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Panel: P4 Enabled Solutions for Operator Networks

Brian O'Connor
Stratum Project Lead
Open Networking Foundation

Meet the Panelists

Brian O'Connor

Stratum Lead at ONF

Suresh Krishnan

CTO at Kaloom

Vijay Sivaraman

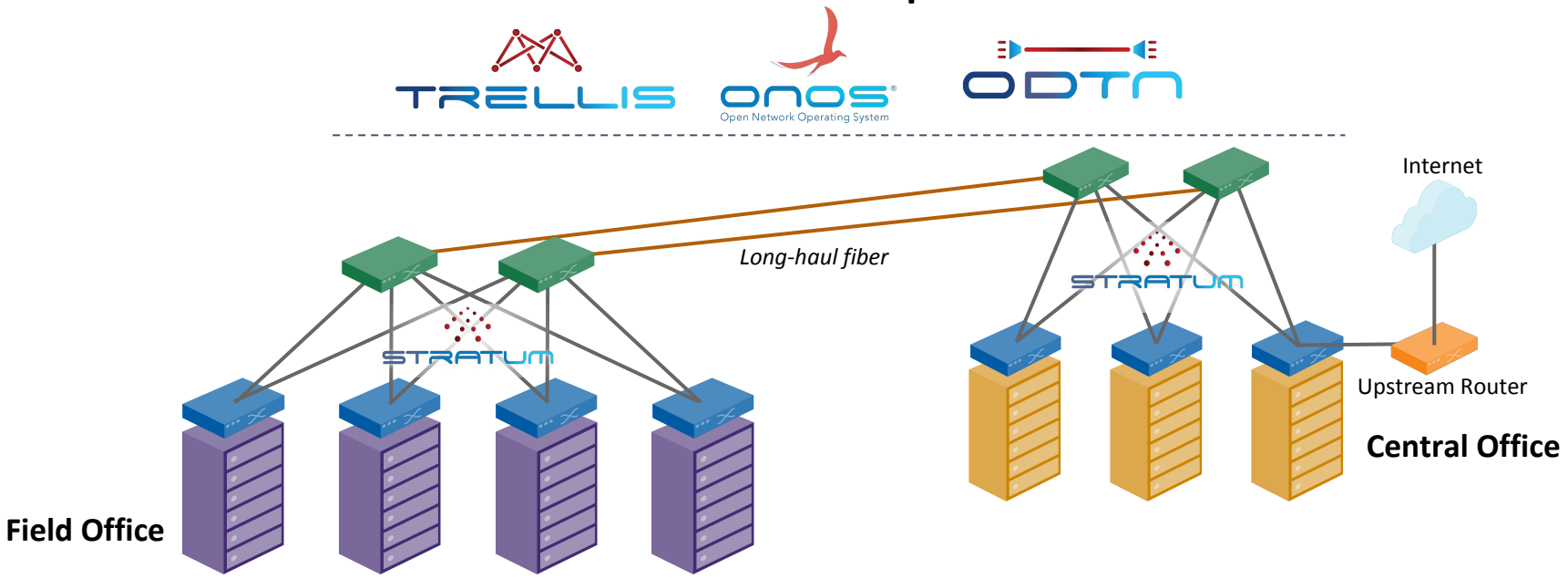
Co-Founder & CEO at Canopus Networks

Operator Opportunities with P4

- ONF is an operator led community built by and for network operators
- The ONF community has embraced P4
  - Host to P4.org and open source P4 programs
  - Stratum: switch OS is build around P4
  - Extended ONOS to support P4 and P4Runtime
- P4 is making its way into all major ONF use cases and solutions
  - Trellis
  - SEBA
  - ODTN
  - Aether
  - NG-SDN

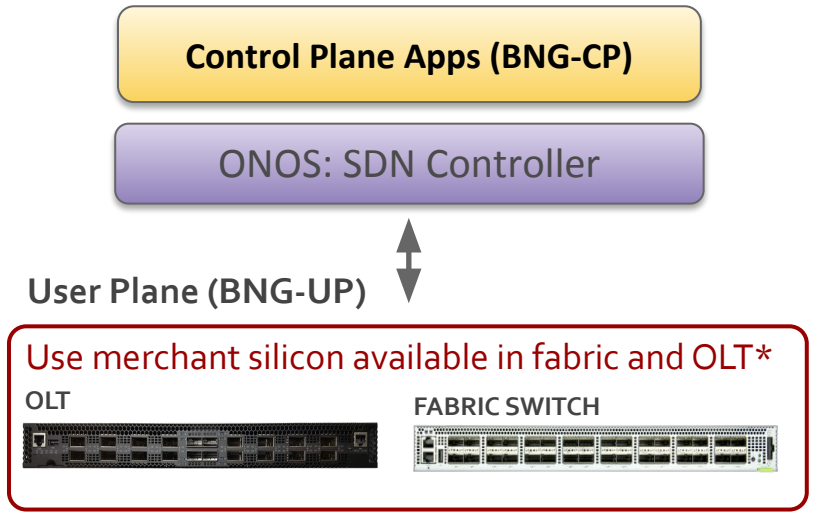
Enabling SDN

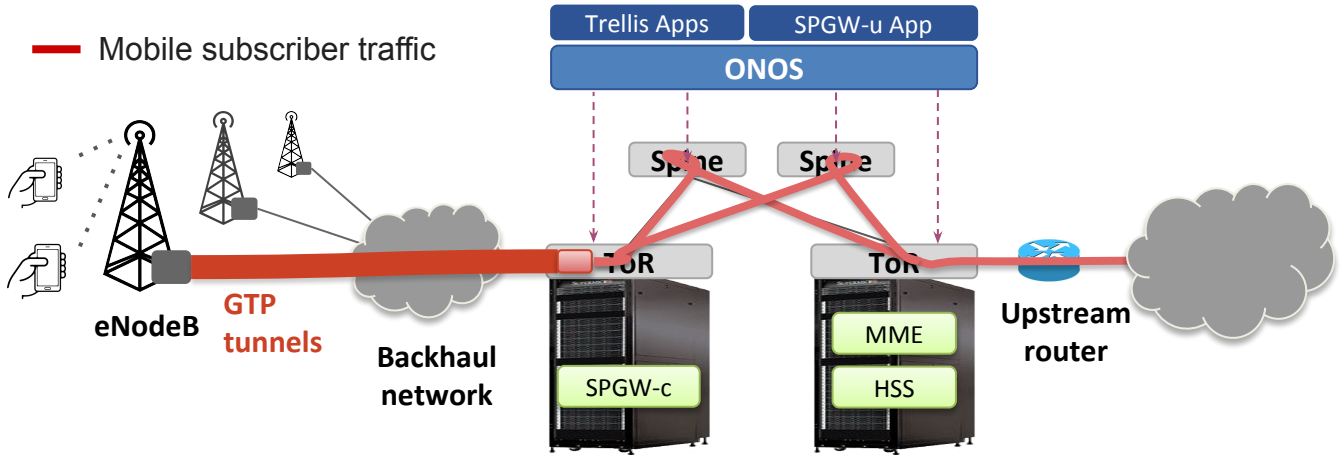
- ONF has deployed Trellis with OpenFlow at Comcast
- P4 is enhancing Trellis
  - P4 provides a clear contract that enables heterogeneity
  - P4Runtime offers multiple improvements to OpenFlow
    - protocol level (move to gRPC) & path to extensibility
  - P4 offers enhanced data plane feature velocity
- Trellis works on switches from multiple hardware vendors using Stratum



