Cloud Learning and Skills Sessions

Spring Cohort: April 29 – May 10, 2024

Networking/IaC Project

Team Members:

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Project Objective

Quickly and repeatably build hosted connectivity using Internet2's Cloud Connection (I2CC) using Internet2's Insight Console

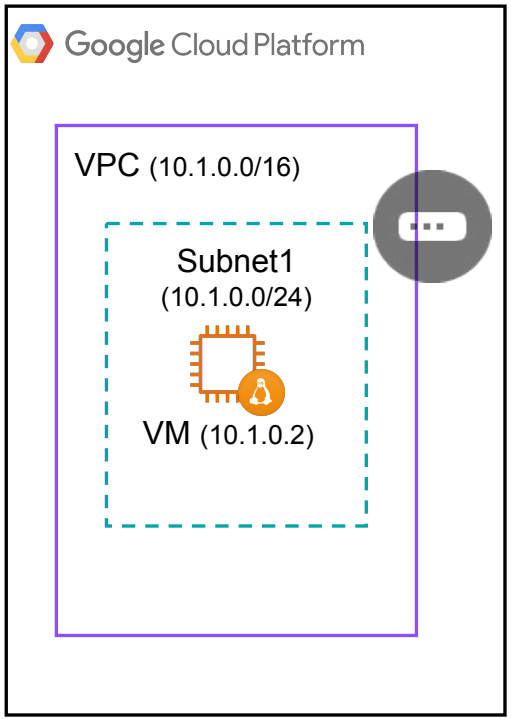
The Plan

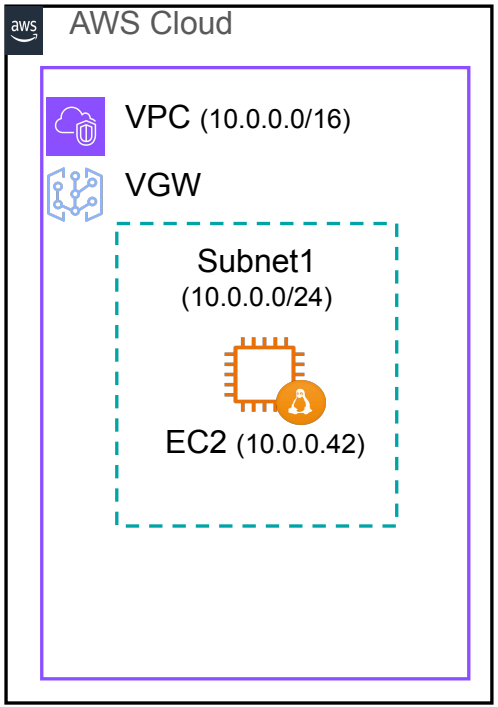
- Manually create a VPN connections between AWS and GCP
- Manually create the I2CC, connections between AWS and GCP
- Figure out the Terraform code

