# FD.io : The Universal Dataplane

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.io Foundation

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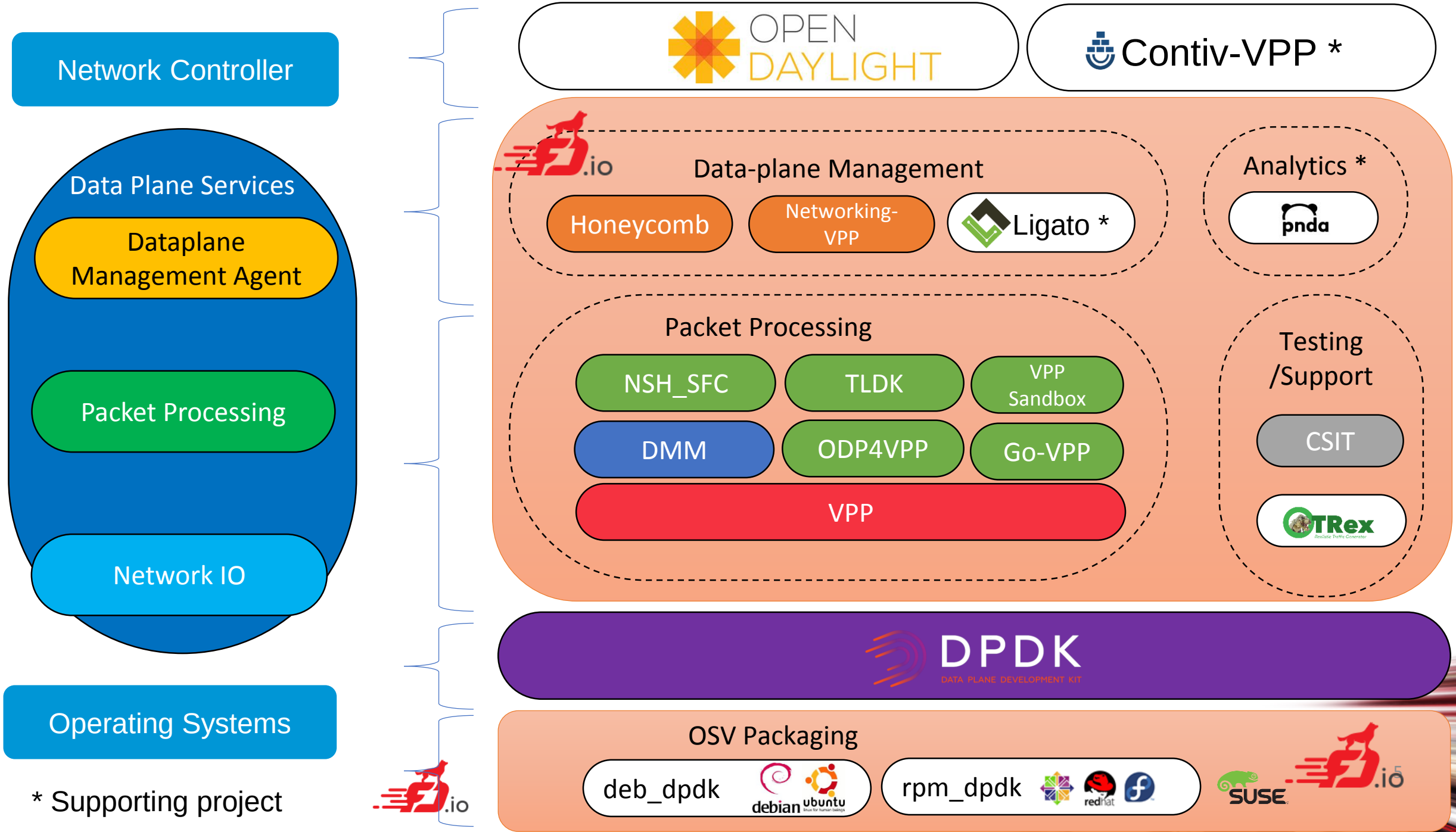
# AGENDA

- The FD.io Networking Ecosystem
- Introducing FD.io VPP
- What's new in FD.io?
    - Asymmetric Pipelines
    - Containers
    - TCP Acceleration
    - Accelerators
- Summary

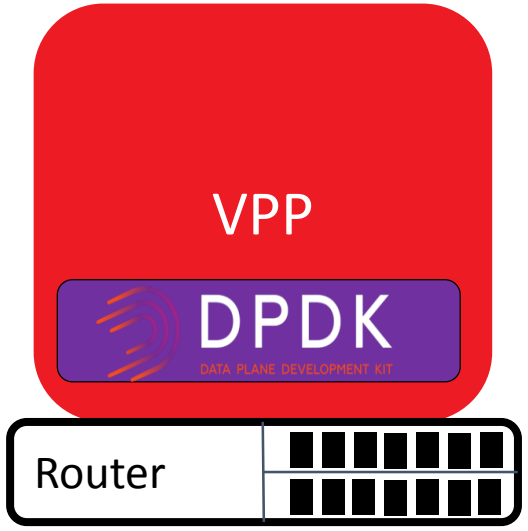
# The FD.io Networking Ecosystem


Network Controller
OPEN DAYLIGHT
Contiv-VPP *
Data Plane Services
Dataplane Management Agent
Packet Processing
Network IO
.io
Data-plane Management
Honeycomb
Networking-VPP
Ligato *
Analytics *
pnda
Packet Processing
NSH_SFC
TLDK
VPP Sandbox
DMM
ODP4VPP
Go-VPP
VPP
Testing /Support
CSIT
TRex
DPDK
DATA PLANE DEVELOPMENT KIT
Operating Systems
OSV Packaging
deb_dpdk
debian
ubuntu
rpm_dpdk
redhat
SUSE
.io
* Supporting project

# Introducing VPP

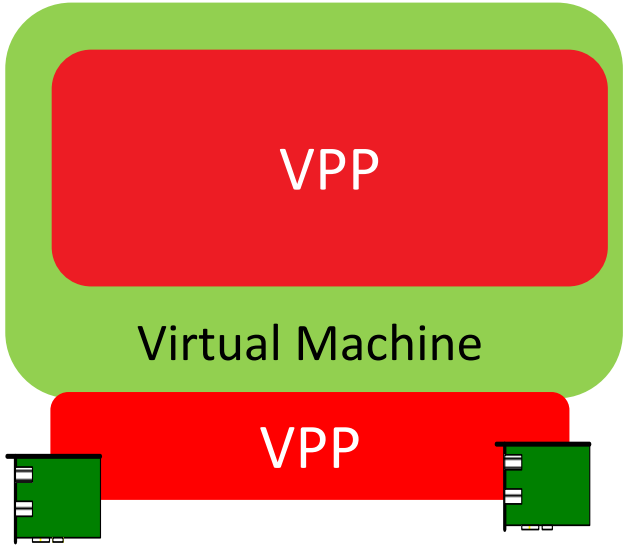
# FD.io VPP, the new networking multi-tool!