Improving Network Functions

- **Idea**: Disaggregate a network function and embed the data plane into hardware
- **Benefit**:
  - Increased performance
  - Reduced latency and jitter
  - Reduced compute resources and power consumption
- **Examples at ONF**: SD-BNG, Aether 4G/5G User Plane





Enhancing Visibility

- P4 community has introduced INT: In-band Network Telemetry
  - Allows for monitoring any (and every) packet
- Improved user experience and enhanced debuggability
  - Path to added customer revenue
  - Less customer downtime
- P4 is the basis for zero-touch operations and closed loop control
  - Required to scale operations without dramatically increasing cost

Open Platforms for Innovation

- fabric.p4
  - Built for operators (L2/L3/MPLS/Double VLAN/Multicast)
  - Foundation for network functions (INT, SD-BNG, Aether UPF)
- Stratum
  - Next generation, thin switch OS
  - Supports P4/P4Runtime and OpenConfig/gNMI/gNOI
  - Works on data center switches, NICs, packet-optical transponders, and software switches
- ONOS
  - SDN Control Plane with high performance and availability
  - Supports OpenFlow, P4/P4Runtime, and OpenConfig/gNMI
- Trellis
  - SDN-powered leaf-spine fabric with Network Operator features
  - Designed for scale and extensibility

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Thank You

Brian O'Connor
brian@opennetworking.org

Suresh Krishnan, CTO

Kaloom 5G UPF

- The Kaloom UPF is a highly scalable, distributed low latency UPF based on the Intel Barefoot Tofino ASIC
  - It is highly programmable and can be updated and augmented in the future using software
- It is designed to support multi-terabit speeds on a single Kaloom UPF node
- It offers extremely low latency (< 4 µs) to support demanding 5G applications
- Extremely energy efficient

A programmable data plane

- Add new features and services in runtime without impacting traffic
- Allow developers to develop new code and drive innovation
- Avoid vendor lock-in & eliminate the need to wait for silicon upgrades
- Allow for customer programmability
- **Industry standard** P4 programming language
- Hardware Independence

