The “Platform as a Service” Model for Networking

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INM/WREN 2010
Hosted Infrastructures

• Shift towards hosted and shared infrastructures
  – Cloud computing

• Benefits:
  – Dynamically scale up/down
  – Cost benefits
Hosted Network Infrastructure

- Poised to happen for networking
- Similar benefits
- Additional driver: in-network inaccessibility
Old News

• I’m not the first to believe this

• Large body of research in **Network Virtualization**
  – Run multiple virtual networks concurrently on a shared infrastructure
That’s the Wrong Approach

• Instead… abstraction should be a platform
  – Customers can focus on their application/service

• “Single Router Platform”
What’s the problem with network virtualization?
Undesirable Business Model
(for infrastructure provider)

**End Users**

**Applications**
Builds application which uses in-network functionality
(e.g., Virtual Worlds provider using a multi-cast service)

**Service Providers**
Leases slices of virtualized routers to create network
Runs custom software/protocols/configurations
(e.g., a multi-cast or reliable connectivity)

**Infrastructure Providers**
Owns and maintains physical routers/links
Undesirable Business Model (for infrastructure provider)

- **End Users**
- **Applications**
  - Builds application which uses in-network functionality (e.g., Virtual Worlds provider using a multicast service)
  - Leases slices of virtualized routers to create network
  - Runs custom software/protocols/configurations (e.g., a multicast or reliable connectivity)
- **Service Providers**
  - Owns and maintains physical routers/links
- **Infrastructure Providers**

Commodity Service (unappealing to traditional ISPs)
Difficult to Manage
(for application providers)

• Same as managing physical network
  – Traffic engineering
  – Configuring a distributed collection of routers
  – Deal with failure
  – Managing resources to meet demand

• Yes, but won’t service providers deal with that?
Limited Market Opportunity
(for service providers)

• Applications just want some control
  – Either service provider provides it or develop themselves

• Services must be general to have a large market
  – Are there really that many generic services?

• Don’t count on infrastructure providers
  – That’s today’s model
If not network virtualization, then what?
Cloud Computing Landscape

• Infrastructure as a Service (IaaS)
  – e.g., Amazon EC2, Rackspace Cloud
  – Abstraction is managing set of virtual machines
  – Freedom: run any software you want
  – Effort: manage redundancy, all software

• Platform as a Service (PaaS)
  – e.g., Google App Engine, Heroku
  – Write application using libraries and without worrying about actual servers
  – Freedom: tied to specific platform capabilities
  – Effort: apps scale automatically, build on the platform

• (And everything in between)
Key Differences
(why IaaS makes sense for computing)

• **Compute:**
  – Legacy applications
  – Workflow used to writing applications on servers

• **Network:**
  – Limited developer community
  – Not the end application

Goal

Platform enabling in-network functionality, without having to manage a network
The Router Platform (PaaS)

- Present customers (application developers) with platform
  - Decoupled from physical infrastructure
  - Customers can focus on their application/service
  - Infrastructure owner has freedom in managing the infrastructure
The Single Router Abstraction

• Router abstraction covers functionality, doesn’t bother with physical infrastructure
  – Router more than just just routing

• Note: this is preliminary thinking
Interactive Program

- Customer provides executable script (rather than static configuration file)
  - Initialization routine
  - Dynamic modification to configuration
  - Driven by events (control message, event notification)
Routing

• Specify sessions with neighboring routers
  – Customer’s routers or infrastructure provider’s neighbors

• Know what links are available
  – Interface to query, metrics, callback when change

![Diagram of routing system]

- Customer Program
- Routing Software
- General purpose functions
- Data Plane
Data Plane

• Direct configuration of data plane functions
  – Setting up multi-cast groups, access control lists, etc.
General-Purpose Processing

- As name suggest, can be anything
- Can be written by customer as well
Customer Controlled Routing

ISP chooses one route, no choice to customers

Customer: Configure Router in ISP

Low cost route

Low latency route

Dest.
IaaS offerings give you servers and connectivity

Customer: configure middlebox (firewall, load balancer), VPN, route selection
Gaming/Live Video Streaming

Limited ability to setup multi-cast, perform update aggregation

Customer: configure router to manage multi-cast group, add custom software
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Challenge: The Physical Reality
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- Physical Infrastructure is Distributed
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- Physical Infrastructure is Distributed
- Physical Infrastructure is Shared
Distributed Router Workload

- Network virtualization – specify exact topology
- Single router platform – specify work to be done

- Leeway to distribute this workload
  - Some tied to physical router (e.g., BGP session)
  - Some can be replicated (for latency or to handle work)
  - Configure “inter-processor communication”
Dynamically Adjust Distribution

- Estimates are used to choose how to distribute
- Monitor the routers
  - CPU, update freq., traffic
- Re-distribute workload as necessary
  - e.g., migrate BGP session
  - e.g., add replicated instances
  - Comes at cost
Shared Infrastructure

- Virtualization is part of solution
- Routing sessions can be shared
  - Tag message, process it, send out based on tag
Conclusion

• Shift towards hosted and shared infrastructure
  – Can help management of private infrastructures

• Worth exploring an alternate to the IaaS model

• Some challenges in the single router platform
Questions?

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