

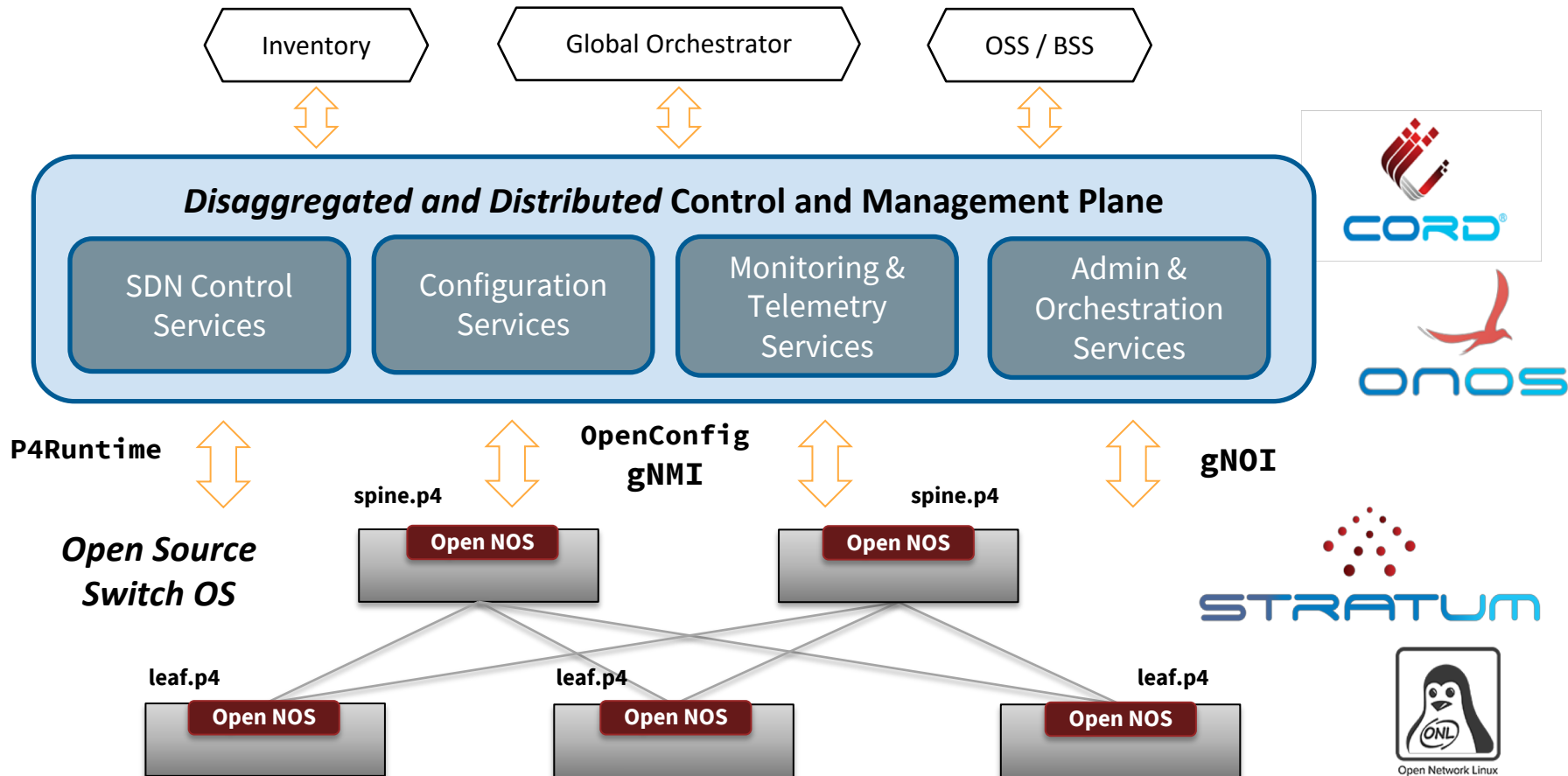
STRATUM

Stratum / P4 Update & Google's Use Case

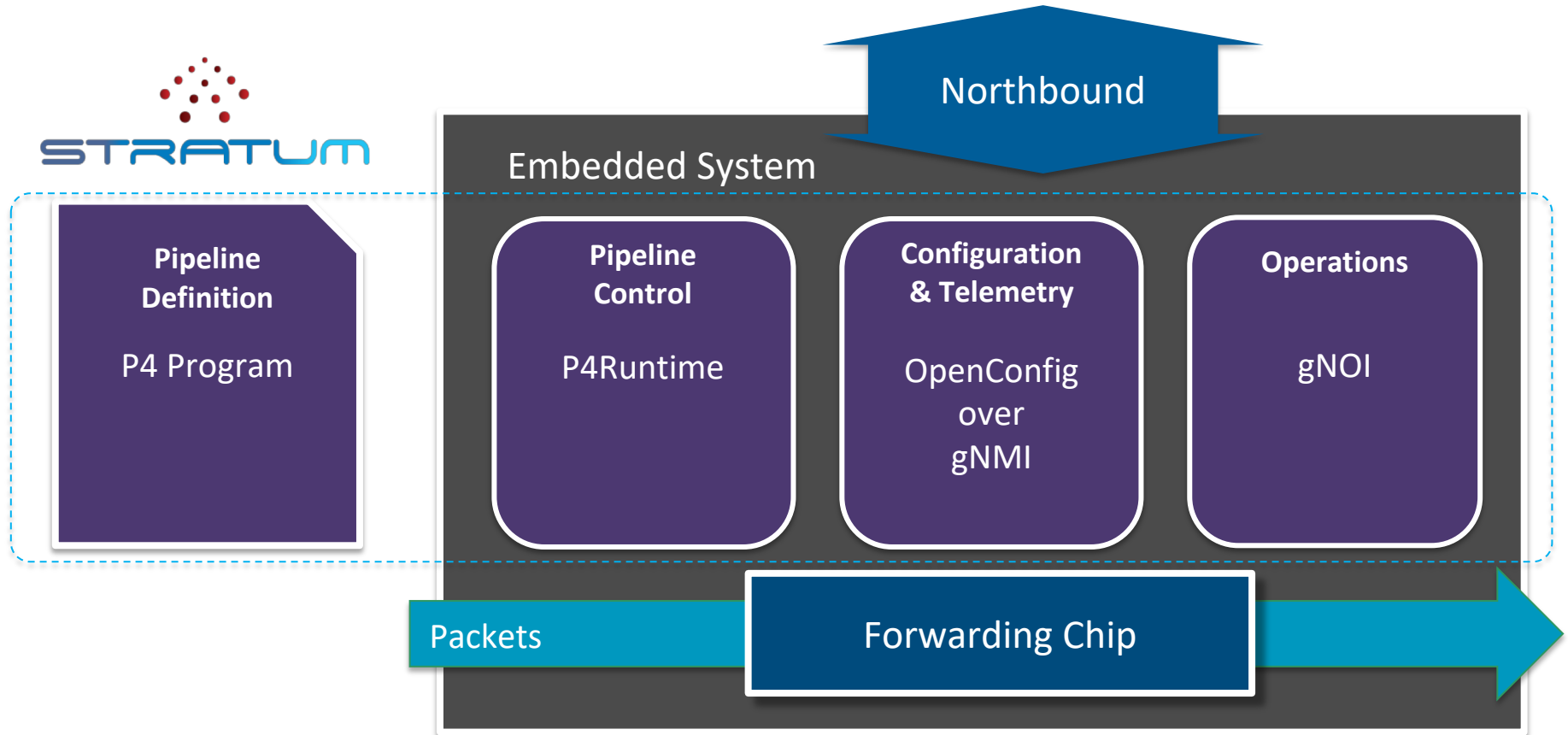
Brian O'Connor, ONF
Devjit Gopalpur*, Google
ONS North America - April 3, 2019

*On behalf of many at Google (Alireza Ghaffarkhah, Waqar Mohsin, Shashank Neelam, Jim Wanderer, Lorenzo Vicisano, Amin Vahdat, ...)

