

INTERNET2

2022
TECHNOLOGY
exchange

Resilient Connectivity Architectures for Your Cloud Environment

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Networking For Cloud

i Note: I have the most experience with AWS; most examples will reference AWS

If we don't keep this interactive it's going to be a tedious 3 hours

I'm still not



i Danger! : I reserve the right to be completely wrong!



Storytime



Storytime



Table of Contents

- ☁ Cloud Service Models
- ☁ Cloud Networking Strategies
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 - Internet2 Peer Exchange (I2PX)
 - Internet2 Cloud Connect (I2CC)
 - Internet2 Rapid Private Interconnect (RPI)
- ☁ Why, how and when to use I2CC
- ☁ Putting it all together!
- ☁ What’s next?!

Goals

- Inventory of *Your* cloud services
- Understanding Resiliency options
- Expert on Internet2 “Networking for Cloud”
- Apply your knowledge to your cloud environment
- Gain feedback from all of you

Cloud Service Models



Know your cloud service models

IaaS can be thought of as the original 'as a service' offering: Amazon Web Services, Google Cloud, IBM Cloud, Microsoft Azure - began by offering some form of IaaS.

Examples of **PaaS** solutions include AWS Lambda, Google App Engine, Microsoft Windows Azure

Examples of **SaaS** solutions include Salesforce (CRM software), Box/Dropbox (cloud storage), Trello (workflow management), Slack (collaboration and messaging), and Office 365 (productivity apps).

Cloud Computing Services: Who Manages What?

	Traditional IT	IaaS	PaaS	SaaS
Applications	You manage	You manage	You manage	Provider manages
Data	You manage	You manage	You manage	Provider manages
Runtime	You manage	You manage	Provider manages	Provider manages
Middleware	You manage	You manage	Provider manages	Provider manages
OS	You manage	Provider manages	Provider manages	Provider manages
Virtualization	You manage	Provider manages	Provider manages	Provider manages
Servers	You manage	Provider manages	Provider manages	Provider manages
Storage	You manage	Provider manages	Provider manages	Provider manages
Networking	You manage	Provider manages	Provider manages	Provider manages

Legend: ■ You manage ■ Provider manages

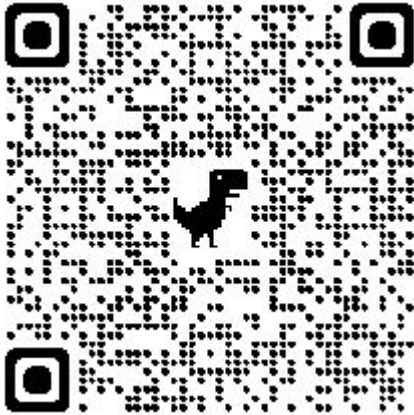
Cloud Services Inventory

Cloud Service	Cloud Service Model (Traditional IT, IaaS, PaaS, SaaS)	How do users reach the service? Internet -or- Private Connection																																																		
AWS VPC	IaaS	Private Connection (IPSEC/VPN)																																																		
O365	SaaS	Internet																																																		
Box	SaaS	Cloud Computing Services: Who Manages What? <table border="1"> <thead> <tr> <th></th> <th>Traditional IT</th> <th>IaaS</th> <th>PaaS</th> <th>SaaS</th> </tr> </thead> <tbody> <tr> <td>Applications</td> <td>You manage</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Data</td> <td>You manage</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Runtime</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Middleware</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>OS</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Virtualization</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Servers</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Storage</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> <tr> <td>Networking</td> <td>You manage</td> <td>Provider manages</td> <td>Provider manages</td> <td>Provider manages</td> </tr> </tbody> </table>		Traditional IT	IaaS	PaaS	SaaS	Applications	You manage	You manage	Provider manages	Provider manages	Data	You manage	You manage	Provider manages	Provider manages	Runtime	You manage	Provider manages	Provider manages	Provider manages	Middleware	You manage	Provider manages	Provider manages	Provider manages	OS	You manage	Provider manages	Provider manages	Provider manages	Virtualization	You manage	Provider manages	Provider manages	Provider manages	Servers	You manage	Provider manages	Provider manages	Provider manages	Storage	You manage	Provider manages	Provider manages	Provider manages	Networking	You manage	Provider manages	Provider manages	Provider manages
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Cloud Services Inventory

Cloud Computing Services: Who Manages What?



<http://bit.ly/3FjY5jJ>

https://docs.google.com/spreadsheets/d/1y3KTmGPRlrws21N_Ey6qQn4352O7dKNcAPaDD_1LKH8/edit?usp=sharing

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Legend: ■ You manage ■ Provider manages



Cloud Connectivity Strategies



Cloud Connectivity Strategies

- ☁ VPN Tunnels
- ☁ Public Internet
- ☁ Private MPLS circuits
- ☁ Dedicated Connectivity (Direct Connect, Express Route, etc.)



Public Internet for Cloud Connectivity



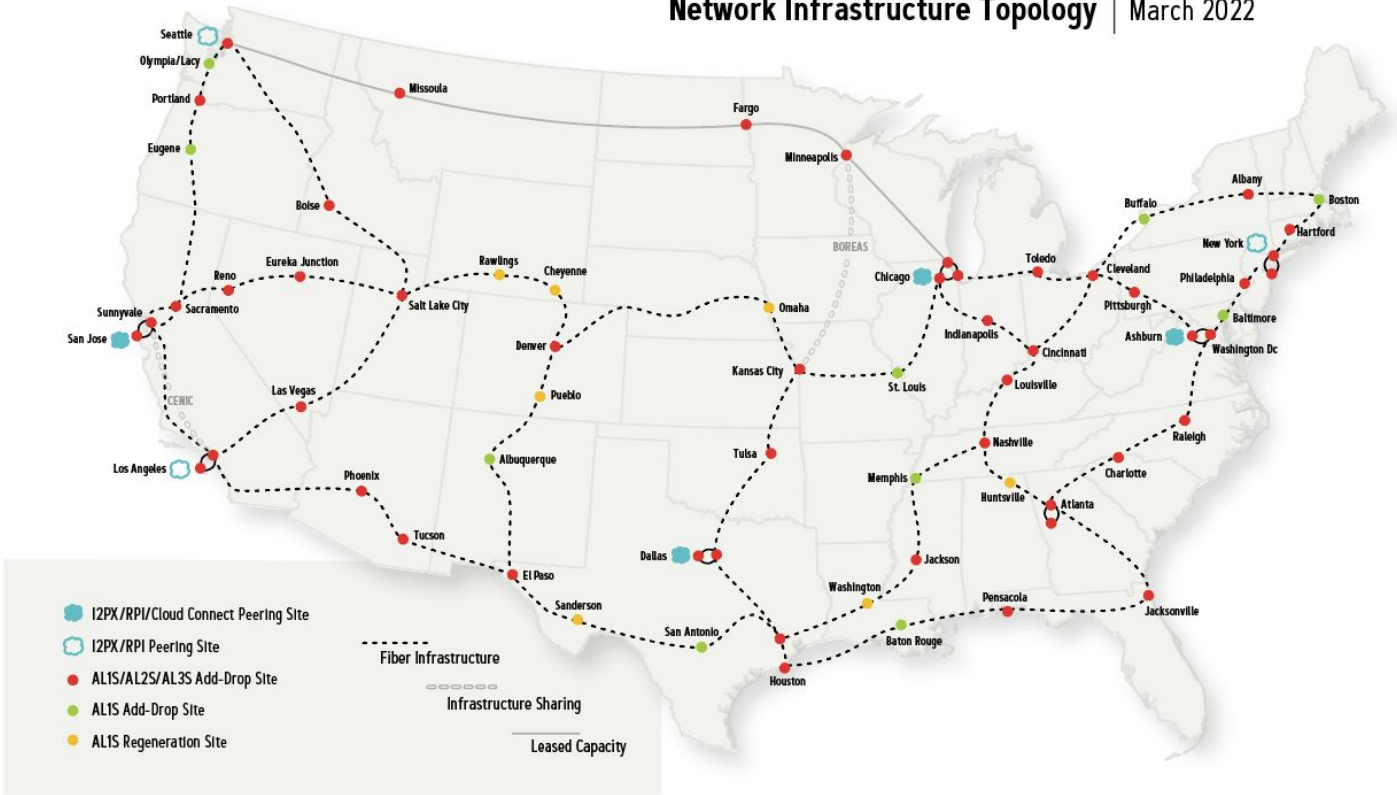
I2 Peer Exchange (I2PX): for SaaS cloud services

- > 3 Tbps peering capacity with major providers for access to cloud SaaS services
- Available to all Internet2 Connectors at no extra cost
(not necessarily passed on to participants behind connectors)
- Large capacity paths to many cloud providers. Mostly 100G interconnects with AWS, Microsoft, Google, Oracle.
- CDN Access: Used by many cloud services for hosting bulk content
- I2PX gives access to everyone's public cloud hosted services.
- Access to all of the US cloud regions for the big 4 cloud providers.
- Access to smaller cloud providers (compute, storage, etc)



