

NETRONOME

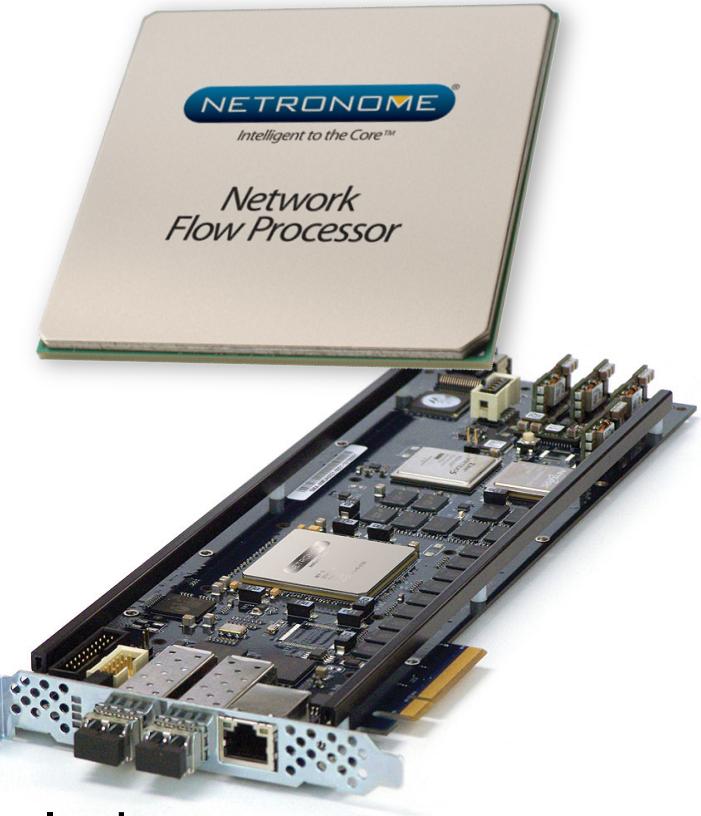
The Flow Processing Company

Scaling Network Security Solutions to 40Gbps and beyond

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Agenda

- Internet bandwidth growth
- Evolving threat landscape
- Network security appliances
 - Trends and requirements
- The need for stateful flow processing
- Network security workload analysis
- Product architecture comparison
- Proposed solution architecture
- Reference architecture performance analysis



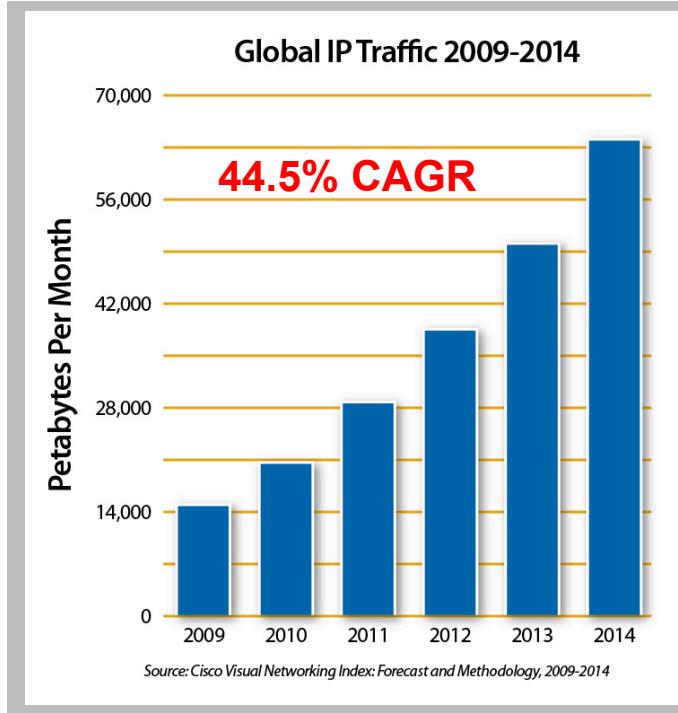
*An architecture to scale security
applications to 40/100 Gbps*

Incredible Network Growth!

By 2014...

- Annual global IP traffic will increase 4x
 - Growing from 176 exabytes to three-quarters of a zettabyte (767 exabytes) in four years

1 ZB = (1,000,000,000,000,000,000,000
bytes = 10^{21})



- Drivers? Video and mobile data
 - Video (TV, VoD, Internet Video, and P2P) will exceed 91 percent of global consumer traffic
 - Internet video will grow to over 57% of Internet traffic (12 billion DVDs)
 - Mobile data traffic will double every year, increasing 39 times
 - Peer-to-peer no longer the most voluminous, but still substantial

Source: Cisco Visual Networking Index: Forecast and Methodology, 2009-2014

Evolving Threat Landscape

Trends affecting Network Security

- Attacks are becoming more sophisticated (Stuxnet)
- Attackers are getting better organized
 - Groups out for financial gain, trade secrets or military information
 - Organized crime or even government agencies
 - “Speed-bump” defenses are no longer sufficient
- Social media changes the face of security
 - New attack vector to distribute malware
 - Short URL Service Abuse – you don’t know what you are clicking on
 - Location Service Abuse – the bad guys know where you are
- Cloud computing and virtualization are imposing new security requirements
 - VMs are less secure than their original bare-metal counterparts
- Need to find the “needle in the haystack” for Lawful Intercept
- Sensitive data is increasingly on the move (mobile)
- Mobile smartphones are computers and as susceptible to attacks.
- Encryption and VoIP create covert channels to smuggle threats in or data out



