The Evolution of Open vSwitch

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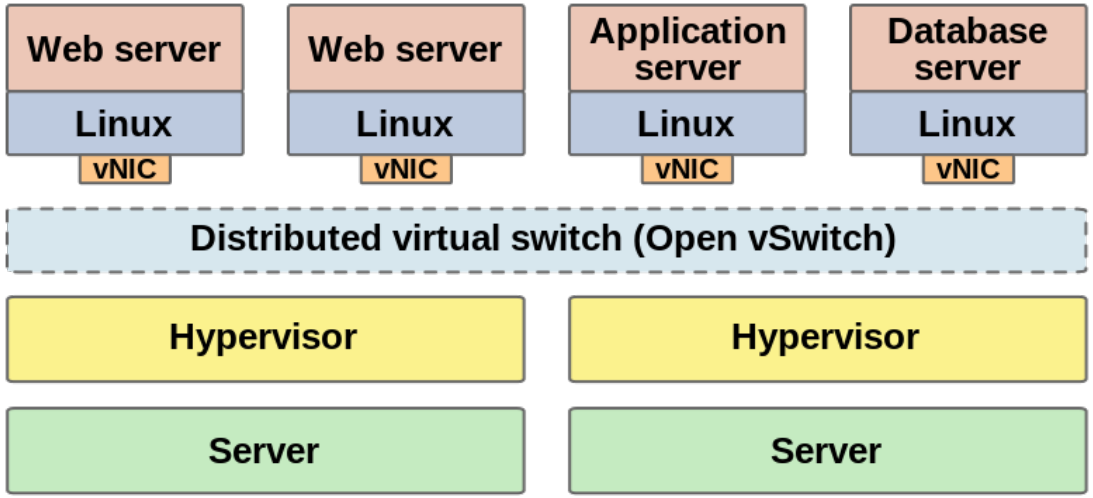
A Very Brief Introduction to OVS

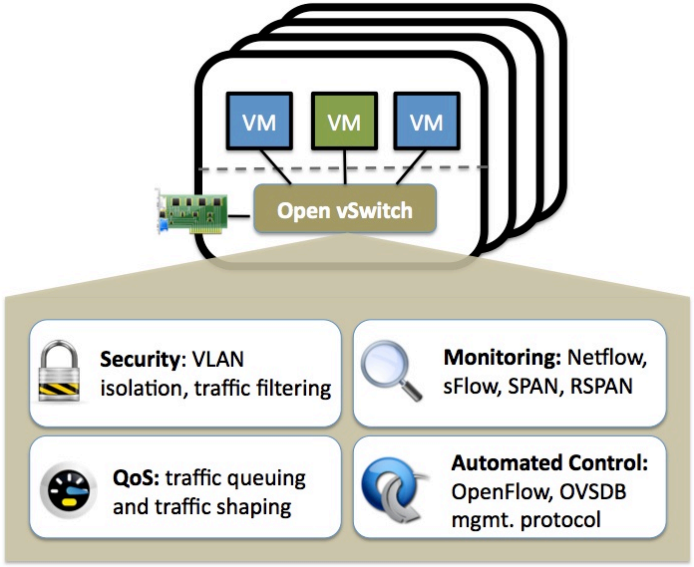
A programmable switch!

- Optimized around large scale automation and control
- Efficiently handle large amounts of state
- Distribute state around the network



Where We Started (in ~2009)

- Truly began life (in 2007) as an academic project
- Original uses were for enforcing policy and security
- Later turned into what is now OpenFlow
- Reborn as an open source project in 2009