I2 Peer Exchange (I2PX): for SaaS cloud services

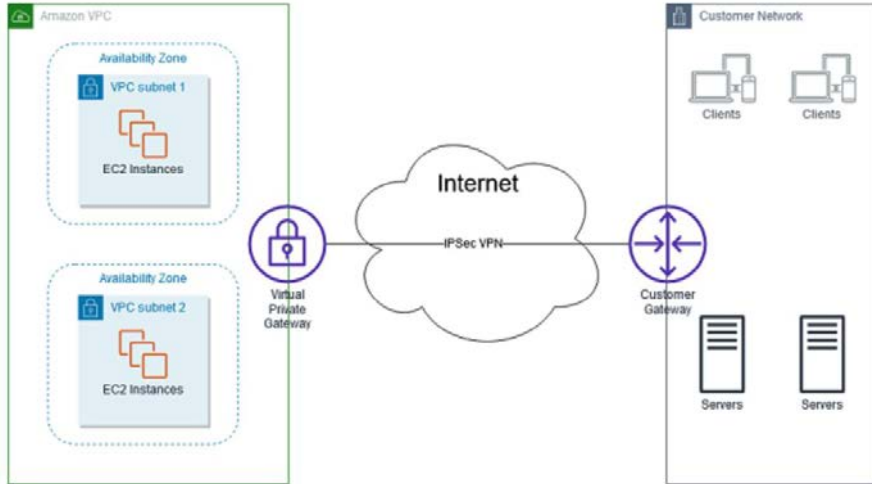
Network Infrastructure Topology | March 2022



VPN Tunnels for Cloud Connectivity

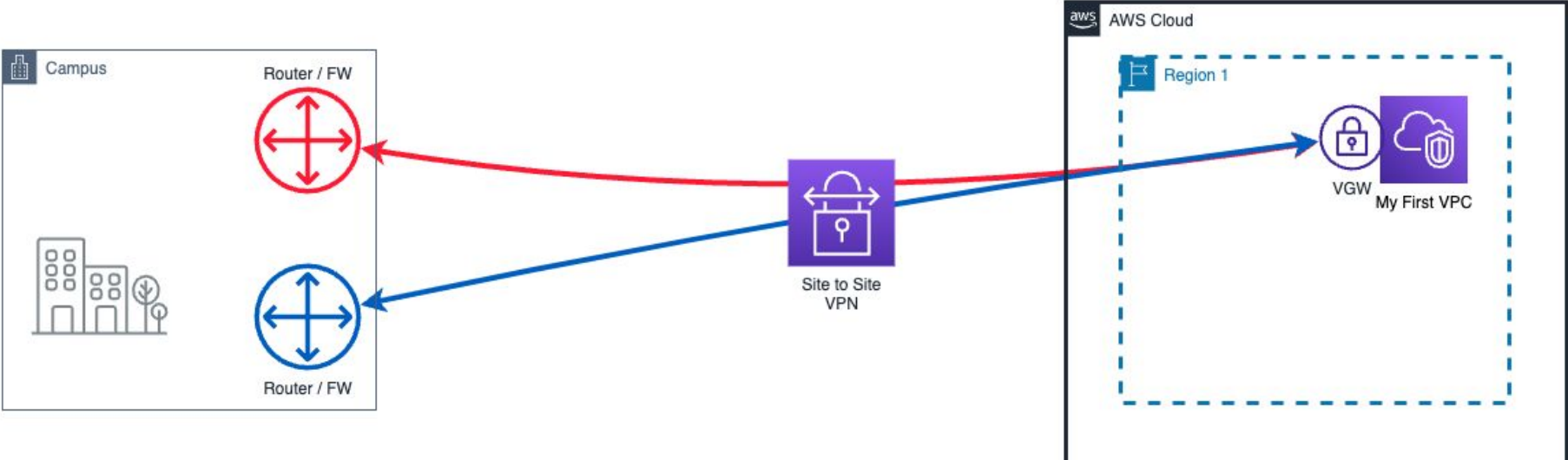


Common Cloud Network Architectures: VPN

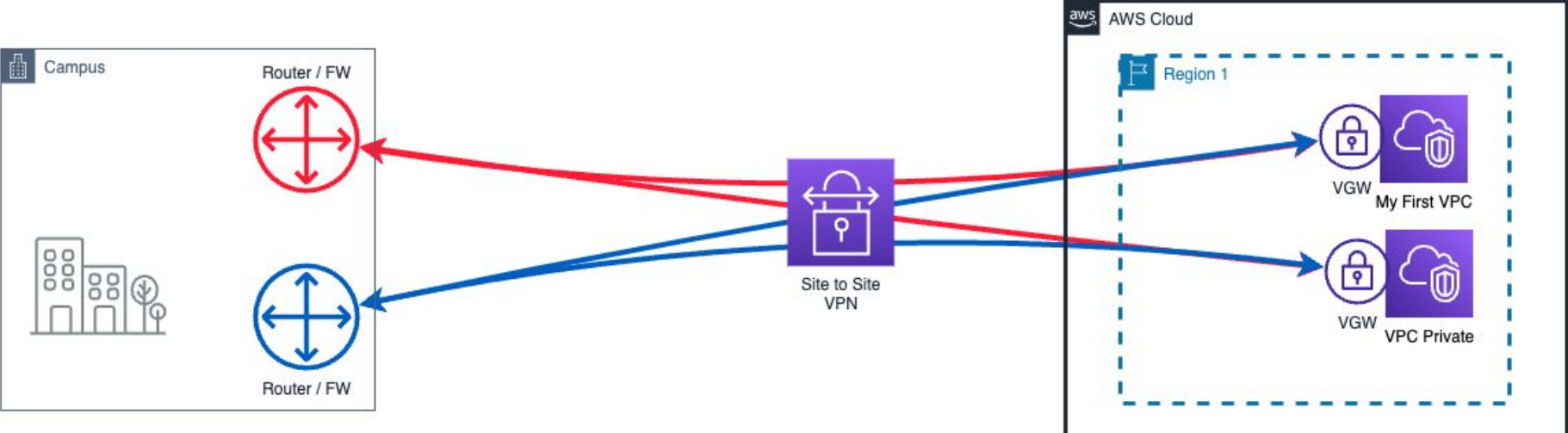


- Performance up to 1.25Gbps per tunnel
- Fully encrypted from campus to cloud
- Uses your existing Internet connections
- Can be cost effective for lower bandwidth needs
- Quick and Easy way to establish private connectivity to the cloud

