The "Platform as a Service" Model for Networking

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Hosted Infrastructures

- Shift towards hosted and shared infrastructures
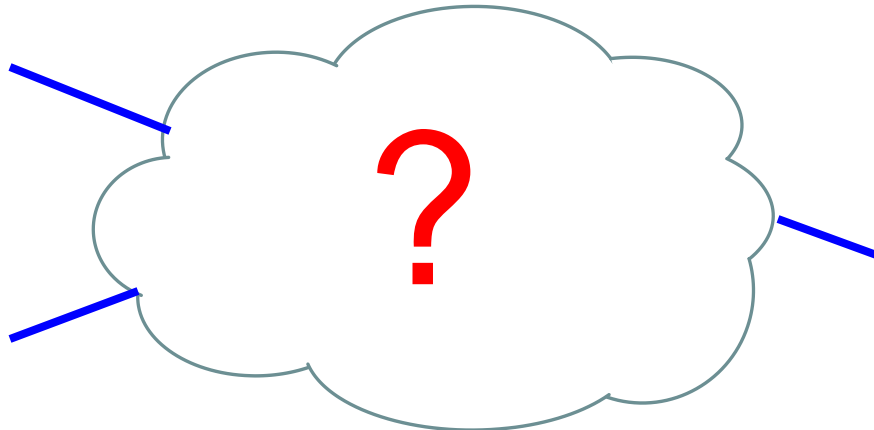 - Cloud computing

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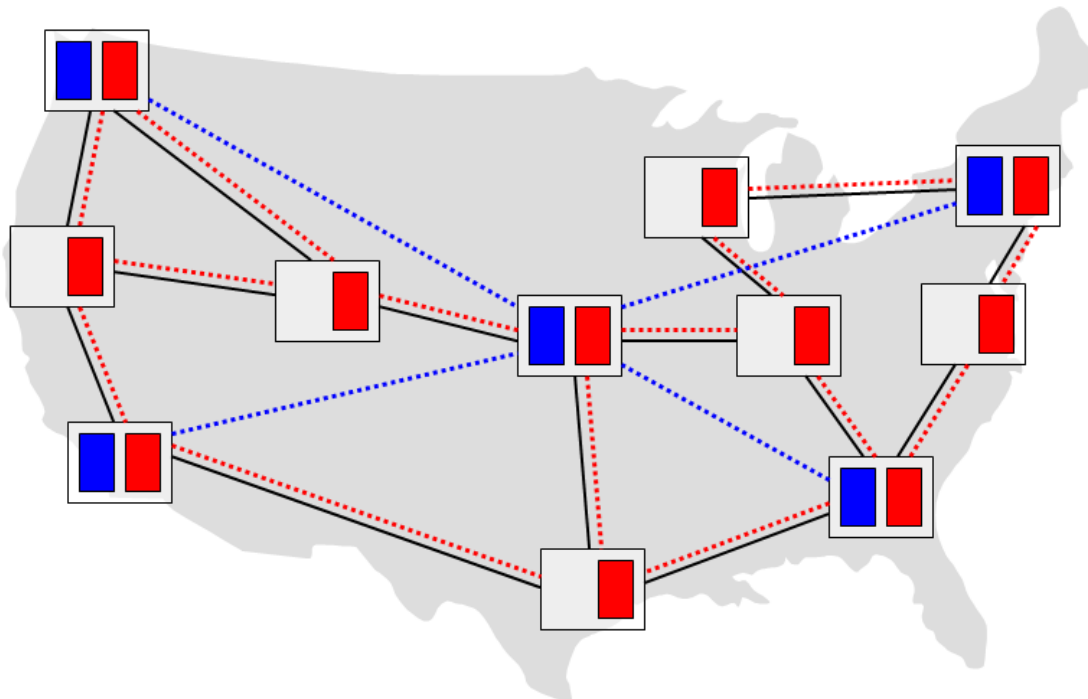
Hosted Network Infrastructure

- Poised to happen for networking

- Similar benefits

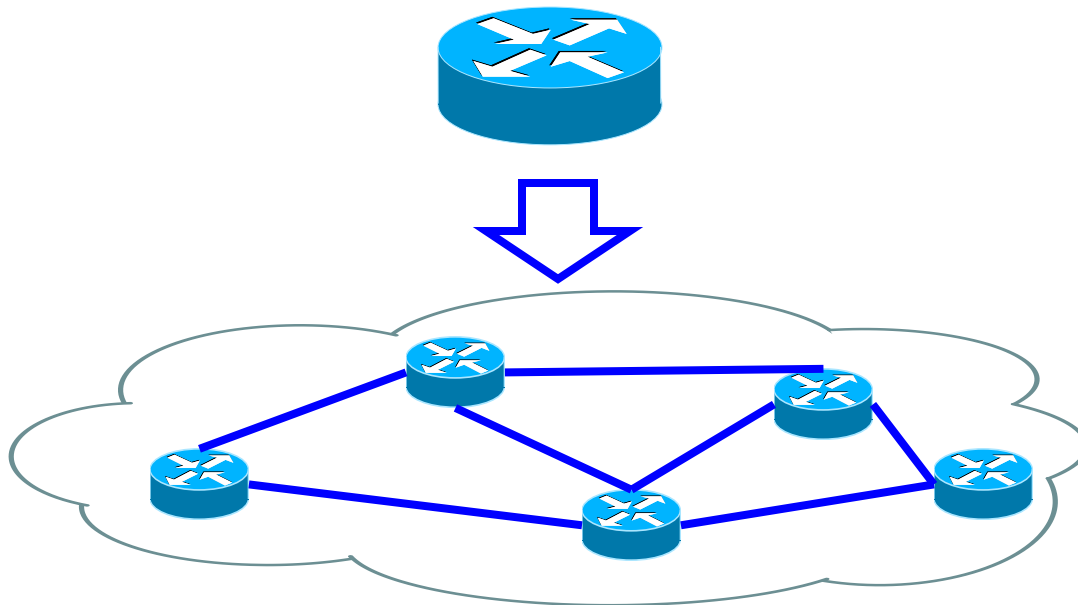- Additional driver: in-network inaccessibility