STEP1

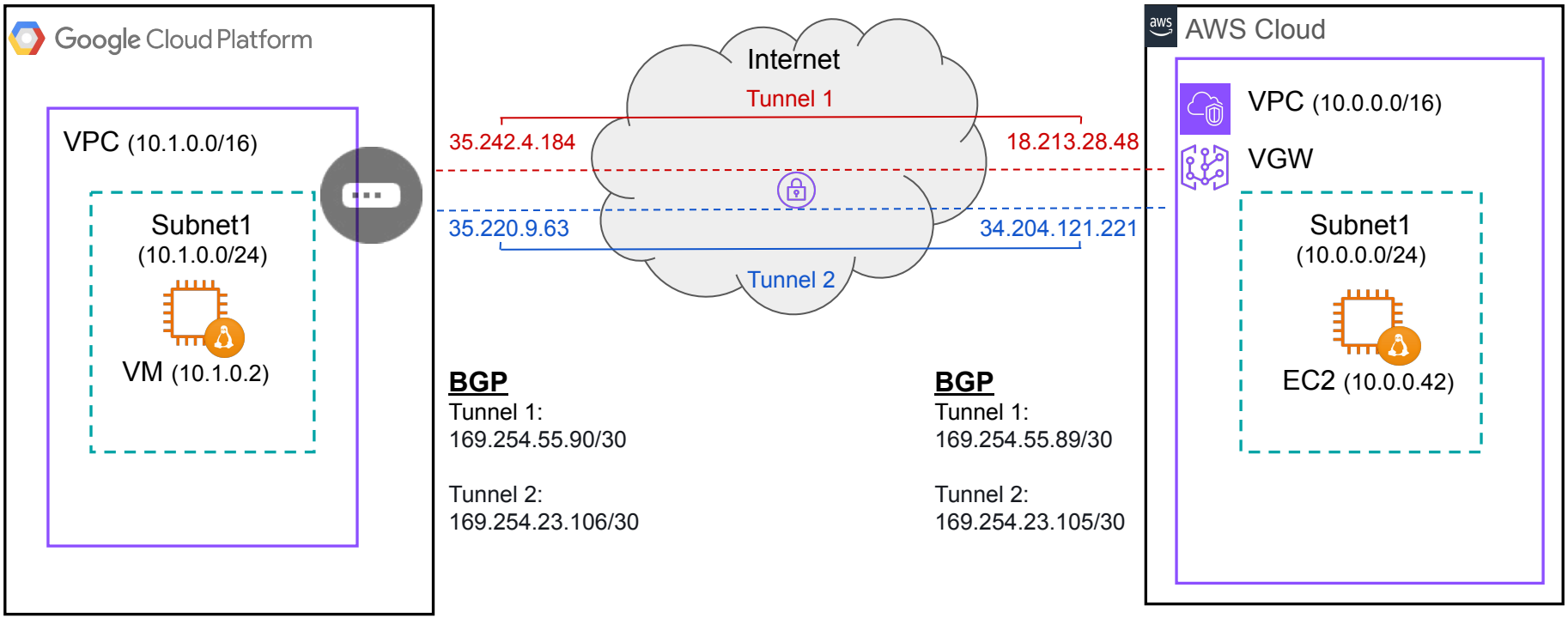
Manually create a VPN connections between AWS and GCP