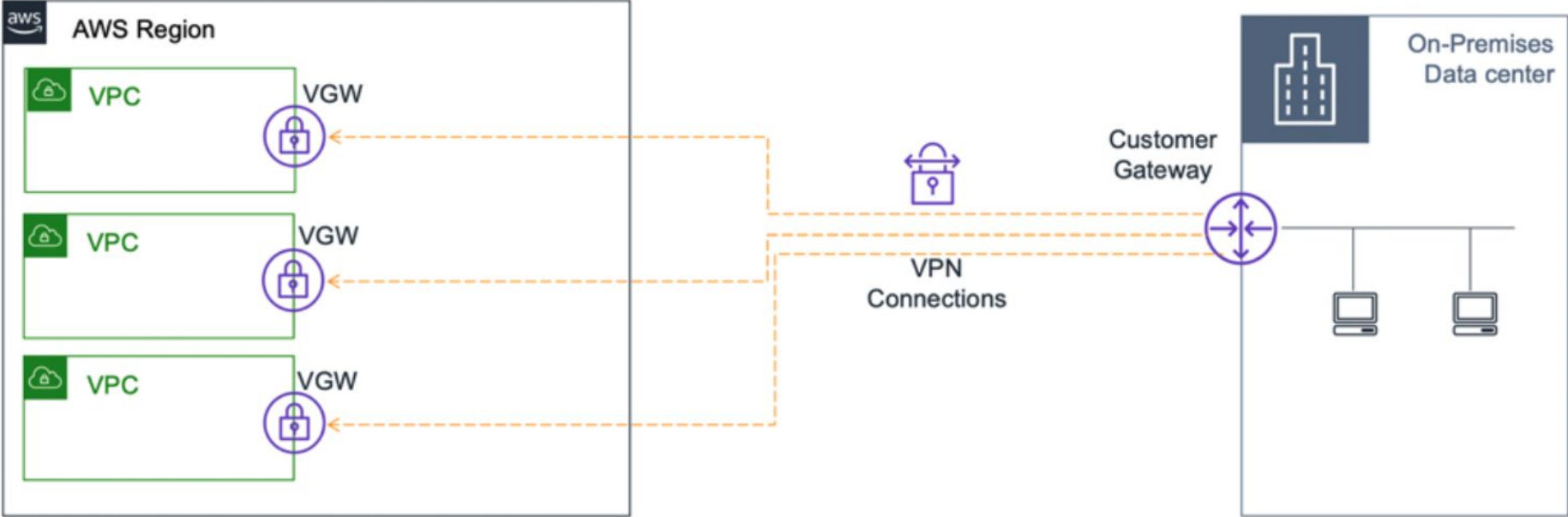
VPN Tunnels



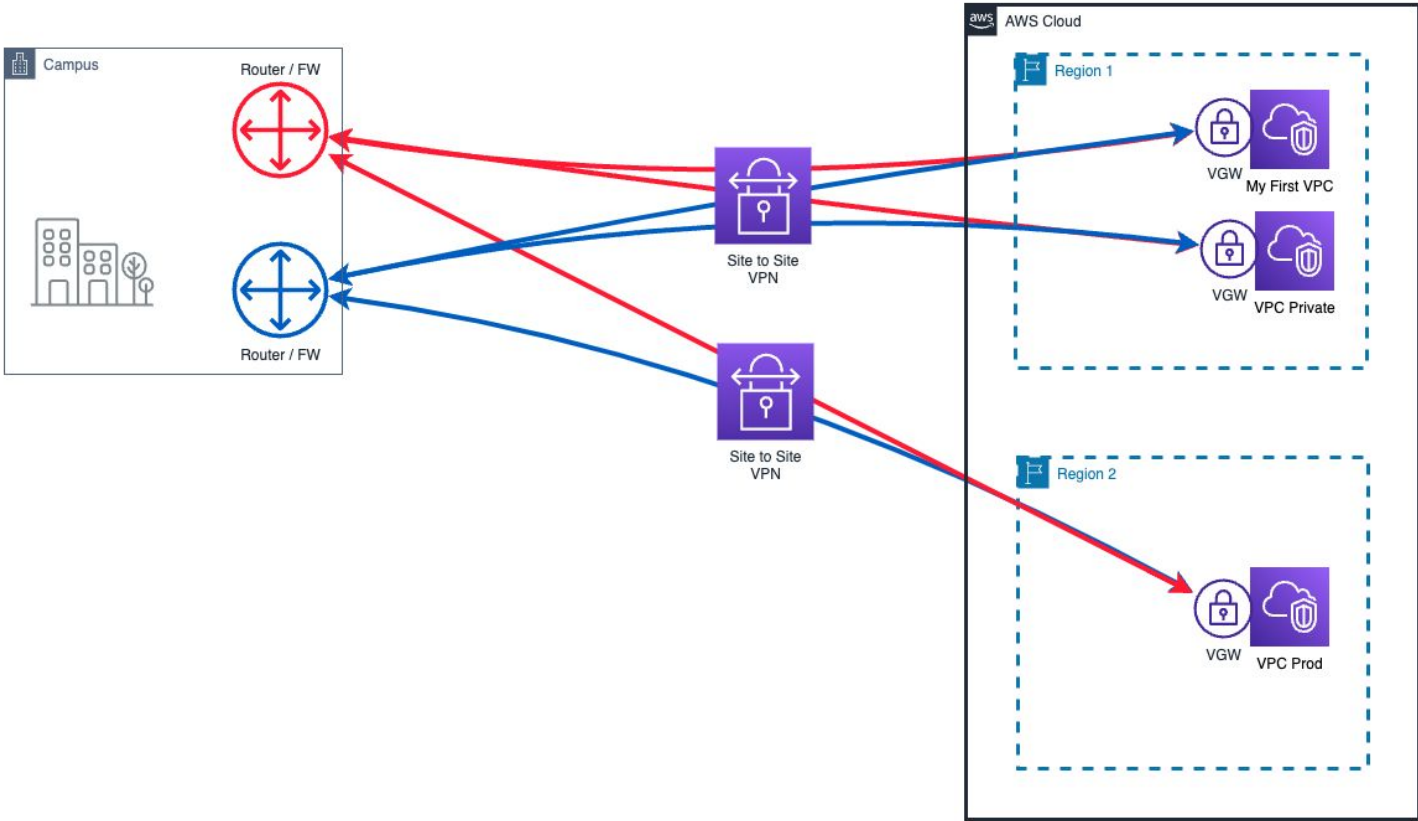
VPN Tunnels



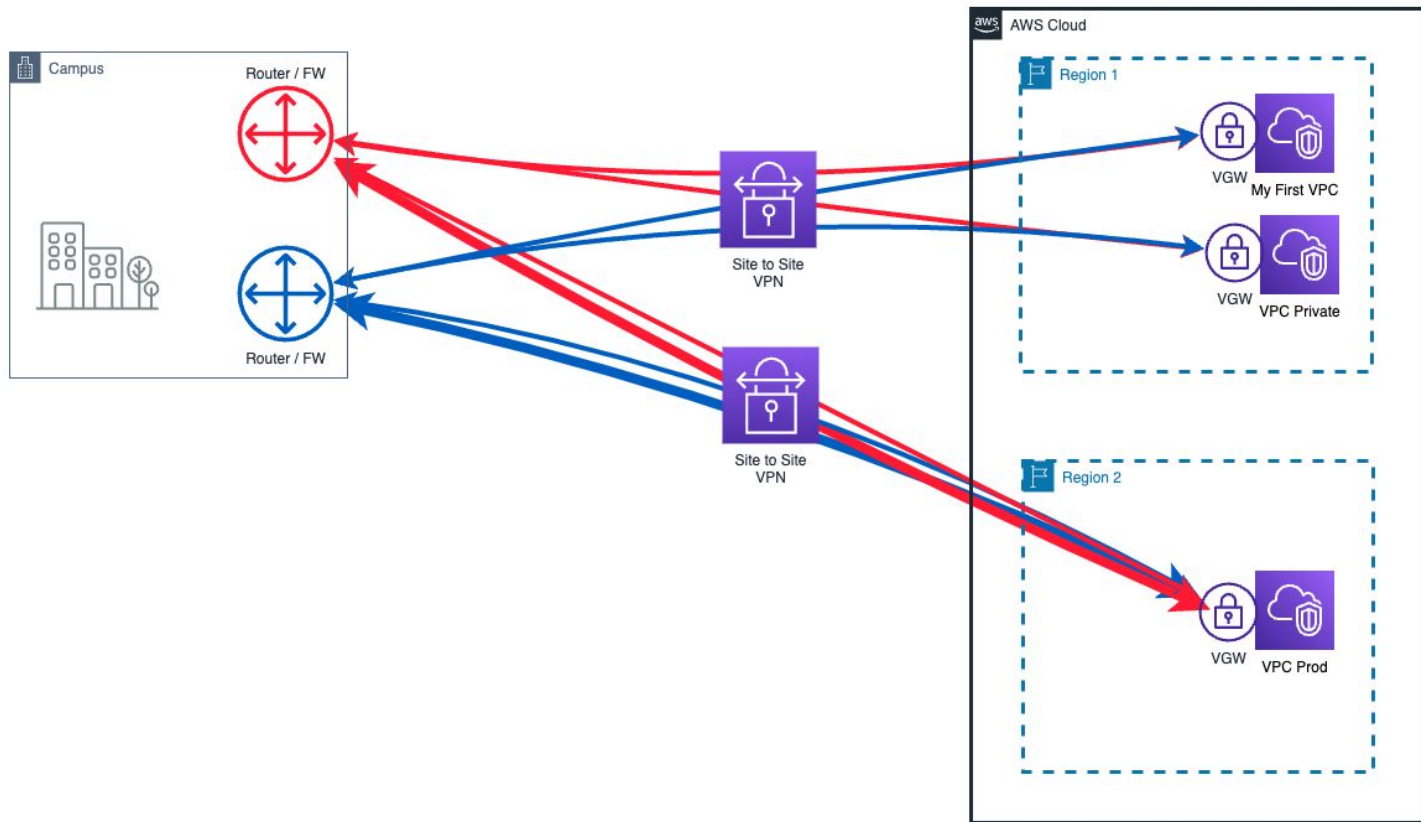
Common Cloud Network Architectures: VPN



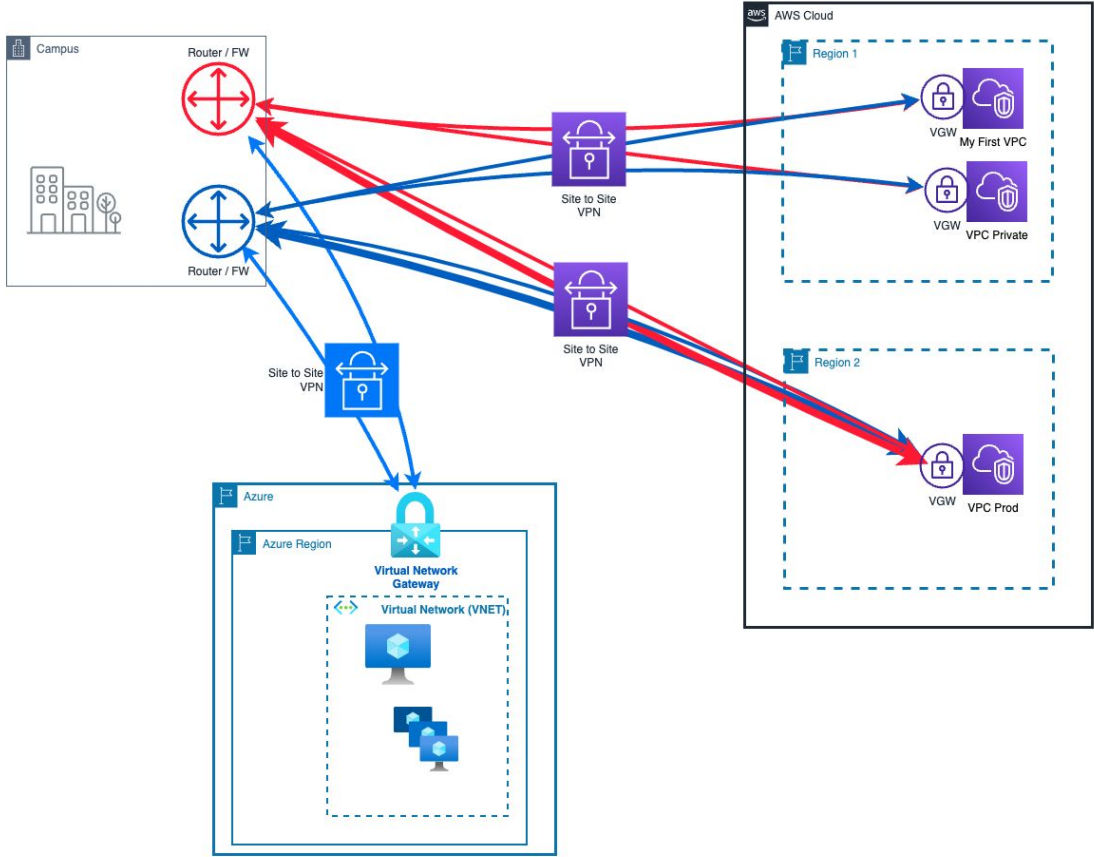
VPN Tunnels



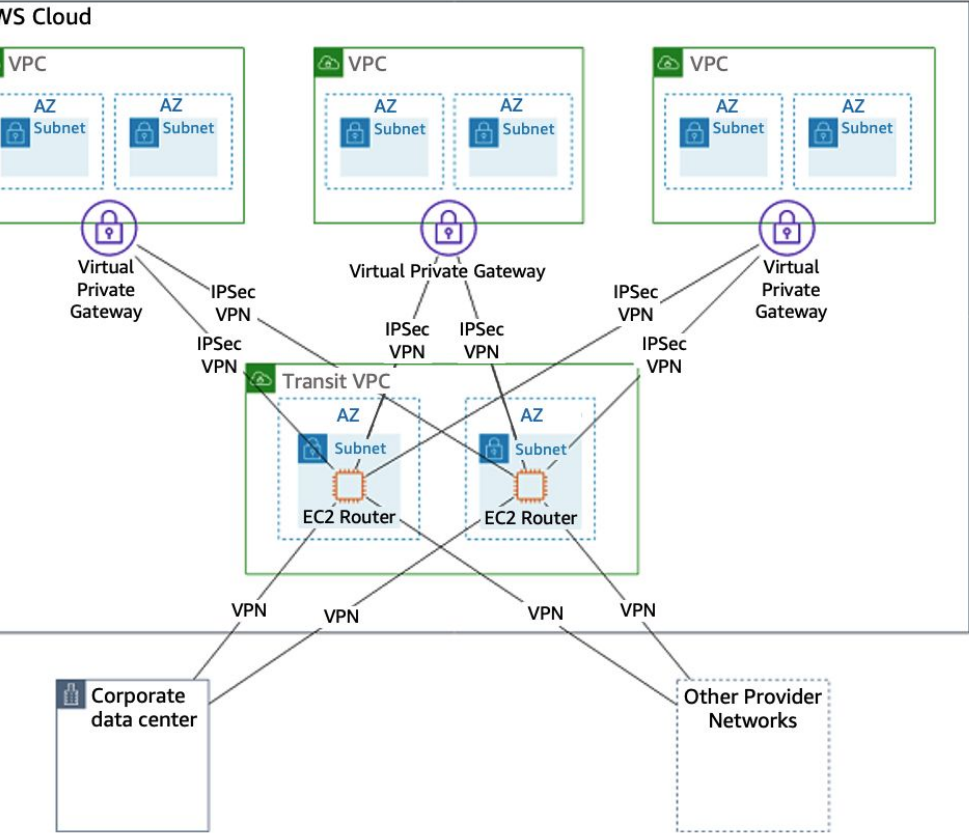
VPN Tunnels