Next Generation SDN picture



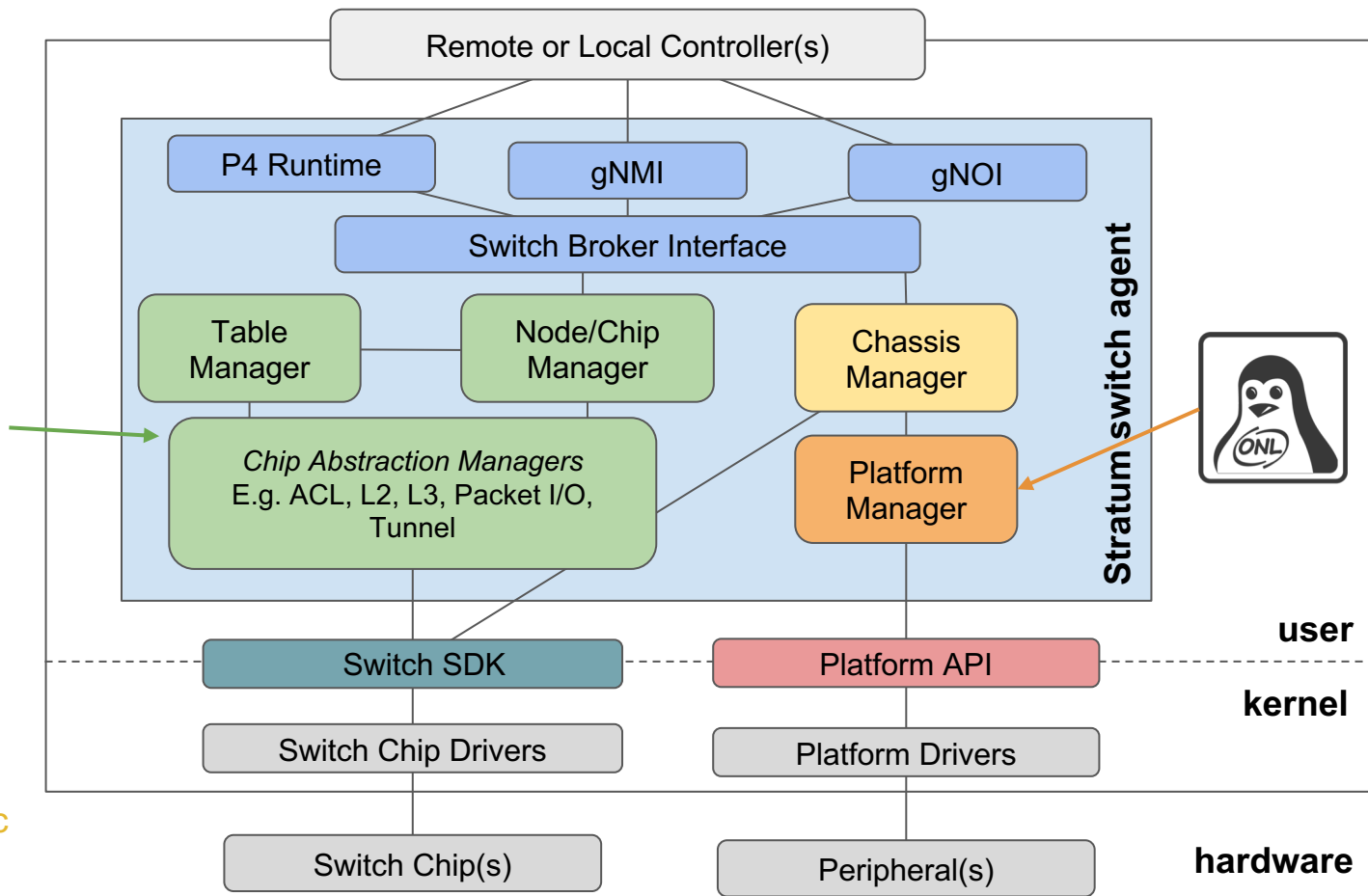
Next Generation SDN Interfaces



Stratum High-level Architectural Components



PI and fpm-based
implementations



Stratum Demo Series



[P4Runtime v1.0.0 released](#) on
March 11, 2019!

