A Revolution (Revelation?) in Networking

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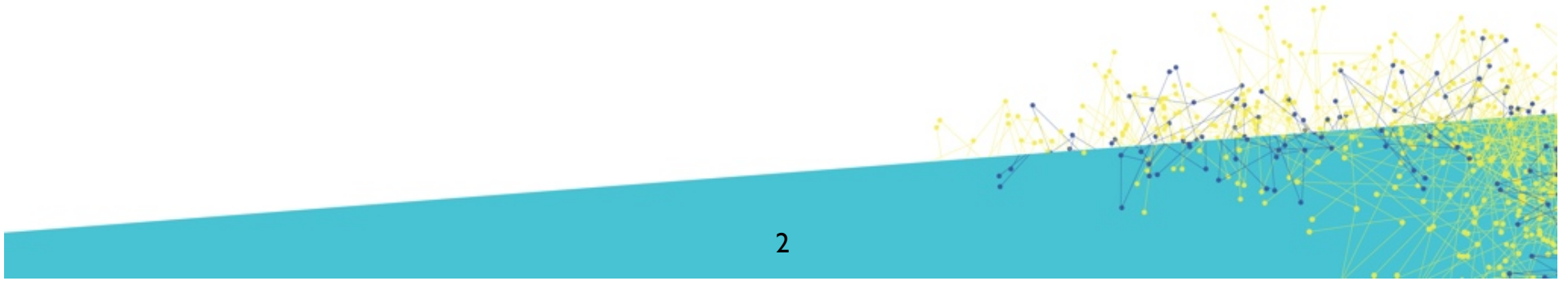
We should leave this session with a common understanding of…

- Overview of SDN & OpenFlow
- Who is the Open Network Foundation (ONF)
- Overview of SDN and state of OpenFlow and the ONF community



Software-Defined Networking (SDN)

From:

Static, inflexible networks, not helpful for new business initiatives, little agility and flexibility

To:

Programmable networks that enable new business initiatives through flexibility, agility, and virtualization

If you build, operate, or maintain large networks OR if networking technologies are important to your organization then SDN will significantly impact you

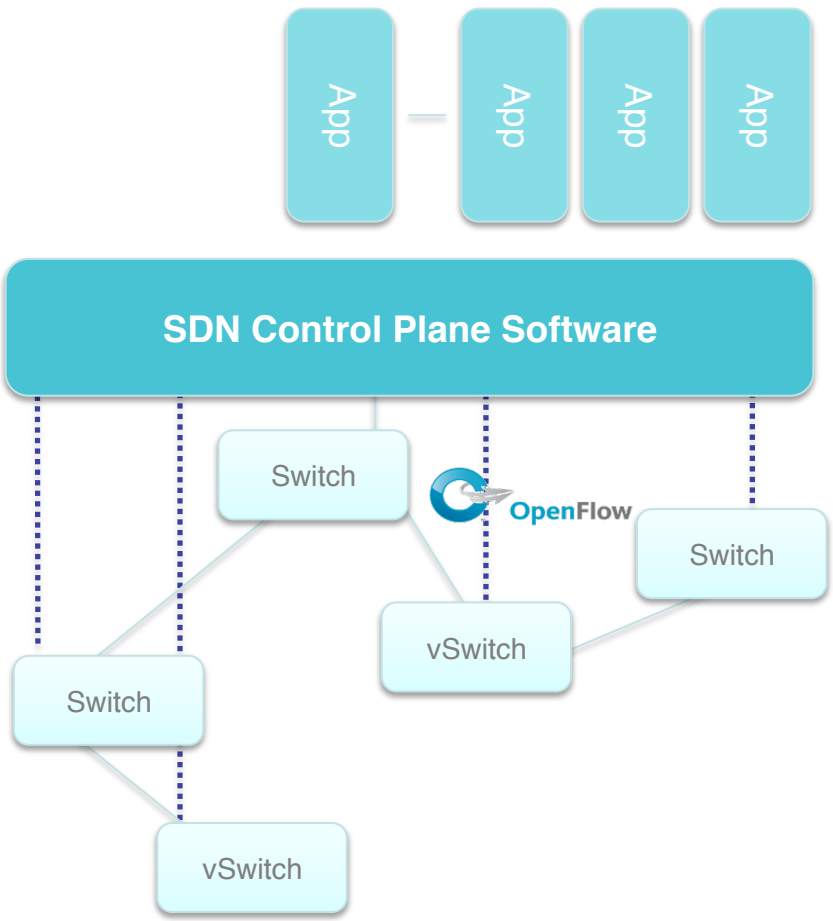
Generational Shift in Networking

From:	To:
Hardware/Appliances	(Open) software
Distributed control plane	(Logically) centralized control plane
Custom ASICs/FPGAs	Merchant silicon
Protocols	APIs