Opposing Forces

Network throughputs
continue to explode

The network security
threat landscape
continues to evolve



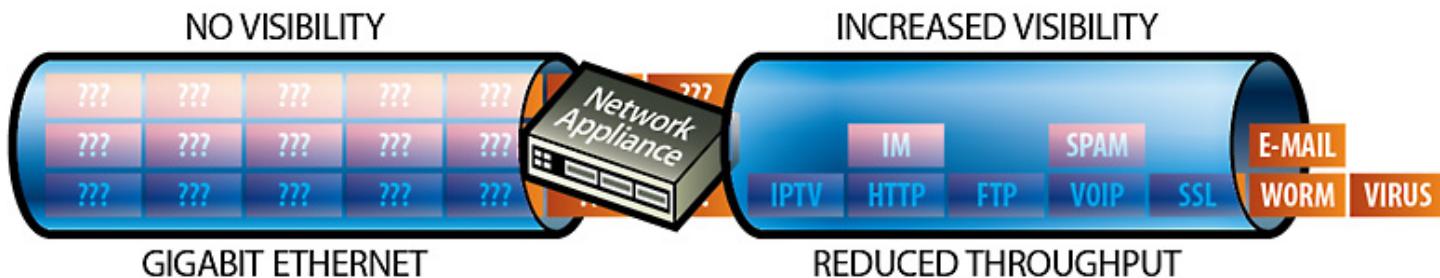
- *Security architects are demanding solutions at 10 and 40 Gbps today*
- *100 Gbps is on the near horizon*

Next Generation Security Appliances

Trends



- Network and security solutions traditionally software applications
- Developed and deployed in network appliances based on general purpose processors

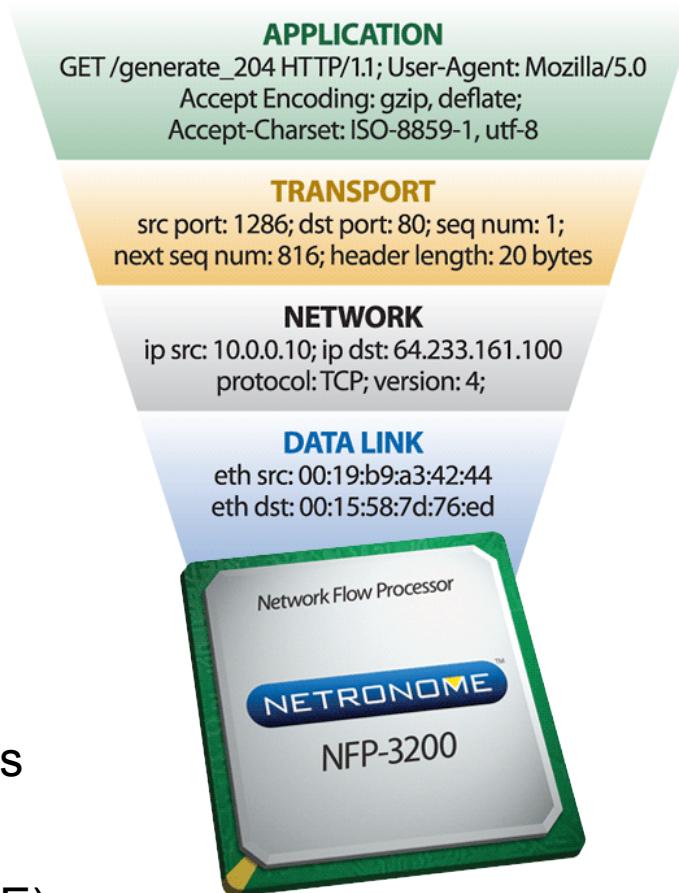


Can general purpose processing architectures keep up?

Network Security Appliances

Requirements

- Configurable L2-L4 network processing (ACLs)
- Programmable L4-L7 intelligence (DPI)
 - Application identification
 - PCRE (signatures), behavioral heuristics
 - Content inspection
- Stateful flow-based processing
- Ability to parse traffic across flow boundaries
- Inspection of encrypted flows (SSL)
- I/O virtualization
- Active (Inline), passive, switched, routed topologies
- Integrated bypass for inline deployment
- Flexible port configurations (GigE, 10GigE, 40 GigE)
- Scalable common software architecture



Flows or Packets?

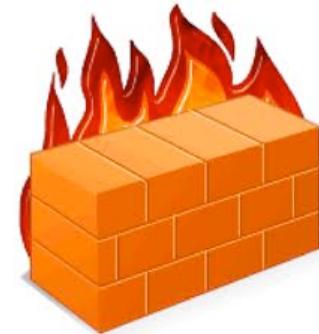
- More users and more applications driving an increase in throughput
- Results in more individual “network conversations” per segment
- What is a flow?
 - A unidirectional sequence of packets all sharing a set of common packet header values
 - 2-tuple, 3-tuple, 5-tuple, 7-tuple are common criteria
 - 15-tuple used in the OpenFlow specification
- Most network equipment based on NPUs including Ethernet switches and routers processes traffic solely based on packet headers
 - State is not kept on each forwarding decision
 - No memory of previous packets

Flow Definition Fields
Ingress Interface
Ethernet Source MAC Address
Ethernet Destination MAC Address
Ethertype
VLAN ID
Source IP Address
Destination IP Address
IP Protocol
TCP/UDP Source Port
TCP/UDP Destination Port
ICMP Type/Code