Kaloom UPF Key Benefits

10x
TCO Reduction

HIGH THROUGHPUT
Multi-terabit speeds

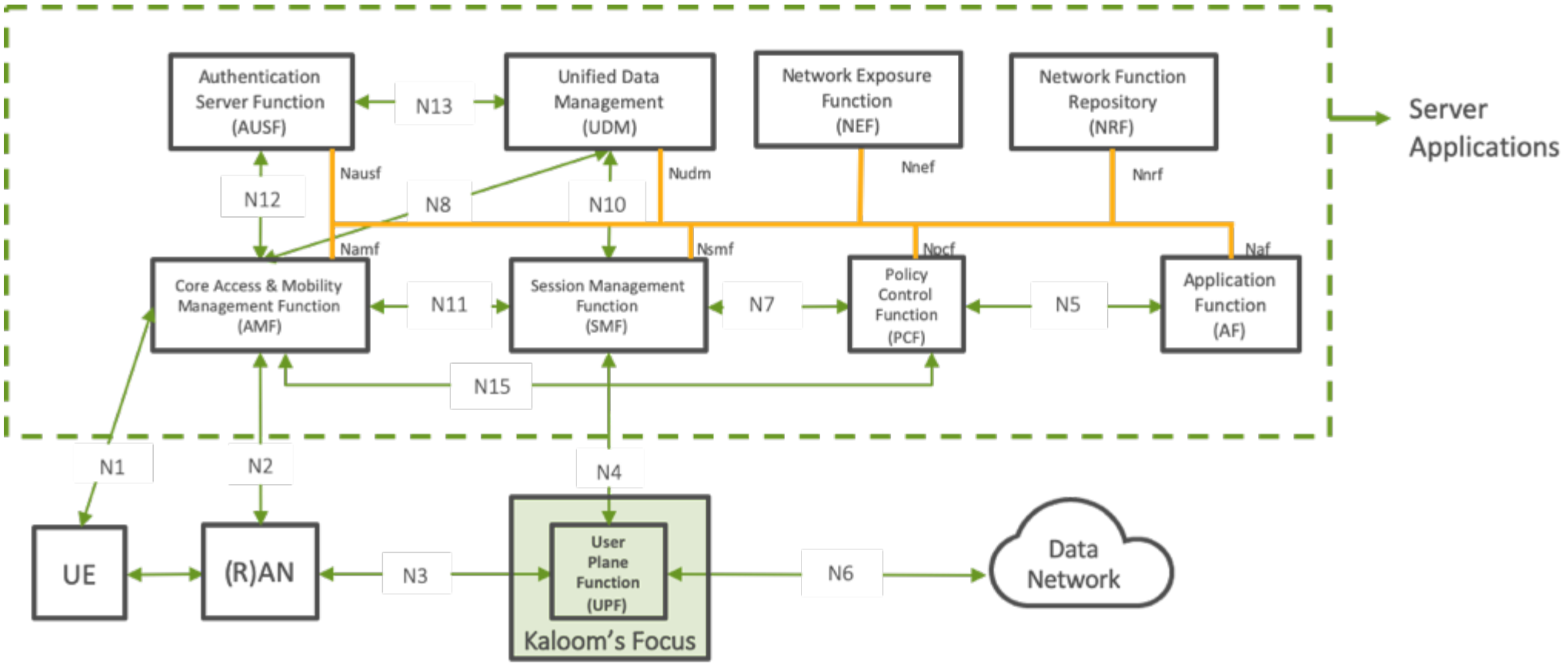
LOW LATENCY
< 4 µs

FLEXIBLE
Centralized/ Distributed

SCALABLE
Millions of users

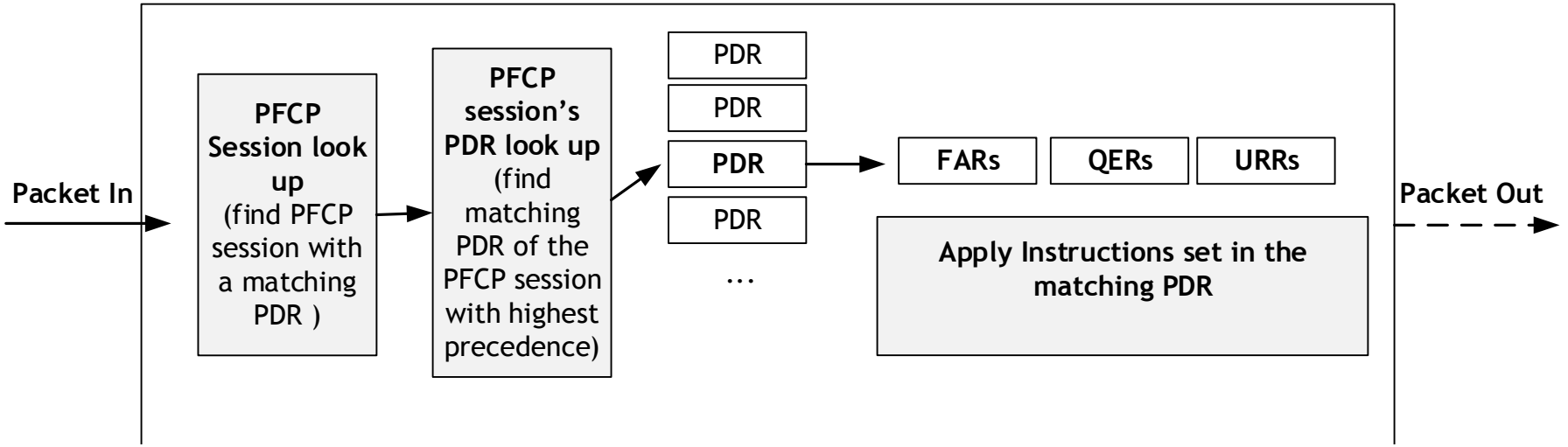
MULTI-VENDOR
Fully Standards based

5G Packet core based on the Kaloom 5G UPF



Packet processing model

Completely implemented using P4 on the Intel Barefoot Tofino

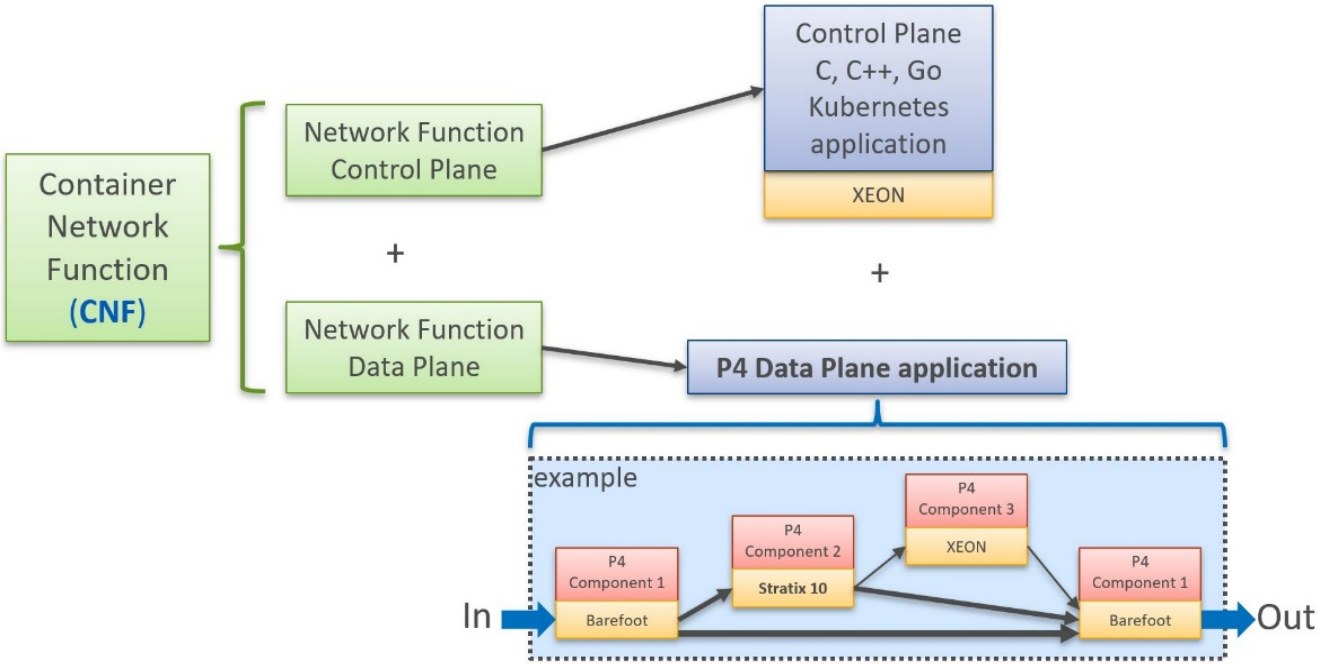


UPF Data plane

- PFCP session lookup
- PDR: Packet Data Rules (flow identification)
- FAR: Forwarding Action Rules
- QER: QoS Enforcement Rules
- URR: Usage Reporting Rules

Kaloom's Hardware Strategy

- Kaloom **strongly** believes in a **heterogenous hardware strategy** and using the hardware best suited for the required characteristics
- P4 is supported on heterogenous hardware including
  - Intel XEON CPUs
  - Programmable ASICs such as Barefoot Tofino
  - FPGAs (Stratix 10) and FPGA based SmartNICs from Intel
- The Kaloom dataplane can execute on any of these platforms including any combinations