1. Flow programming using **P4Runtime**
 - Feature parity with OpenFlow on programmable ASICs
 - Interoperability with ONOS and Trellis
 - Demoed at: **ONS Europe 2018, GNTC 2018, ONF Connect 2018**
2. Configuration and operations using OpenConfig's **gNMI / gNOI**
 - Support for interface and peripheral config and telemetry
 - Demoed at: **OCP 2019, ONS North America 2019**
3. P4Runtime support on **fixed-function** and **programmable** ASICs
 - gNMI and gNOI for config and telemetry (goal: zero-touch provisioning)
 - Demo planned for H2 2019 (ONF Connect 2019)

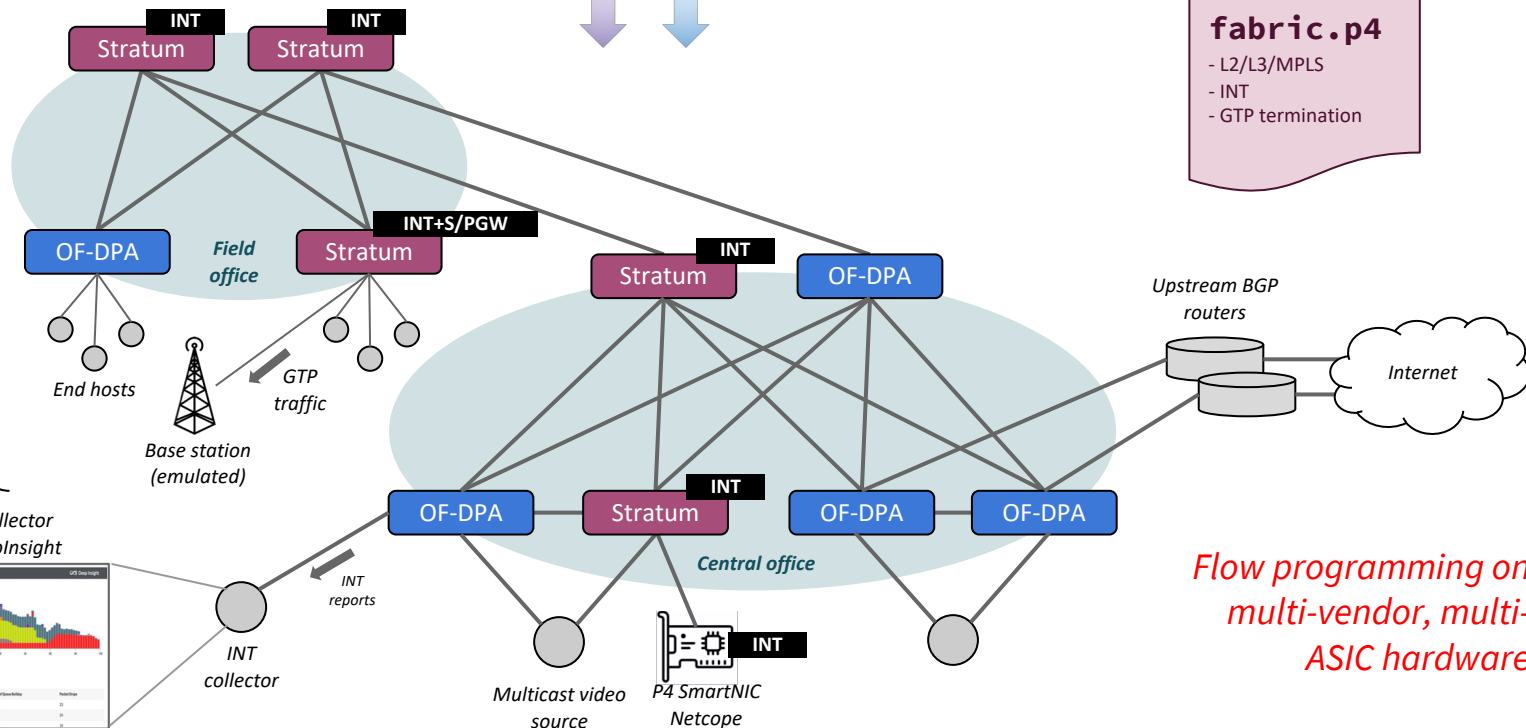
**VNF Offloading
Control (S/PGW)**



OpenFlow

- L2/L3/MPLS
- INT
- GTP termination

*Broadcom, Barefoot, Edge-Core,
Inventec, Delta*

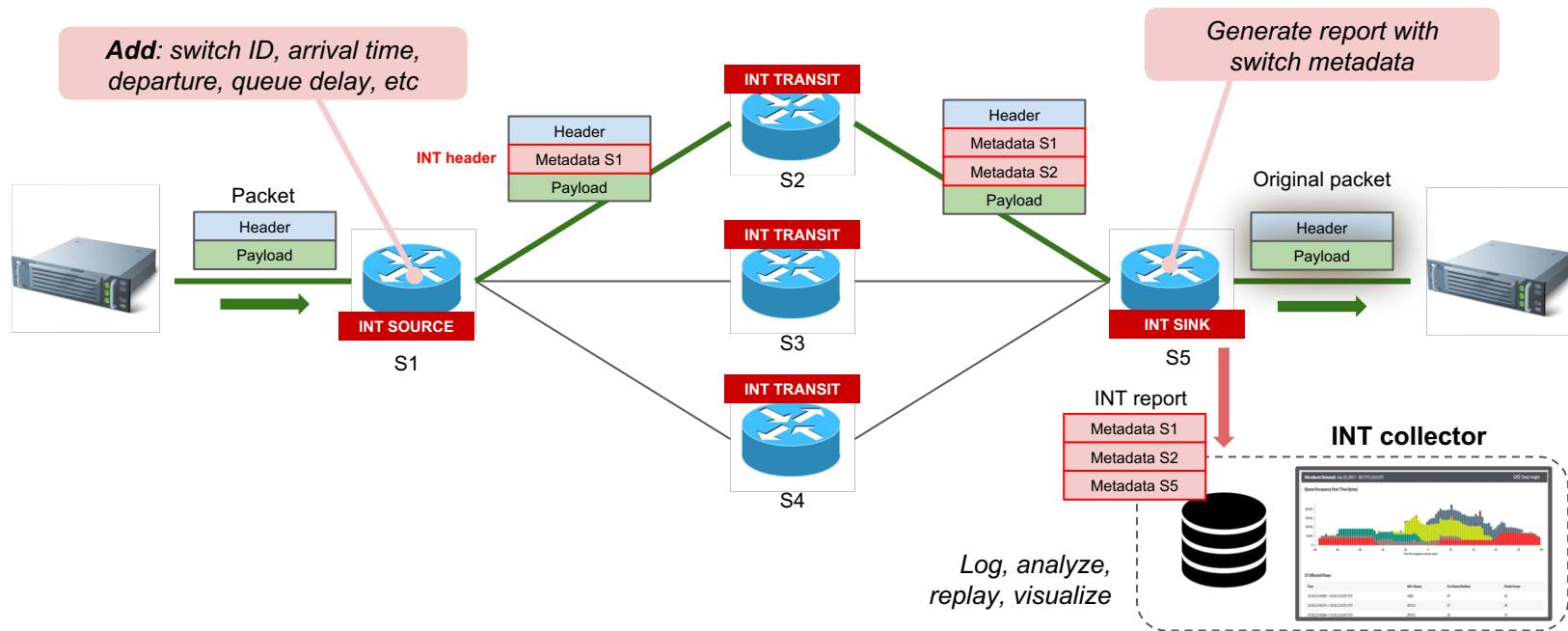


Flow programming on multi-vendor, multi-ASIC hardware

Value Add: Inband-Network Telemetry (INT)



- Idea: use same data packets to carry data plane state
- Use P4 programmability to implement INT in the switch