## Discrete Appliance




**Control Plane for routers and switches. Has been used in Router products since 2002.**

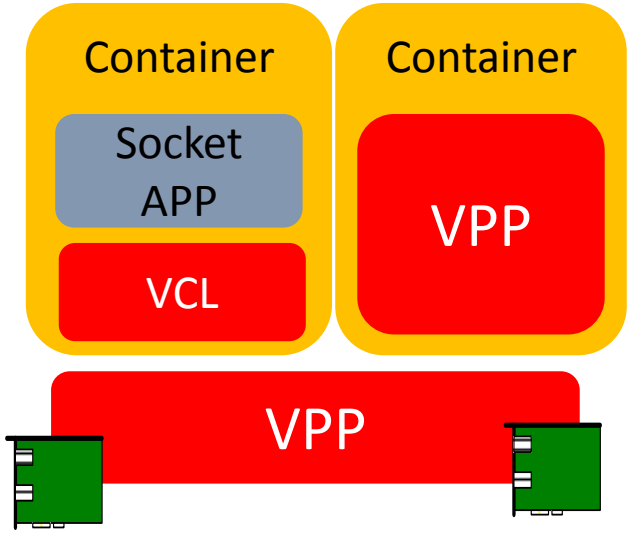
## NFVi & VNF




**NVFi : vSwitch and vRouter in OpenStack & KVM deployments.**

**VNF: Load Balancer, CG-NAT, Firewall, Forwarder, IPSEC Gateway, BRAs ….**

## Cloud Native




**Infra: vRouter in Kubernetes & Docker deployments. TCP, UDP etc Host Stack for Socket apps.**

**VNF: Load Balancer, CG-NAT, Firewall, Forwarder, IPSEC Gateway, BRAs ….**

# Introducing VPP (Vector Packet Processing)

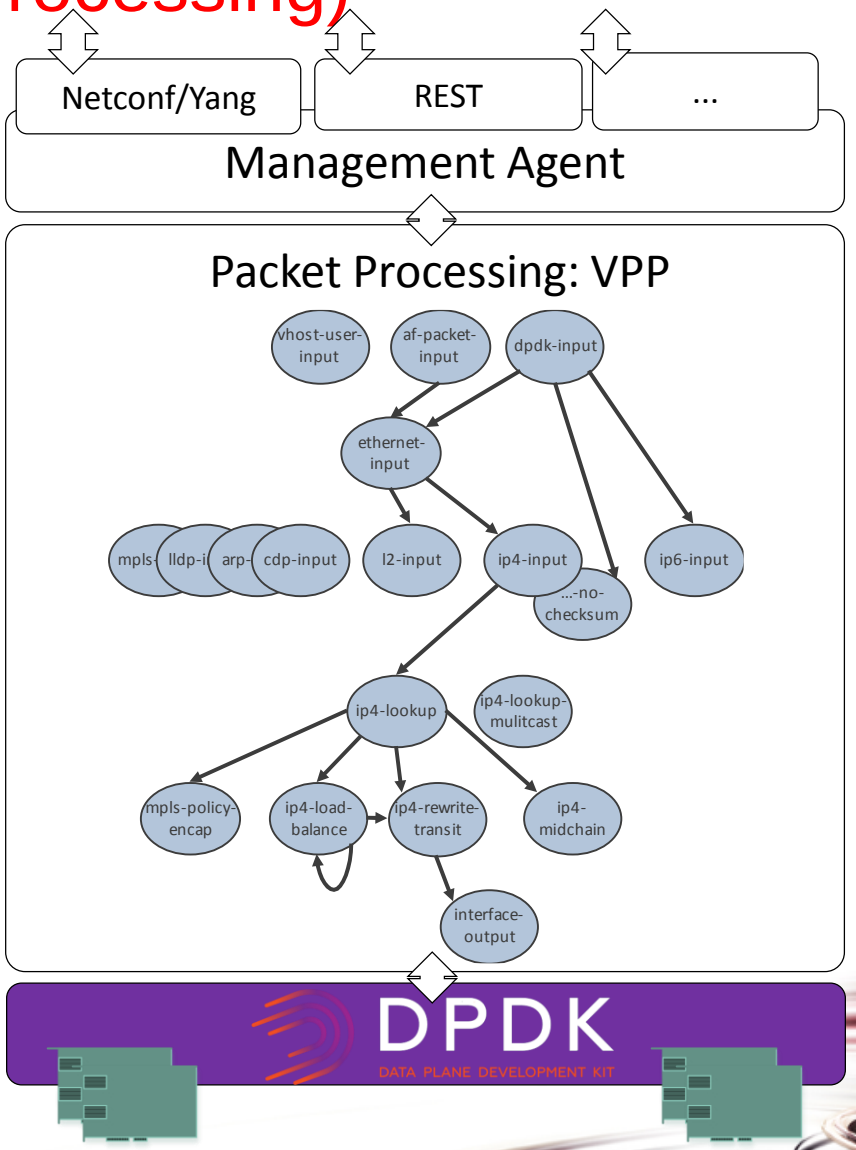
## Fast, Scalable and Determinisic

- 15+ Mpps per core
- Tested to 1TB
- Scalable routing/forwarding tables, supporting millions of concurrent entries.
- 0 packet drops, ~15µs latency

## Optimized

- **Optimized for** x86 and ARM Architectures.
- **DPDK** for fast I/O
- **ISA:** SSE, AVX, AVX2, NEON ..
- **IPC:** Batching, no mode switching, no context switches, non-blocking
- **Multi-core:** Cache and memory efficient

VPP is fast!

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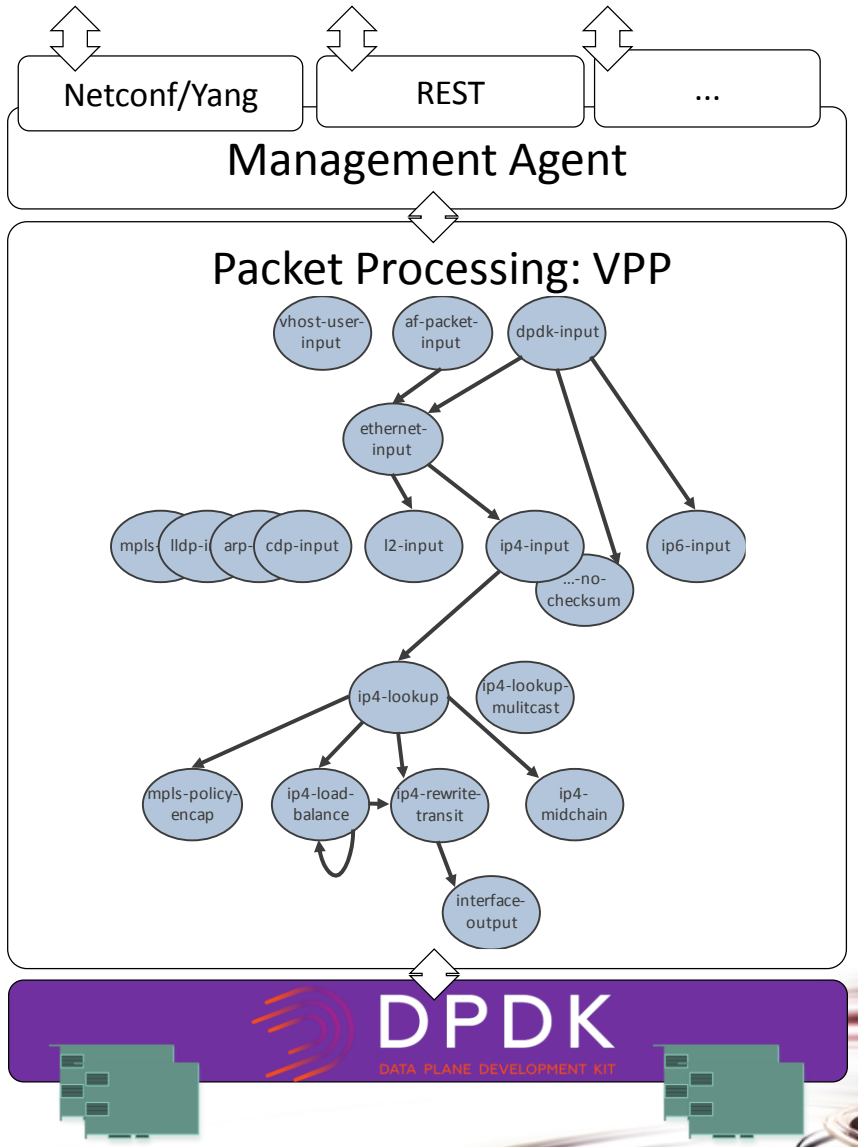
# Introducing VPP