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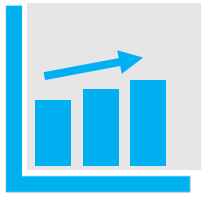
Using P4 for Traffic and CX Visibility in Operator Networks

Vijay Sivaraman
Co-Founder & CEO
Canopus Networks

The Challenge

Global Internet traffic is growing at 26% each year, i.e. doubling every 3 years [1]



Global Telco (ISP) revenue for 2015-18 grew by 3.7% and margin by 0.6% [2]

Australian traffic grew +50% YoY while revenue declined -4.1% [3]

Operators are largely driving blind:

- No visibility into CX; under constant pressure to “fatten” network pipes
- Over-the-top (OTT) providers get the benefit; operators get the blame
- “Connectivity” is a commoditized service with diminishing margins
- ISPs must create new value-add services and retain customers via exceptional CX

[1] https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html
[2] https://www.ey.com/Publication/vwLUAssets/ey-accelerating-the-intelligent-enterprise/$FILE/ey-accelerating-the-intelligent-enterprise.pdf
[3] “ACMA says Telco sector revenues down despite explosion in data usage”, CommsDay 27-Feb-2020.

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Existing DPI Solutions

Custom hardware appliances:

- Expensive
- Single-purpose

VNF software solutions:

- Hardware cost per Gbps is high (compared to network switch)
- Scaling to 400Gbps and beyond requires excessive cores

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The Canopus Approach

P4-programmable switch:

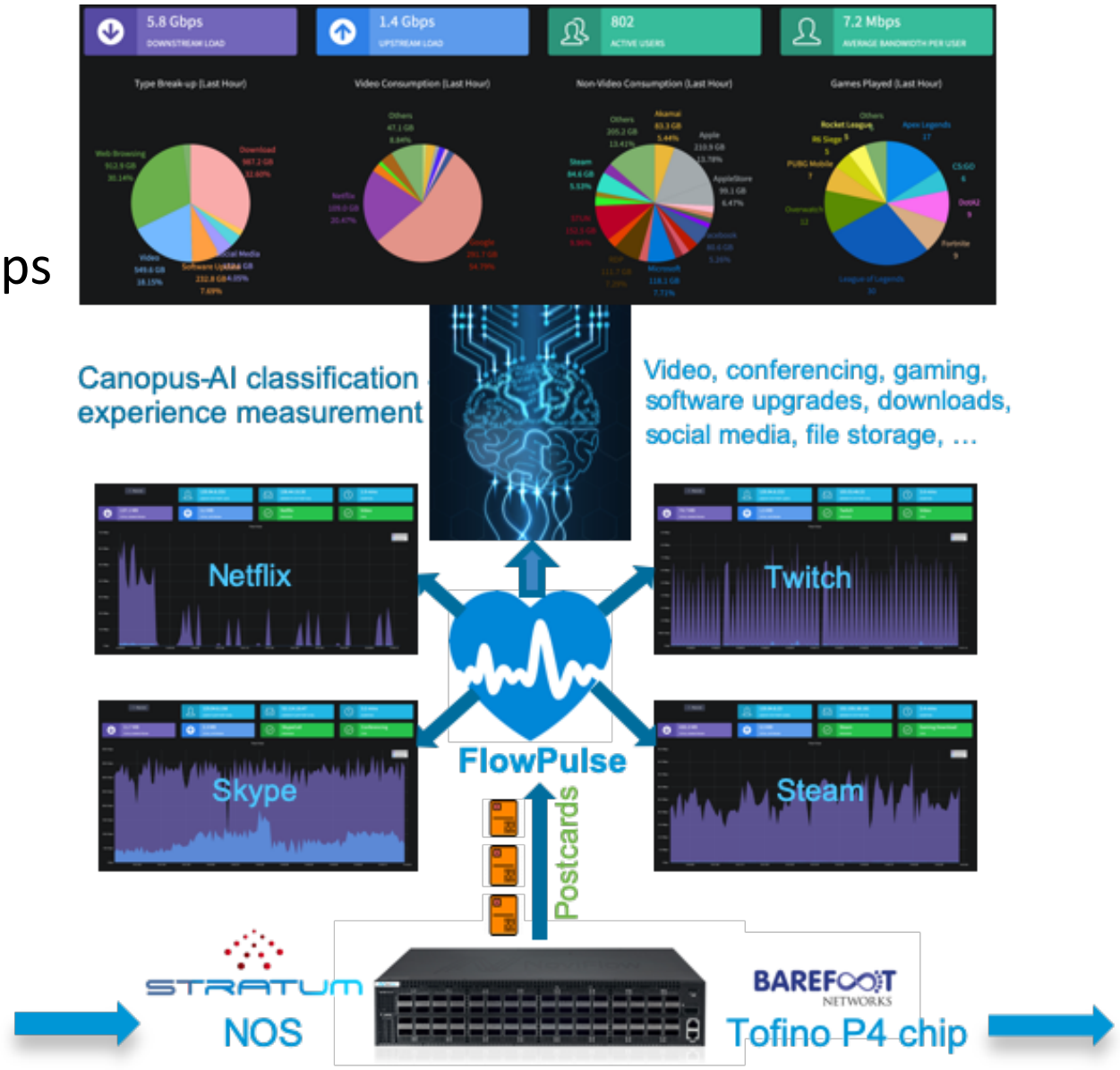
- Absorbs majority of traffic, low cost per Gbps
- Exports fine-grained per-flow telemetry