SDN Abstractions

Forwarding	• Common API for programming network hardware
State Distribution	• Single state-distribution algorithm for a network
Global Management	• Programmer interacts with entire network instead of individual nodes

What SDN looks like



Application tier:

Virtual network overlays, network slicing (delegation), tenant-aware broadcast, application-aware path computation, integration with other software packages, policy, security, traffic engineering

Control plane tier:

Data plane resource marshaling, common libraries (e.g., topology, host metadata, state abstractions)

Data plane tier:

Packet forwarding (as per flow table), packet manipulation (as per flow table), statistics collection

Where does OpenFlow Fit In?

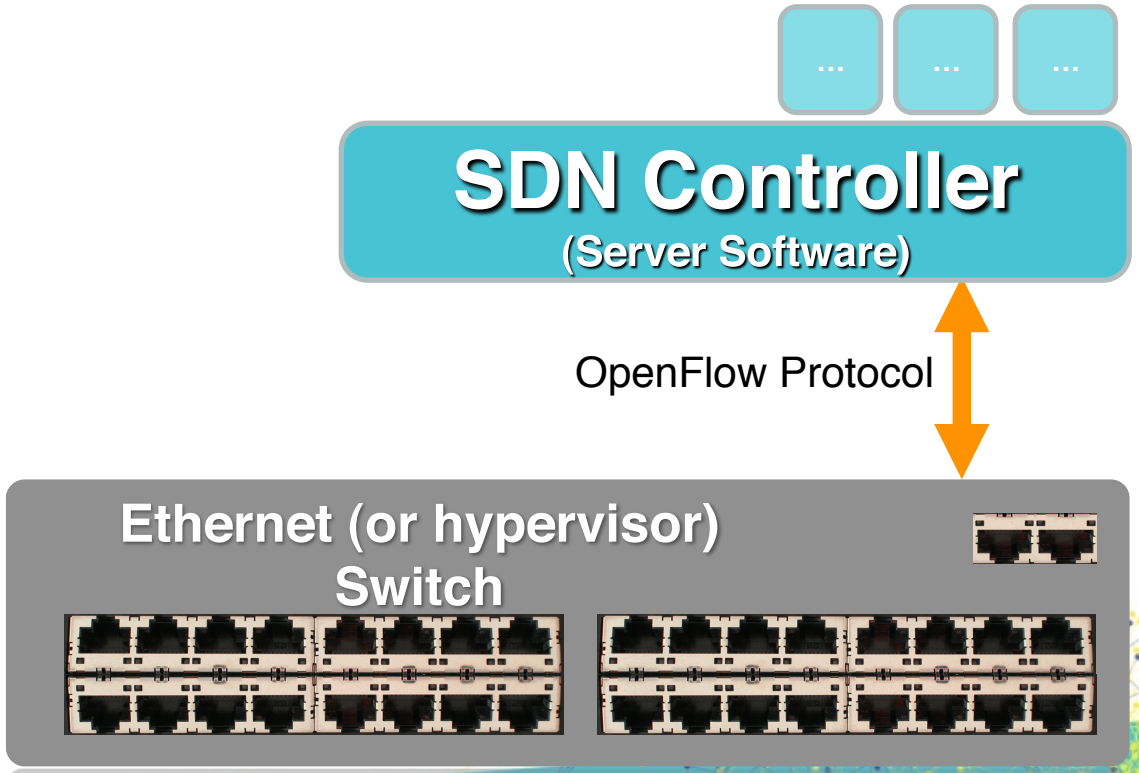
The x86 instruction set of SDN

Protocol that allows a external control software ("controller") to control the data path of a switch; the OpenFlow protocol is an open standard maintained by the ONF