**Extensible and Flexible modular design**

- Implement as a directed graph of nodes
- Extensible with plugins, plugins are equal citizens.
- Configurable via CP and CLI

**Developer friendly**

- Deep introspection with counters and tracing facilities.
- Runtime counters with IPC and errors information.
- Pipeline tracing facilities, life-of-a-packet.
- Developed using standard toolchains.




VPP is extensible!

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# Introducing VPP

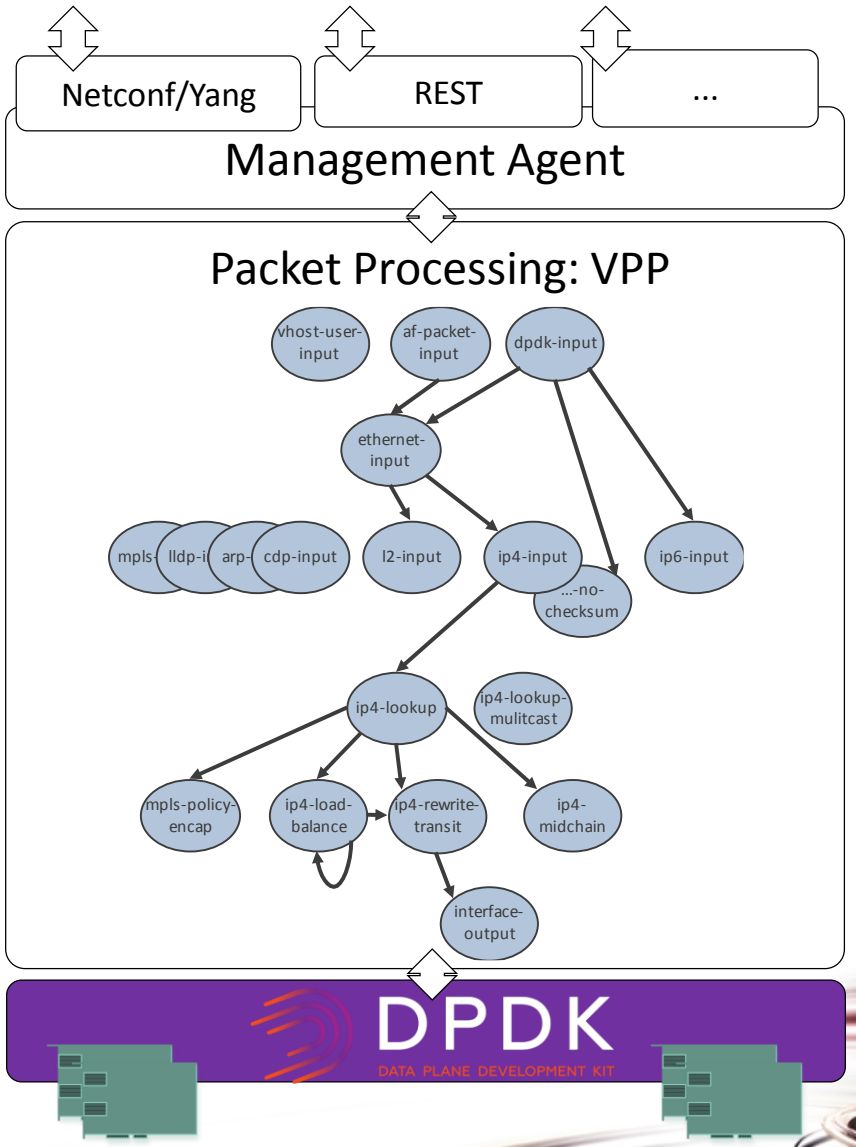
## Fully featured

- **L2:** VLan, Q-in-Q, Bridge Domains, LLDP ...
- **L3:** IPv4, DHCP, IPSEC …
- **L3:** IPv6, Discovery, Segment Routing …
- **L4:** SCTP, TCP, UDP …
- **CP:** API, CLI, IKEv2 …
- **Overlays:** GRE, VXLAN, Geneve …

## Usability

- Language bindings
- Open Stack/ODL (Netconf/Yang)
- Kubernetes/Contiv-VPP (Python API)
- OSV Packaging

VPP bootstraps VNF development!

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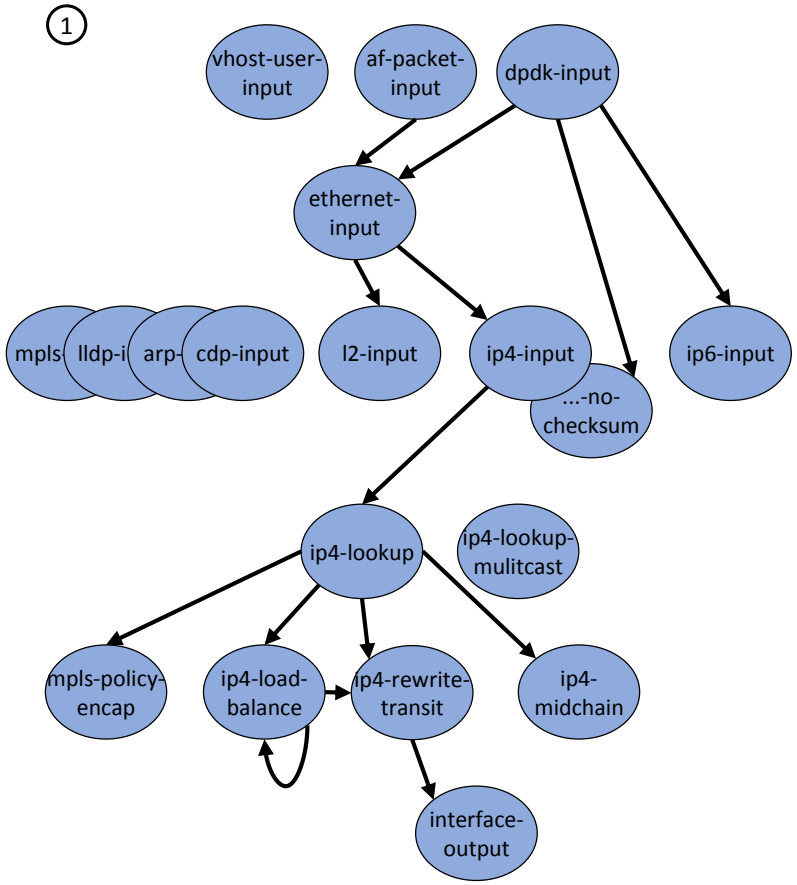
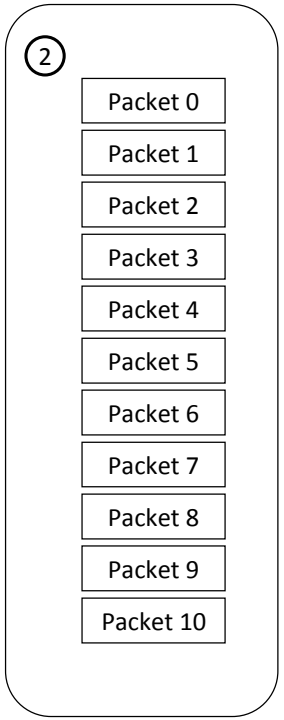
# VPP: How does it work?