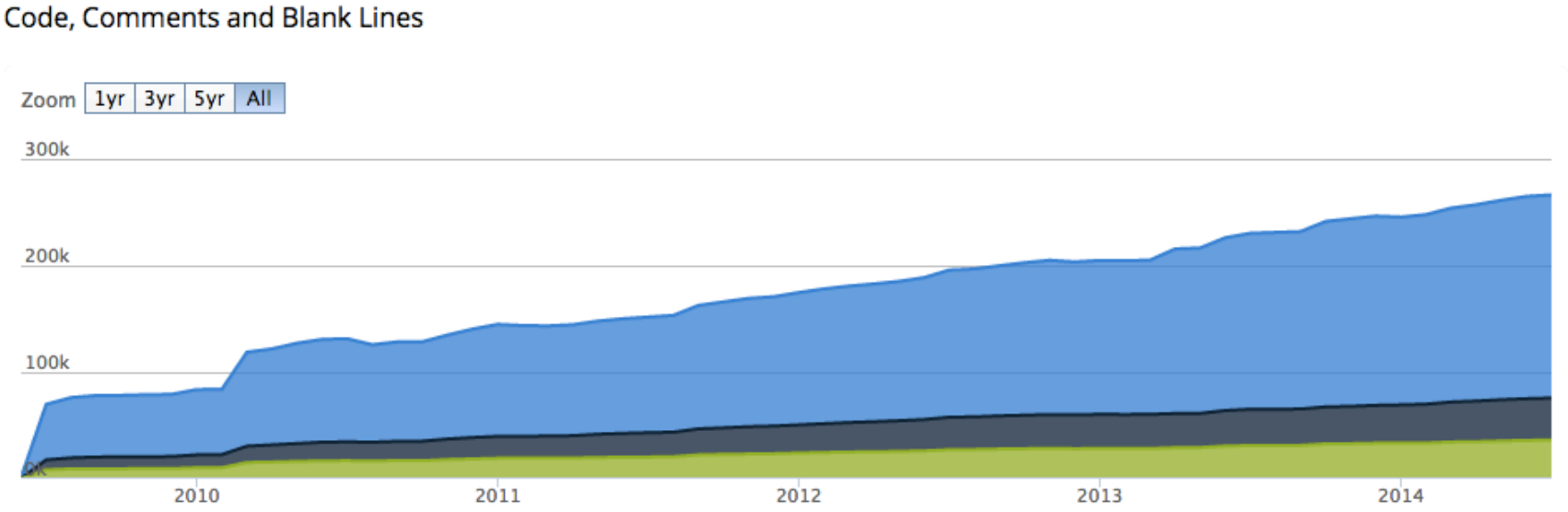


Where We Are Today

- Used in most SDN/network virtualization systems
- Reference implementation for OpenFlow
- Large feature set beyond OpenFlow
- Integrated with Linux, libvirt, cloud management tools
- Ported onto several switching ASICs
- Incorporated into many vendors' products (code is Apache licensed)