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 multi-cast service)

Service Providers

Lea... ...k
Run...
(e.g...

Commodity Service
(unappealing to traditional ISPs)

Infrastructure Providers

Owns and maintains physical routers/links

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
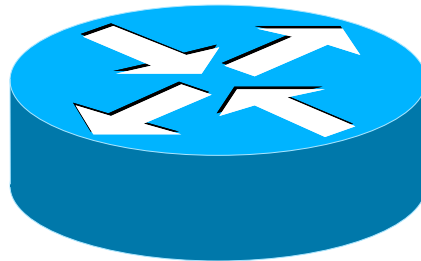 - Not the end application

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 routing

- Note: this is preliminary thinking
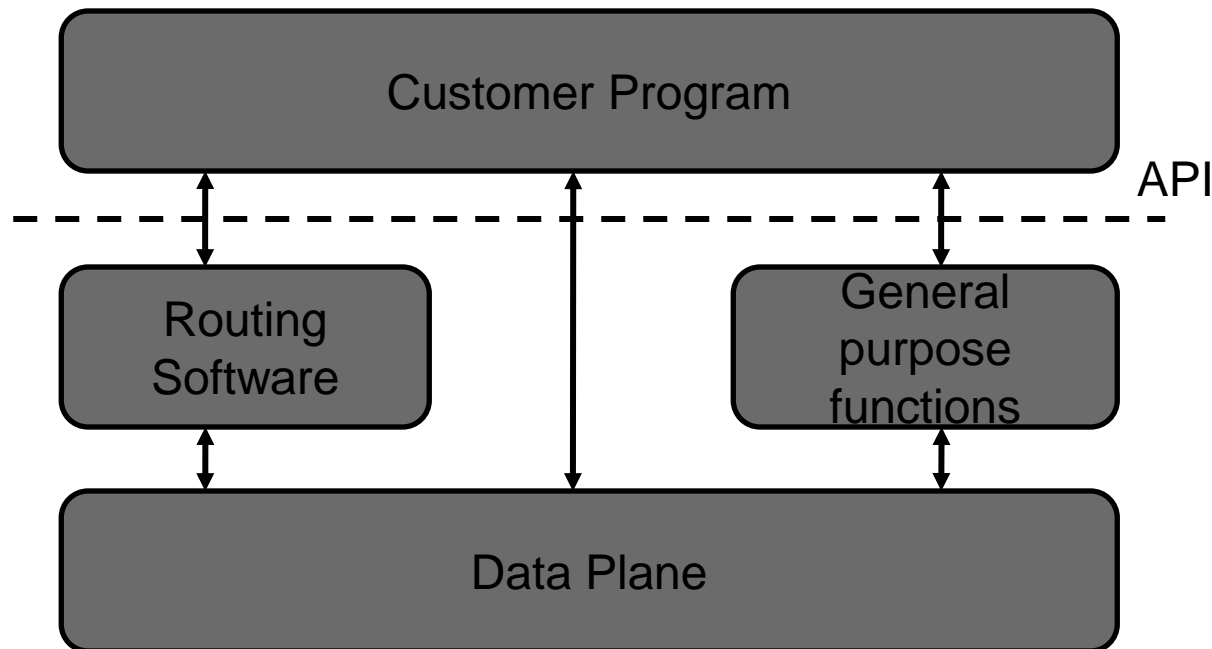
Interactive Program