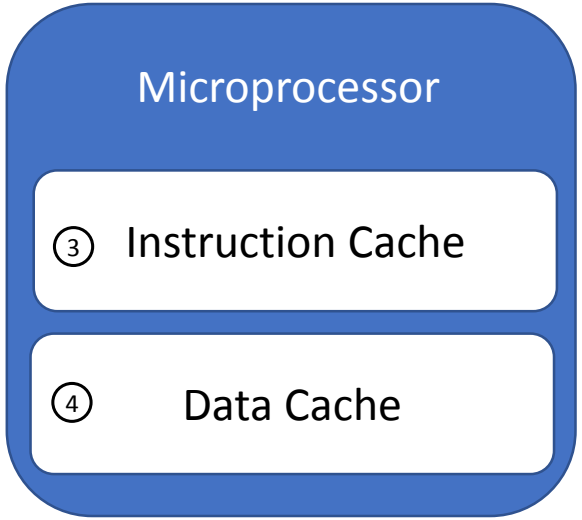

Packet processing is decomposed into a directed graph node …

* approx. 173 nodes in default deployment




… packets moved through graph nodes in vector …

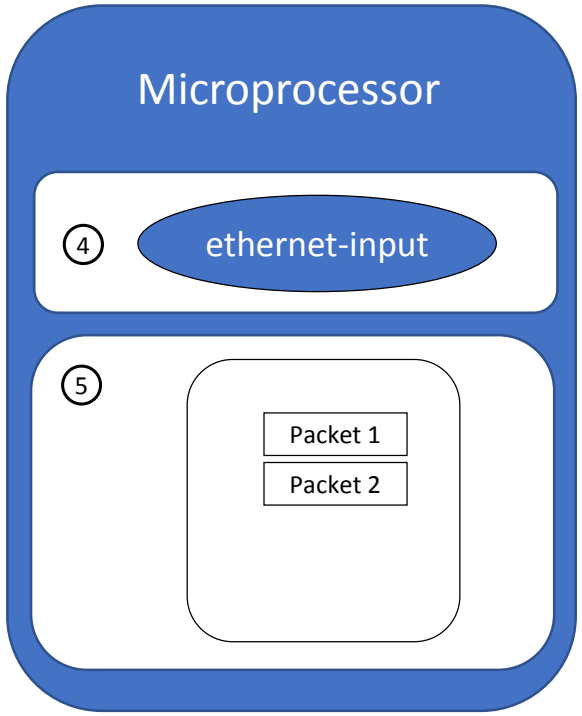
… graph nodes are optimized to fit inside the instruction cache …




… packets are pre-fetched, into the data cache …

# VPP: How does it work?

… instruction cache is warm with the instructions from a single graph node …




… data cache is warm with a small number of packets ..

6

```
dispatch fn()
```

**while packets in vector**

- Get pointer to vector
- **while 4 or more packets**
  - PREFETCH #3 and #4
  - PROCESS #1 and #2
  - ASSUME next_node same as last packet
  - Update counters, advance buffers
  - Enqueue the packet to next_node
- **while any packets**
  - <as above but single packet>

… packets are processed in groups of four, any remaining packets are processed on by one …

# Related Projects

- OPNFV Fast Data Stacks (FDS)
- CSIT: Continuous System Integration and Testing
- Cloud Native : Kubernetes, Contiv-VPP & Ligato.

# OPNFV FastDataStacks (FDS)

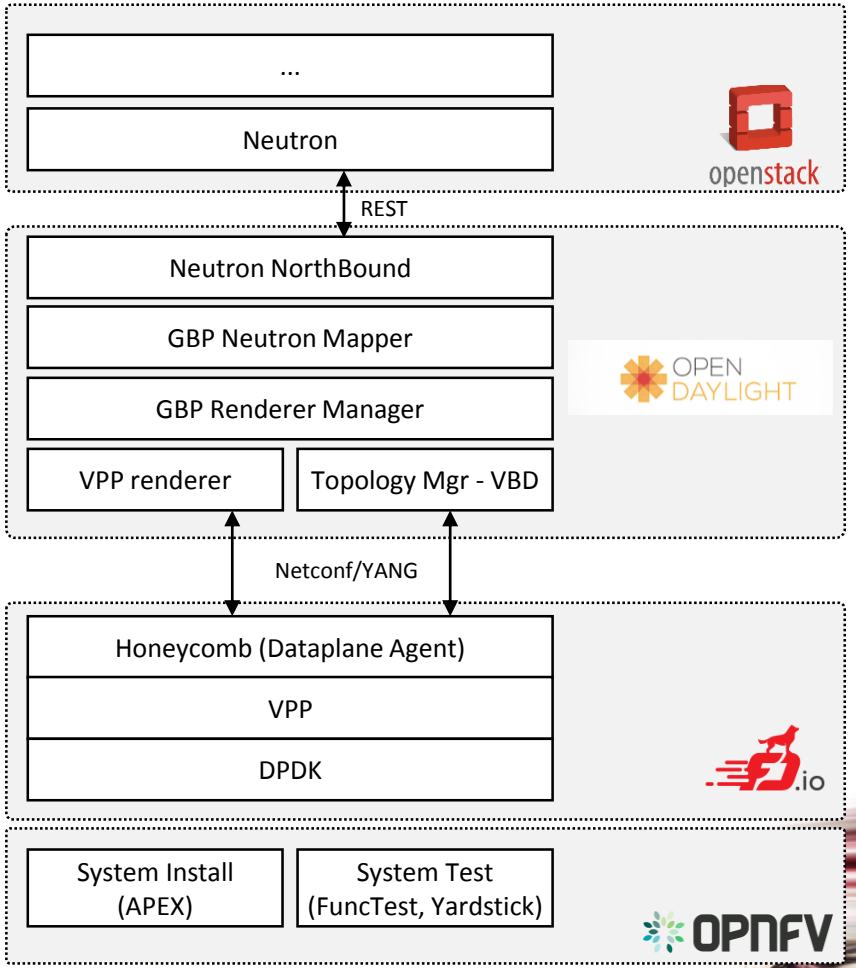
*"The 20th century was about invention, the 21st is about mashups and integration"* – Toby Ford, AT&T