Stateful Flow Processing



- OpenFlow
 - Up to a three-tiered recursive flow table
 - Flow-based network slicing
- Stateful firewalls
 - Security processing happens at beginning of the flow
 - Flow state is used process the session afterwards
- IDS/IPS
 - Attacks spread across packets/payloads/fragments
 - Snort Stream5 preprocessor reassembles TCP flow to run signature-based rules against whole payload
- Antivirus
 - Terminate TCP, parse protocol (HTTP, SMTP, P2P)
reassembles file attachments, scans for threats
- Next generation firewall
 - IPS + L2 switching, L3 routing, NAPT, stateful flow processing, App ID

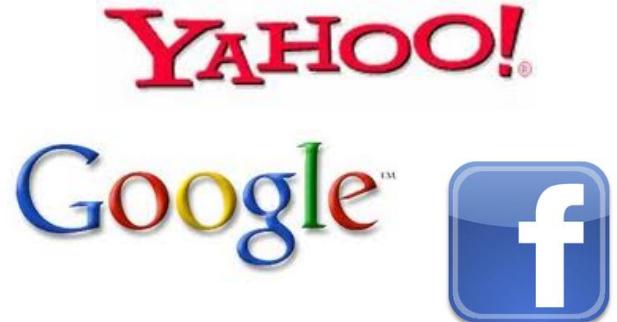


*These applications are
impossible without stateful
flow-based processing*

OpenFlow Networking

- Today's network needs to be smarter and more flexible
- OpenFlow idea is to separate the packet switching and control functions
- Users can freely develop applications independently of switching/slicing
- Give customers per-service performance guarantees
- Offer network slices based on comprehensive flow forwarding architecture
- Not just a data center technology
 - Carriers involved too
 - New service opportunity

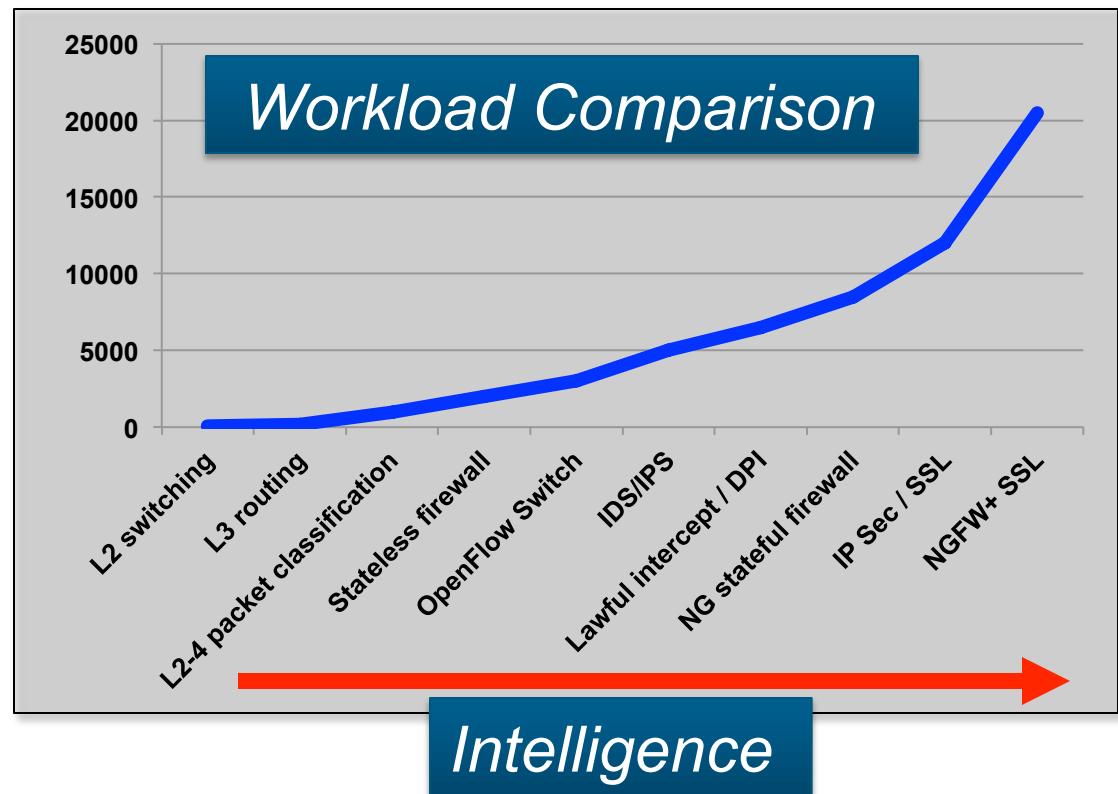
Internet2 initiative building nation-wide OpenFlow/SDN Network



Network Security Workloads Comparison

- Applications requiring sophisticated packet, flow, and security processing require a very high instruction rate