VPN connections GCP and AWS





aws ⟺ via IPSEC Tunnel

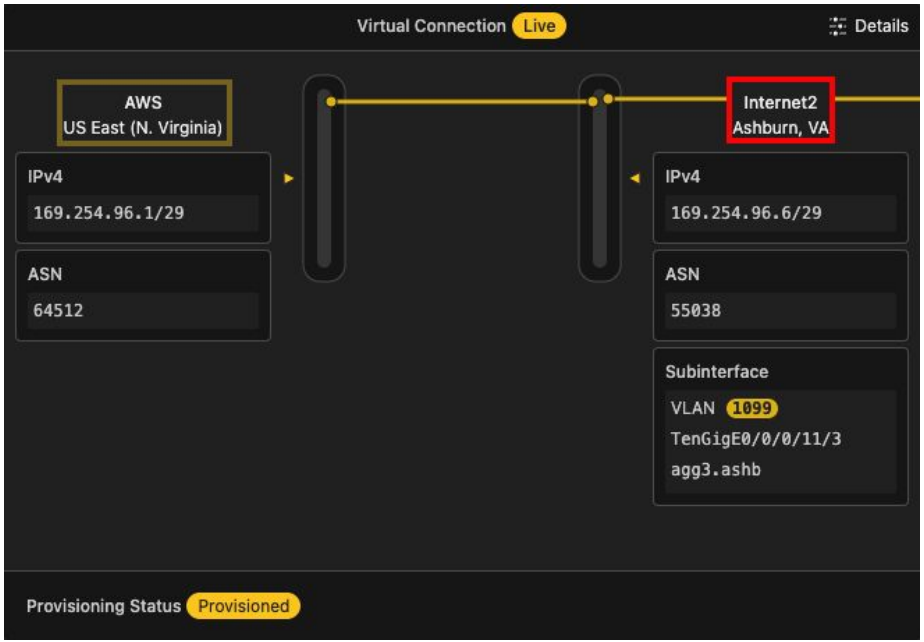


STEP 2

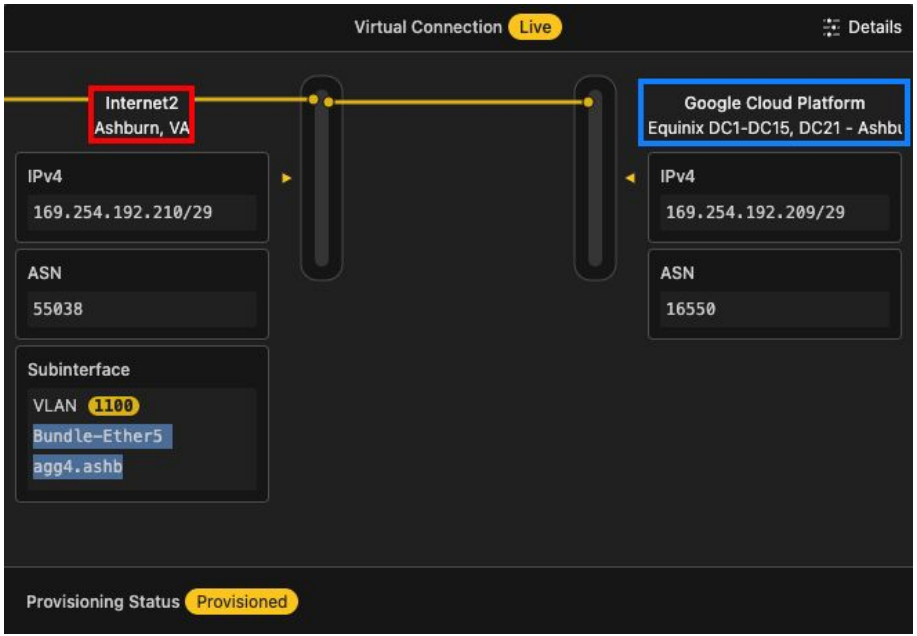
Manually create the I2CC, connections between AWS and GCP