OpenFlow

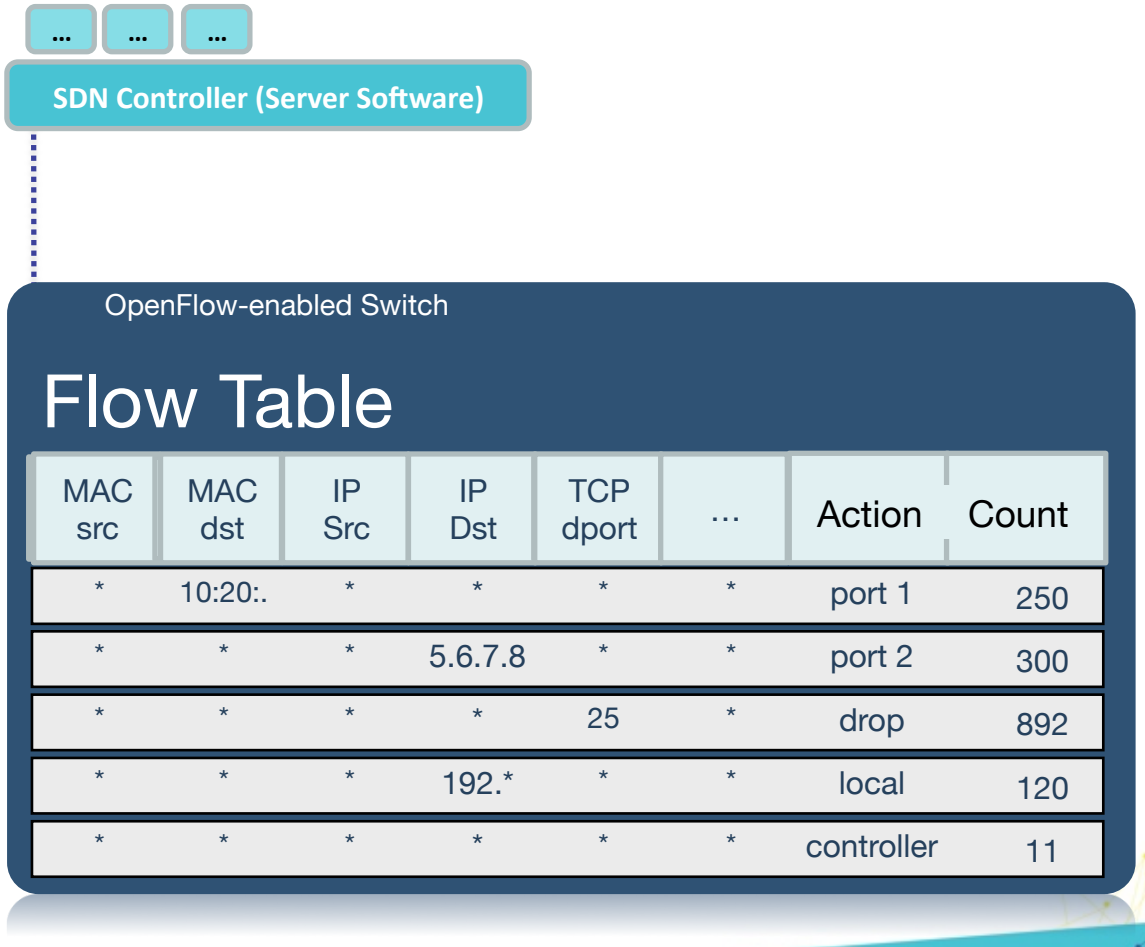
Controller can program the network – bypassing conventional L2/L3 protocols and their configuration

Controller can prepopulate instructions or send instructions dynamically (just like a typical switch on a cache miss)



What does it do?

The x86 instruction set of SDN



Flow Table

Generic primitive that sits on top of (virtual) switch TCAM, designed to match well with common switch ASICs

Example actions:

1. Switching and routing (port),
2. Firewalling (drop),
3. Using to switch's non-OpenFlow logic (local),
4. Send to controller for processing (controller)

Foundation network functions are split between per-packet rules on the switch and high-level decisions at the server