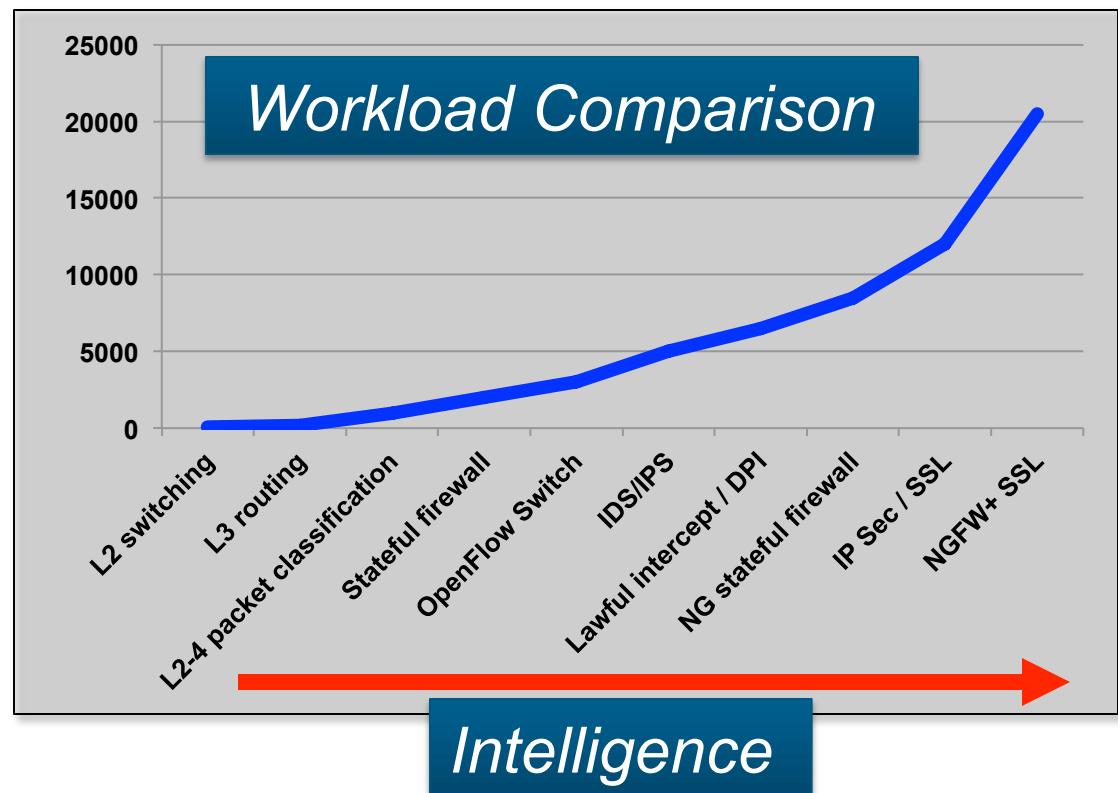
Function	Cycles required
L2 switching	75
L3 routing	200
L2-4 packet classification	1,000
Stateful firewall	2,000
OpenFlow Switch	3,000
IDS/IPS	5,000
Lawful intercept / DPI	6,500
NG stateful firewall	8,500
IP Sec / SSL	12,000
NGFW+ SSL	20,500



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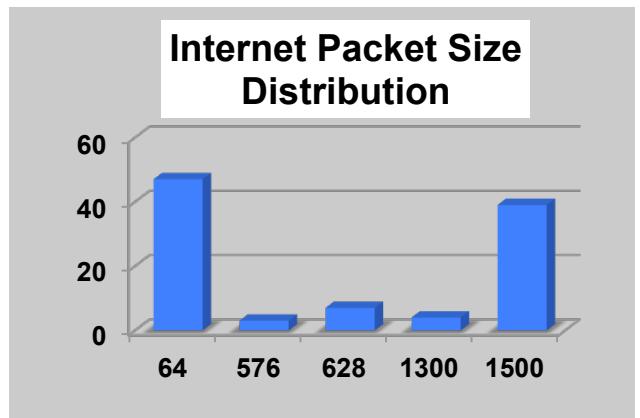
Processor Comparison

- Network security equipment designers have to consider computing workload needs when choosing their product architecture
- General Purpose CPUs
 - Intel Xeon 5645
 - 6 cores @ 2.4 Ghz
 - 14.4 billion instructions per second
 - Multicore MIPS
 - 4 cores @ 2 Ghz
 - 8 billion instructions per second
 - Multicore MIPS
 - 8 cores @ 1.5 Ghz
 - 12 billion instructions per second
- Programmable Network Flow Processors
 - Netronome NFP
 - 40 cores @ 1.4 Ghz
 - 56 billion instructions per second



Network Security Workloads Comparison

- General purpose processors are inadequate for network security applications in real-world use cases



Instructions Required for line rate operation @ 10 Gbps

Packet Size	L2 switching	L3 routing	L2-L4 classification	Stateful firewall	IDS/IPS	Lawful Intercept / DPI	NG stateful firewall	IP Sec / SSL	NGFW + SSL
64	1.12 B	2.98 B	14.9 B	29.8 B	74.4 B	96.7 B	126.5 B	178.6 B	305.1 B
128	633 M	1.69 B	8.5 B	16.9 B	42.3 B	54.9 B	71.8 B	101.4 B	173.1 B
256	340 M	906 M	4.5 B	9.1 B	22.6 B	29.4 B	38.5 B	54.3 B	92.8 B
440	204 M	543 M	2.7 B	5.4 B	13.6 B	17.7 B	23.1 B	32.6 B	55.7 B
512	176M	470 M	2.4 B	4.7 B	11.7 B	15.3 B	19.9 B	28.2 B	48.2 B
1024	143 M	383 M	1.9 B	3.8 B	9.6 B	12.5 B	16.3 B	23.0 B	39.3 B
1500	61 M	163 M	813 M	1.6 B	4.1 B	5.3 B	6.9 B	9.8 B	16.7 B