Used by the majority of OpenStack deployments as the network switch

In Between



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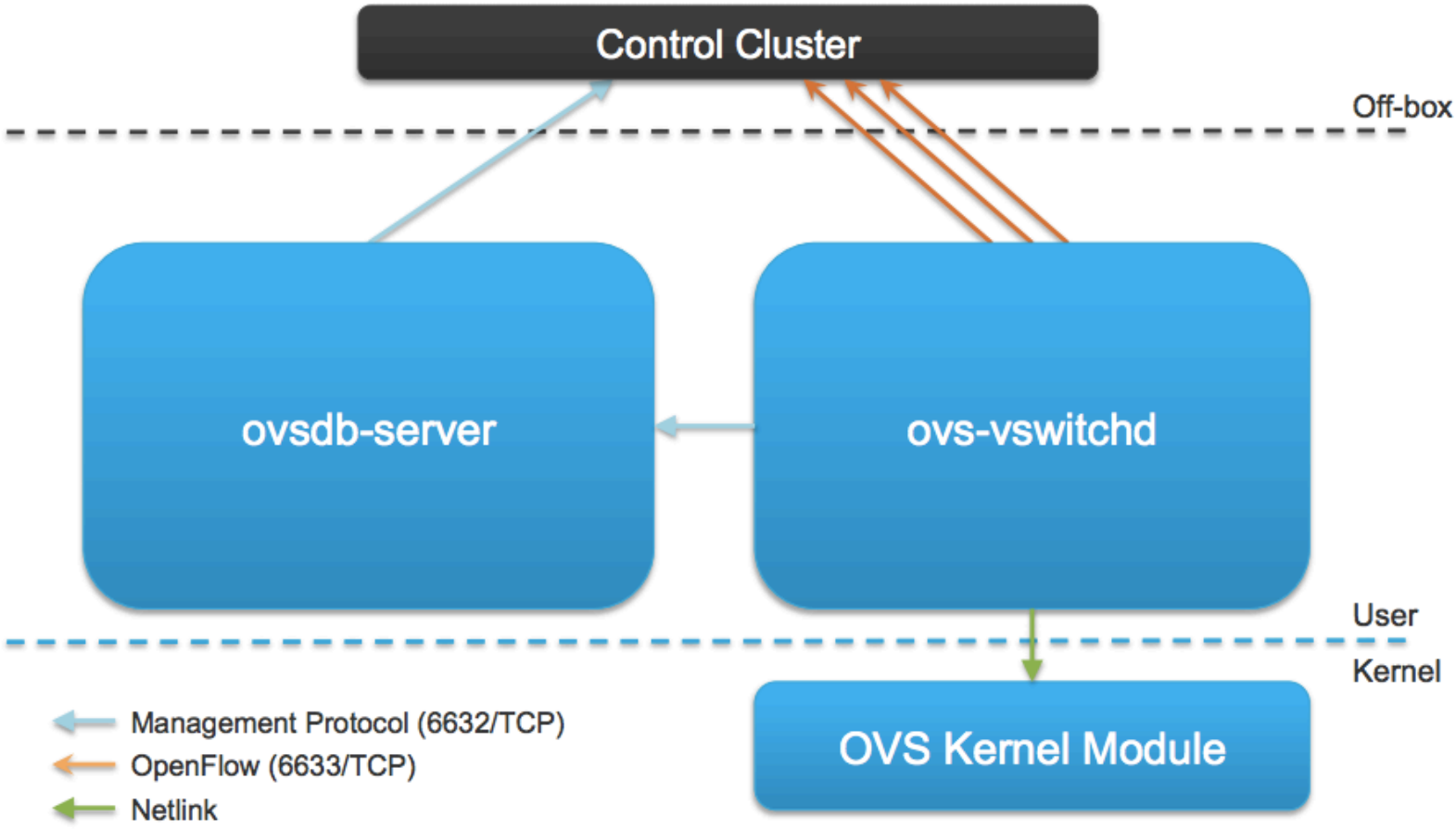
Open vSwitch Architecture



Challenges

“No plan survives contact with the enemy.”

Issues in Production Deployments

- Performance
- Performance
- Performance

Why?

Not actually that surprising:

- Open vSwitch design goal is flexibility and programmability
  - ➔ Usually this isn't free
- Common use cases usually involve large amounts of state
- Software sometimes has a bad name in networking performance
  - ➔ If you are using virtualization, you are probably already using a software switch.

What Does ‘Performance’ Mean?

Many ways to measure network performance:

- Bandwidth (bytes per second)
- Small packets (packets per second)
- Flow setup rate
- Latency
- CPU usage