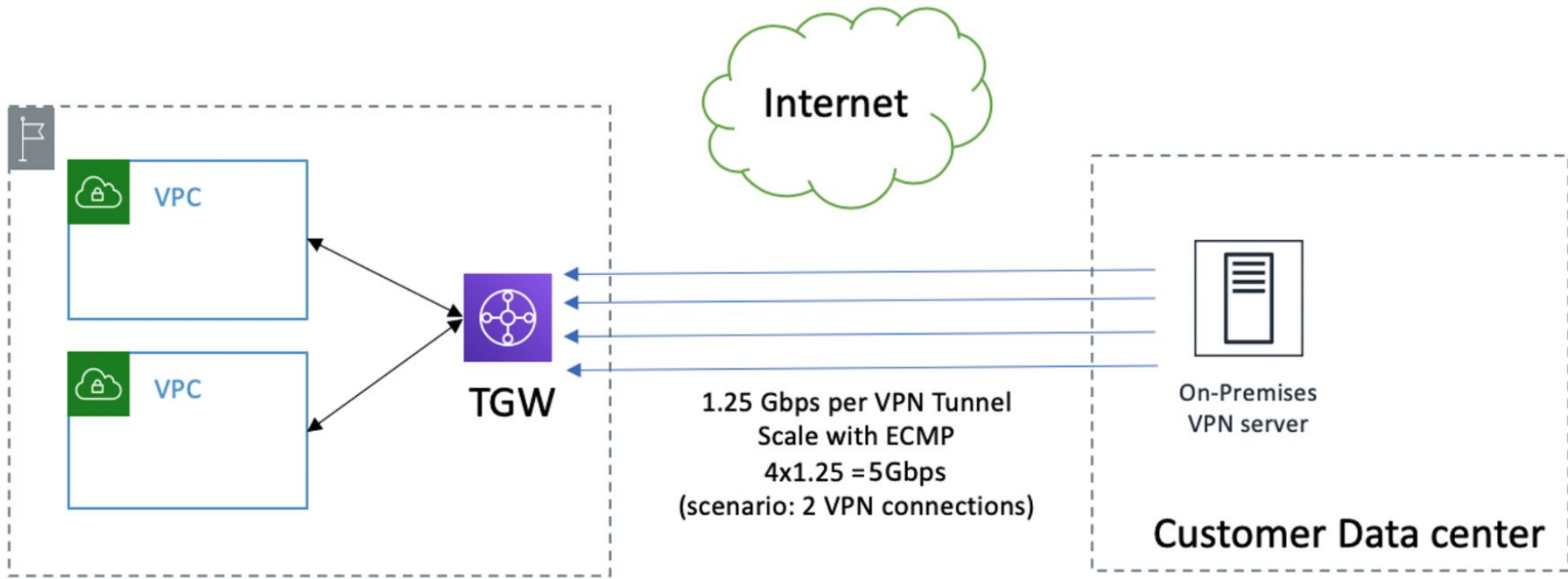
VPN Tunnels



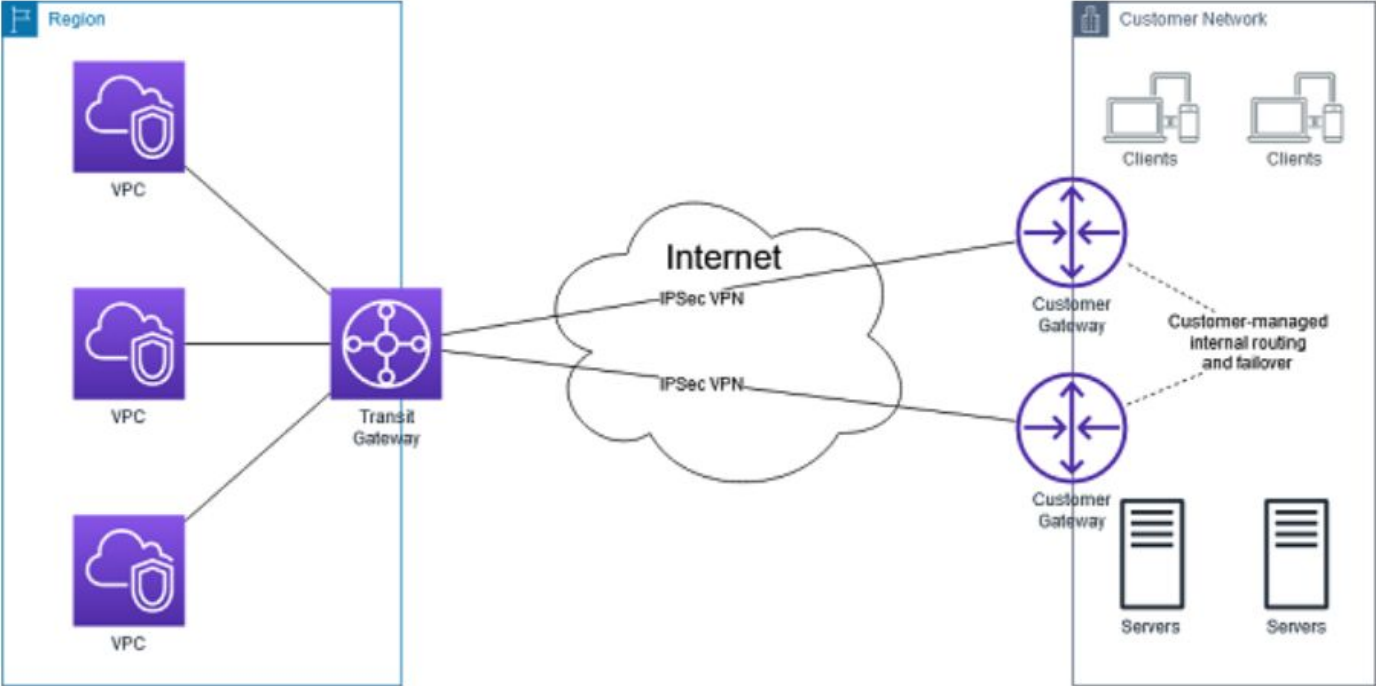
VPN Tunnels - Transit VPC Model



VPN Tunnels - Transit Gateway Model



VPN Tunnels - Transit Gateway Model



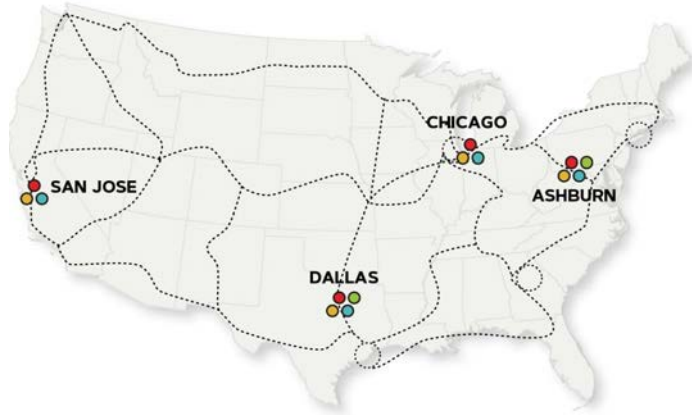
Networking For Cloud



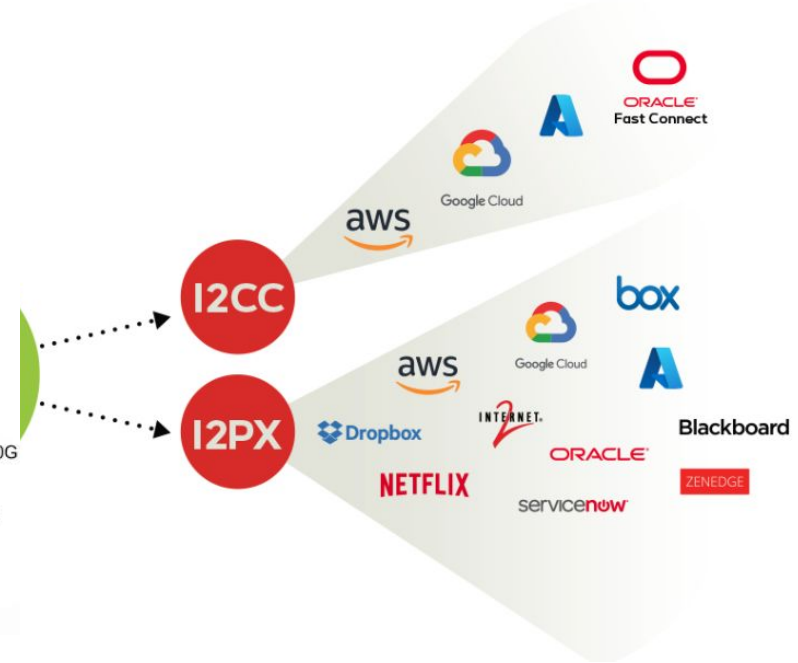
I2 Cloud Connect (I2CC)



