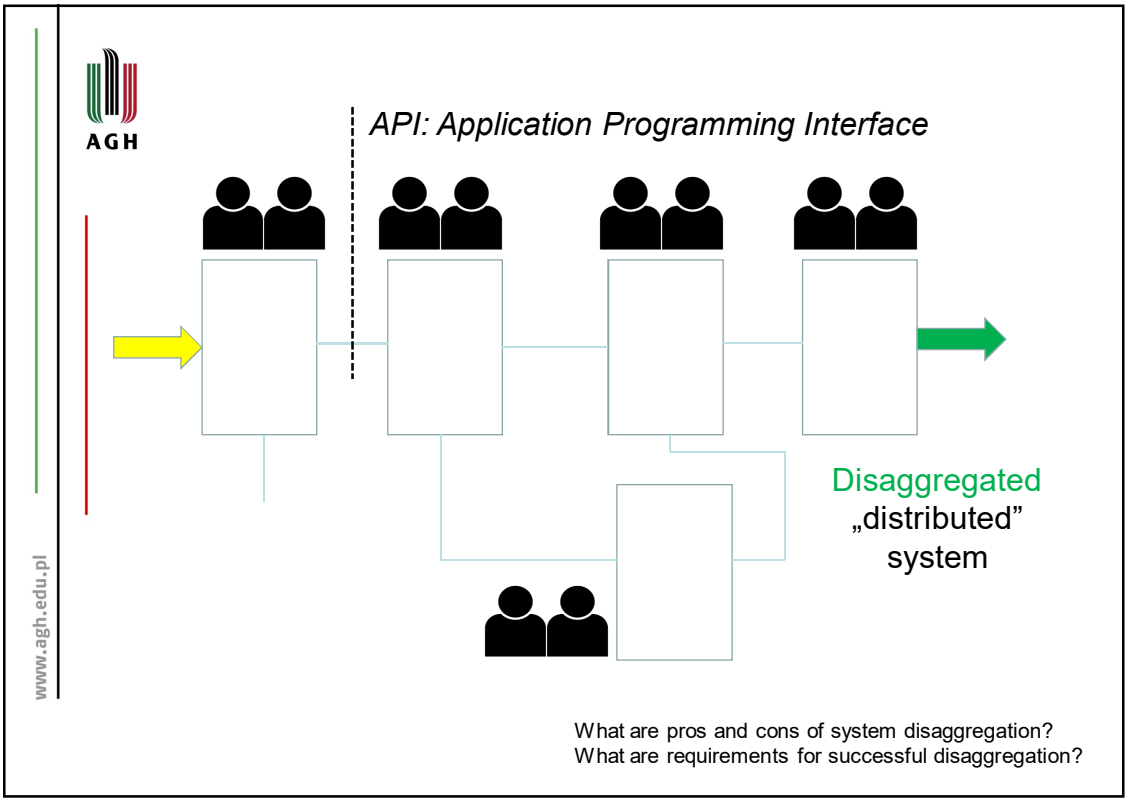
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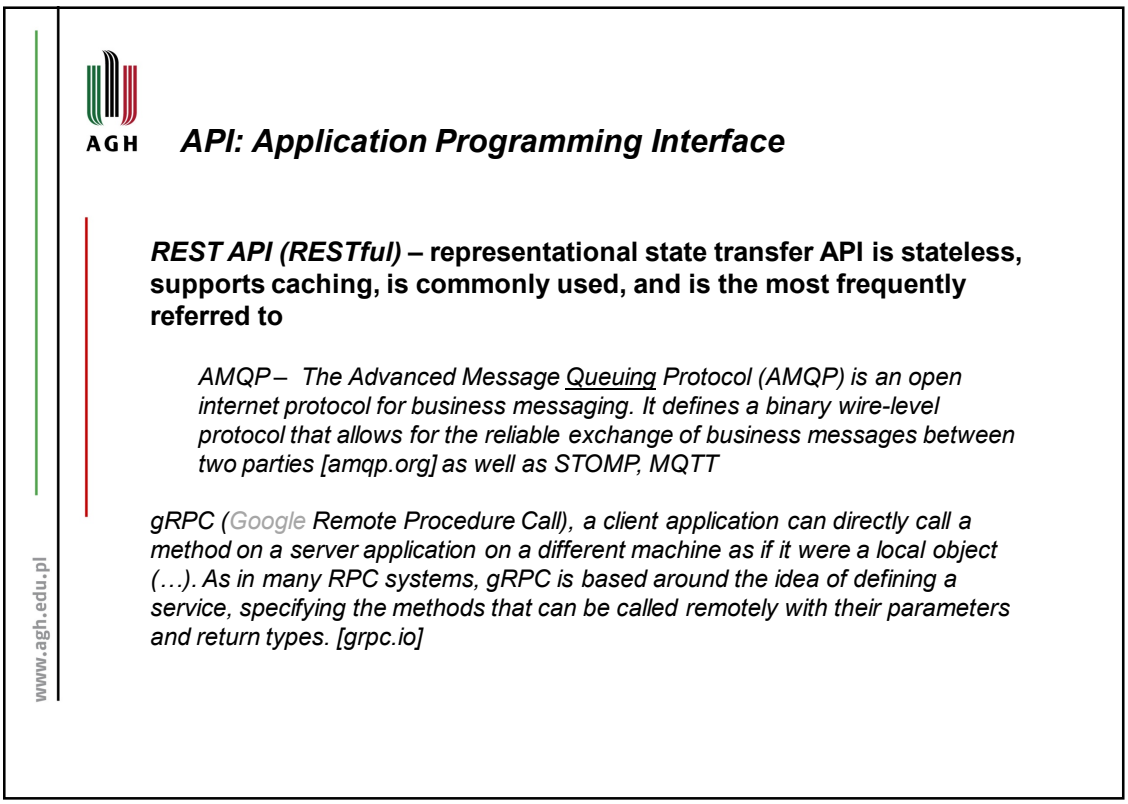
API: Application Programming Interface
Disaggregated
„distributed”
system
www.agh.edu.pl
What are pros and cons of system disaggregation?
What are requirements for successful disaggregation?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API: Application Programming Interface
REST API (RESTful) – representational state transfer API is stateless, supports caching, is commonly used, and is the most frequently referred to
AMQP – The Advanced Message Queuing Protocol (AMQP) is an open internet protocol for business messaging. It defines a binary wire-level protocol that allows for the reliable exchange of business messages between two parties [amqp.org] as well as STOMP, MQTT
gRPC (Google Remote Procedure Call), a client application can directly call a method on a server application on a different machine as if it were a local object (…). As in many RPC systems, gRPC is based around the idea of defining a service, specifying the methods that can be called remotely with their parameters and return types. [grpc.io]
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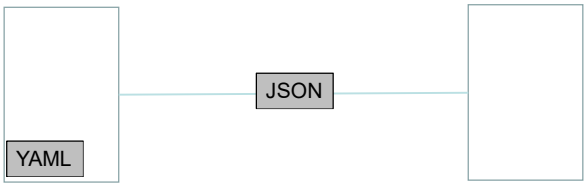
Data representation for API