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

Customer Program

API

Routing Software

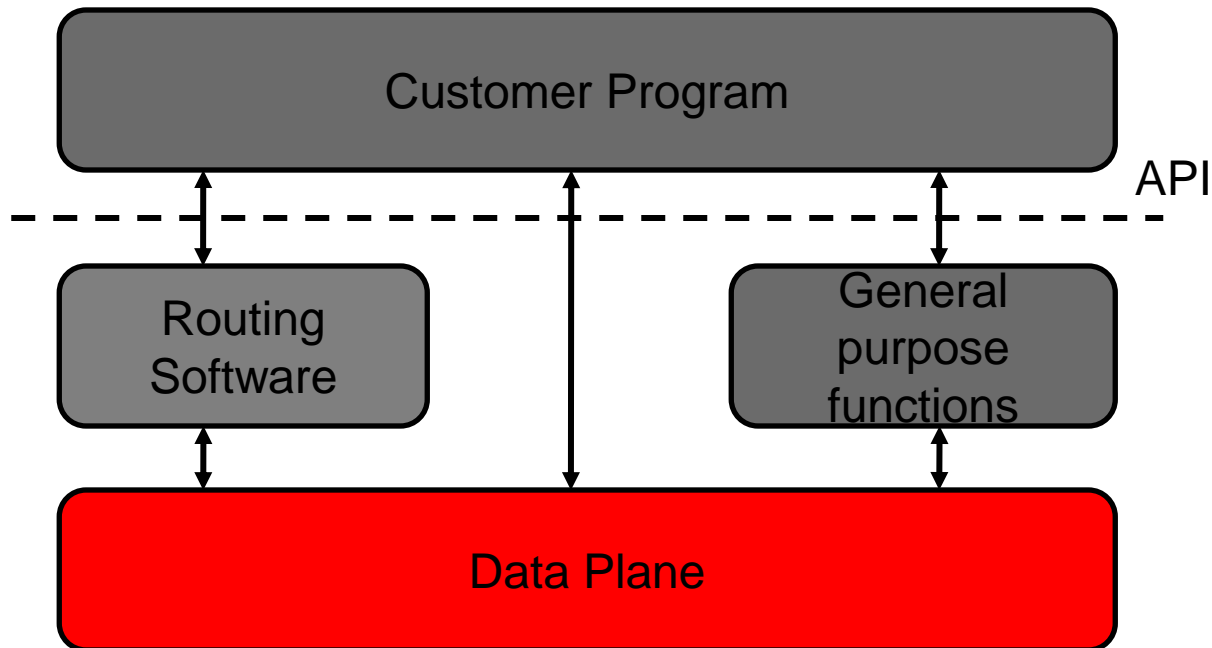General purpose functions

Data Plane

16