Four cloud service providers (*cloud provider fees apply*)
Up to 5G dedicated circuits (*no additional fee*)
Now Supporting(!!) 10G connections (*will include additional fee*)



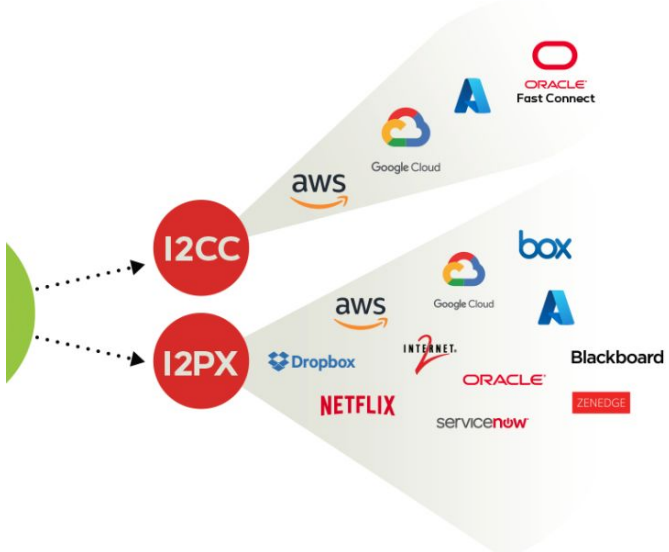
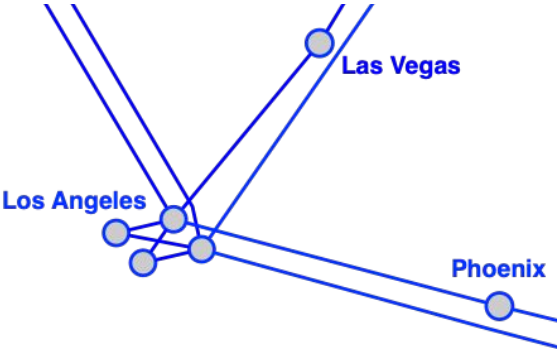
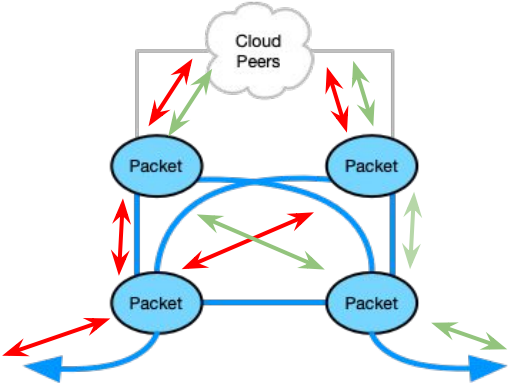
- Amazon Direct Connect**
Ashburn: 11x10G
Chicago: 4x10G
Dallas: 4x10G
San Jose: 4x10G
- Google Cloud Interconnect**
Ashburn: 1x100G, 1x2x10G
Chicago: 1x2x10G
Dallas: 1x2x10G
San Jose: 1x2x10G
- Microsoft ExpressRoute**
Ashburn: 1x2x100G, 2x2x10G, 1x2x10G GovCloud
Chicago: 1x2x10G
Dallas: 1x2x10G, 1x2x10G GovCloud
San Jose: 1x2x100G, 1x2x10G
- Oracle Fast Connect**
Ashburn: 2x100G
Dallas: 2x100G



I2 Cloud Connect (I2CC)



NGI Topology
(Split Core and Edge Layers)