JavaScript Object Notation (JSON) is a lightweight, text-based, language-independent data interchange format. (…) JSON defines a small set of formatting rules for the portable representation of structured data. [RFC8259]

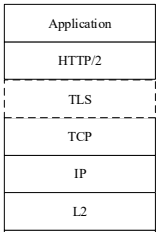
YAML (a recursive acronym for "YAML Ain't Markup Language") is a data serialization language designed to be human-friendly and work well with modern programming languages for common everyday tasks. [yaml.org]



Service Based Architecture / Interfaces

3GPP TS 23.501 defines the 5G System Architecture as a Service Based Architecture, i.e. a system architecture in which the system functionality is achieved by a set of NFs providing services to other authorized NFs to access their services.

The service based interfaces use HTTP/2 protocol (…) with JSON (…) as the application layer serialization protocol. For the security protection at the transport layer, all 3GPP NFs shall support TLS and TLS shall be used within a PLMN if network security is not provided by other means (…).
[3GPP TS 29.500 V17.5.0]



SBI Protocol Stack

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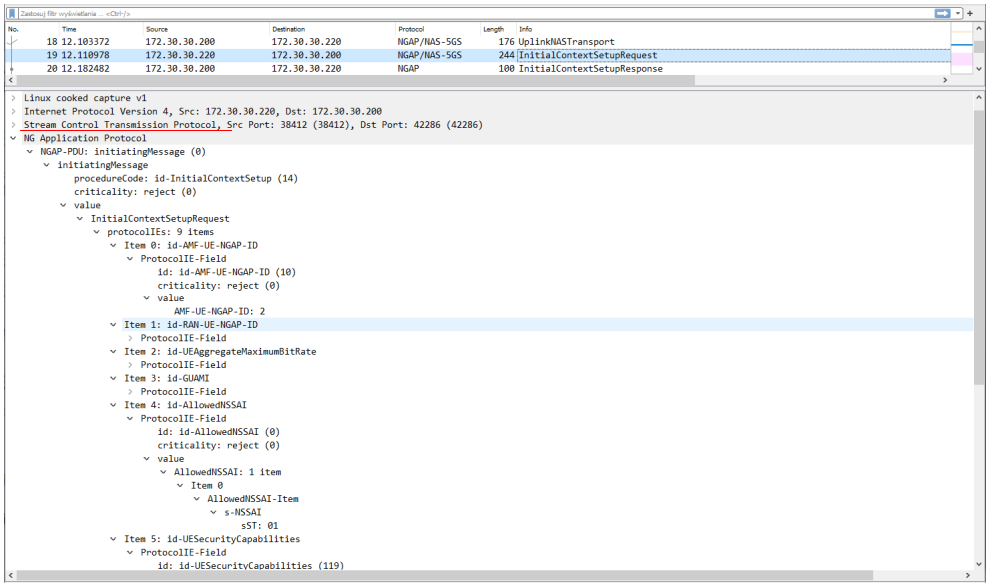
TCP/TLS vs SCTP vs QUIC



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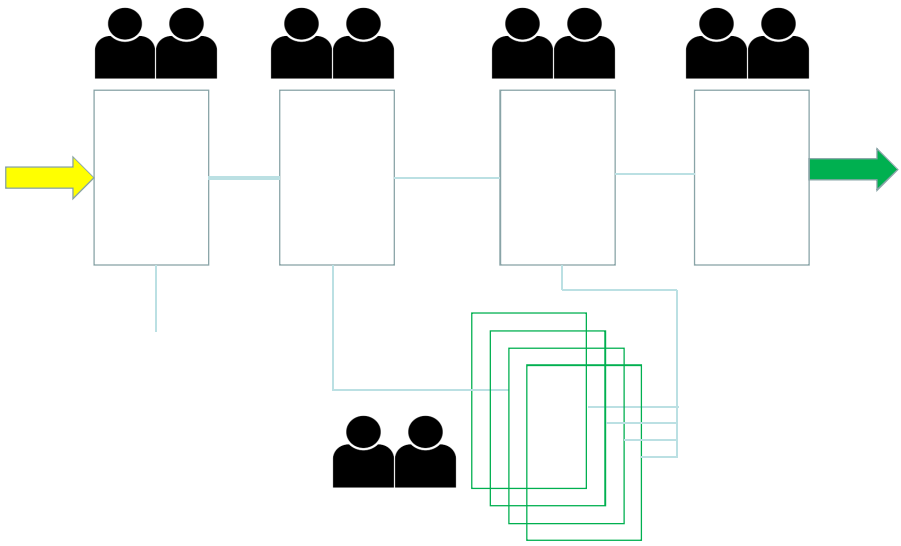
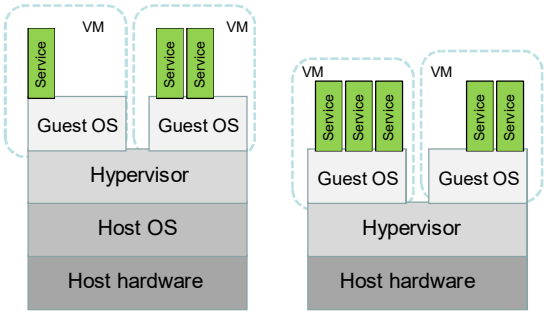