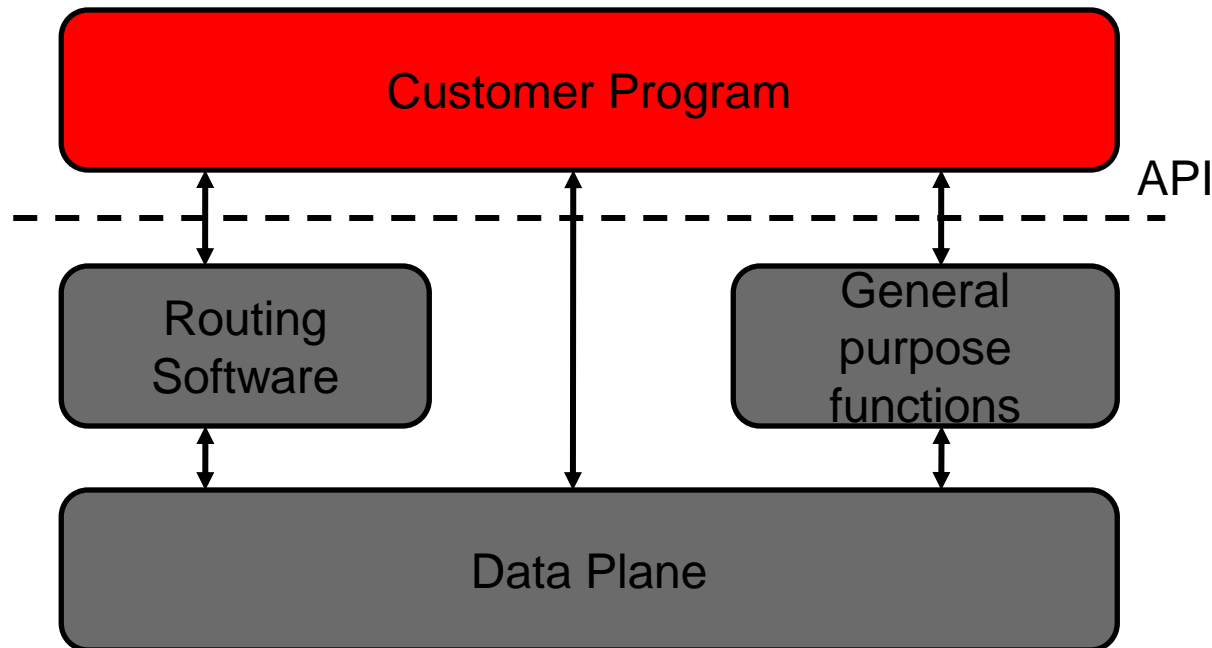
Routing

- 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
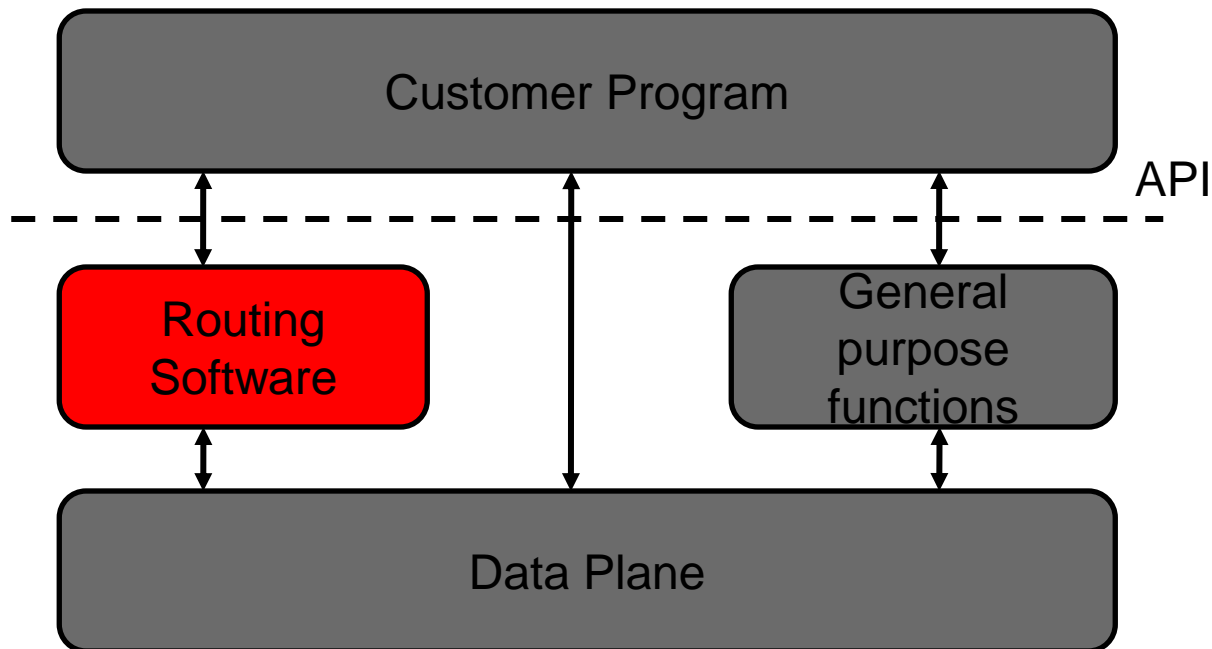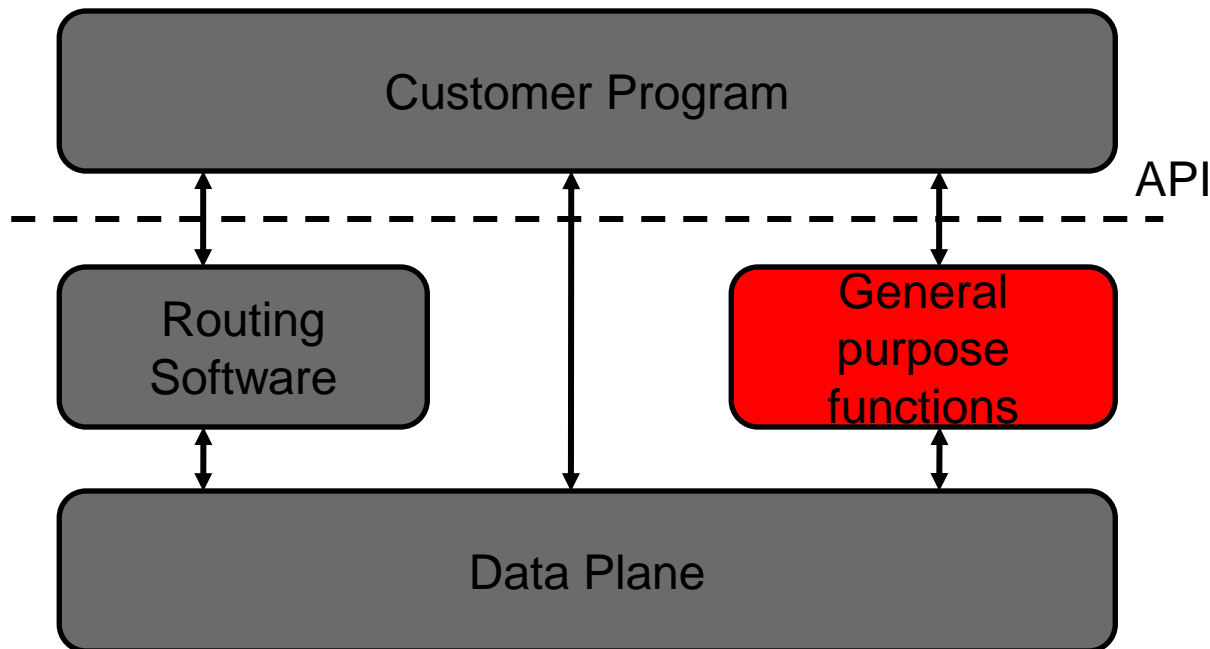
Data Plane