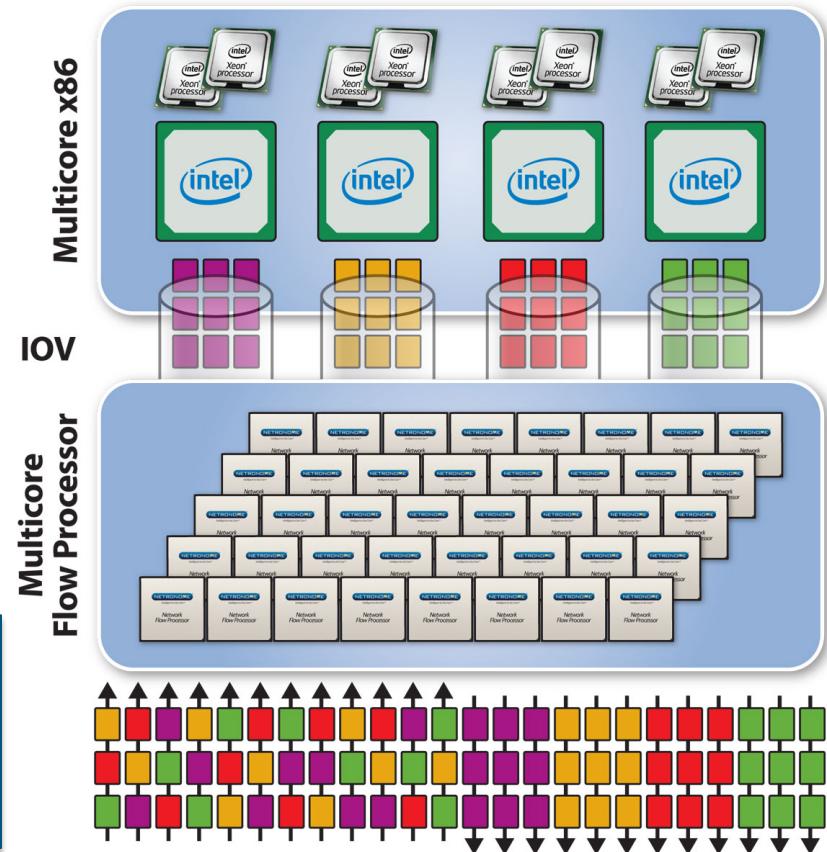
Intelligent Offloads

The Solution

- The x86 architecture suffers in data plane and security intense applications
- Combine general purpose x86 cores with network flow processor cores for pre-processing
- Scale networking and security plane independently from x86 application and control plane processing

Introduce an intelligent I/O-coprocessor to accelerate x86 multicore CPUs

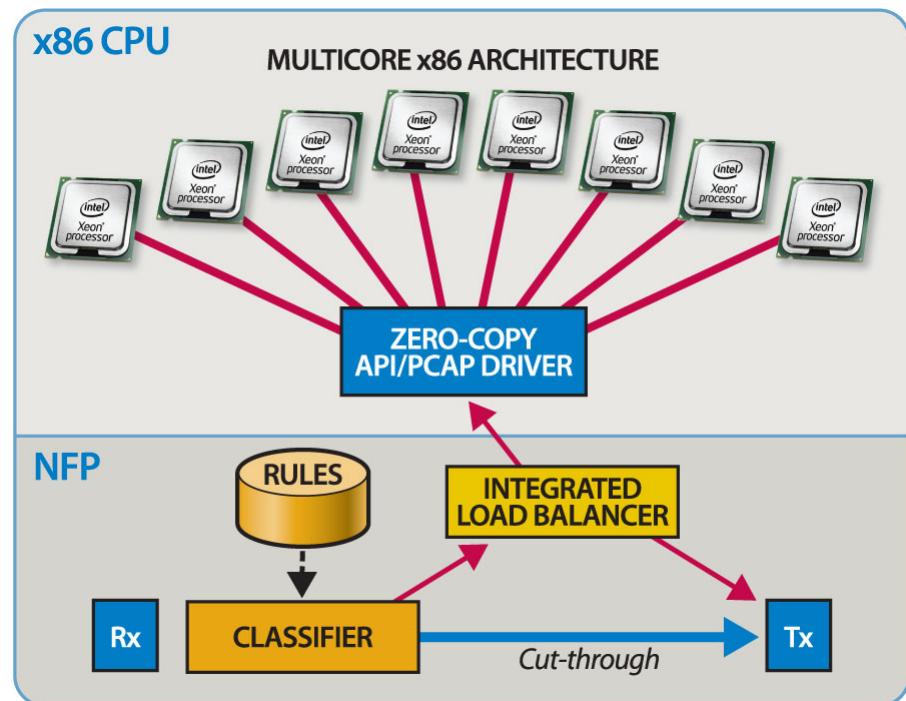
A dual Xeon, dual NFP system solution provides 126 B instructions/second