- Integrate VPP into existing OPNFV test scenarios
- Scenarios
  - OpenStack – ODL (Layer2) – VPP
  - OpenStack – ODL (Layer3) – VPP
  - OpenStack – Networking-VPP – VPP
  - etc
- Diverse set of contributors:

cisco redhat CENGN PANTHEON technologies intel HUAWEI

- https://wiki.opnfv.org/display/fds

See also:
FDS Architecture: https://wiki.opnfv.org/display/fds/OpenStack-ODL-VPP+integration+design+and+architecture

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# CSIT: Continuous System Integration and Testing

## Built into the development process – patch by patch


### Build/Unit Testing
120 Tests/Patch

Build binary packaging for
- Ubuntu 14.04
- Ubuntu 16.04
- Centos 7

Automated Style Checking

Unit test :

| | |
|---|---|
| IPFIX | IPv6 |
| BFD | IP Multicast |
| Classifier | L2 FIB |
| DHCP | L2 Bridge Domain |
| FIB | MPLS |
| GRE | SNAT |
| IPv4 | SPAN |
| IPv4 IRB | VXLAN |
| IPv4 multi-VRF | |

### System Functional Testing
252 Tests/Patch

- DHCP – Client and Proxy
- GRE Overlay Tunnels
- L2BD Ethernet Switching
- L2 Cross Connect Ethernet Switching
- LISP Overlay Tunnels
- IPv4-in-IPv6 Softwire Tunnels
- Cop Address Security
- IPSec
- IPv6 Routing – NS/ND, RA, ICMPv6
- uRPF Security
- Tap Interface
- Telemetry – IPFIX and Span
- VRF Routed Forwarding
- iACL Security – Ingress – IPv6/IPv6/Mac
- IPv4 Routing
- QoS Policer Metering
- VLAN Tag Translation
- VXLAN Overlay Tunnels

### Performance Testing
144 Tests/Patch, 841 Tests

- L2 Cross Connect
- L2 Bridging
- IPv4 Routing
- IPv6 Routing
- IPv4 Scale – 20k,200k,2M FIB Entries
- IPv4 Scale - 20k,200k,2M FIB Entries
- VM with vhost-userr
  - PHYS-VPP-VM-VPP-PHYS
  - L2 Cross Connect/Bridge
  - VXLAN w/L2 Bridge Domain
  - IPv4 Routing
- COP – IPv4/IPv6 whiteless
- iACL – ingress IPv4/IPv6 ACLs
- LISP – IPv4-o-IPv6/IPv6-o-IPv4
- VXLAN
- QoS Policer
- L2 Cross over
- L2 Bridging

### Usability

Merge-by-merge:
- apt installable deb packaging
- yum installable rpm packaging
- autogenerated code documentation
- autogenerated cli documentation