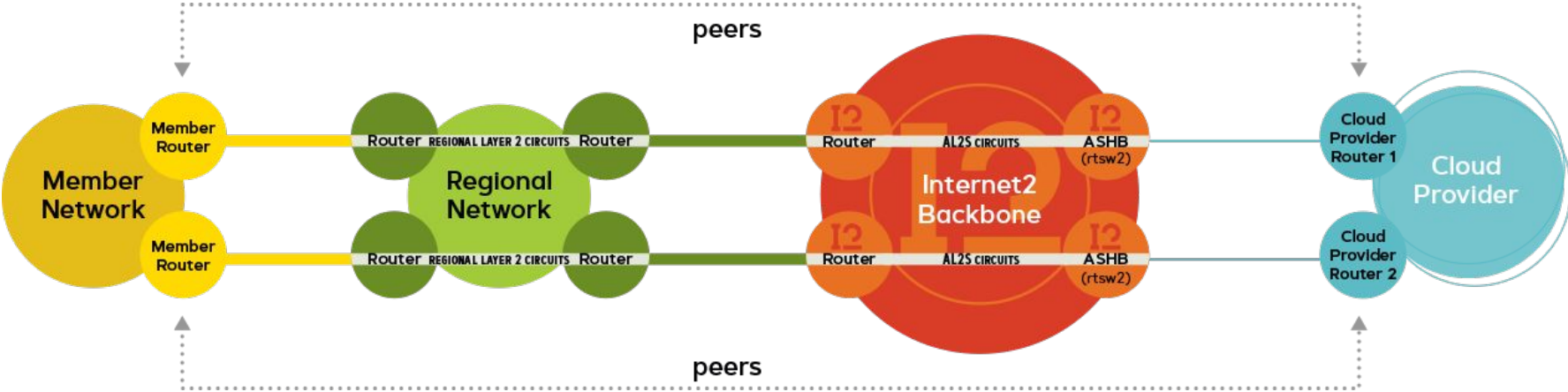


Dedicated Connections for Cloud Connectivity



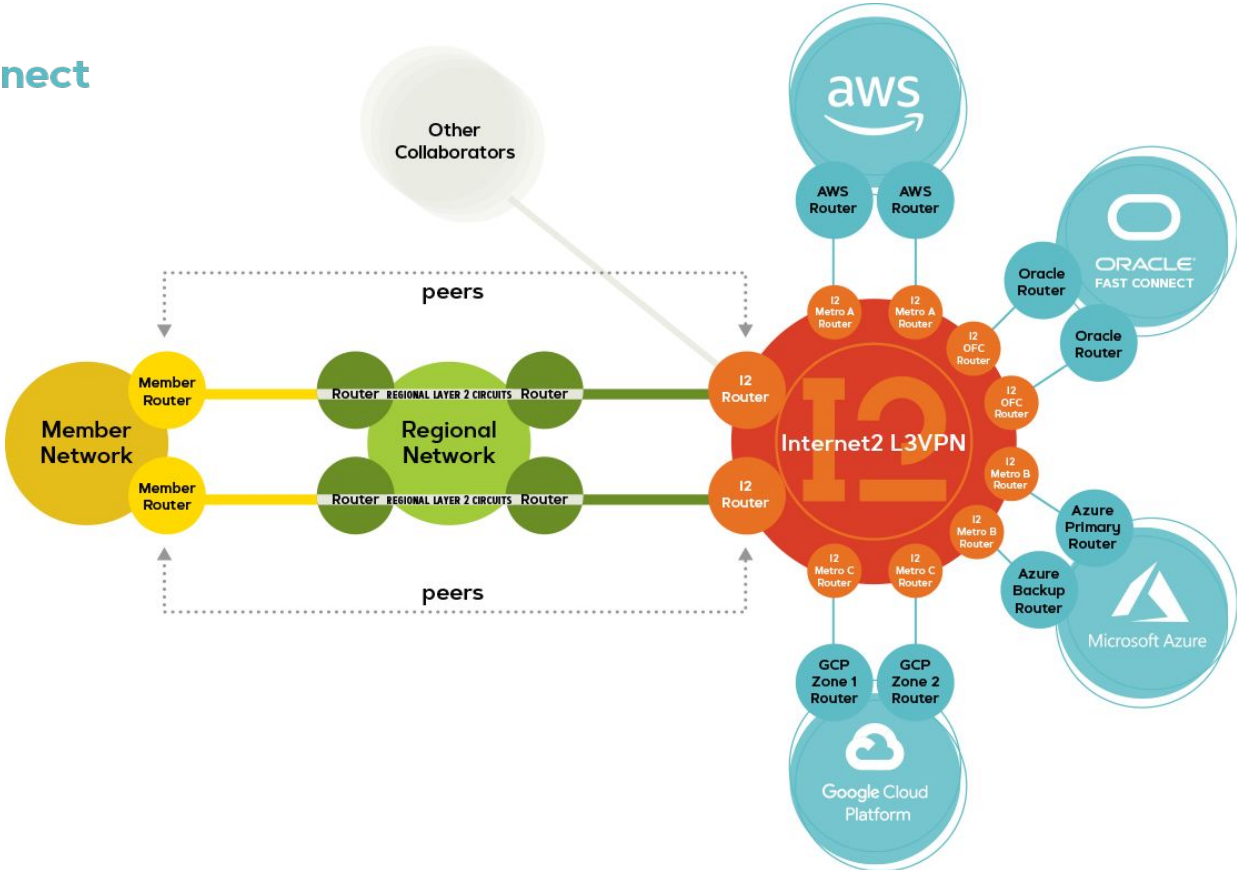
I2CC Layer2 Connectivity

Internet2 Cloud Connect
I2CC



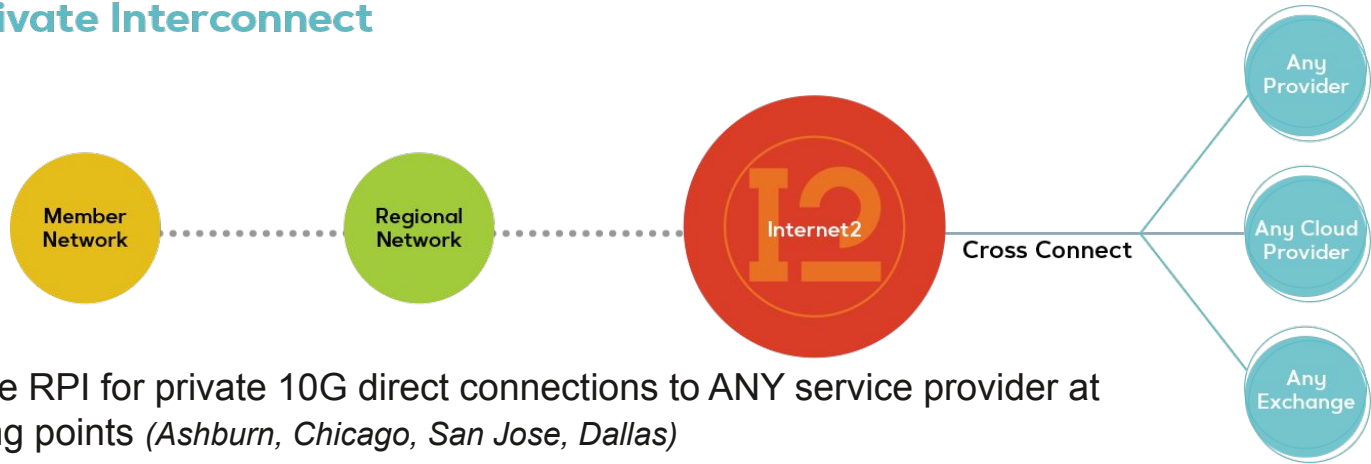
I2CC Layer3 Connectivity

Internet2 Cloud Connect
I2CC



I2 Rapid Private Interconnect (RPI) - Niche Cloud SP's

Internet2 Rapid Private Interconnect I2RPI








- Members can use RPI for private 10G direct connections to ANY service provider at four major peering points (*Ashburn, Chicago, San Jose, Dallas*)
- Members can use RPI for private 10G direct connections to Amazon Direct Connect, Google Cloud Interconnect, Microsoft Azure ExpressRoute, or Oracle Fast Connect services
- Can connect to peers at Layer 2 or Layer 3
- Available through your regional network today for an additional fee

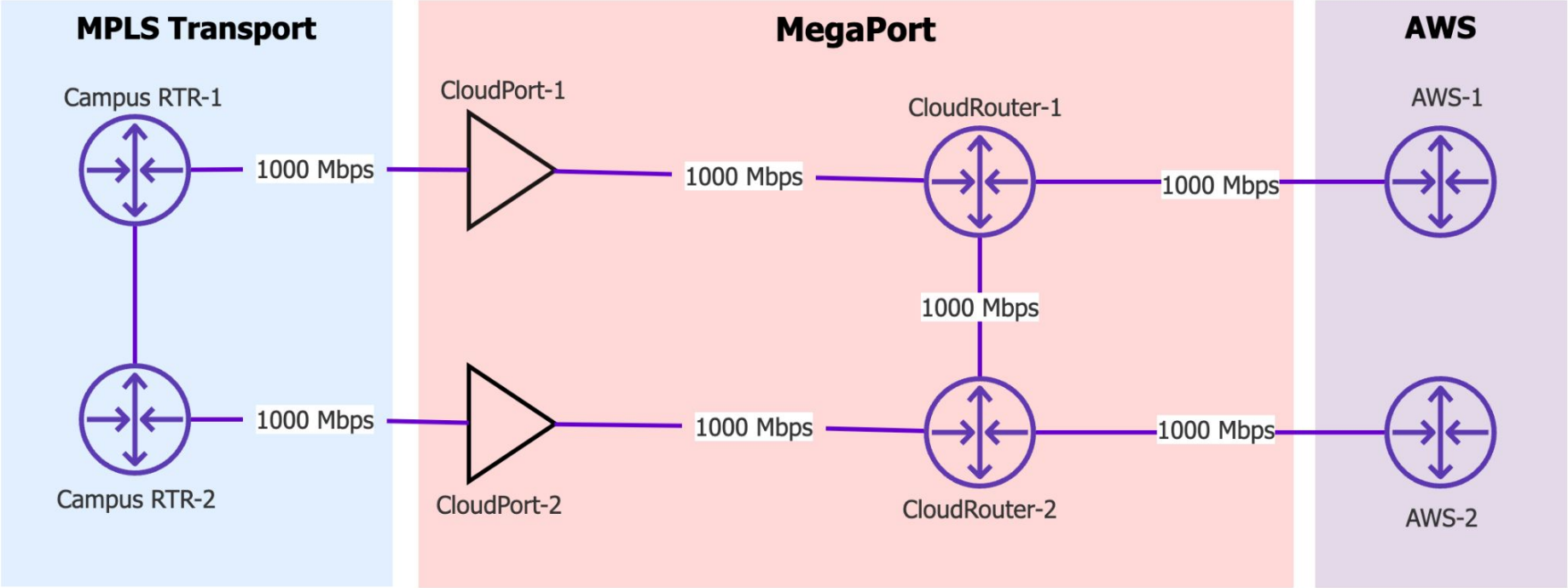
Why, How and When to use I2CC



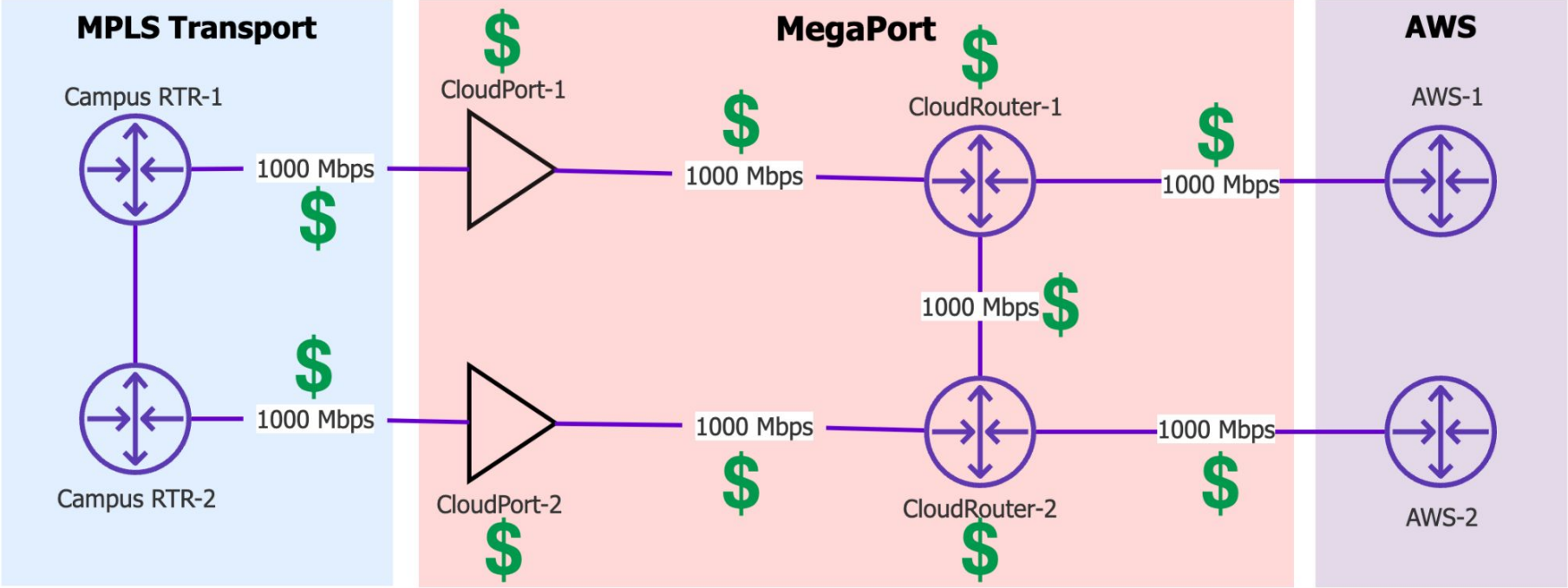
Why, how and when to use I2CC

-  Boost Network Performance
-  Architect for Resiliency
-  Simplify Connectivity
-  Better Supportability
-  Reduce Cost