Applying the Heterogeneous Architecture

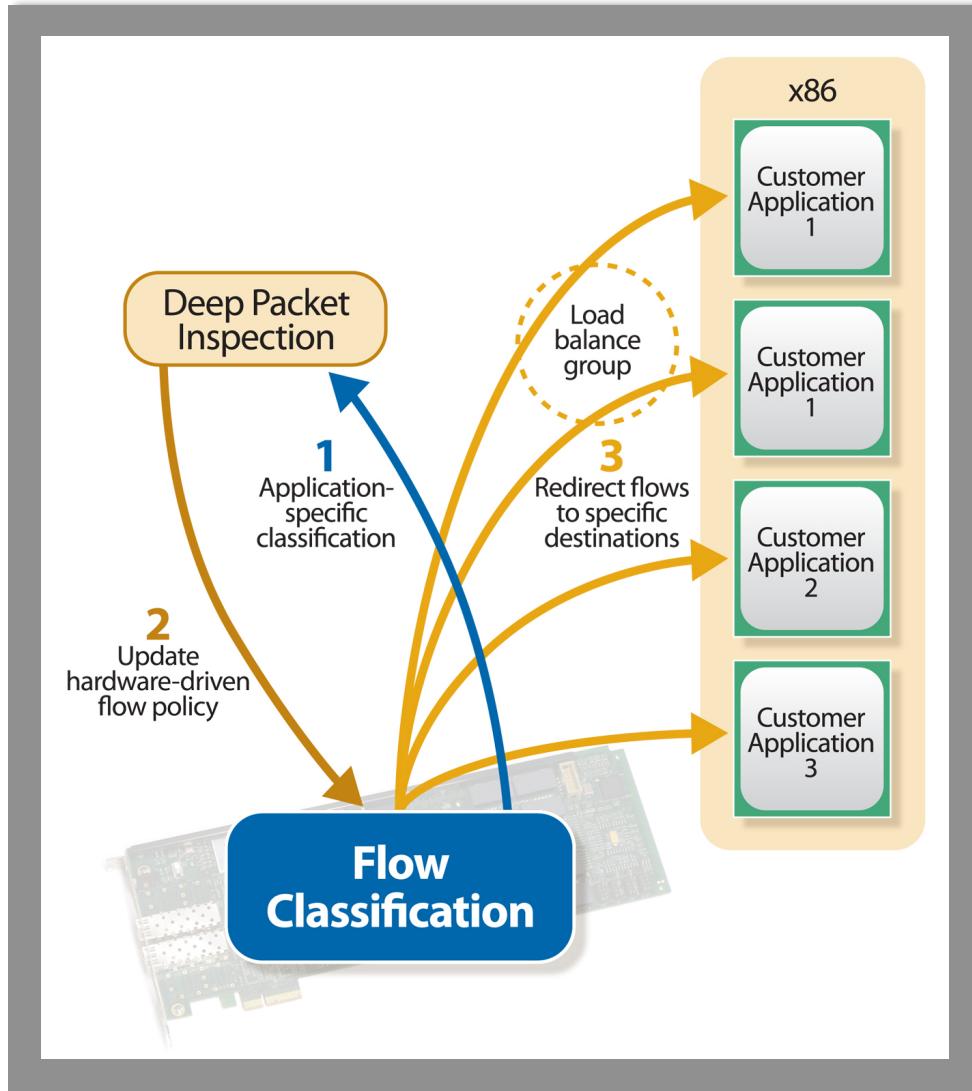
Acceleration Mechanisms and offloads

- Packet classification/filtering
- Efficient delivery of data directly to Linux user mode applications
- Load balancing to application instances on x86 cores
- Stateful flow management
 - Pin flows to core destinations
 - Redirect/drop flows
- Port to port forwarding ("cut-through" of trusted traffic or of the remaining packets of a flow)
- L2/L3 forwarding, NAPT, VPN
- Cryptography, PKI, TRNG
- Off-loading protocol specific functions, e.g. IP or TCP related processing



Deep Packet Inspection/Lawful Intercept

In a heterogeneous multicore architecture



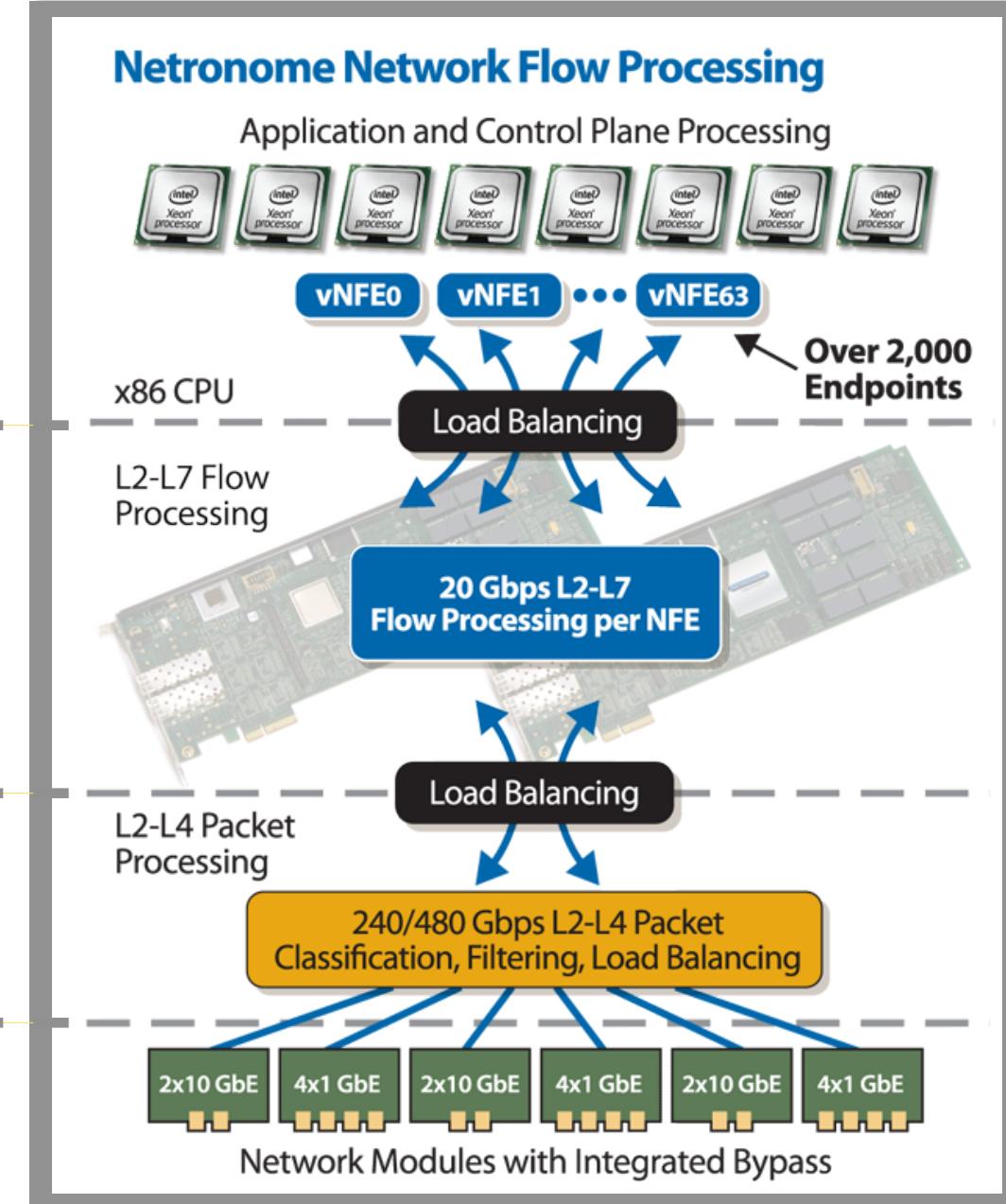
- Packets are classified on ingress
- Sent to x86 for DPI processing
- Results in application or protocol awareness
- New classification rule programmed to NFP for each flow