Per release:
- autogenerated testing reports
  - report perf improvements

Puppet modules

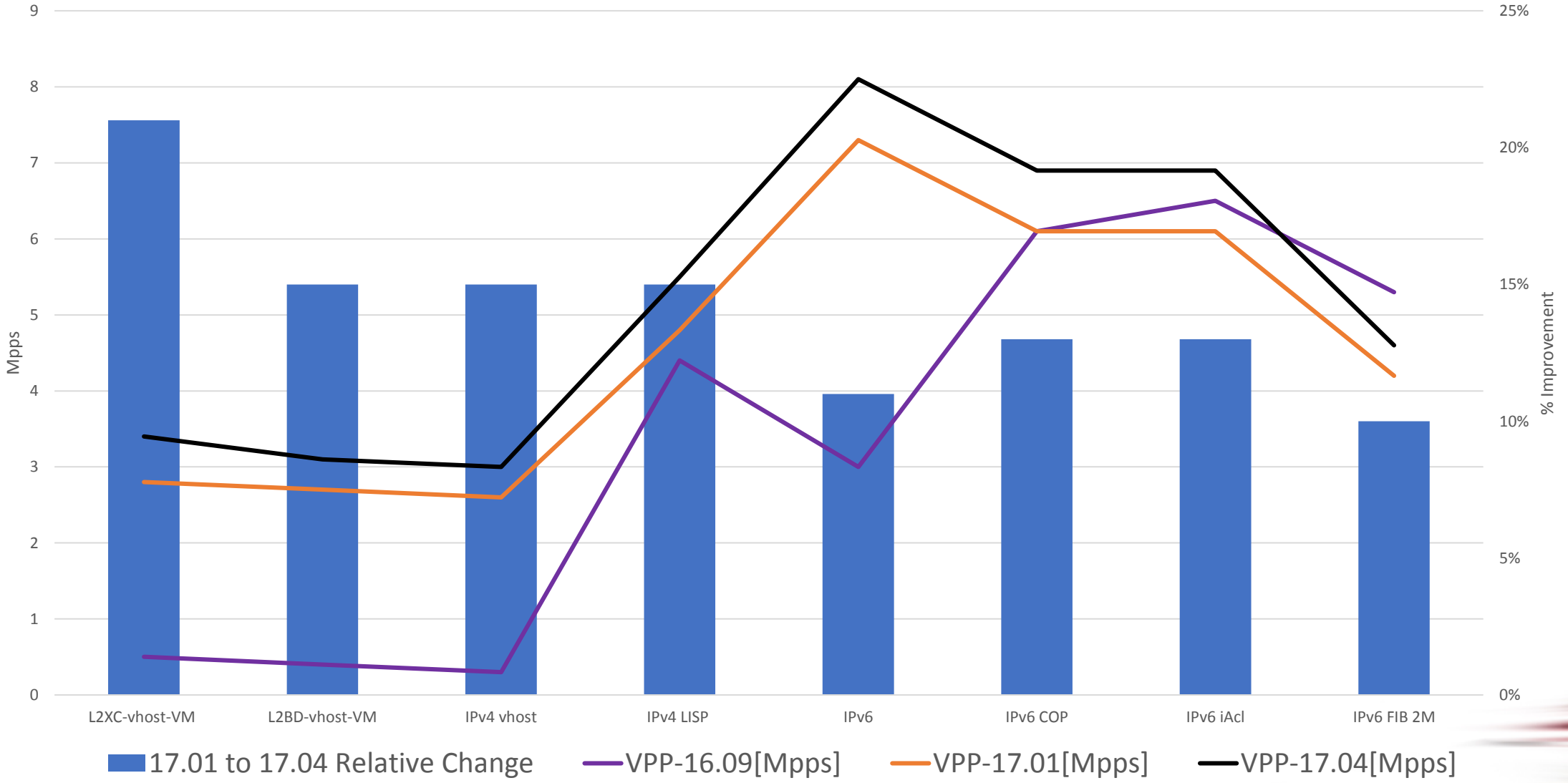
Training/Tutorial videos

Hands-on-usecase documentation

Merge-by-merge packaging feeds Downstream consumer CI pipelines

Run on real hardware in fd.io Performance Lab

# CSIT NDR Throughput Improvements

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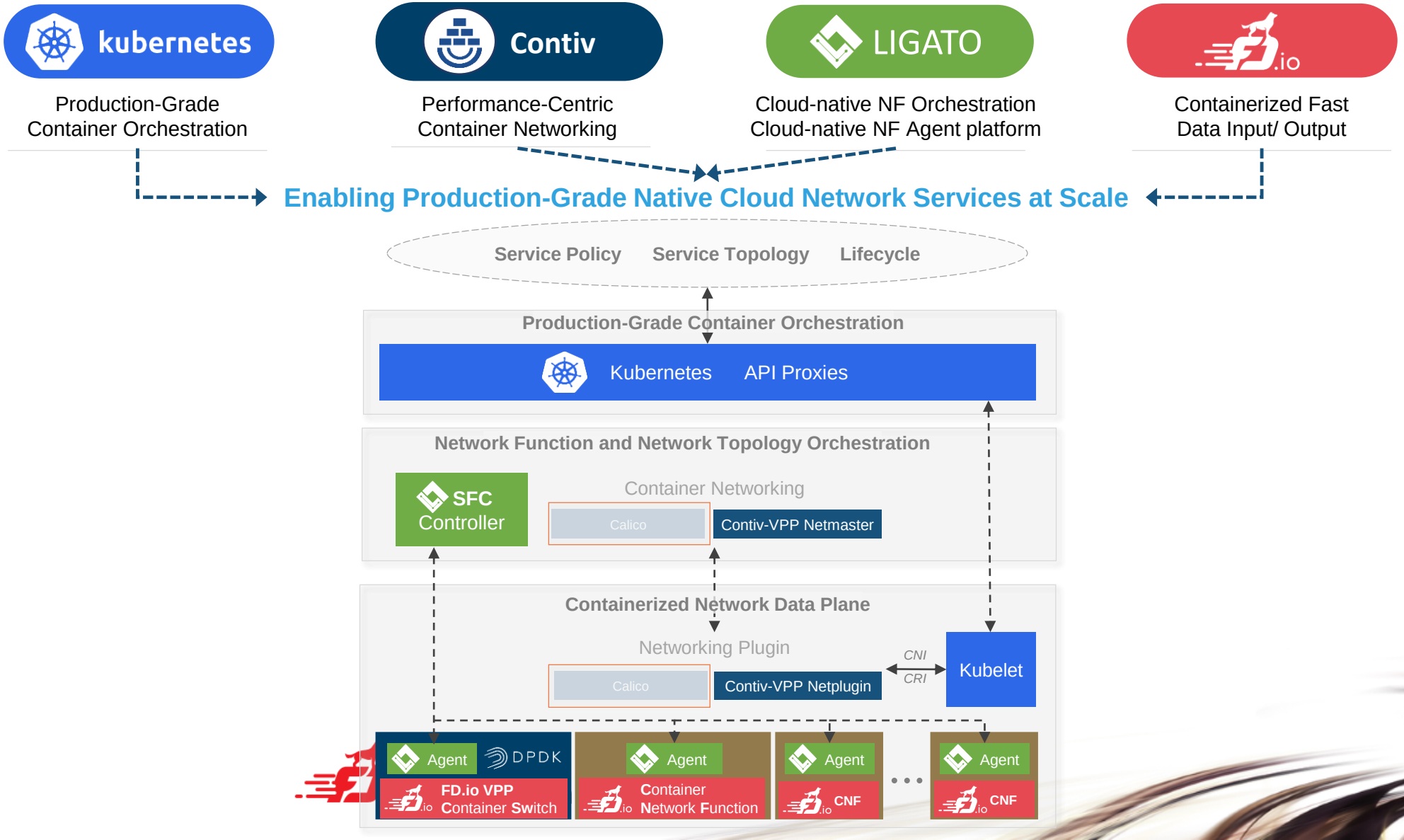
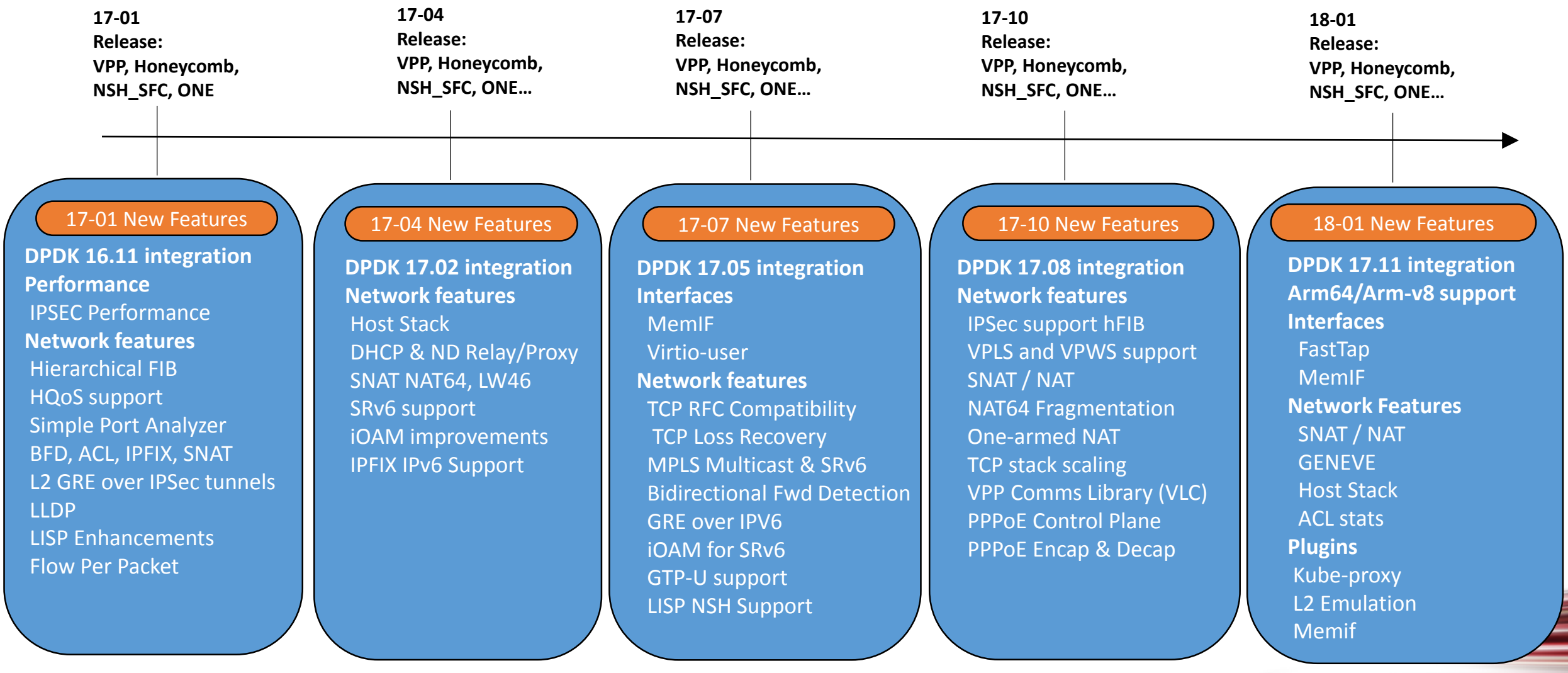
# Cloud Native : Kubernetes, Contiv-VPP & Ligato.