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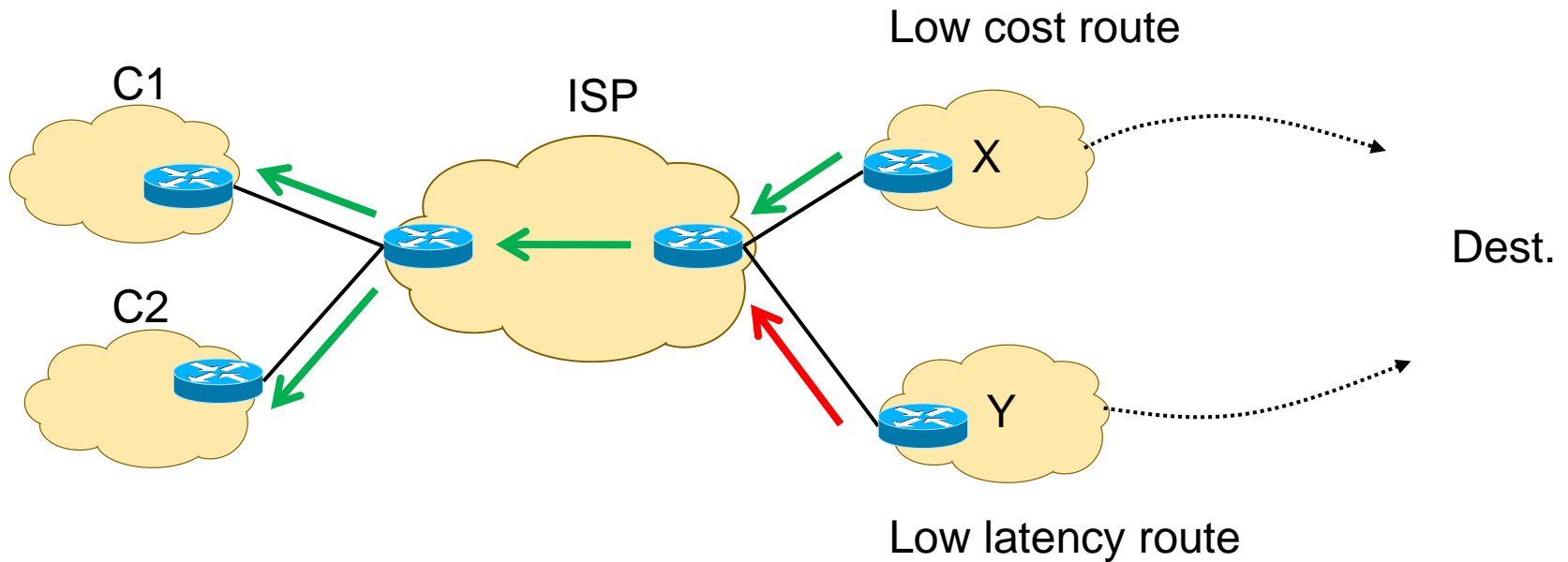
General-Purpose Processing

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

Customer Controlled Routing

ISP chooses one route, no choice to customers
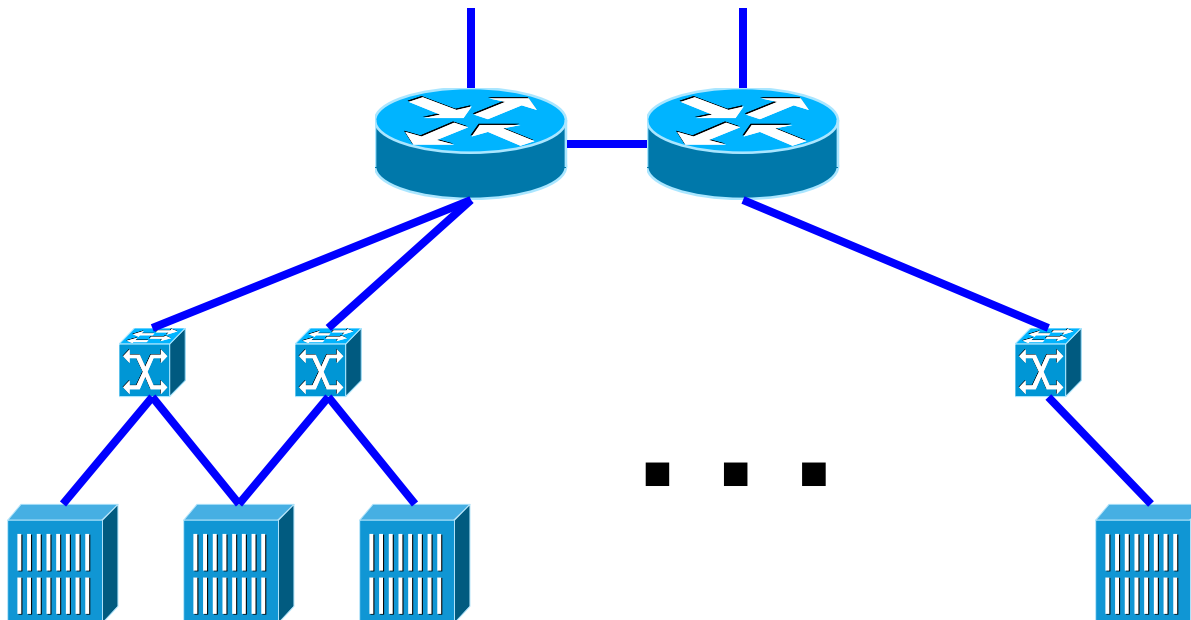
Customer: Configure Router in ISP