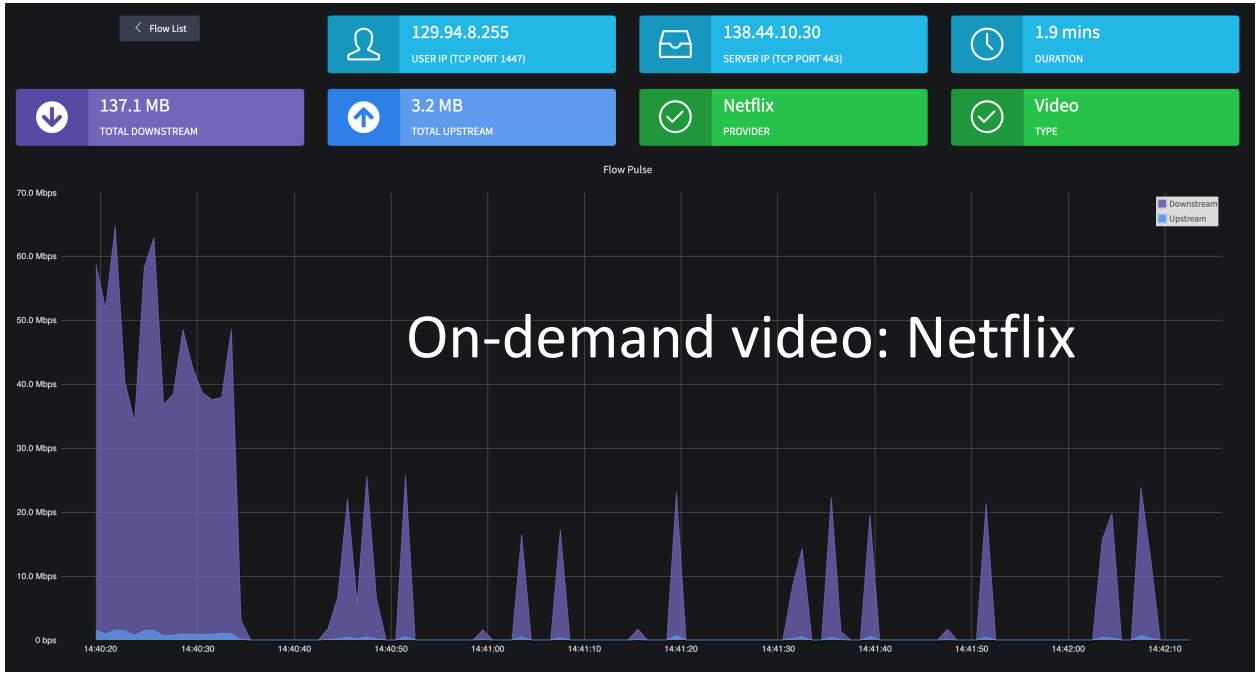
AI engines:

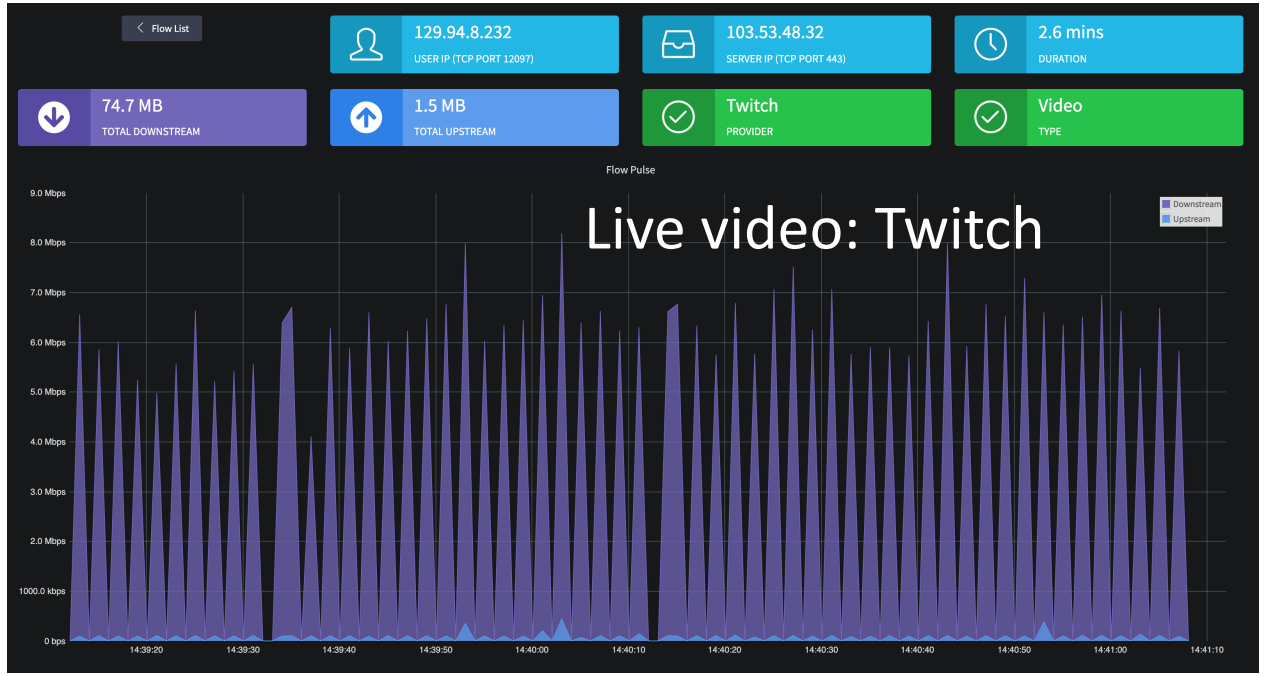
- Applications have “pulse” signature
- Used to derive application type and CX