SDN Examples

User	Problem	Potential Leverage SDN to…
Mobile Service Provider	Hyperscale growth of mobile devices; limited spectrum & coverage, high costs, poor customer experience	…enable dynamic roaming between cellular and WiFi for cellular offload to accommodate more devices on same spectrum
Carrier	Long service-introduction times; feature dependency on vendors	…write or procure own SW to create and offer new classes of datacenter or hosted services, meet long tail of user needs
Web 2.0	Hyperscale datacenters with low server utilization ➔ need to build more datacenters ($1B+)	…enable network virtualization and agility to drive up server utilization, delay or avoid building new datacenters
Public or Private Cloud	Network inflexibility inhibiting ability to turn-on new customers; or inadequate domain isolation	…virtualize the physical network and securely provide each a customer a domain the can customize in public or private cloud
Financial Services	Compliance mandates for network isolation; separate physical networks expensive, complex	…enable auditable network isolation, collapse isolated domains across one physical network, simplify compliance

ONF: Commercialization

Vision:

Make Software-Defined Networking ubiquitous

Mission:

Foster a vibrant market for SDN products, services

User Driven

Board of world's largest networking customers

66+ member companies & organizations

ONF: Standardization

- Unique Power in the board
- Standards developed by implementors
- Standardize as little as necessary
- Rapid, relevant, real-world
- Innovate like a Silicon Valley startup

What We Do

Standards Development

- Customer-relevant standards
- 'Agile' standards development process
- Drive SDN on switching platforms
- Initial focus on OpenFlow protocol

Architecture & Framework

- Abstractions
- Interfaces
- Services

Market Education

- Drive common definition and lexicon for SDN
- Evangelize SDN
- Vendor neutral ("it's us, not me")

Intellectual Property

- Automatic cross-licensing of OpenFlow-related IP across members
- RAND-Z royalty-free use of protocol, trademarks, etc.
- No IP owned by ONF

ONF Board of Directors

- Urs Hölzle (Sr. VP, Engineering, Google), chairman
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66 Members and Counting

A10 Networks
Argela Software
Big Switch Networks
Broadcom
Brocade
Ciena
Cisco
Citrix
Colt
Comcast
CompTIA
Cyan Optics
Dell
Deutsche Telekom
Elbrys
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Extreme Networks
EZchip
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Gigamon
Goldman Sachs
Google
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Hitachi
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Ixia
Juniper Networks
Korea Telecom
LineRate Systems
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Luxoft
Marvell
Mellanox
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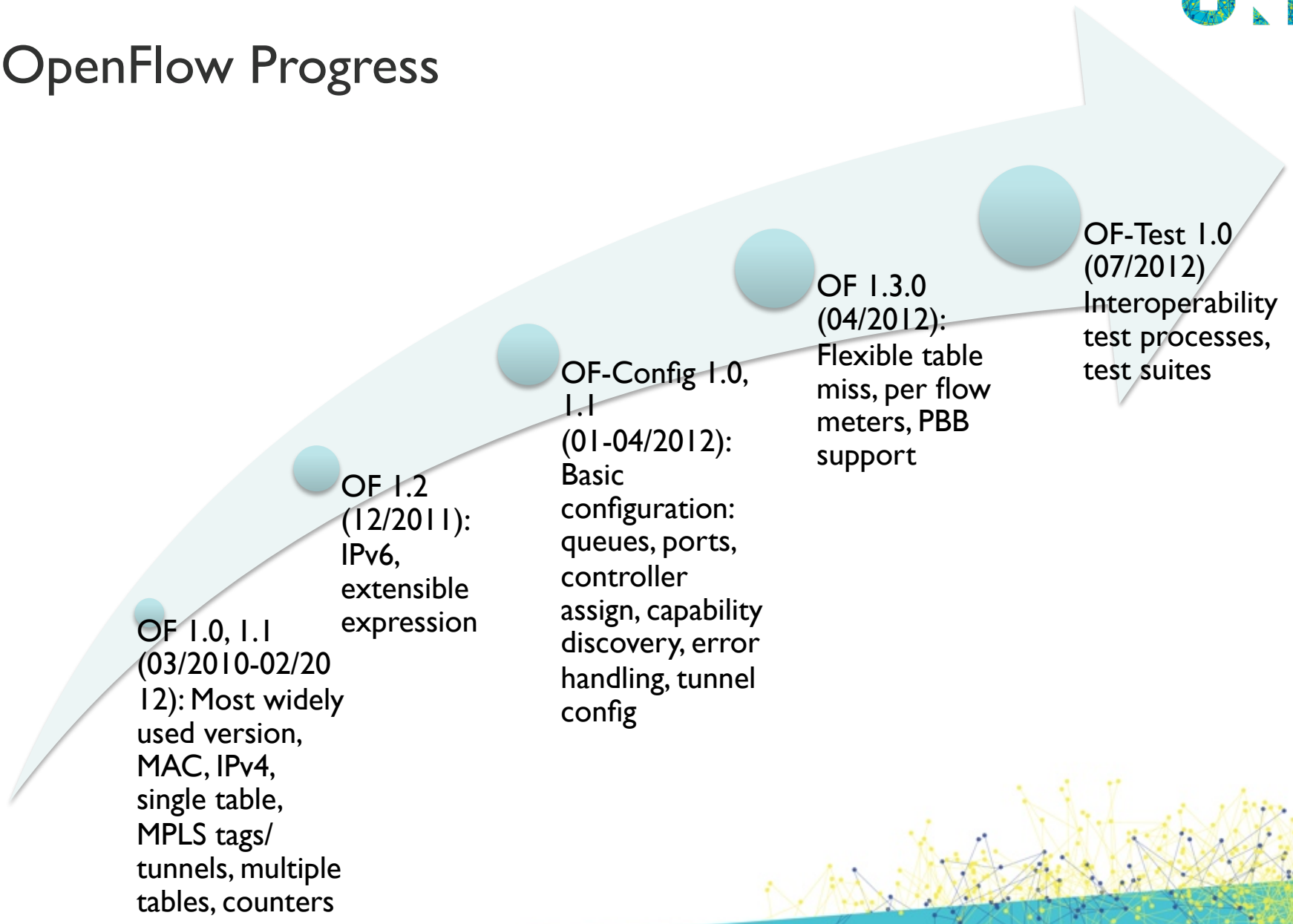
Pica8
Plexxi
Radware
Riverbed Technology
Samsung
Spirent
Tencent
Texas Instruments
Vello Systems
Verizon
VMware
Yahoo!
ZTE