Cloud Computing

IaaS offerings give you servers and connectivity

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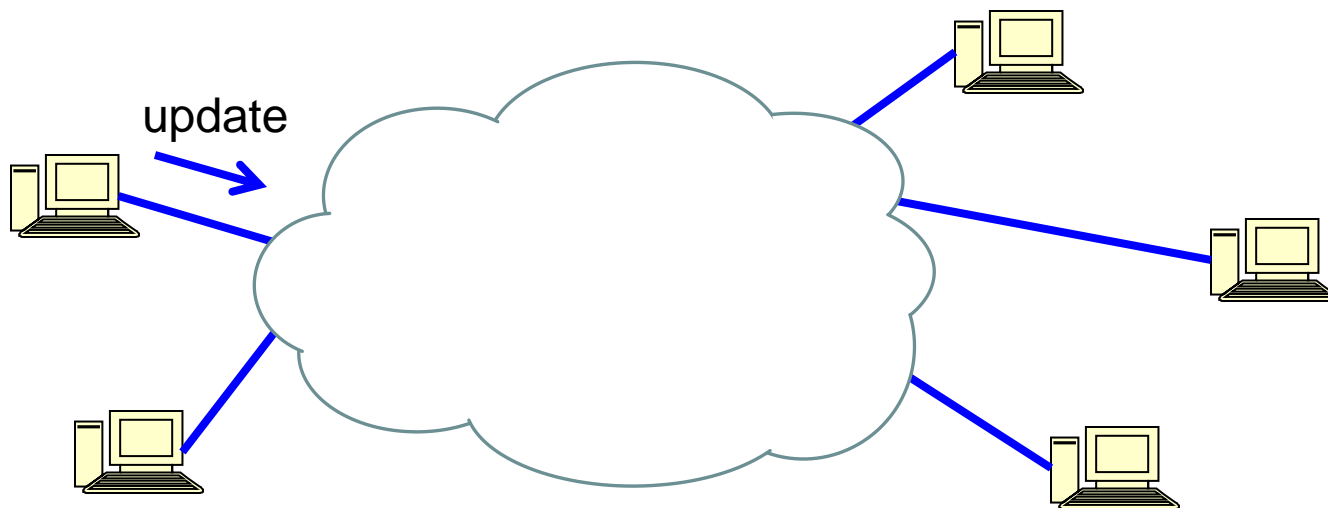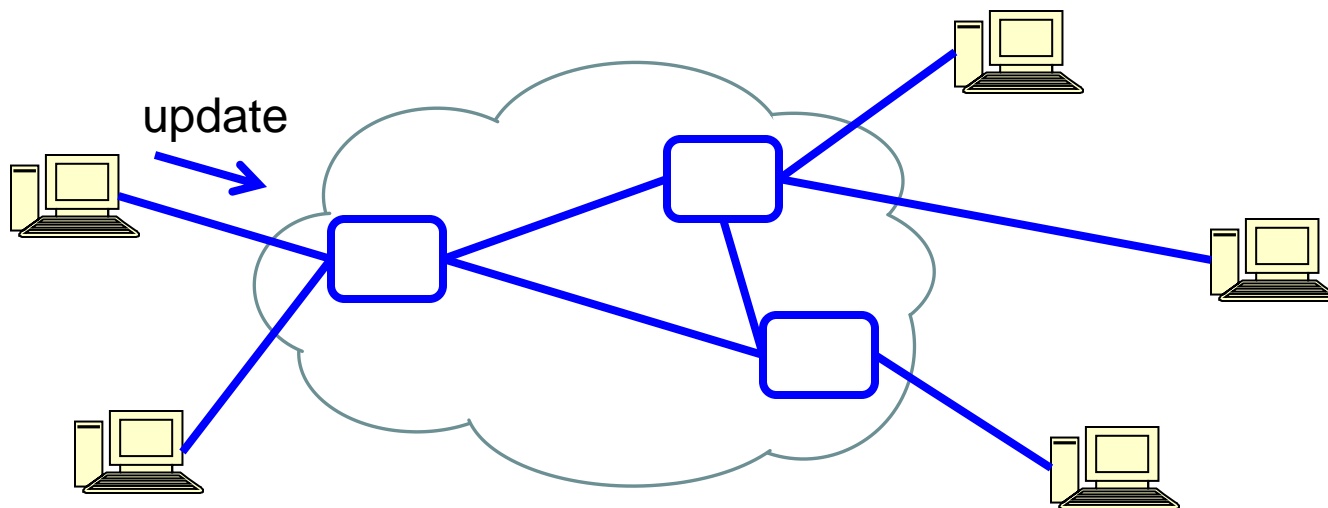
Gaming/Live Video Streaming

Limited ability to setup multi-cast, perform update aggregation

Customer: configure router to manage multi-cast group, add custom software
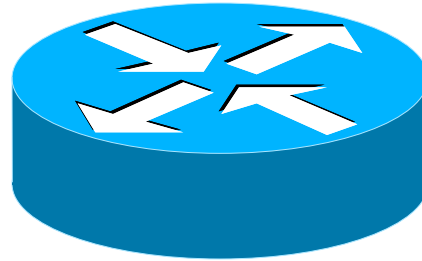
update