What are pros and cons of system virtualization?
What are requirements for successful virtualization?

Disaggregated and virtualized system

Full (VM) virtualization

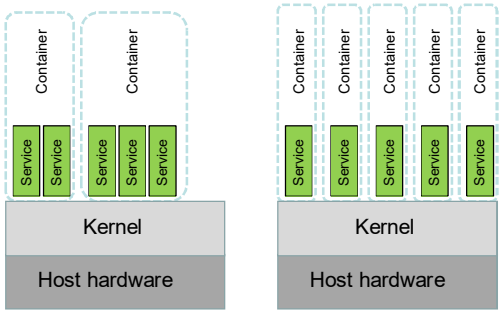


Type 2 Hypervisor
(KVM, VirtualBox)

Type 1 Hypervisor
(Xen, VMWare ESXi)

Type 2 and Type 1 Hypervisor comparison usually in terms of performance, security

Lightweight (container) virtualization



Machine containers
(lxc)

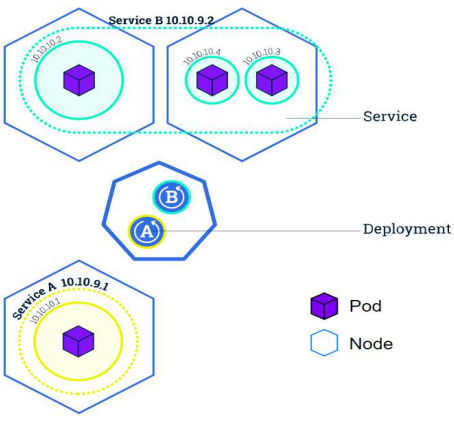
Process containers
(docker)

Containers management and orchestration

There are two competing or/and complementary solutions for managing clusters of containers: Kubernetes (k8s) and OpenShift

Kubernetes	OpenShift
Open source project	Red Hat product
Any Linux distribution	Red Hat RHEL (CentOS)
Available at Google, AWS, Azure	Available at Google, AWS, Azure
Software flexibility	Software security
Great community support	Great commercial support

Container, pod, service, deployment (replica_set)

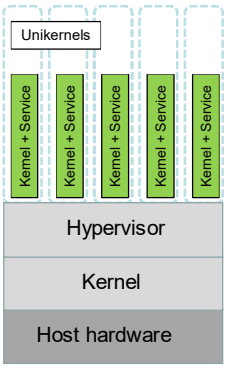


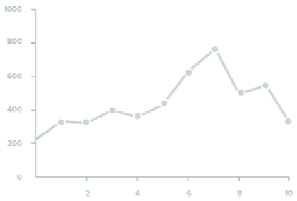
Deployment: Rolling deployment, Canary deployment, Blue/green deployment