- Application/control plane processing
- Deep packet inspection
 - Content inspection, behavioral heuristics, forensics, PCRE

-
- L2-L7 classification
 - Stateful flow processing
 - Cryptography/PKI operations
 - Flow-based load balancing
 - L2 switching/L3 routing
 - NAPT/VPN
-

- L2-L4 packet classification
 - Packet-based load balancing
-

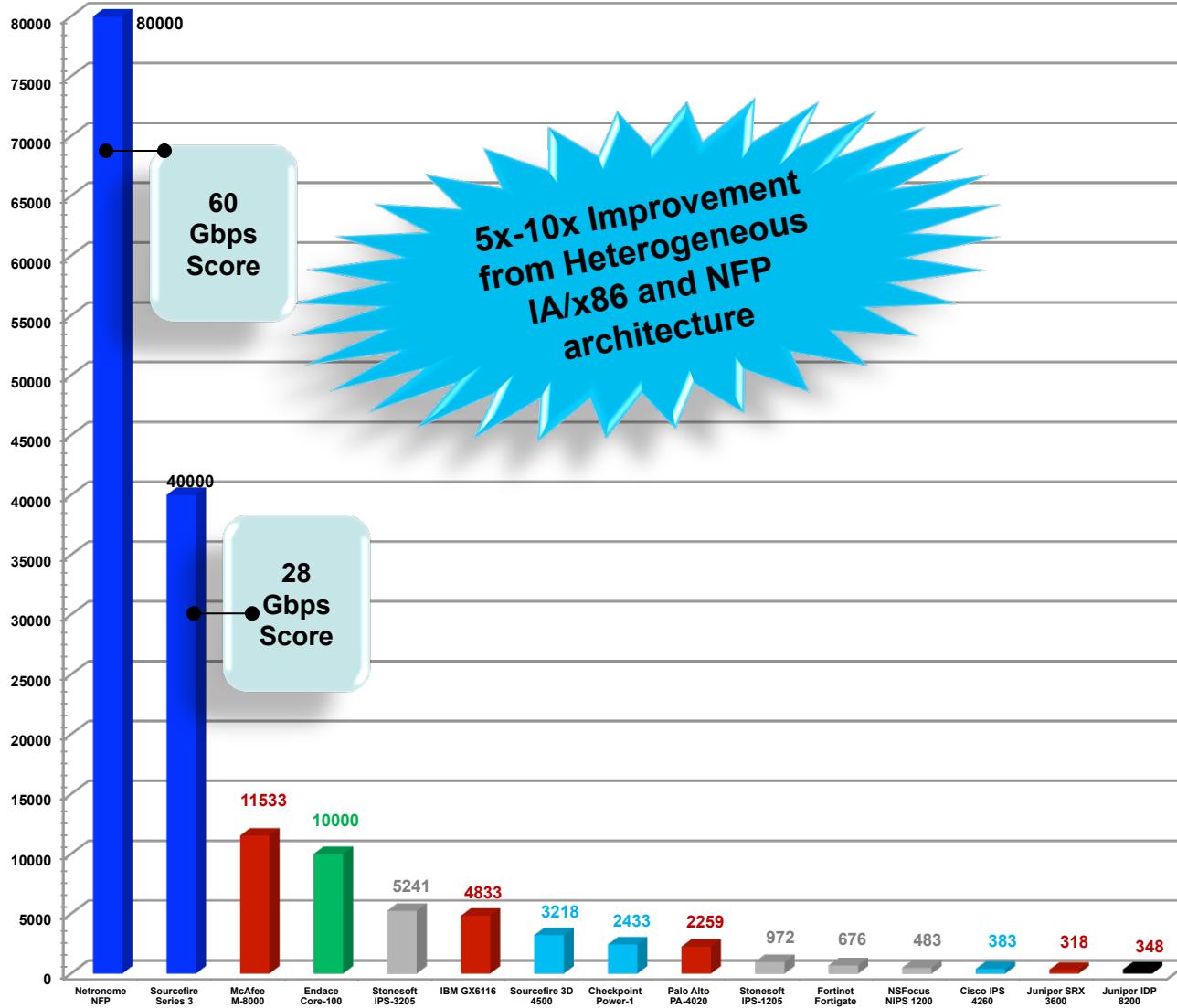
- Physical Interfaces
- Integrated bypass relays



Real World Benchmark

Intrusion Prevention System

- Netronome NFP
- Multicore MIPS
- FPGA
- x86
- Unknown



- Independent validation
 - NSS Labs
 - April 2011 IPS test report
- IPS use case
 - Computationally intense
 - Application- and data-planes
 - >4000 PCRE rules
 - Variable packet sizes, protocol mix
 - Inline measurements - latency
- Results
 - 80 Gbps system throughput
 - 66 Gbps large mix
 - 48 Gbps strenuous iMix
 - 98% security effectiveness
 - 60 million flows
 - ~ 500K TCP and HTTP - CPS
 - <100uS latency
 - Greenest TCO
 - All without application optimization