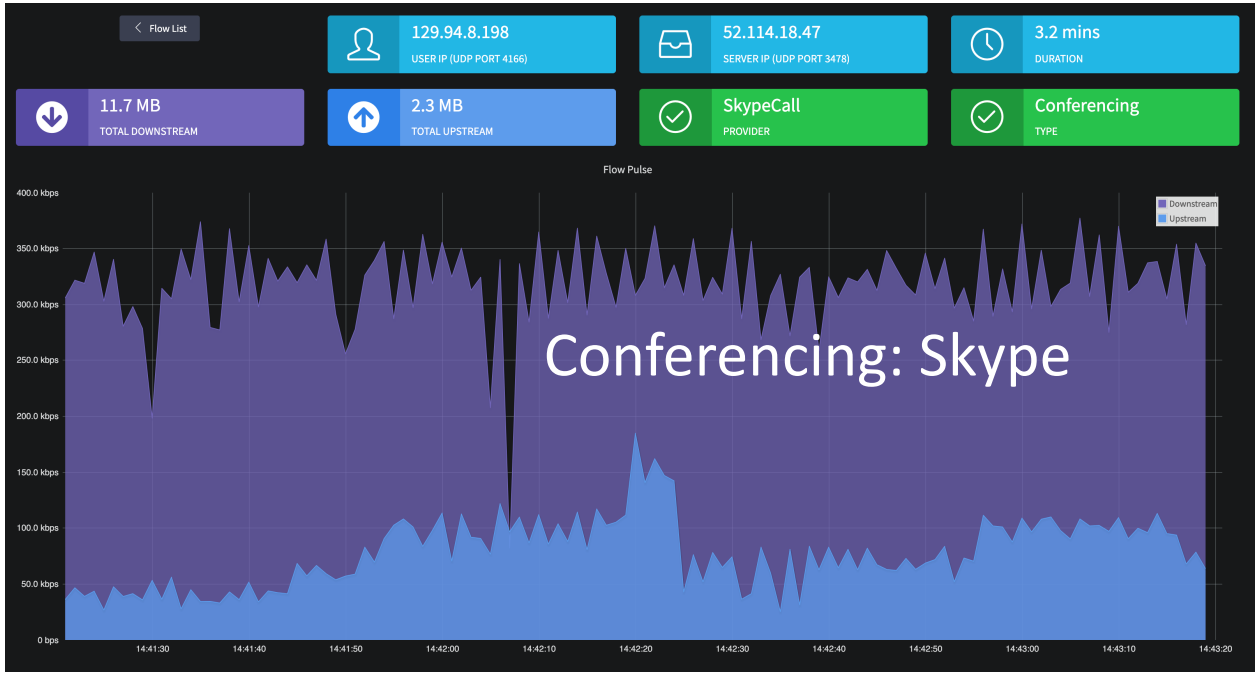
Software “app” + off-the-shelf hardware

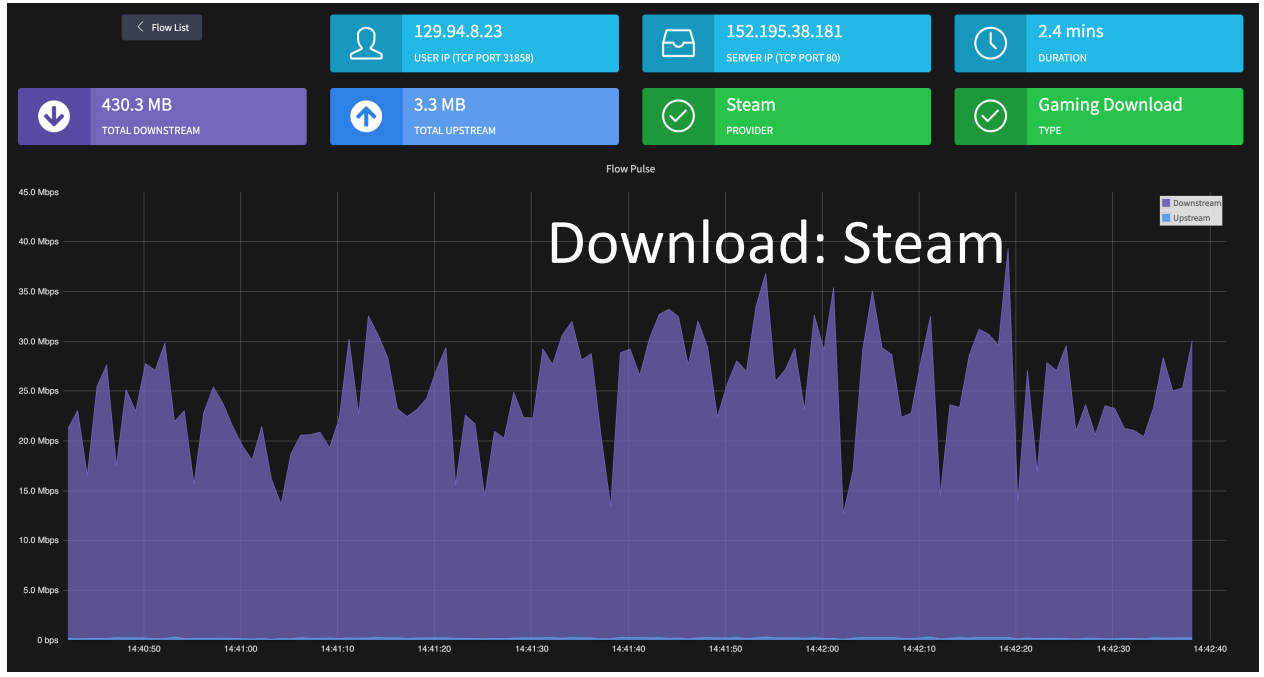
- Cost, scale, vendor choice, multi-purpose
- Encryption resistant and future proof




Flow List
129.94.8.255
USER IP (TCP PORT 1447)
138.44.10.30
SERVER IP (TCP PORT 443)
1.9 mins
DURATION
137.1 MB
TOTAL DOWNSTREAM
3.2 MB
TOTAL UPSTREAM
Netflix
PROVIDER
Video
TYPE
Flow Pulse
On-demand video: Netflix


Flow List
129.94.8.232
USER IP (TCP PORT 12097)
103.53.48.32
SERVER IP (TCP PORT 443)
2.6 mins
DURATION
74.7 MB
TOTAL DOWNSTREAM
1.5 MB
TOTAL UPSTREAM
Twitch
PROVIDER
Video
TYPE
Flow Pulse
Live video: Twitch

