Challenges in Implementing High-Performance SDN and NFV Systems

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EZchip Overview

- Fabless semiconductor company, NASDAQ listed (EZCH)
- Leading provider of Network Processors (NPUs) to the Carrier Ethernet (CE) market, especially for edge routers
- EZchip is a strategic supplier to the top Carrier Ethernet vendors
- Recently announced the NPS, a revolutionary line of NPUs
  - For next generation L2-7 router line cards, data center and cloud
  - Enabling new scalable architectures for SDN & NFV
  - 256 C-programmable Task Optimized Processors, 4K virtual threads
  - Large set of hardware and algorithmic accelerations
  - Integrates EZchip’s highly differentiated TM technology
- EZchip founded in 1999; 200 employees, 160 in R&D in Israel
- Global offices in Israel (HQ); San Jose, CA; Boston, MA; and China
- Strong financial model; $191M in cash, no debt
The Promise of SDN & NFV

SDN & NFV

- Improve network agility and operational efficiency
- Deliver secure functionality to thousands of tenants across dozens of datacenters
- Reduce CAPEX & OPEX

New Network Architectures

- Virtualize also the network resources (in addition to compute and storage)

SDN
- Decoupling data from control plane
- Data Plane: Virtual networks
- Control Plane: Centralized

NFV
- Decoupling software from hardware
- Software: Virtual functions
- Hardware: Common platform

Separate but complementary architectures
Virtualizing the network functions

Virtualizing the CPE
Implementation Challenges

- NFV creating large server overhead
  - Most or all server cycles spent on networking functions
  - Performance does not scale much beyond 10G
  - Performance cliffs due to cache and TLB misses causing unpredictable behavior
  - vSwitch per server adds huge network management overhead

- Fixed function networking silicon lacks critical capabilities
  - Lacks support for large number of addresses, flows, tunnels, buffering, security, QoS, sophisticated traffic management
  - ACLs becoming more complex, not just basic 5-tuple anymore
    - Requirements of 1K ACLs per VM, 40 VMs per server, 40 servers per rack yields 1.6M ACLs per rack
    - No switch can support that
  - Unable to support new standards, features, protocols; features are burned in the silicon
SDN & NFV Drive SW Solutions

Software solutions: Programmable (e.g. CPUs & NPUs)

Hardcoded solutions: Fixed function ASICs

SDN & NFV Network Challenges

Performance and Scalability:
- Data Path Acceleration
- Load Balancing
- Performance Monitoring
- Many vSwitches
- Many Subscribers

Reliability:
- High Availability
- Faults & Correlation
- Health Monitoring

Security:
- Tenants
- Services
- Functions
Need to Accelerate

- L2/3 switching & routing
- Network overlay termination
- TCP termination
- Security
- DPI
- Classification & ACL
- Traffic Management
- Service chaining
- Scaling to millions of flows

Required

- High-performance, feature-rich, easily-programmed NPU
  to integrate within the NFV & SDN framework
- L2/3 switching & routing
- Network overlay termination
- TCP termination
- Security
- DPI
- Classification & ACL
- Traffic Management
- Service chaining
- Scaling to millions of flows
Introducing the NPS

**NPS**
NPU for Smart Networks

- Scaling to millions of flows
- L2/3 switching & routing
- Network overlay termination
- Service chaining
- Traffic Management
- Classification & ACL
- DPI
- Security
- TCP termination

Introducing the NPS-400

**NPS**
NPU performance with CPU programmability

- 400 Gbps
- C-programmable
- Security and DPI hardware acceleration
- Linux OS
- Layer 2 - Layer 7 processing
NPS-400 Key Features

- 400Gbps all layer C-programmable NPU
  - 600Mpps wire speed with up to 960Gbps oversubscription
- On chip Traffic Manager & VOQ
  - 1M queues, 5-level H-QoS
- 960Gbps of network I/O
  - Including 1GE, 10GE, 40GE, 100GE, 400G ILKN and PCIe Gen 3.0
- Integrated EFA (Ethernet Fabric Adaptor)
  - Enables a full line card on a chip
- 256xCTOP processors with 4K HW threads at 1GHz core speed
  - Native algorithmic instructions for efficient execution
  - 4K-way SMP Data Plane Linux, run to complete architecture with no SW overhead
- Supports various inline services via dedicated HW accelerators
  - Security: IPSec/SSL encryption & decryption at 200Gbps
  - DPI: C-programmable RegEx stream content processing at 200Gbps
- On-chip TCAM with TCAM algorithmic extension to external DRAM
  - Scales to millions of ACL rules
- Based on commodity DDR3 & DDR4 memory providing up to 96GB
  - Virtually unlimited tables, states, counters at wire-speed performance

NPS: Optimized for Data Plane

- Optimized for server architecture
- Designed for highest single-thread performance
- General purpose capabilities
- Best for control plane and general purpose applications
- Optimized for networking systems
- Designed for massive parallel processing
- Large set of networking HW accelerations
- Best for L2-L7 data plane processing

A single NPS-400 can deliver network processing capacity equal to 48 servers (full rack) with power of less than one server
An NFV network layer can be located in multiple network elements.

Replace an ASIC-based TOR switch with a Smart NFV TOR:
- Network layer processing for VNFs
- Complete offload of vSwitch and network overlay
- Minimum server I/O overhead
- Significant reduction in cost and power
NFV Enabled Edge Router

Smart edge router to facilitate an effective NFV architecture:

- Deep packet classification for mapping traffic into flows and service chains
- Dynamic load balancing among various distributed VNFs
- Accommodate many subscribers and service chains

NFV Service Blade/Appliance

Blade or appliance with network processing resources:

- Virtualized on-demand services per VNF
- Servers and VNFs throughout the data center
NPS in the Data Center

Smart NFV TOR

- Complete offload of vSwitch and network overlays
- Network layer processing for VNFs
- Mapping traffic into flows and service chains
- Dynamic load balancing among distributed VMs & VNFs

NFV Enabled Edge Router

NFV Accelerated White Box/Appliances/Blades

Summary

SDN & NFV virtualize the cloud network

Improve network agility, efficiency & cost

Network performance, scalability & management challenged

NPS enables smart edge routers, TOR switches & appliances

One NPS is equivalent to a rack of servers for network processing

For use by all network equipment and software vendors