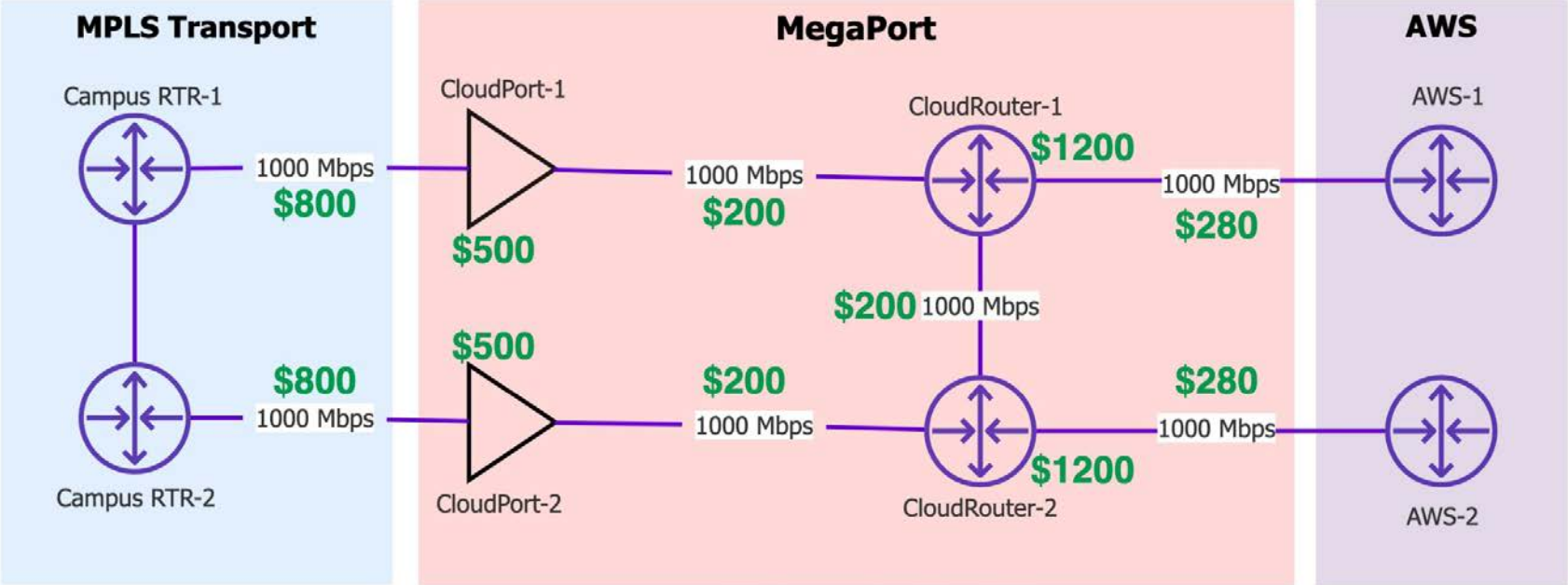
Let's talk Cost



MegaPort Example



Monthly Expense Example

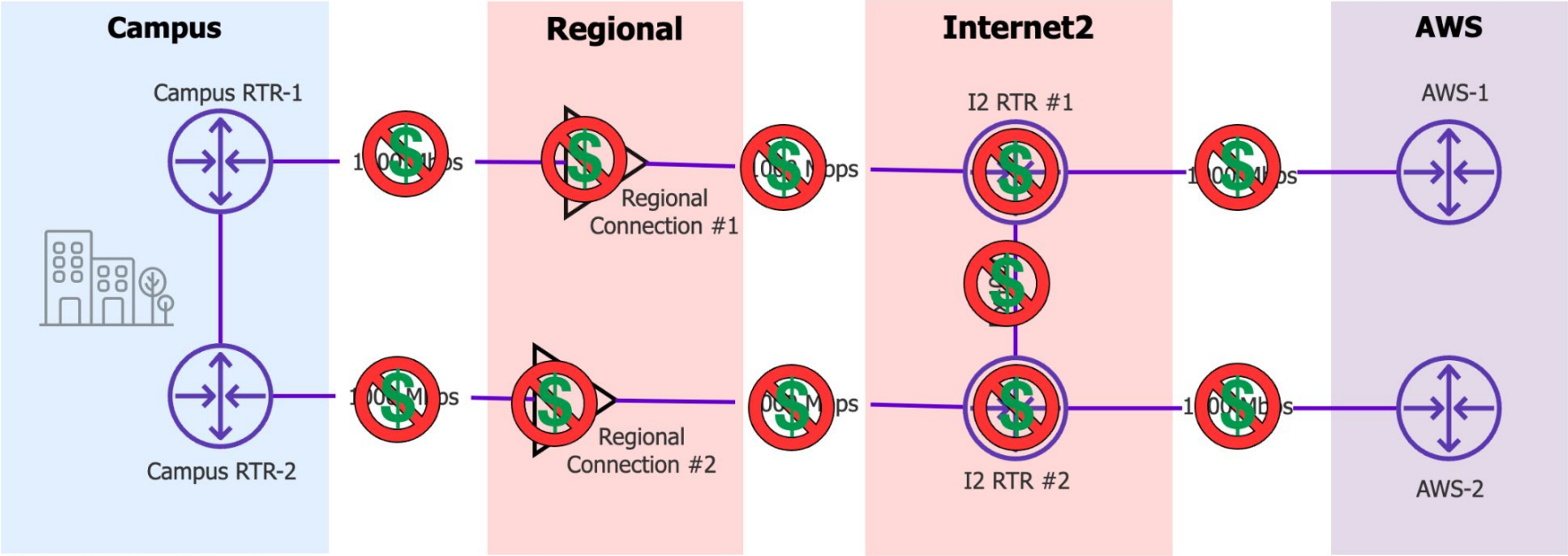


Transport Monthly Expense = \$1600

MegaPort Monthly Expense = \$4560

Total Monthly Expense = \$6160

I2CC Monthly Savings



Total Monthly Savings = \$6160



Putting it all together

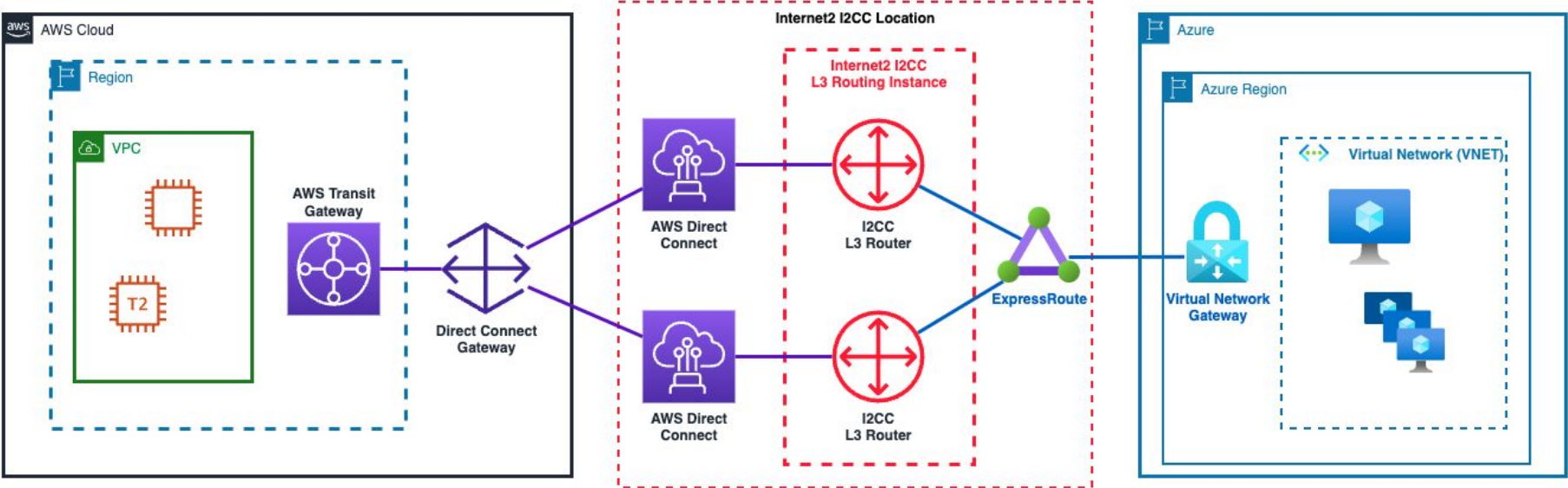


Putting it all together - Build your own network

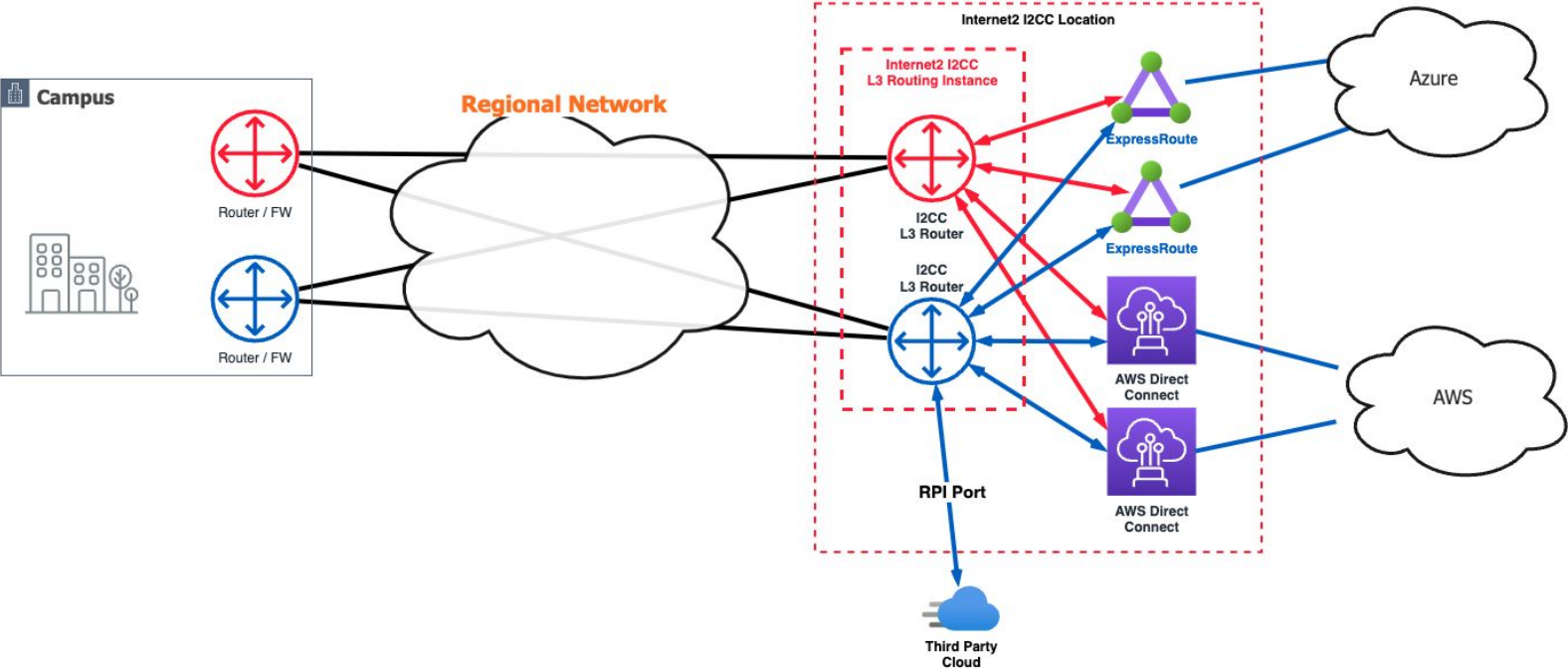
Cloud to Cloud Connectivity

Leverage I2CC so you are not hairpinning traffic back to campus

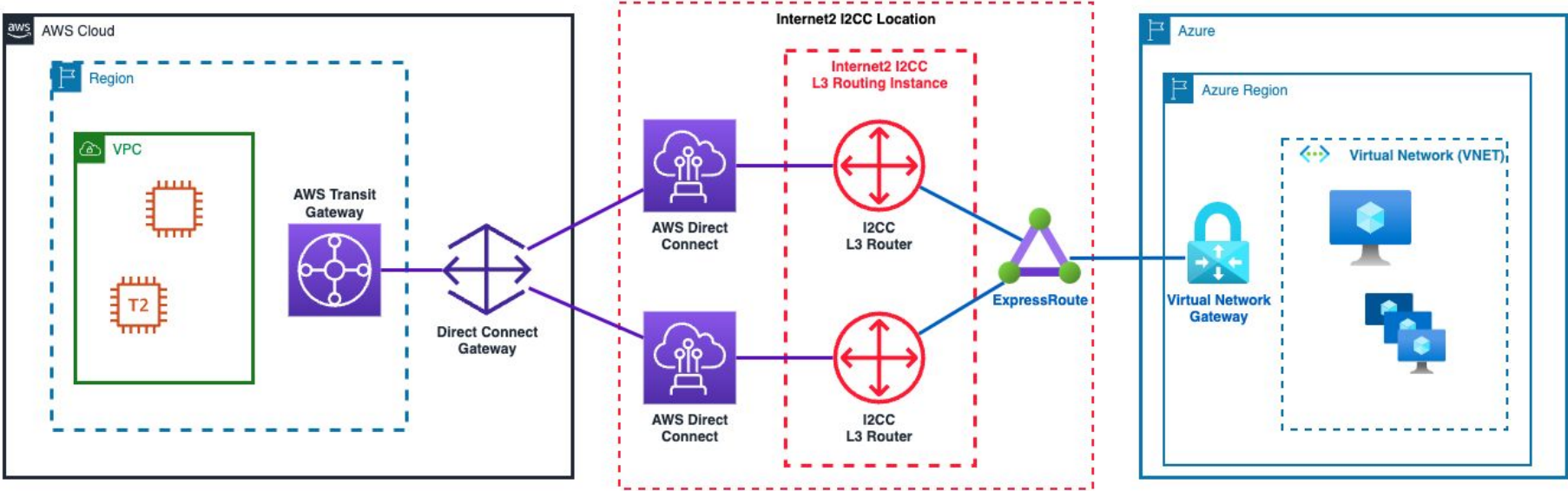
Could do this with VPN connectivity between clouds or leveraging Dedicated Connections



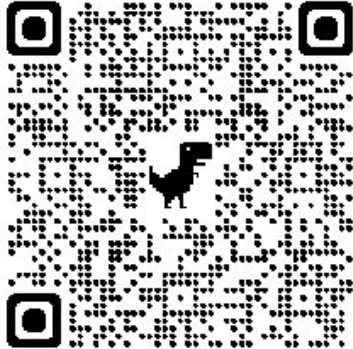
Putting it all together - Build your own network



Putting it all together - Build your own network



Cloud Services Inventory

Cloud Service	Cloud Service Model (Traditional IT, IaaS, PaaS, SaaS)	Primary Connectivity Strategy	Resiliency Strategy
AWS VPC	IaaS	I2CC	IPSEC / VPN: (I2PX + Commodity IP)
O365	SaaS	I2PX	Commodity IP (Internet)
http://bit.ly/3iuis5P			
https://docs.google.com/spreadsheets/d/1CYlo6X8gOTf4vQiiO1etlIF_Yx1pP70f5Ugpl6xZd0M/edit?usp=sharing			



What's Next?!



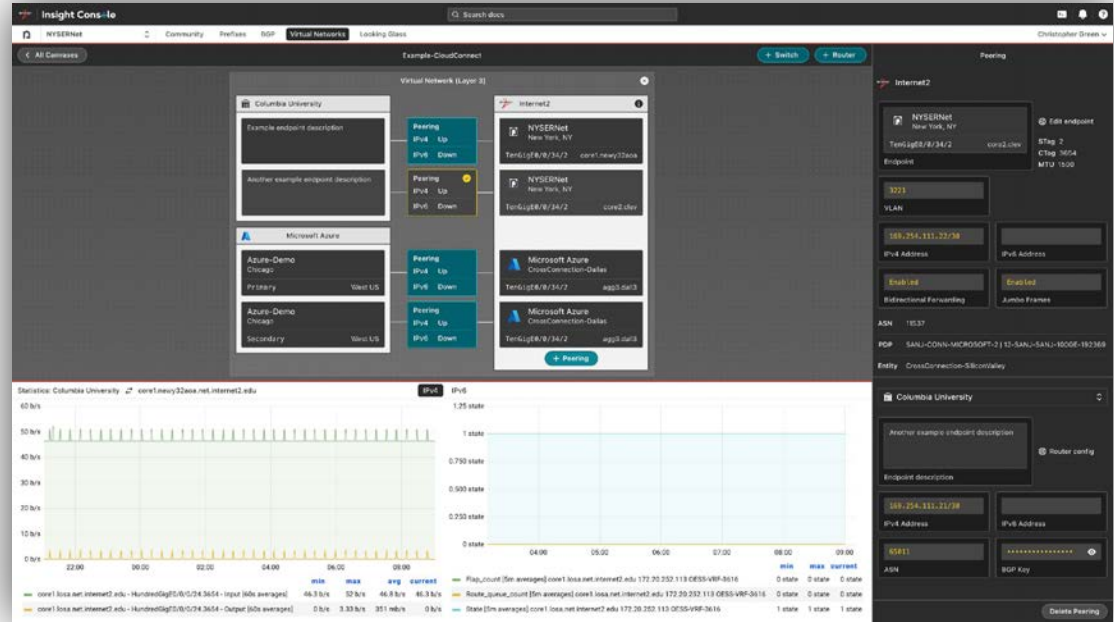
What's Next?!

- ☁ Internet2 Insight Console
- ☁ Regional Networking for Cloud Workshops
 - Hands on Labs
- ☁ What else do you want to see?
 - Best Practices
 - Templates
 - ???

Take Insight Console for a test drive



usability.ns.internet2.edu



Plaza Room 5
Drop-in or schedule in advance



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feedback.ns.internet2.edu