INTERNET2®

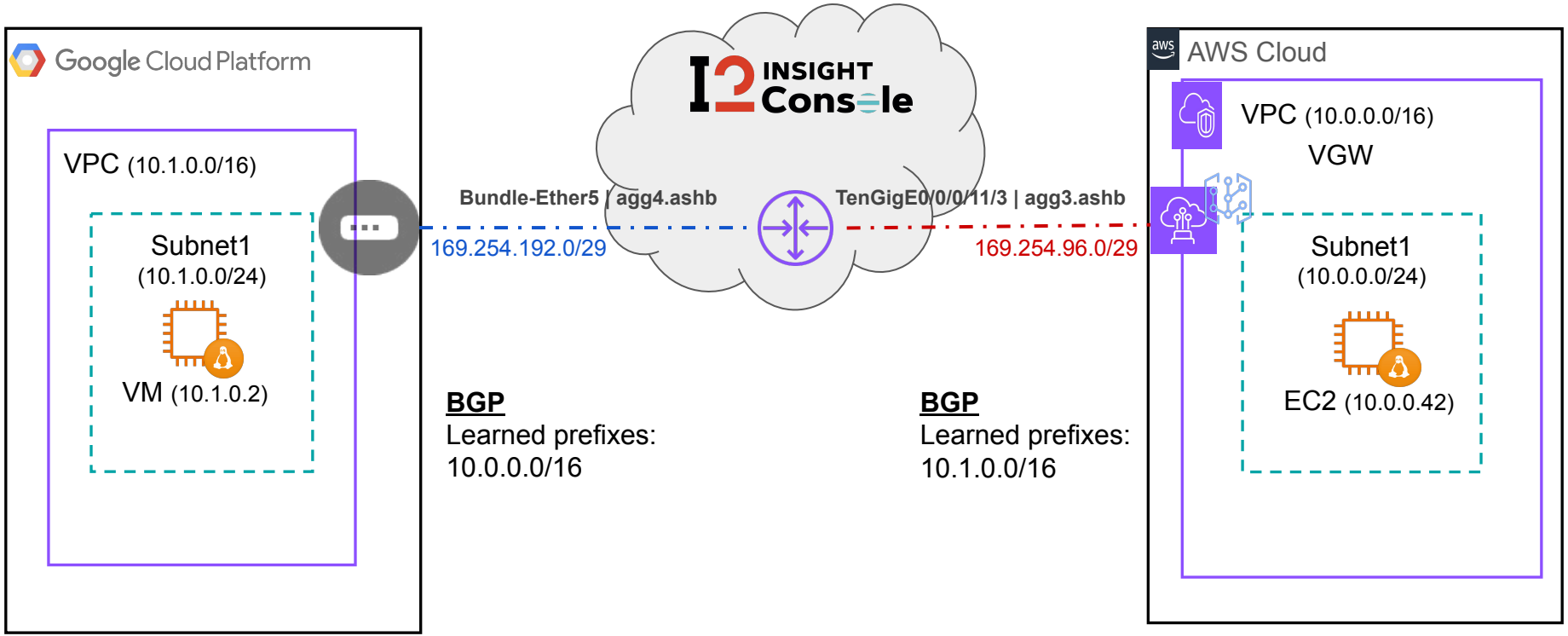
Insight Console



Insight Console



aws ⟺ via I2IC Broker Connection



BGP Peering in aws

INTERNET 2 Broker

ID	BGP ASN	Your router peer IP	Amazon router p...	AWS logica...	State	BGP status
dxpeer-ffum10wa	55038	169.254.96.6/29	169.254.96.1/29	EqDC2-20v...	available	up

VPN tunnel

Tunnel number	Outside IP address	Inside IPv4 CIDR	Inside IPv6	Status	Last status change	Details
Tunnel 1	18.213.28.48	169.254.55.88/30	–	Up	May 7, 2024, 15:25:30	1 BGP ROUTES
Tunnel 2	34.204.121.221	169.254.23.104/30	–	Up	May 7, 2024, 15:39:58	1 BGP ROUTES

BGP Peering in

Google ASN	Interconnect / VPN gateway	Connection	BGP sessions
65000	i2-project-gcp-vpn-1	i2-project-gcp-vpntunnel-1 i2-project-gcp-vpntunnel-2	i2-project-gcp-bgp-1 i2-project-gcp-bgp-2
16550	gci-ashb-100g-zone2	i2-project-gcp-vlan-1	auto-ia-bgp-i2-project-gcp--5da65c803534b8e

auto-ia-bgp-i2-project-gcp--5da65c8035

Name
auto-ia-bgp-i2-project-gcp--5da65c803534b8e

Lowercase letters, number

Sets the broker path as the preferred path

Peer ASN *
55038

Advertised route priority (MED)
0

MED value is used for Active/Passive configuration

Cloud Router BGP IP
169.254.192.209

BGP peer IP
169.254.192.210

i2-project-gcp-bgp-1

Name *
i2-project-gcp-bgp-1

Lowercase letters, numbers

Sets the VPN Tunnel path as the less preferred path

Peer ASN *
65001

Advertised route priority (MED)
100

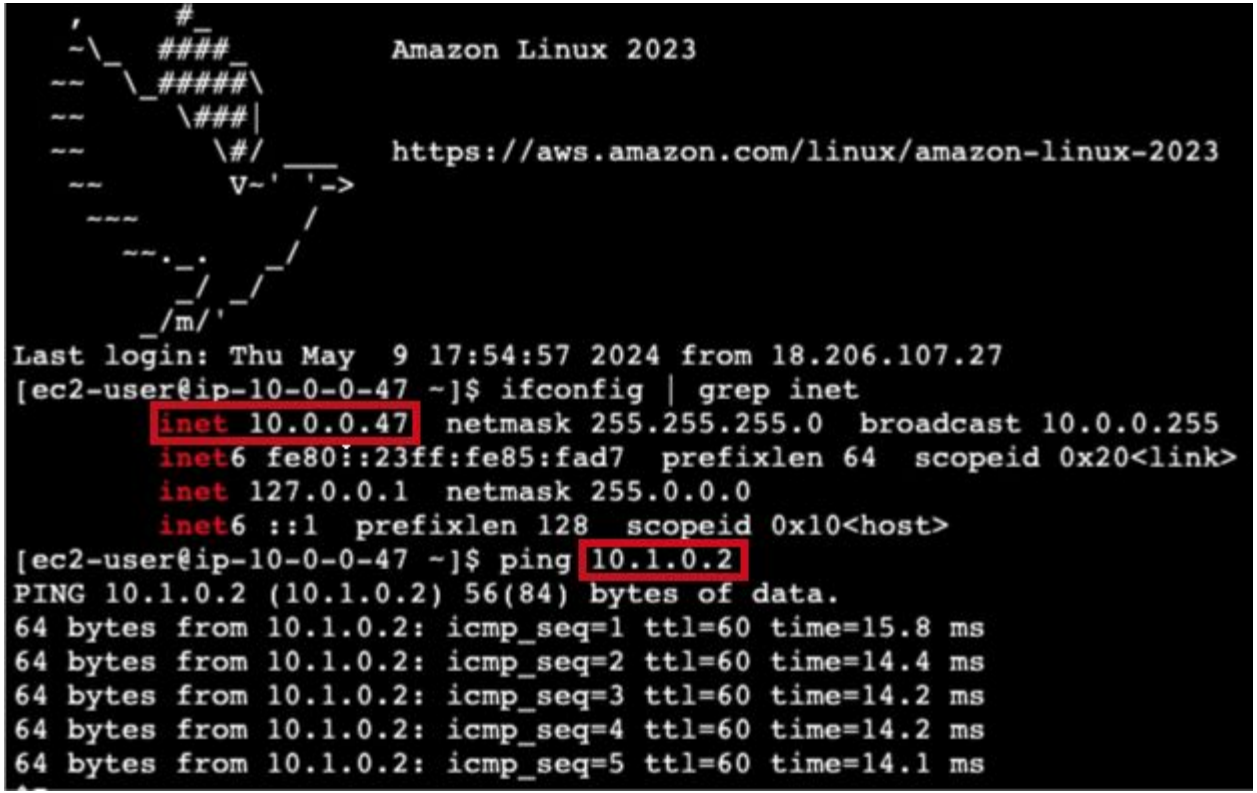
MED value is used for Active/Passive configuration