BACKUP

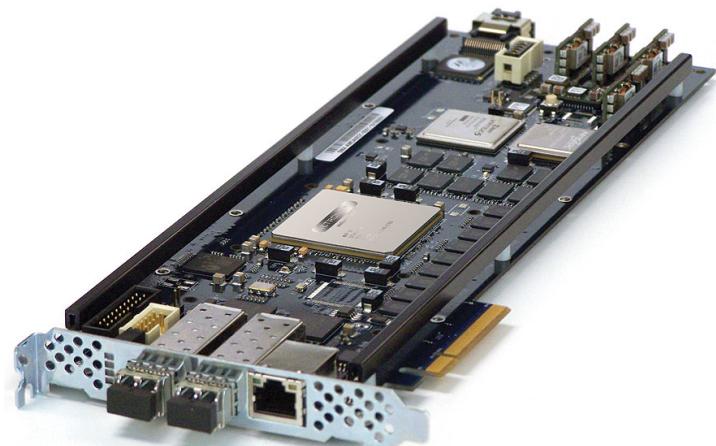
NFP-3200 Summary

- **High performance**
 - 40 cores @ 1.4 GHz
 - 1,800 instructions / packet at 30M pps
 - 40 Gbps of packet, flow, and content processing
- **I/O Virtualization**
 - PCIe v2.0 with IOV support
- **Highly Integrated Design**
 - 40Gbps of line-rate security/crypto
 - Integrated MAC, PKI, PCIe, Interlaken, ARM
- **Unmatched ease of use**
 - Proven tools, software development kit, product-ready software, reference platforms



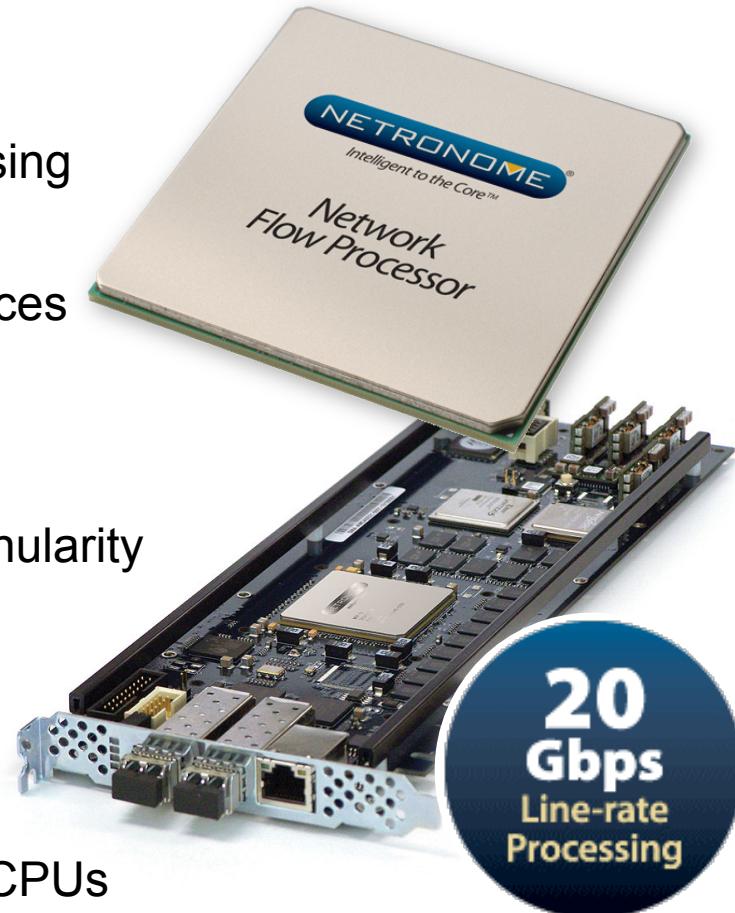
Netronome Overview

- 40 Gbps Network Flow Processors
- Intelligent Network Optimized Acceleration cards
- Flow processing platform solutions up to 100Gbps
- Comprehensive development tools
- Software Libraries and OEM Applications
 - NFM Open Flow Manager Software APIs
 - IPS, SSL, NG Firewall enabling software



Netronome Processors & PCIe Cards

- NFP-3240-based PCIe Cards
 - 20Gbps of line-rate packet and flow processing per NFE
 - 6x1GigE, 2x10GigE (SPF+), netmod interfaces
 - PCIe Gen2 (8 lanes)
 - Virtualized Linux drivers via SR-IOV
 - Flexible/configurable memory options
 - Packet time-stamping with nanosecond granularity
 - Integrated cryptography
 - Packet-capture and Inline applications
 - Hardware-based stateful flow management
 - TCAM-based traffic filtering
 - Dynamic flow-based load balancing to x86 CPUs



***Highly programmable, intelligent, virtualized acceleration cards
for network security appliances and virtualized servers***

Network Flow Processing Platforms

- Standard 1U/2U platforms
- 3 layers of processing
- Modular interface options
- Industry-leading port density
- Flexible clustering support
- High availability



Flexible solution allows customizable configuration of port types, densities and processing power

Appliance Clustering

- For certain compute intensive security applications, I/O outpaces CPU resources
- Each clustered appliance adds up to 80 NFP cores and 12 x86 cores



***Clustered configurations
can scale to 100's of Gbps
of throughput***