Throughput

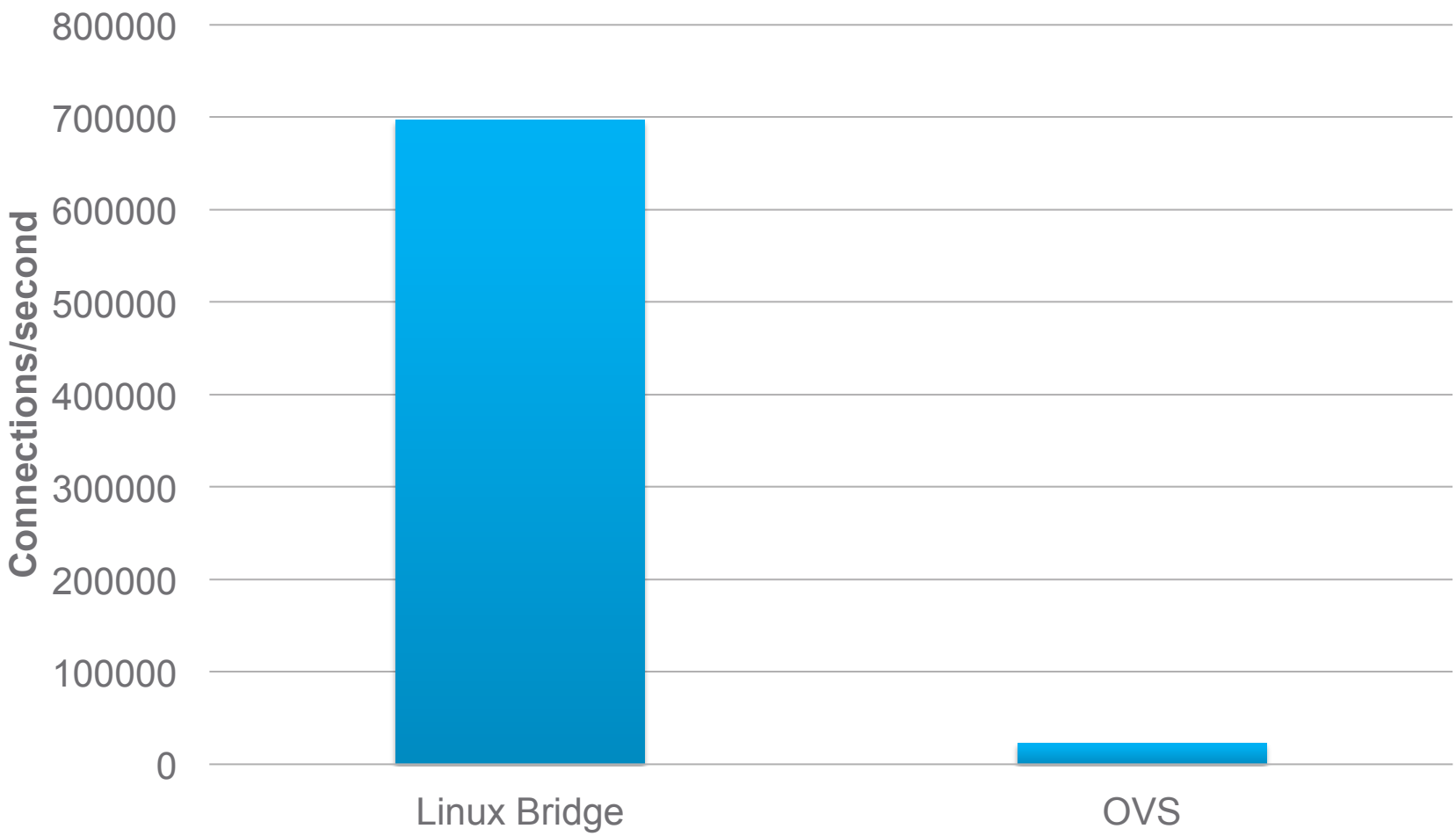
Common configuration: 10G NIC, bulk traffic

9.88 Gbps

(i.e. full rate after packet headers)

Dual socket Sandy Bridge class CPUs, Spirent traffic generator

New Connections



Megaflows

OVS maintains a set of flow entries in the kernel for established traffic

Good:

- Hits provide good performance even for complex rules

Bad:

- Missing the entry

Idea: Dynamically change the definition of a flow based on rules.

L2 learning switch:

Before: Input port, Ethernet src/dst, IP src/dst, TCP src/dst, …

After: Input port, Ethernet src/dst

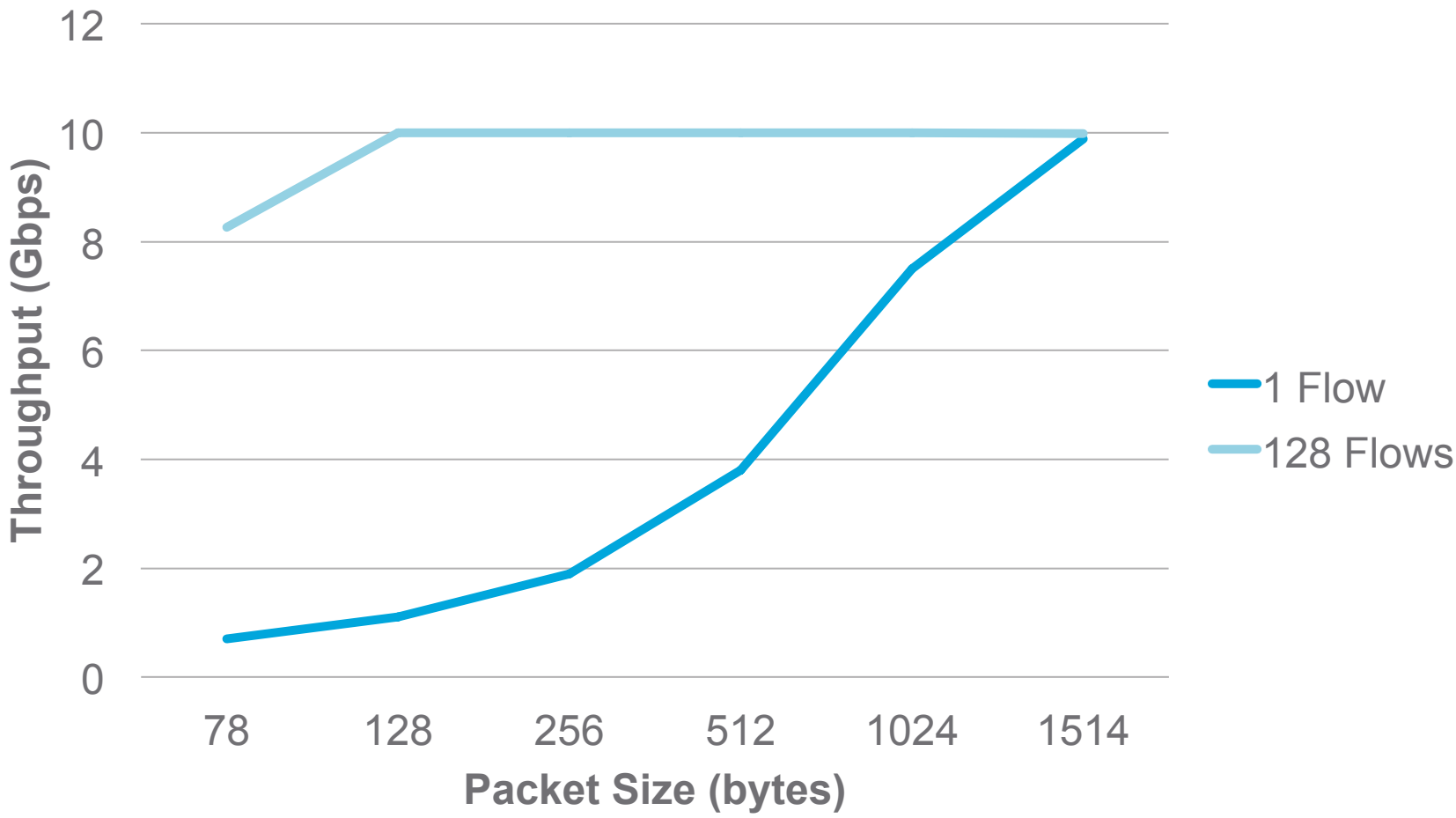
Megaflows: Results

Megaflows largely either work or they don't:

- If wildcards match, performance is the same as established flows.
- If no match, performance is the same as without megaflows.

Wildcard set (and performance) depends on OVS configuration.

Small Packets



Dataplane Development Kit (DPDK)