Observability – Service mesh, code „instrumentalisation”

https://kubernetes.io/docs/tutorials

Unikernels based virtualization



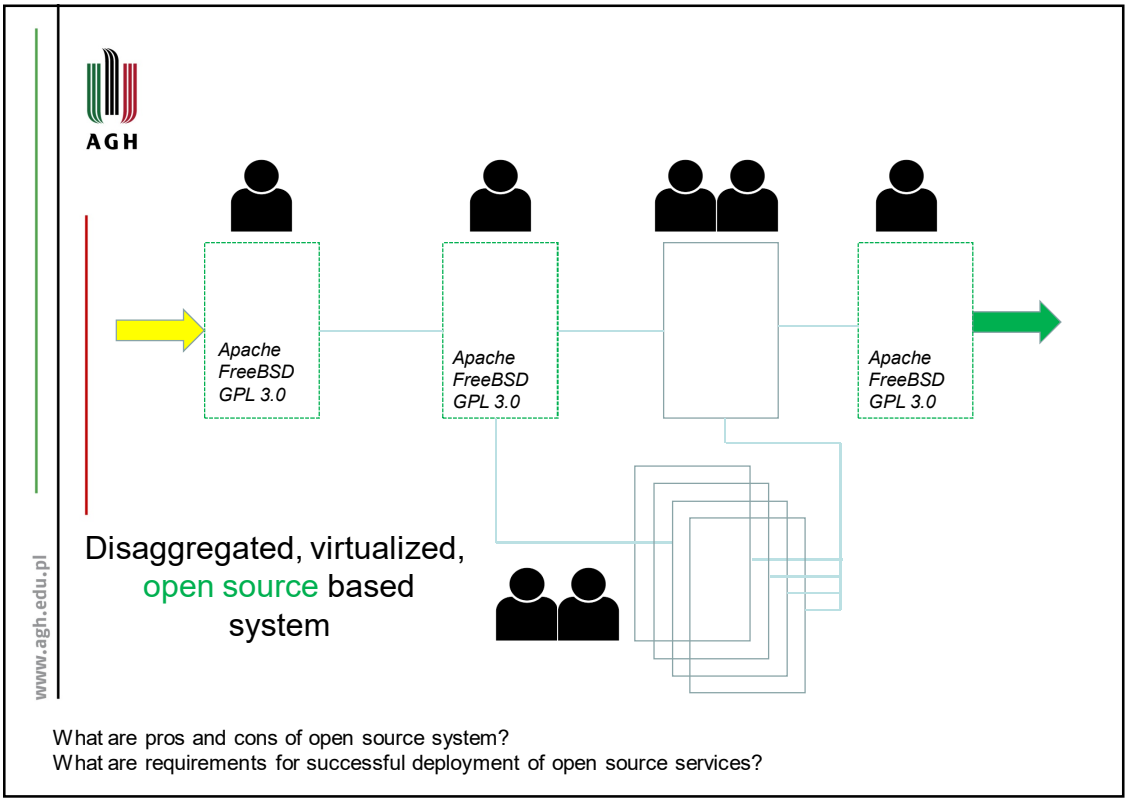


Unikernel based VMs

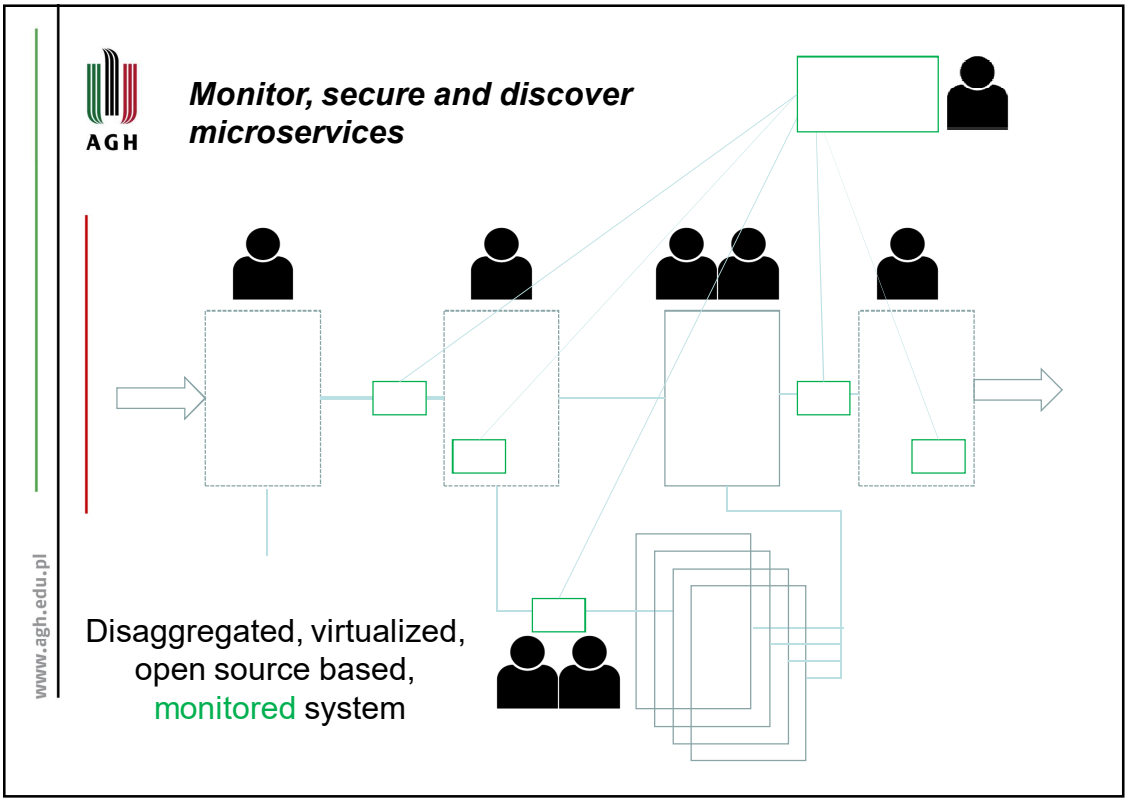
Serverless computing

What is the key difference between „light virtualisation" and serverless computing ?

Knative, KEDA, others
AWS Lambda, Cloud Run, Serverless functions, others

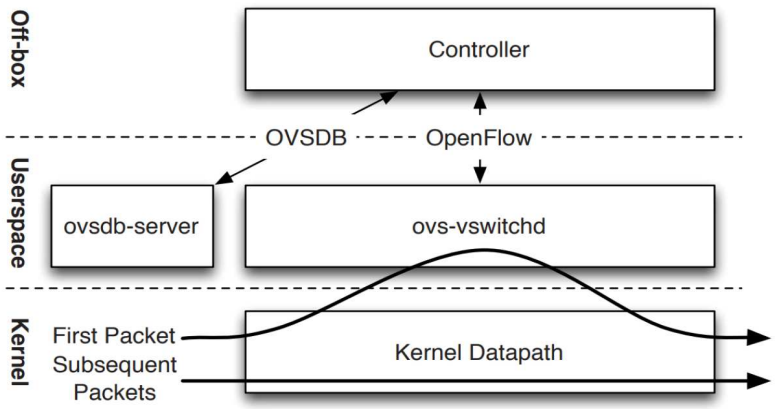


What are pros and cons of open source system?
What are requirements for successful deployment of open source services?



