Using Network Acceleration for an Optimized Edge Cloud Server Architecture

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About Packet
Packet empowers developer-driven companies to deploy physical infrastructure at global scale.
A “Go Anywhere” Cloud Model

Packet’s automated infrastructure is delivered in our public cloud, as well as in Enterprise deployment models.

Cloud
The leading bare metal public cloud for developers, available in 20+ locations.

On-Premises
A software solution for on-premises environments with 5,000+ servers.

Edge
Our bare metal cloud experience, deployable in 1000’s of global locations.
20+ Public Cloud Locations

- Amsterdam
- Ashburn
- Atlanta
- Boston
- Chicago
- Dallas
- Dublin
- Frankfurt
- Hong Kong
- Los Angeles
- Marseille
- New York
- Phoenix
- Pittsburgh
- Seattle
- Singapore
- Sydney
- Sunnyvale
- Tokyo
- Toronto
Why Packet?
The Experience of the Cloud on Bare Metal

*Built by developers, for a developer world - the Packet experience is both intuitive and powerful.*

- No Multi Tenancy
- Scalable, Hourly Pricing
- Powerful, Intuitive API
- CloudInit & Meta Data Support
- Native API Libraries
- Leading Integrations
## Automating at the Hardware Layer

<table>
<thead>
<tr>
<th>Lock-In Risk</th>
<th>Hardware Access</th>
<th>Automation Layer</th>
<th>Bare Metal Servers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High</strong></td>
<td><strong>No Access</strong></td>
<td><strong>Hypervisor</strong></td>
<td></td>
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<tr>
<td>Proprietary services are the core business model.</td>
<td>Hardware is not exposed. No chance for optimization.</td>
<td>Forced virtualization &amp; multi-tenancy.</td>
<td></td>
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<tr>
<td>None</td>
<td>100% Dedicated</td>
<td>Hardware</td>
<td></td>
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<tr>
<td>Workloads are portable to any datacenter.</td>
<td>Users have full access to hardware.</td>
<td>No virtualization tax or noisy neighbors.</td>
<td></td>
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</tbody>
</table>

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Hardware at Software Speed

By separating the hardware from the software, disaggregation is resulting in significant acceleration of innovation. DevOps users now control the pace of innovation.

- Proprietary Solution
- 18 Month Integration
- IT Managed

- Open Software
- Realtime Integration (CI)
- DevOps Managed
What changes at the Edge?

Sub-Scalable Architecture
Solving For Latency And Edge Cloud Constraints

- Traditional cloud data centers are incredibly large and too far away

- Edge Cloud deployments have stringent cost, power and latency requirements

- Solution: A different architecture in a distributed location
  - Enable smaller and more cost-efficient servers: independently available to developers
  - Utilize network accelerators to enhance compute performance
Bare Metal IaaS For Edge Cloud Apps Using Open19 Design

Edge Cloud Customer
- Owns one or more microserver (bare metal)
  - O/S or hypervisor of choice
  - Run low-latency 5G/IoT oriented applications – at the Edge
  - Develop accelerated networking apps using eBPF programming
  - Option of SmartNIC or basic NIC

With SmartNIC
- Offloads eBPF data plane programming to SmartNIC
- Programmable RSS
- Security
- Upstream OVS-TC and RHEL options.

Operator
- Manages bare metal microservers using SmartNIC
  - ACL rules, Firewall, Encryption
  - Control and data planes and Operator SDN controller
- Offer wide range of customer solutions
  - SmartNIC/non-SmartNIC enabled microservers
  - Cost and power-efficient servers

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Accelerating Compute With Disaggregated Architecture

**Homogeneous Architecture - Historical**
- Performance is throttled when CPU manages all traffic
- Scaling performance is breaking the cost/power budget
- CPUs alone cannot keep up with demands of new workload

**Disaggregated Architecture**
- Disaggregation is key to unlocking performance
- Enable servers to use more cost/power effective CPUs
- Provide lower latency to application and Edge devices
Innovative Edge Cloud Microserver Form Factors

Standard 1U Form Factor Solution with 4 Microservers and Integrated Netronome SmartNIC

Open19-based Solution with 4 Microservers and Integrated Netronome SmartNIC

Open19 Chassis
Offloaded TLS Enables Superior Application Performance

- **Queries per Second**
  - SW TLS: 812,002
  - HW TLS: 971,164
  - **20% Throughput Improvement**

- **Latency**
  - SW TLS: 261 us
  - HW TLS: 204 us
  - **22% Latency Reduction**