SSH-in-browser

```
Linux i2-project-vm-1.c.class-adv2024-vueibaezis10.internal 6.1.0-20-cloud-
04-11) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Thu May  9 17:57:44 2024 from 35.235.240.65
jeffery_bowmar@i2-project-vm-1:~$ ip address | grep "inet 10"
    inet 10.1.0.2/32 metric 100 scope global dynamic ens4
jeffery_bowmar@i2-project-vm-1:~$ ping 10.0.0.47
PING 10.0.0.47 (10.0.0.47) 56(84) bytes of data.
64 bytes from 10.0.0.47: icmp_seq=1 ttl=125 time=16.3 ms
64 bytes from 10.0.0.47: icmp_seq=2 ttl=125 time=14.3 ms
64 bytes from 10.0.0.47: icmp_seq=3 ttl=125 time=14.3 ms
64 bytes from 10.0.0.47: icmp_seq=4 ttl=125 time=14.2 ms
64 bytes from 10.0.0.47: icmp_seq=5 ttl=125 time=14.2 ms
64 bytes from 10.0.0.47: icmp_seq=6 ttl=125 time=14.3 ms
64 bytes from 10.0.0.47: icmp_seq=7 ttl=125 time=15.2 ms
```


Access to
Amazon Linux 2023
https://aws.amazon.com/linux/amazon-linux-2023
Last login: Thu May 9 17:54:57 2024 from 18.206.107.27
[ec2-user@ip-10-0-0-47 ~]$ ifconfig | grep inet
inet 10.0.0.47 netmask 255.255.255.0 broadcast 10.0.0.255
inet6 fe80::23ff:fe85:fad7 prefixlen 64 scopeid 0x20<link>
inet 127.0.0.1 netmask 255.0.0.0
inet6 ::1 prefixlen 128 scopeid 0x10<host>
[ec2-user@ip-10-0-0-47 ~]$ ping 10.1.0.2
PING 10.1.0.2 (10.1.0.2) 56(84) bytes of data.
64 bytes from 10.1.0.2: icmp_seq=1 ttl=60 time=15.8 ms
64 bytes from 10.1.0.2: icmp_seq=2 ttl=60 time=14.4 ms
64 bytes from 10.1.0.2: icmp_seq=3 ttl=60 time=14.2 ms
64 bytes from 10.1.0.2: icmp_seq=4 ttl=60 time=14.2 ms
64 bytes from 10.1.0.2: icmp_seq=5 ttl=60 time=14.1 ms