The screenshot shows the 'Internet2 Insight Console' interface. At the top left, it says 'Internet2 Insight Console' with a logo. Below that, a message reads: 'We'd love to hear what you're thinking about. What can we do better? This is the place for you to vote, discuss and share ideas.' There is a text input field labeled 'Enter your suggestion here...' and a 'Powered by Fider' logo below it. On the right, there's a search bar and a user profile icon. The main content area displays a list of suggestions, each with a vote count and a 'Looking Glass' tag. The suggestions are:

- 1** **Commands completing**
Do all commands eventually complete? There's no way to tell if it's just taking a long time or if the process is stuck in a loop or something. I just selected all agg3 and agg4 routers (8 in all) and issued show interfaces desc. It's going on 5 minutes and no telling if these commands wi...
- 2** **In Looking Glass, allow "j" and "e" as synonyms for "include" and "exclude"**
In Looking Glass, allow "j" and "e" as synonyms for "include" and "exclude". Also allow section and synonyms.
- 1** **In Looking Glass, add timestamps to each device output block**
In Looking Glass, add timestamps to each device output block. (See attached screenshot.)
- 3** **I want to share a URL which selects devices and pre-fills the command box in Looking Glass**
When a Network Engineer follows the URL, Looking Glass should open with the devices and command box pre-filled.
- 1** **Clear command output**

What should Insight Console do?

How can it be improved?

Share and vote on ideas.

What's Next?!

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Feedback - Discussion - Questions?



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