Working Groups & Committees

Extensibility	Configuration & Management	Testing & Interoperability	Hybrid Programmable Forwarding Plane	OpenFlow Future	Northbound API/SDN abstractions	Market Education
300+ members	300+ members	200+ members	200+ Members	200+ members	200+ members	100+ Members
OpenFlow: wire protocol, extensible match & error messages, forwarding model, MAC, IPv4, IPv6	Protocol & schema for config, management of a switch	Interoperability tests, plug-fests; conformance test suites; performance benchmarking	Insertion of OpenFlow into legacy network: hybrid switches, hybrid networks	Future of OpenFlow and interfaces to other protocols	Object & service models, virtualization, characterization, interaction	Defining Use Cases , SDN lexicon, and SDN tutorials
Chair: Jean Tourrihels (HP)	Chair: Deepak Bansal (Microsoft)	Chair: Mike Haugh (Ixia)	Chair: Jan Medved (Cisco)	Leaders Curt Beckmann (Brocade)	Carrier services; OSS; inter-carrier	Chair: Isabelle Guis (Big Switch)
Vice Chair: Justin Pettir (Nicira)	View Chair: Stu Bailey (InfoBlox)	Vice Chair: Rob Sherwood (Big Switch)	Vice Chair: Dan Talayco (Big Switch)	Dave Mayer (Cisco)	SDN interfaces above OF not very appropriate for *de jure* standardization	Vice Chair: Marc Cohn (IP Infusion) & Rakesh Saha (IBM)

OpenFlow Progress



2012 Focus

Extend the technology

- Releases of OpenFlow 1.x, planning for beyond
- Auxiliary components
  - OF-Config, OF-Test
- SDN abstractions, services

Encourage implementation, deployment

- Interoperability testing
- Conformance testing
- Plugfests, demos, trade shows

Evangelize SDN / OF

- Market education
- Public appearances
- All about the benefits

Broader Implications

- Networking: yet another part of computing
- Enterprises: exiting plumbing
- Operators: becoming software companies
- IT: identifiable business value
- GenY: networking software startups

Key Takeaways

- SDN and OpenFlow: the most important & fastest rate of change in networking in decades
- Industry: massive momentum
- ONF: where thought leaders are shaping the future

Software-Defined Networking: Happening Now

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