Panel : Future Data Center Networks
Networking folks were poor

- Custom silicon or poor functionality
- Low bandwidth ASICs
- Poor topologies
- Immature protocols
- Non-robust control plane software
Data Center network over the past decade

First wave of Data Center (network) deployments were all about Deployment Velocity (Time To Value)

- How quickly can you deploy infrastructure?
- How scalable is the infrastructure?
- How easily can you manage this scale-out infrastructure?

High-capacity
Highly-available
Ease of configuration
Ease of expansion

Deployment Velocity
(Scale-Out)
PCI versus Ethernet Bandwidth
(in Gigabits/sec)

- PCIE Gen 1
- PCIE Gen 2
- PCIE Gen 3
- PCIE Gen 4
- PCIE Gen 5

- I/O in Gbps
- Ethernet (Gbps)

IBM System Networking
Better Topologies

- Multi-tiered tree topologies
- High oversubscription
- Expensive, high bandwidth uplinks
- Robustness of higher tier product has been a concern

- 2-tiered mesh or Clos topologies
- Oversubscription only to WAN/core
- Large cross sectional bandwidth (TOR bandwidth is cheap)
- Mature Layer 2/3 software
We are entering an era of Network Affluence

With affluence comes a demand for Quality of Life:

• Can you ease my provisioning headache?
• Can you hide all complexity of the physical infrastructure?
• Can my applications talk to my network?
• Can you simplify how I monitor my network?

• Can “this particular communication” be of “Platinum” service
  • Can you guarantee certain latency characteristics? End to End?
  • Can you guarantee certain bandwidth? End to End?
Next-Gen Data Center Network deployments will demand both:

- **Application Velocity**
  - Can you provision virtualized network resources along with compute/storage
  - Can the network be smarter due to application awareness
  - Can you quickly and effectively enable newer network services

- **Deployment Velocity**
  - How quickly can you deploy infrastructure
  - How scalable is the infrastructure
  - How easily can you manage this scale-out infrastructure
Virtual Provisioning of an Integrated System

Managing a group of systems – servers, storage, network with the simplicity of a single system

- Virtualized System comprises servers, storage and networking
- End to end experience
  - Initial set up
  - Provisioning of new workloads, including image management
  - Continuous optimization through mobility, etc.
**Virtualized Provisioning : Example**

### Application connectivity services

| Enterprise or Cloud | • allow users to declaratively specify logical application topologies  
|                     | • path attributes, security rules, and service traversal  
|                     | • instantiate paths, rules, etc. using SDN (virtual or physical)  
|                     | • seamless integration between application deployment and required network configuration  
|                     | • removes need for separate network admin handoff  
|                     | • services can be constrained / specified by networking team |

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**group**

*logical grouping of workloads*

**profile**

*Network attributes for cluster communication*

**vlink**

*bidirectional communication link*

**network-service**

*attach services to a vlink*

- firewall rules
- resv bandwidth
- VLAN / scoped bcast
- path diversity

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**middlebox**

*deploy and config a new middlebox*

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**IBM System Networking**
Applications influence the network
What is Software Defined Networking?

• Applications-awareness benefits:
  – Business Applications and Services can program and influence the network
  – Create and deploy new applications and protocols quickly

• Network Hypervisor benefits:
  – Virtualized network resource provisioning
  – De-couples virtual network from physical network
  – Simple “configure once” network
  – Cloud scale (e.g. multi-tenant)

• Control-Data separation benefits:
  – End-2-end Semantics and Guarantees
  – Simpler to deploy, debug and monitor
  – Fine grained control for each client-server pair(s)
  – Openflow (protocol and various controllers) are a standard way of achieving this
Openflow as defined today

Mishmash of concepts within the SAME data center
Distributed or Centralized

- Ethernet topologies were built distributed
  Scalable but hard to monitor

- Openflow topologies (today) are centralized
  Control-data separation forces this model
Packet or Flow Switched

- Ethernet topologies are packet switched
  - Statistical link utilization

- Openflow topologies (today) are flow switched
  - Application level network control
Open questions for the Research & Openflow Communities

- No customer pays for the re-invention of the wheel
- Customers do pay for a smoother ride
Isolate a few (long) flows for preferential treatment by applications

Federation of controllers with each controller handling (smaller) integrated system (pod)