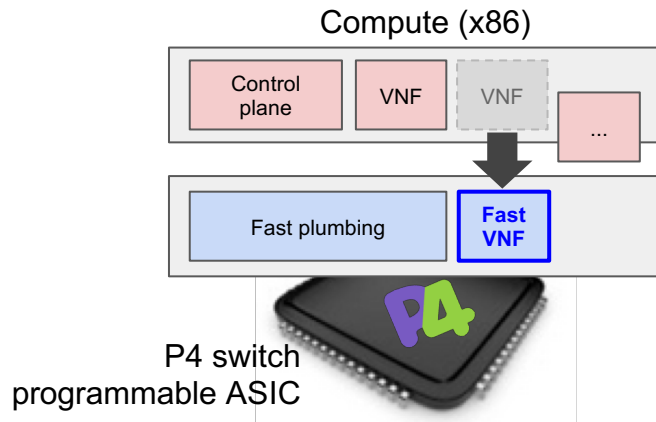


Value Add: VNF Offloading

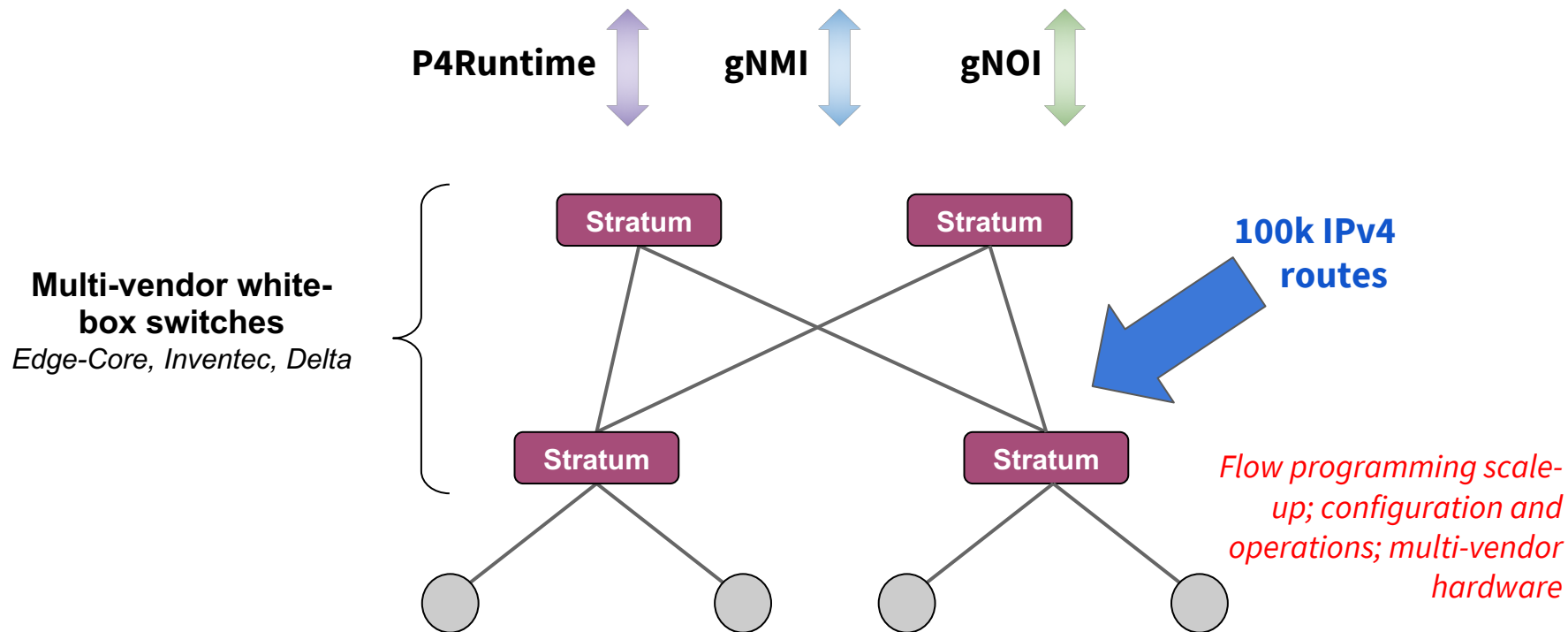


- **Implement Network Functions in HW as part of the switch pipeline**
 - This demo: Mobile core S/PGW user plane (GTP encap/decap)
- **Many benefits**
 - **Increased performance** - VNFs executed at switch line rate, i.e. $O(\text{Tbit/s})$
 - **Reduced latency and jitter** - Avoid non-determinism of x86 processing
 - **Reduced OpEx** - Less CPU resources, less power consumption