(a.k.a. Cloud Native Network Microservices)



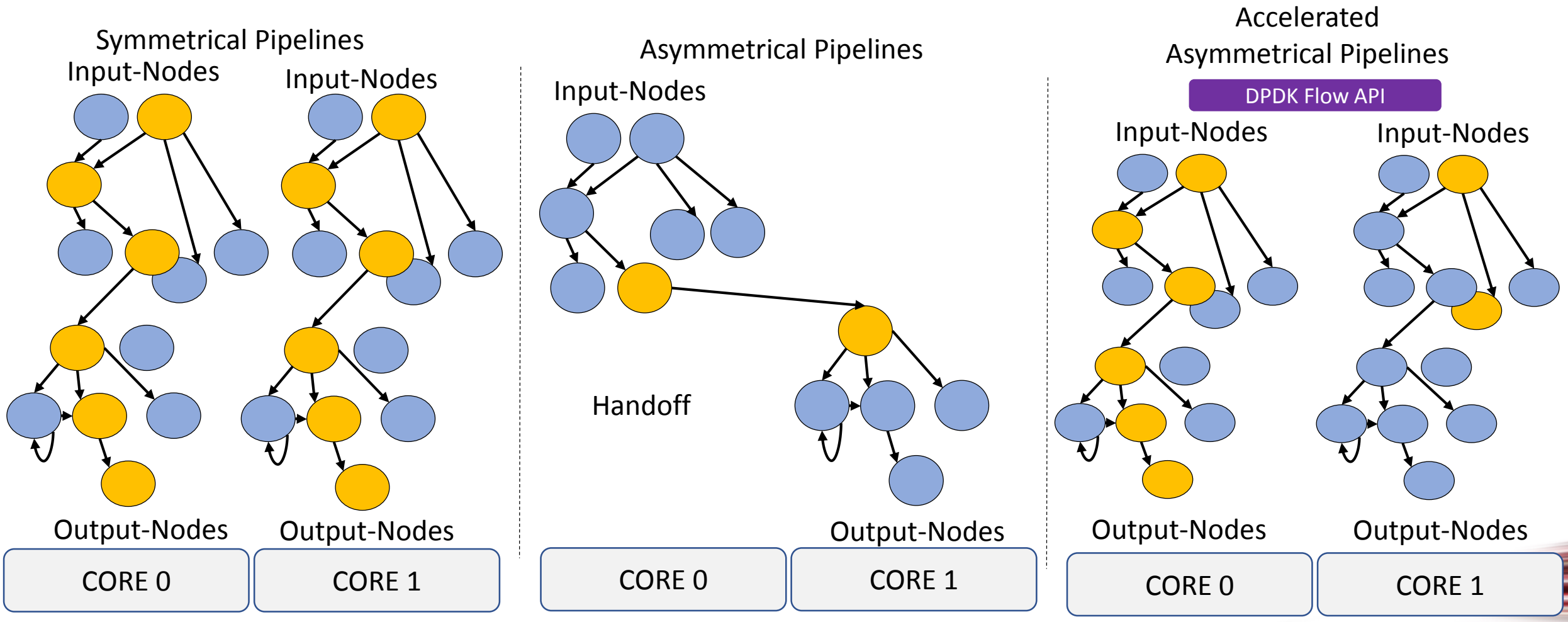
# What’s new in FD.io?

# FD.io Release Notes



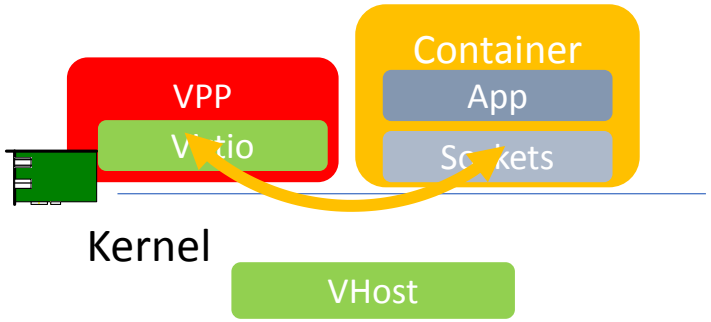

VPP is rapidly evolving!