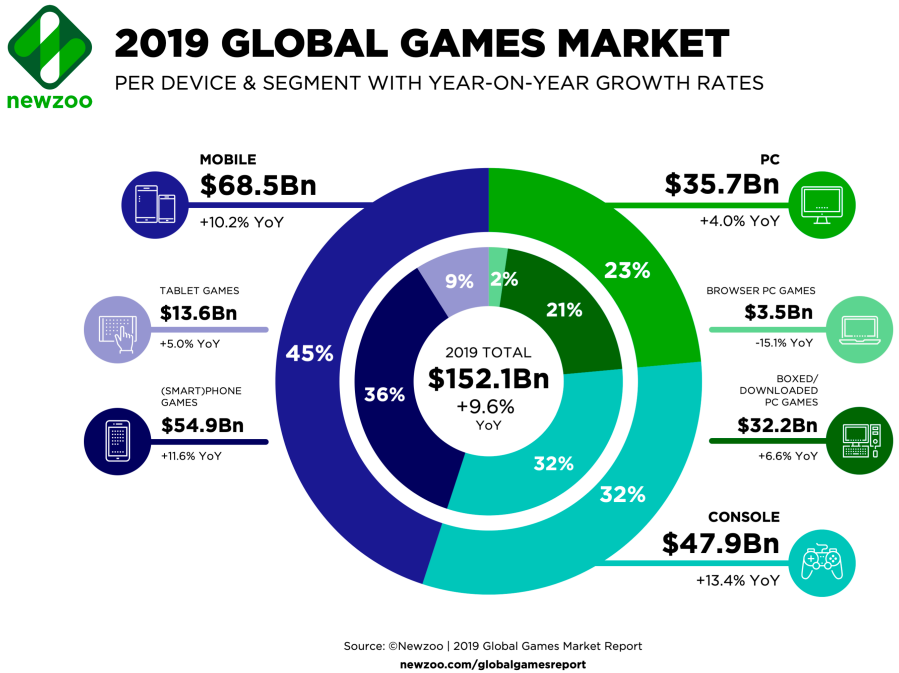

Flow List
129.94.8.198
USER IP (UDP PORT 4166)
52.114.18.47
SERVER IP (UDP PORT 3478)
3.2 mins
DURATION
11.7 MB
TOTAL DOWNSTREAM
2.3 MB
TOTAL UPSTREAM
SkypeCall
PROVIDER
Conferencing
TYPE
Flow Pulse
Conferencing: Skype


Flow List
129.94.8.23
USER IP (TCP PORT 31858)
152.195.38.181
SERVER IP (TCP PORT 80)
2.4 mins
DURATION
430.3 MB
TOTAL DOWNSTREAM
3.3 MB
TOTAL UPSTREAM
Steam
PROVIDER
Gaming Download
TYPE
Flow Pulse
Download: Steam

On-Demand (Netflix) and Live (Twitch) Video

Tracks video quality, bandwidth, buffer health, and degradations

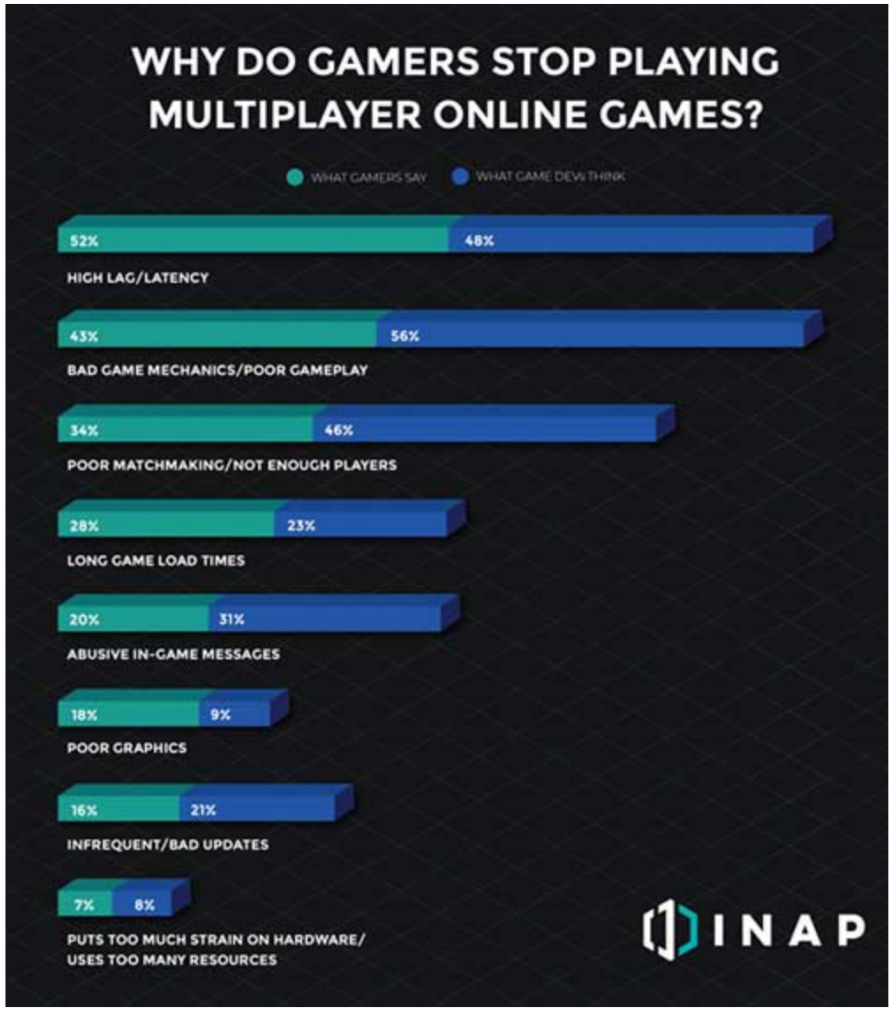
Gaming is a huge opportunity



Arcade STADIA

Online gaming is a $150b+ market

Cloud gaming will accelerate growth



Network lag degrades experience

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Gameplay Flows and Experience

Active Game Details

Client IP	Client Port	Server IP	Server Port	Title	Down Packet Rate	Average Jitter	99th Percentile Jit…	Duration	Status	View Plots
129.94.8.204	30918	103.10.125.146	27037	DotA2	30 pps	13 ms	49 ms	41.5 mins	Active Now	
149.171.43.85	49160	103.10.125.154	27032	DotA2	30 pps	0 ms	0 ms	9.0 mins	Active Now	
129.94.8.173	16270	103.240.227.123	5230	League of Legend…	19 pps	60 ms	703 ms	25.0 mins	Active Now	
129.94.8.208	6398	103.240.227.174	5215	League of Legends	48 pps	24 ms	157 ms	16.8 mins	Active Now	
129.94.8.186	28872	103.10.125.154	27043	DotA2	30 pps	15 ms	71 ms	1.1 hours	Active Now	

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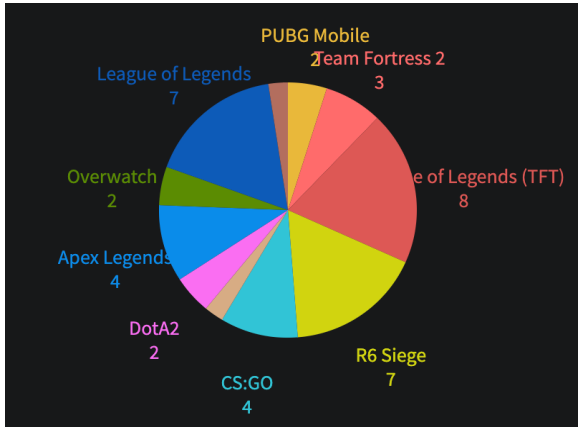