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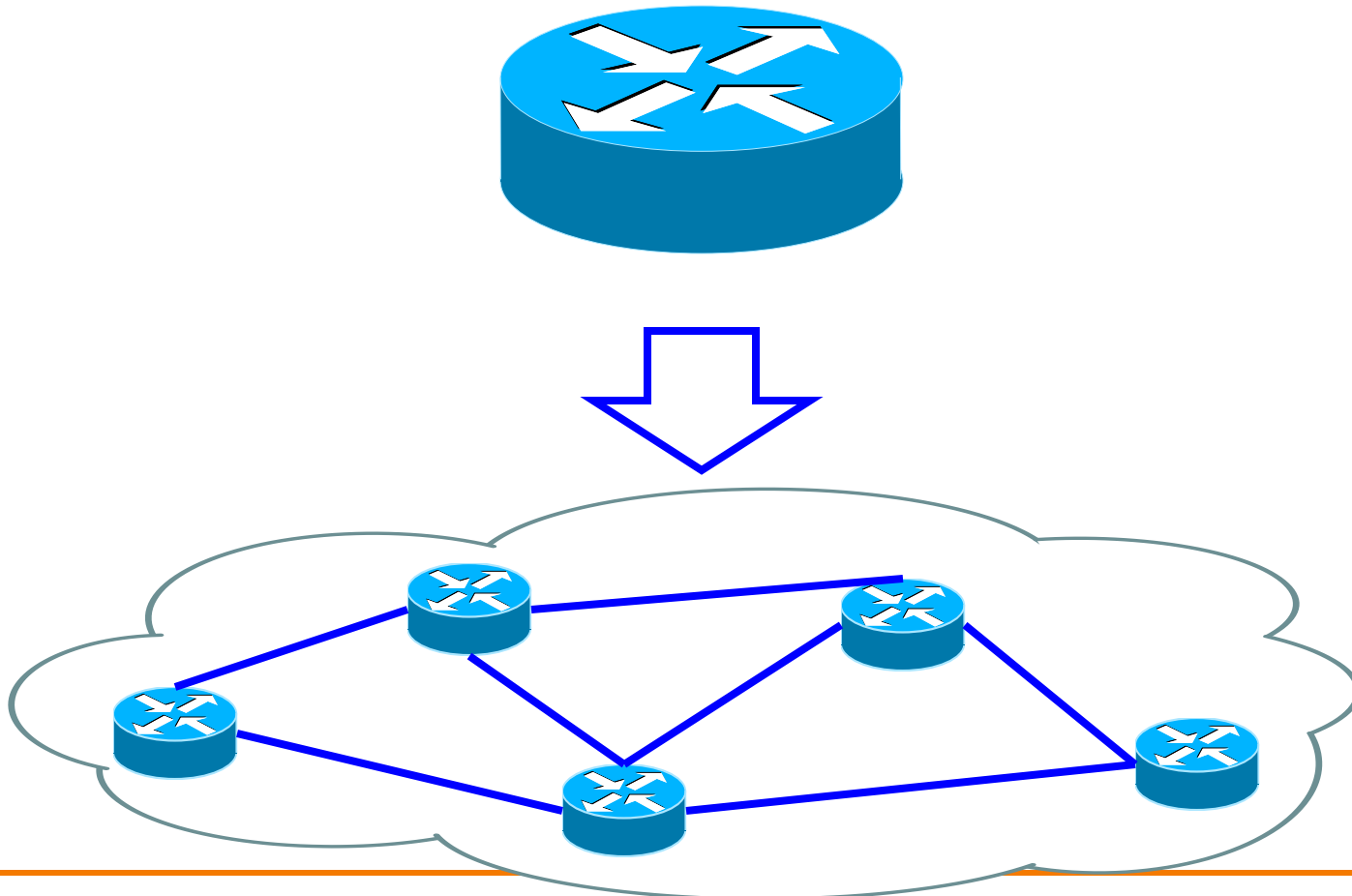
update