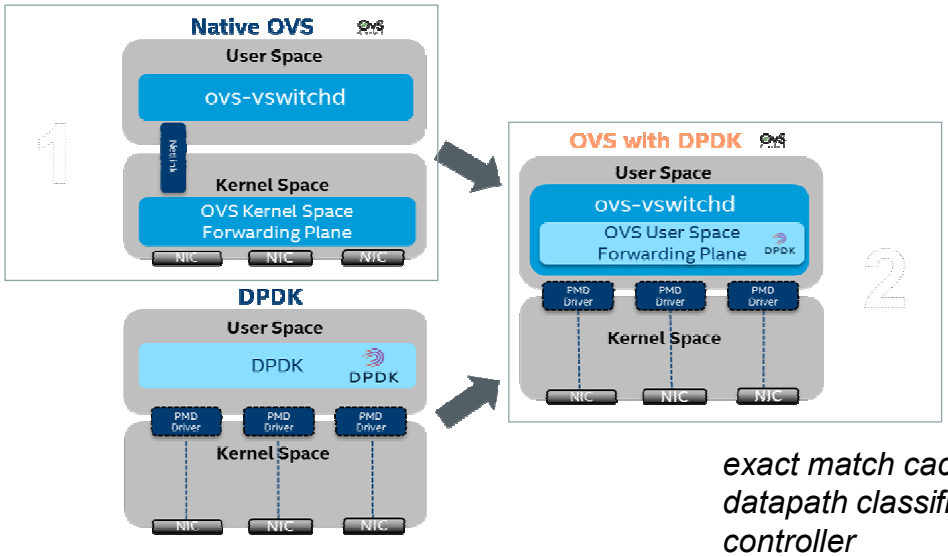
Przełącznik programowy Open vSwitch

Open vSwitch



microflow cache
megaflow cache
forwarding table(s)
controller

DPDK – Data Plane Development Kit

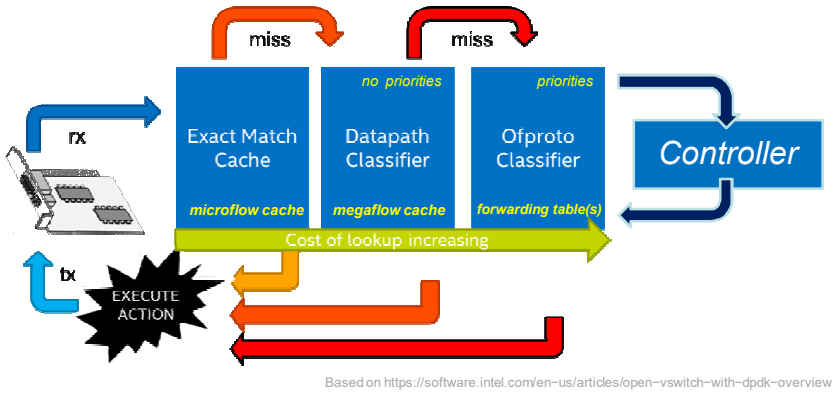


exact match cache
datapath classifier
controller

intel.com

OvS – masterpiece of virtualization technology without TCAM ……..

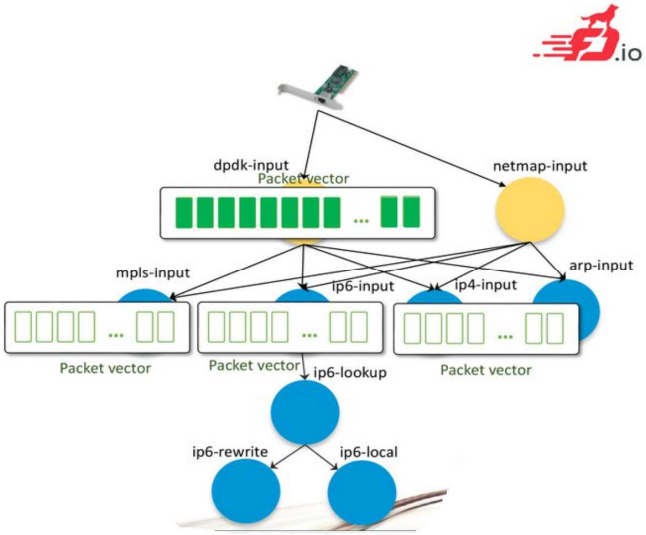
Open vSwitch + DPDK



Based on https://software.intel.com/en-us/articles/open-vswitch-with-dpdk-overview

EMC – hash of a classic 5-tuple
Data path classifier – tuple space search problem
Ofproto classifier – forwarding table optimisation
Controller

Vector Packet Processing (VPP)