Progr. ASIC capabilities	VNF building blocks
Arbitrary header parsing/deparsing	Domain specific encap/decap (e.g. PPPoE termination, GTP, etc.)
Stateful memories	TCP connection tracking (L4 load balancing, NAT, firewall, etc.)
Computational capabilities	Billing



Demo overview



Hardware Used for ONS Demo



Delta AG9064v1

Barefoot Tofino 6.5Tbps
64 x 100G QSFP28



Edgecore Wedge 100BF-32X

Barefoot Tofino 3.2Tbps
32 x 100G QSFP28



Edgecore Wedge 100BF-65X

Barefoot Tofino 6.5Tbps
64 x 100G QSFP28



Inventec D5254

Barefoot Tofino 1.8Tbps
6 x 100G QSFP28 + 48 x 25G SFP28



Stratum Community Milestones

May 2018 - Pioneer phase kick-off with initial code contribution from Google

August 2018 - Initial community switch support

March 2018 - Start of member preview phase with 4 HW platforms and one SW switch

Community Growth

16 founding participants, now **27** Stratum member companies

~**130** participants (~**20** are active contributors)

Stratum Community



NoviFlow



One Source Integration



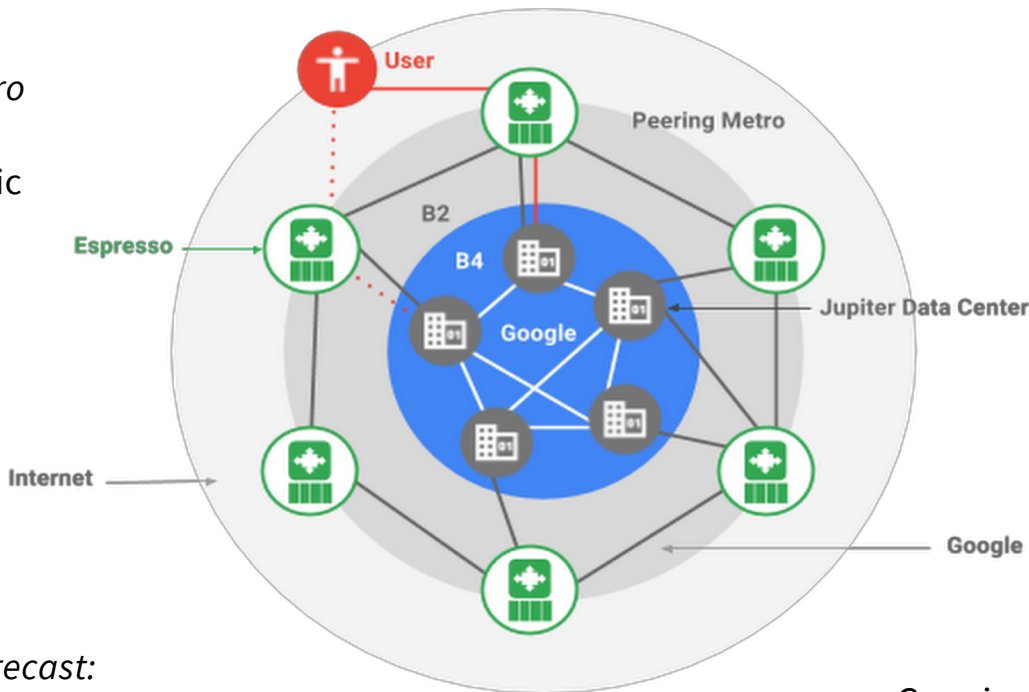
Google's History



Google runs SDN networks at scale

Espresso

SDN Peering Edge / Metro
70 metro sites
25% of all Internet traffic



Jupiter

SDN Data Center
1.3 Pbps
100,000+ servers/site

B4

SDN WAN
Inter-datacenter traffic
Growing faster than Internet traffic

Cisco Global Internet Forecast:

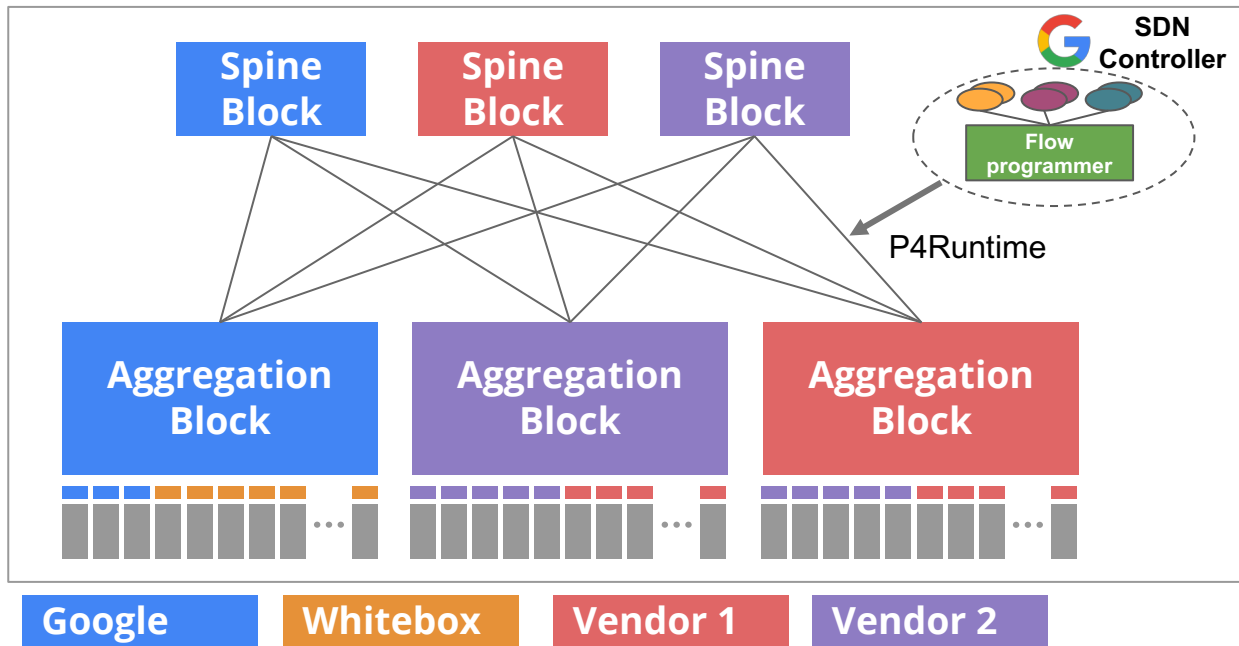
~150 EB/month in 2018 (+ 24% from 2017)

<https://www.blog.google/topics/google-cloud/making-google-cloud-faster-more-available-and-cost-effective-extending-sdn-public-internet-espresso/>
<https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/complete-white-paper-c11-481360.pdf>

Google's Approach to Multi-Vendor SDN



- Heterogeneous network
- Single consistent API
 - P4Runtime
 - OpenConfig
- Exploit unique HW capabilities (without changing the interfaces)
- Leverage commercial technology / vendors
 - Networking Vendors
 - ODMs
 - In-house / OEMs



Requirements for Multi-Vendor SDN



- Support for **vendor-neutral** control applications
 - Control plane is written once, compiled for multiple backends, i.e. hardware.
- Support for **programmable hardware**
 - Pushes hardware abstraction up the stack.
 - Uniform runtime interface for heterogeneous devices and network roles.
- Support for a **uniform network model**
 - Vendor-agnostic model of topology.
 - Simplifies operability of a multi-vendor network.

... which also provides ...



- Enhanced deployment **velocity** at **scale**
 - Introduction of new functionality, hardware, etc. using common workflows.
 - Incremental support for new equipment.
- Simplified **migration** of services
 - From traditional devices to programmable devices.
 - Between heterogeneous device blocks.
- Unified device **management**
 - Operators use common tools to deploy, configure, monitor and troubleshoot devices from multiple vendors.