# New Directions: Asymmetrical Pipelines



# New Directions: Containers

Container Connectivity

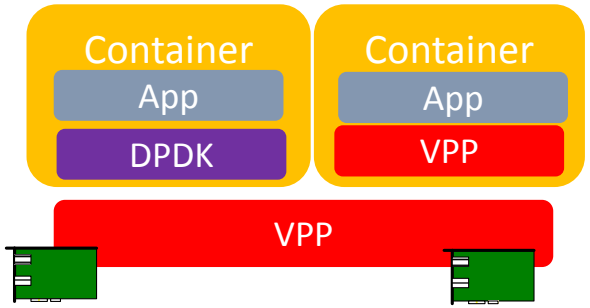



**vEth TAPv2 (FastTap)**

**What is it?**
Classic Linux Kernel Container interface, widely-used.

**Throughput: < 1 mpps**

**Scaling: > 1000 Containers**

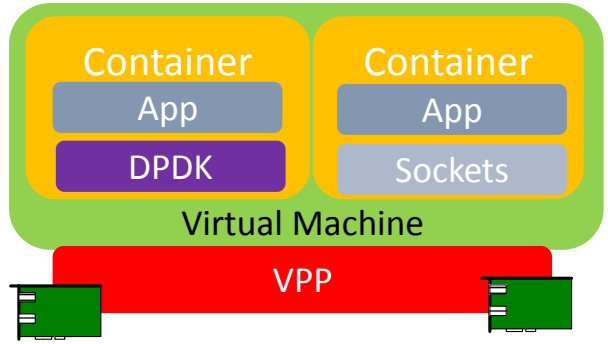



**MemIF & Virtio-User:**

**What is it?**
Container Virtual Interface for **Bare-metal** deployments

**Throughput: < 10 mpps**

**Scaling: < 1000 Containers**




**Master-VM:**

**What is it?**
Container Virtual Interface for **Virtualized** deployments

**Throughput: < 10 mpps**

**Scaling: < 1000 Containers**

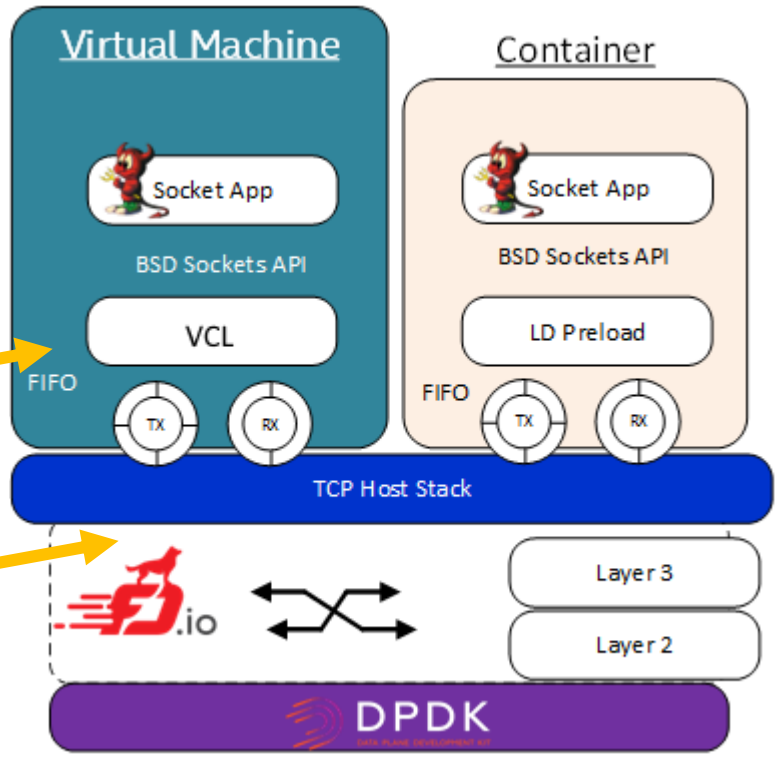
# New Directions: TCP Acceleration

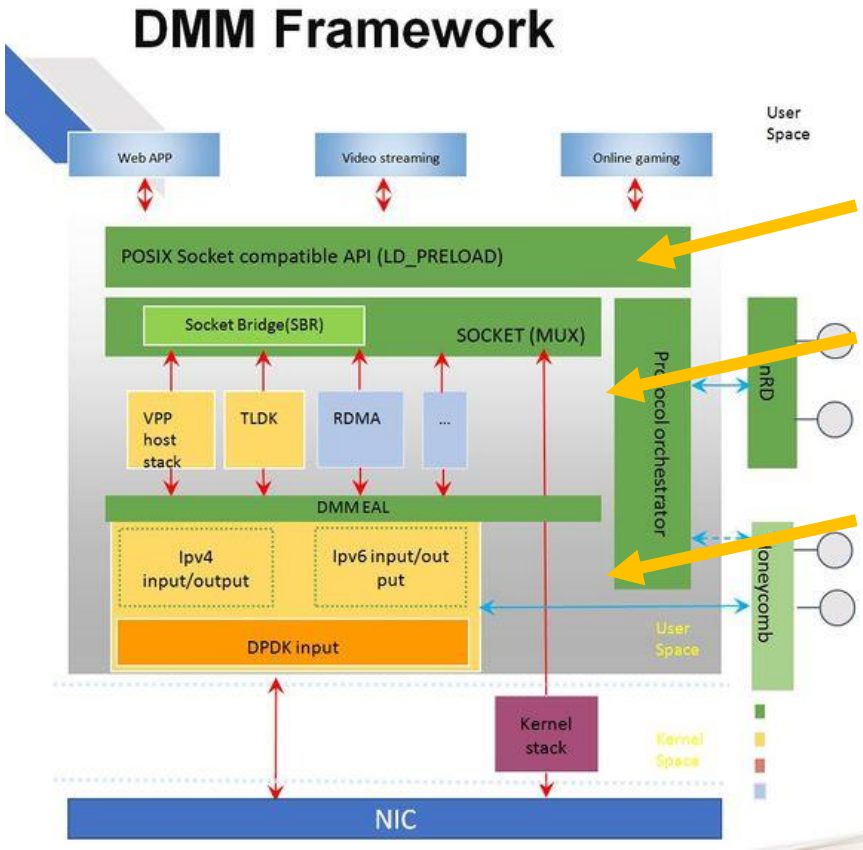
VPP & DMM

VPP TCP Host Stack

VCL Library, directs the TCP bit stream to FD.io VPP.

TCP Streams are aggregated in FD.io VPP




Socket API Library

Network intelligence to route the packet

Stack Abstraction Layer

New novel approaches to accelerating TCP!

# New Directions: Accelerators

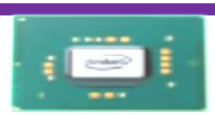
Accelerating IPSEC with FD.io VPP and DPDK

**VPP**

**Cryptodev API**

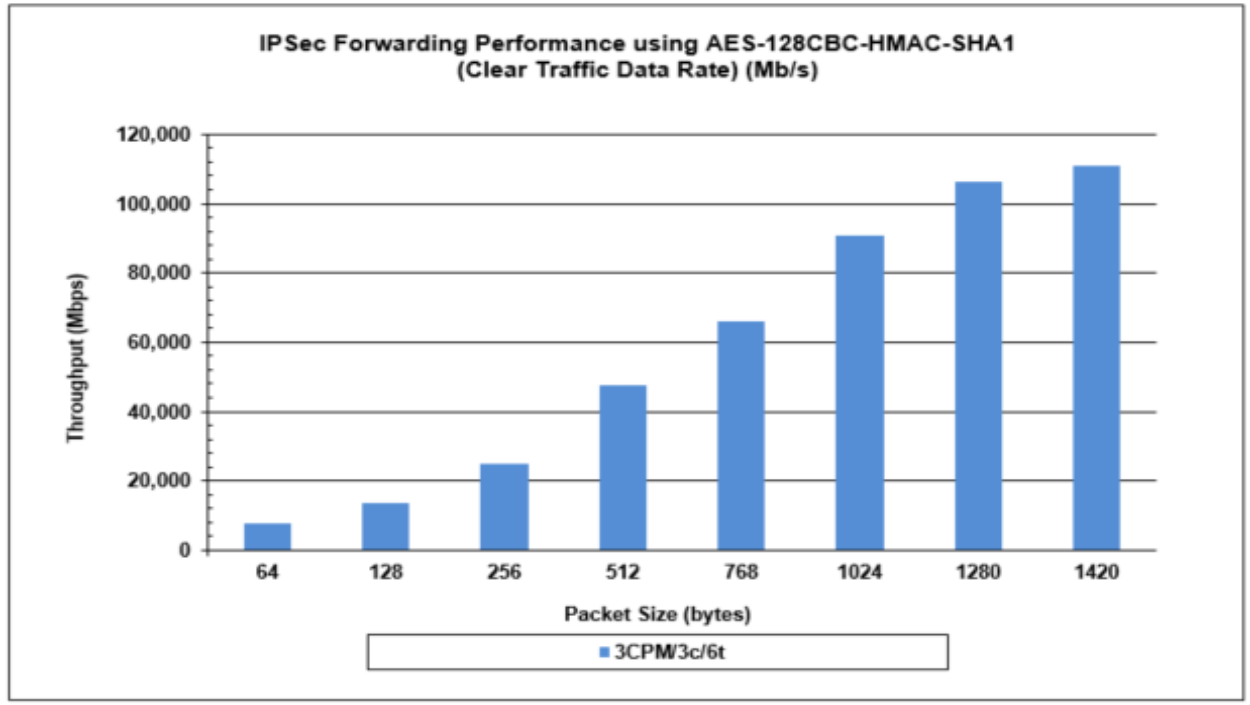
**DPDK**

Vector & Crypto Instructions



Quick Assist Crypto Accelerators

**Intel® Xeon® Scalable Processors @2.1GHz**
**VPP 17.01 IPSec Performance 1:1 Nodes (bi-directional flows)**




Performance numbers are subject to change with later versions.

Disclaimer: Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. Source: Intel internal testing as of July 18, 2016.

100Gb of IPSEC with 3 cores!

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* Other names and brands may be claimed as the property of others.

# Summary

http://fd.io/

- FD.io VPP is a **multi-vendor** packet processing technologies that is leading the **network transformation**.
- FD.io VPP is a fast and easy-to-use tools, so please try them today!
- Please join us in FD.io Today!

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