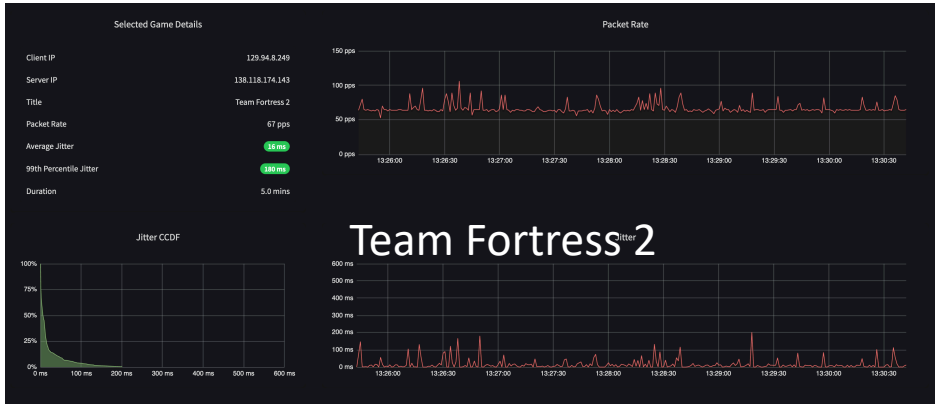

Tracks gameplay flow tick-rate, server, lag, jitter

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Summary

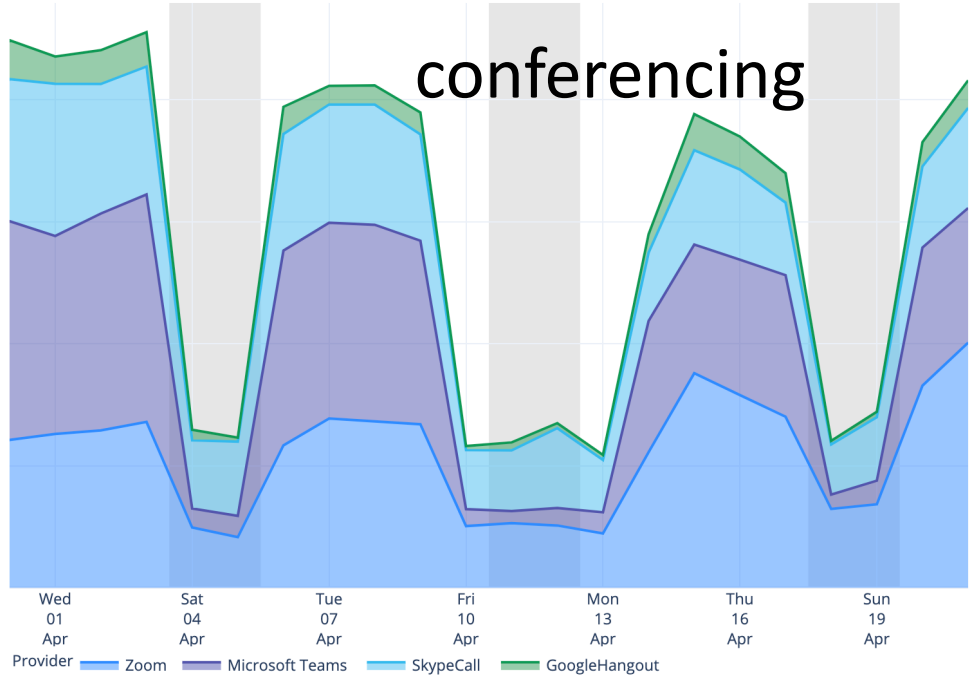
Traffic visibility is achievable using P4-programmable hardware:

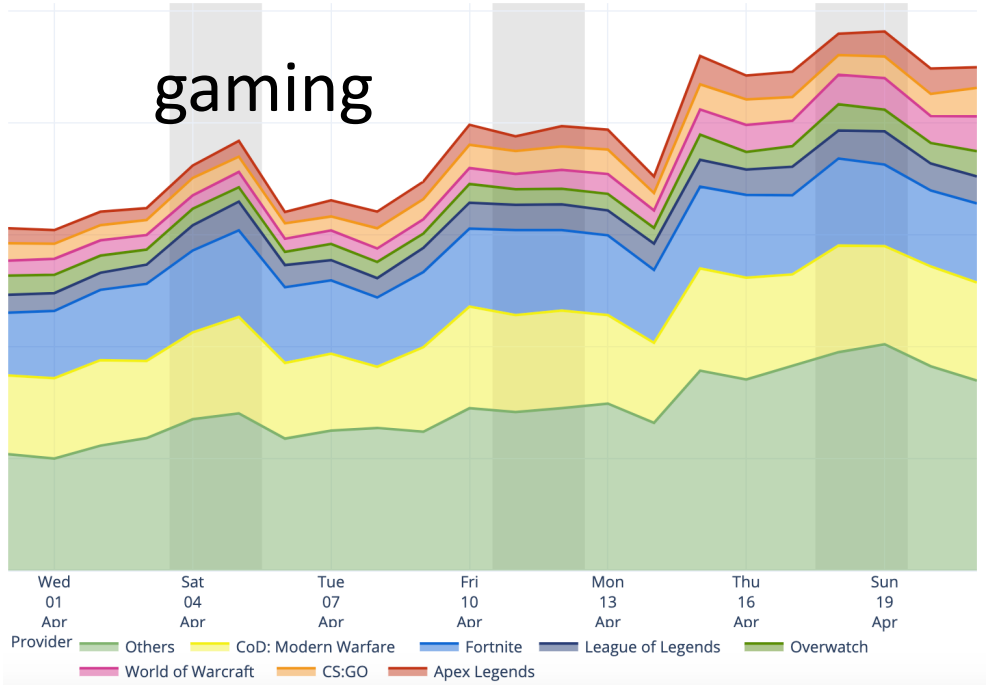
- High-speed, affordable, future-proof

Gaming is a new opportunity for operators:

- Premium gaming experience
- prepare for cloud gaming

Live interactive traffic insights at:
https://canopusnet.com/insights





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Vijay Sivaraman, Canopus Networks
vijay@canopusnet.com
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