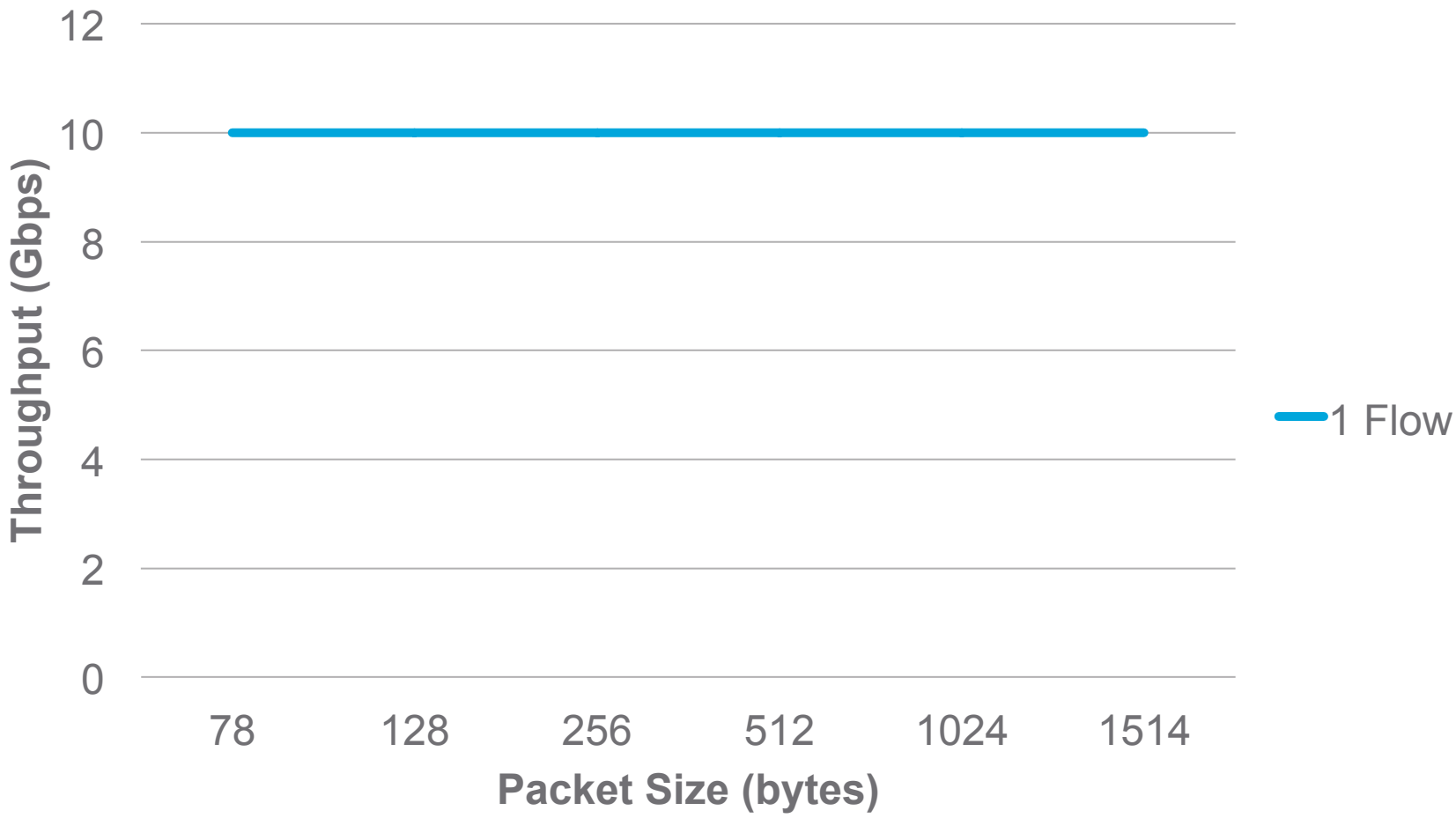
What is DPDK?

- A packet processing environment in userspace
- Application specific, so no general purpose overhead
- Set of libraries to take advantage of modern processor features
- Run-to-completion model, takes over one or more cores fully

OVS kernel code is fairly small and can be ported to DPDK as if it was a different operating system.

DPDK is almost like a hardware offload – but on x86 cores.

DPDK: Results



Hardware Offload

Large variety of hardware offloads seen over the years

Some successful:

- Checksum offload
- Scatter/gather
- TCP segmentation offload (TSO)
- Receive hashing/spreading

Some not:

- TCP offload engine (TOE)
- NIC passthrough (SR-IOV)

Level of software control is the difference between the categories.

Offloading OVS

Some general offloads are particularly useful in OVS environments:

- Stateless offloads for tunnels
- Quality of service (QoS)
- Encryption

OVS flow table offload?

- Partial offload: NIC indicates likely match, software verifies and processes
- Full offload: Table lives in NIC

Still under discussion, no performance results yet.

Questions

(and maybe answers)