- Hardware offloaded TLS provide 20% query throughput improvement
- Hardware offloaded TLS provides 22% latency reduction
- Benchmarked against Mellanox ConnectX-5, 50GbE
- 20% improvement on 28-core server = 6 cores released back to application
eBPF Offload Boosts Performance, Scalability And Efficiency

- eBPF provides transparent acceleration to a wide variety of data center and enterprise edge apps
  - Filtering, Load Balancing, DDoS, Monitoring
  - eBPF-based security for bare metal servers
  - Drivers upstreamed and included in the Linux kernel

- Netronome SmartNICs accelerate and offload eBPF enabling higher performance and efficiency
  - Up to 5X performance for iptables firewalls
>20X eBPF/XDP Load Balancer Offload Performance

- Enables on-the-fly changing of load balancing algorithms
  - direct traffic to available servers based on time of day, geographies served and other security-related criteria)

- Offload of open source eBPF/XDP Load Balancer code to the Agilio SmartNIC yields up to 42Mpps using a single x86 CPU core

- Without offload, 16 x86 CPU cores yield 20Mpps, about 1.5Mpps per CPU core
XDP: Best-in-Class Latency Reduction

3X Latency Reduction: P(99). For P(99.99) see the next slide

- 99% of the flows experience >12ms tail latency with competitor NIC
- 99% of the flows experience <4ms tail latency with Netronome Agilio SmartNIC

3X Benefit for P(99) Latency

- Competitor NIC
- Agilio SmartNIC with Congestion and Buffer Management
Best-in-Class Latency Reduction

33-70X Latency Reduction

2.7-3.8X Latency Reduction

In an OCP data center allows 2 type 1 servers (Twin Lake) to replace a type 6 server (Leopard/Tioga Pass) within a disaggregated flash architecture.

Saves ~100W (33% of total power) per replacement.

Up to 70X Improvement for P(99.99) Latency
Agilio SmartNIC in Web 2.0 App And Data Servers

Multi-host systems can substantially reduce server and cabling costs.

Reduction of storage tail latency is critical to ensure quality user experience.

CONGESTION AND TAIL LATENCY REDUCTION FOR DISAGGREGATED STORAGE

WEB 2.0 APP AND DATA SERVERS

SERVER CPU
Chef Orchestration
Application
SERVER CPU
Chef Orchestration
Application
SERVER CPU
Chef Orchestration
Application
SERVER CPU
Chef Orchestration
Application

Multiple PCIe Interfaces
Agilio SmartNIC
Basic NIC TX/RX and Stateless Offloads
Congestion Management
Buffer Management
Deliver to Host
Update Statistics
Switching

25/50/100GbE Network port
Netronome – The SmartNIC Platform Leader

SmartNIC leader delivering efficient, scalable, programmable and highly secure cloud and hyperscale solutions – from the edge to data center servers

**INNOVATION:** Netronome invented the NFP as a networking app-specific silicon: it has the highest number of cores and processing threads per $ and Watt

**OPEN SOURCE LEADERSHIP:** Prolific open source contributor (10+ orgs), supports an open research community of 200+ users and 70+ projects, founders of ODSA & Open-NFP

**PRODUCTS RANGE:** The Agilio SmartNIC platform supports the widest range of eBPF, P4 and C-programmable SDN, NFV, security and visibility apps
Putting Words Into Actions

Calling All eBPF Lovers!
Edge Architectures are Different

**HYPERSCALE MODEL**

*High Availability for Redundancy of Generic Workload*
Application deployed across 3 zones with 2N+ power redundancy. Cooling within a very limited range. Deployment size of 15k -> 100k servers. Built by the megawatt!

**EDGE MODEL**

*Distributed for Optimization of High Value / Specific Workloads*
Micro datacenters often utilizing grid power, with potential for high temperature variance. Single deployment could be just a few dozen servers. Complex networking around 5G & IoT.
Developers are Ready for eBPF!

Credit: excellent article: “Learn eBPF Tracing: Tutorial and Examples” by Brendan Gregg
An Architecture for Modern Workloads

Containers, containers, containers. Microservers with SmartNICs are the perfect fit for containerized microservices!
Edge Access Program

*Our Edge Access Program accelerates open source and commercial use cases by providing access to edge infrastructure, technology partnerships and expertise.*

- Get access to unique, use-case driven edge sites in the United States.
- Bare metal with full automation (early SmartNIC options available).
- Wireless connectivity (CBRS) and Packet Connect (to Azure, GCP, etc.)

Contact [sales@packet.com](mailto:sales@packet.com) to learn more!
Thank You!

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