Challenge: The Physical Reality

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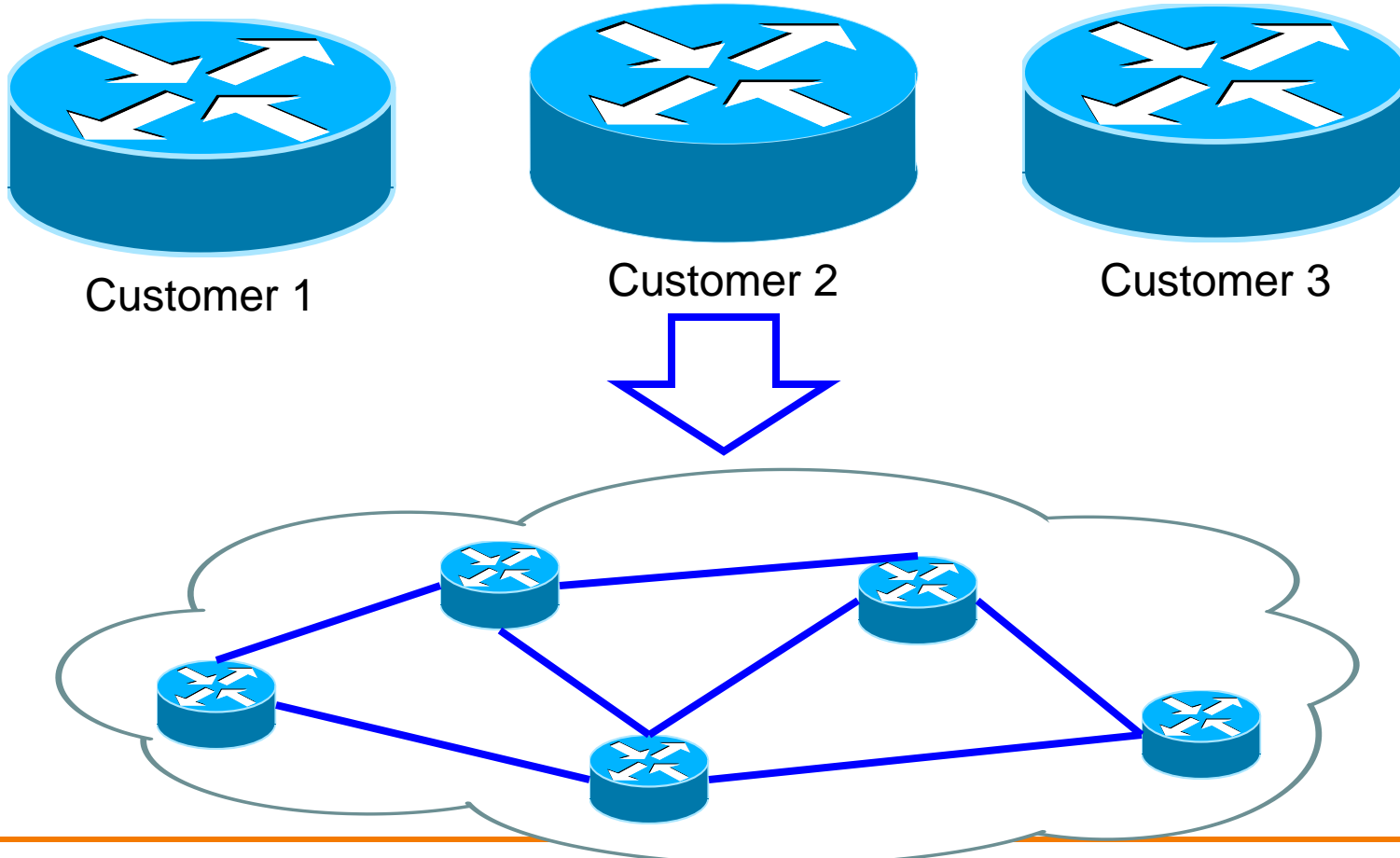
- Physical Infrastructure is Distributed

Challenge: The Physical Reality

- Physical Infrastructure is Distributed

- Physical Infrastructure is Shared

Customer 1   Customer 2   Customer 3

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
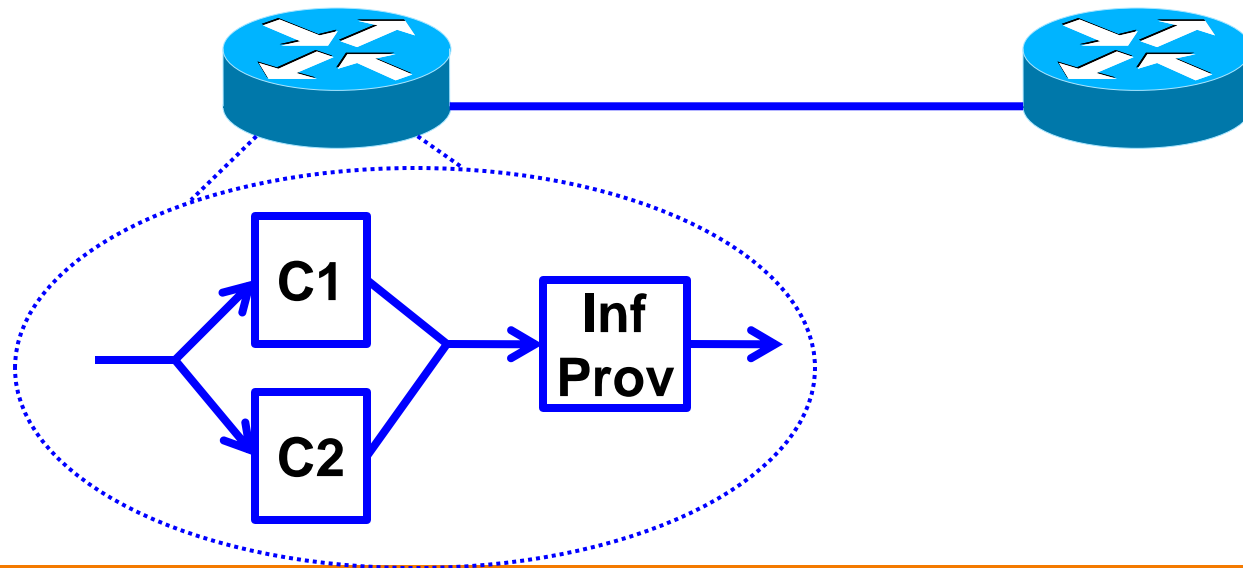
Conclusion

- 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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