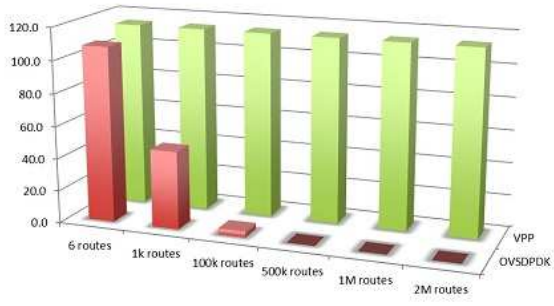


https://slideplayer.com/slide/13096932/

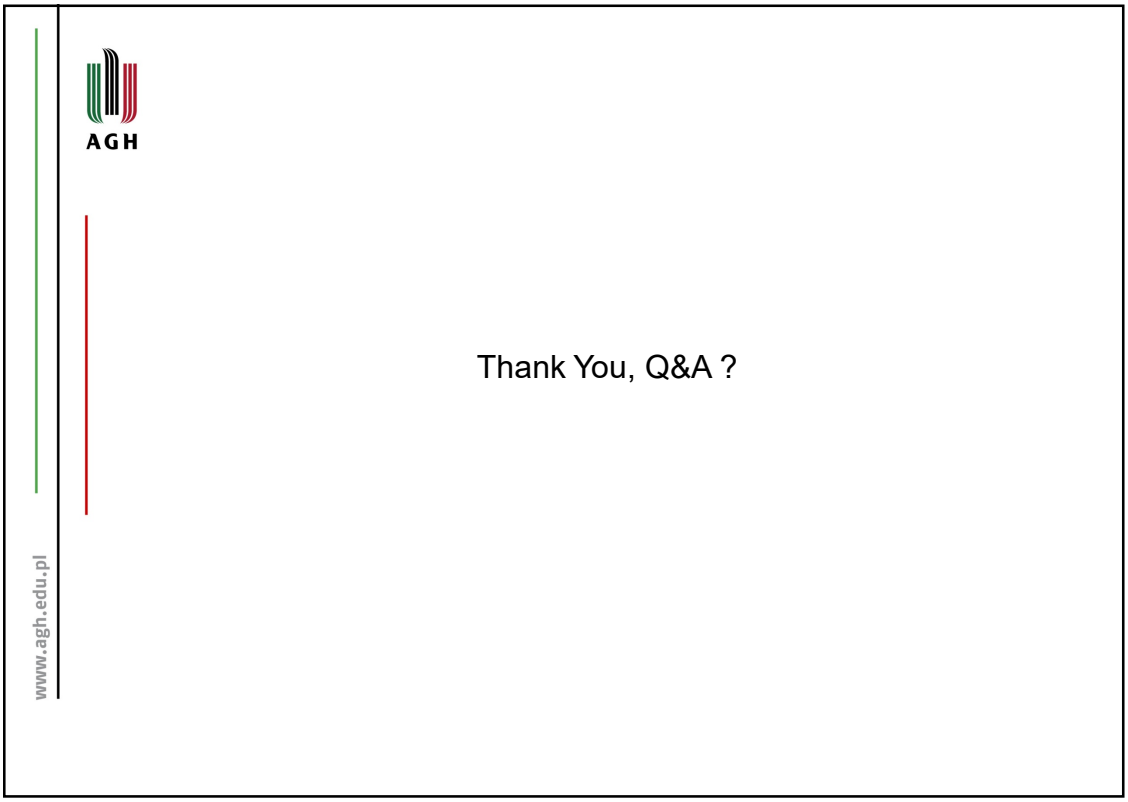
Open vSwitch + DPDK + VPP

Non-drop rates of VPP and OVSDPDK tested on server with E5-2698v3 2x16C 2.3GHz , 12 port 10GE, 16 core, IPv4.

https://wiki.fd.io/view/VPP/What_is_VPP



Open vSwitch is limited due to complex network stack and time-consuming kernel to user space packet forwarding
DPDK handles packets in user space, it still suffers from limited scalability (exact match cache stored in expensive processor cache)
VPP improved performance of software switches due reduced I-cache misses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Thank You, Q&A ?