Access to aws

Name	Instance ID	Status check	Public IPv4 address
i2-project-aws-vm-1	i-02962c50896e31b10	2/2 checks passed	44.201.1.151

aws security group

```
jeffery.bowmar@J4KQ6MWDQC ~ % ifconfig | grep "inet 192"
        inet 19          28 netmask 0xffffff00 broadcast 192.168.0.255
jeffery.bowmar@J4KQ6MWDQC ~ % ping 44.201.1.151
PING 44.201.1.151 (44.201.1.151): 56 data bytes
Request timeout for icmp_seq 0
Request timeout for icmp_seq 1
Request timeout for icmp_seq 2
Request timeout for icmp_seq 3
Request timeout for icmp_seq 4
Request timeout for icmp_seq 5
```

i2-project-vm-1 EDIT RESET CREATE MACHINE IMAGE

Network interfaces

Name	Network	Subnetwork	Primary internal IP address	External IP address
nic0	i2-project-gcp-vpc-1	i2-project-gcp-subnet-1	10.1.0.2	35.211.167.233 (Ephemeral)


```
jeffery.bowmar@J4KQ6MWDQC ~ % ifconfig | grep "inet 192"
        inet 19          28 netmask 0xffffff00 broadcast 192.168.0.255
jeffery.bowmar@J4KQ6MWDQC ~ % ping 35.211.167.233
PING 35.211.167.233 (35.211.167.233): 56 data bytes
64 bytes from 35.211.167.233: icmp_seq=0 ttl=56 time=58.969 ms
64 bytes from 35.211.167.233: icmp_seq=1 ttl=56 time=56.096 ms
64 bytes from 35.211.167.233: icmp_seq=2 ttl=56 time=53.563 ms
64 bytes from 35.211.167.233: icmp_seq=3 ttl=56 time=54.190 ms
64 bytes from 35.211.167.233: icmp_seq=4 ttl=56 time=58.212 ms
```

STEP 3

Figure out the Terraform code

VPN vs Direct Connect

VPN

- A (VPC) over the Internet.
- Quicker to Spin Up
- More cost-effective
- Relies on encryption and security measures
- Traverse through internet paths

Direct Connect

- Physical, Dedicated connection
- More complex to set up
- Very low latency
- The connection is more secure
- Deterministic traffic routing

Direct Connection

SSH-in-browser

```
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64 bytes from 10.0.0.47: icmp_seq=4 ttl=125 time=14.2 ms
64 bytes from 10.0.0.47: icmp_seq=5 ttl=125 time=14.2 ms
64 bytes from 10.0.0.47: icmp_seq=6 ttl=125 time=14.3 ms
64 bytes from 10.0.0.47: icmp_seq=7 ttl=125 time=15.2 ms
```
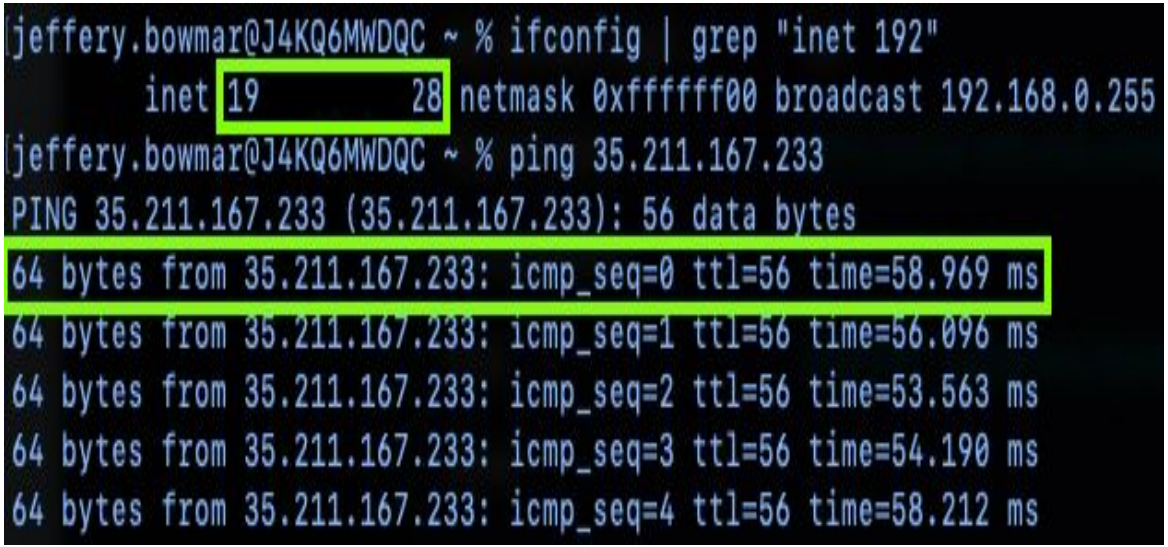

VPN Connection



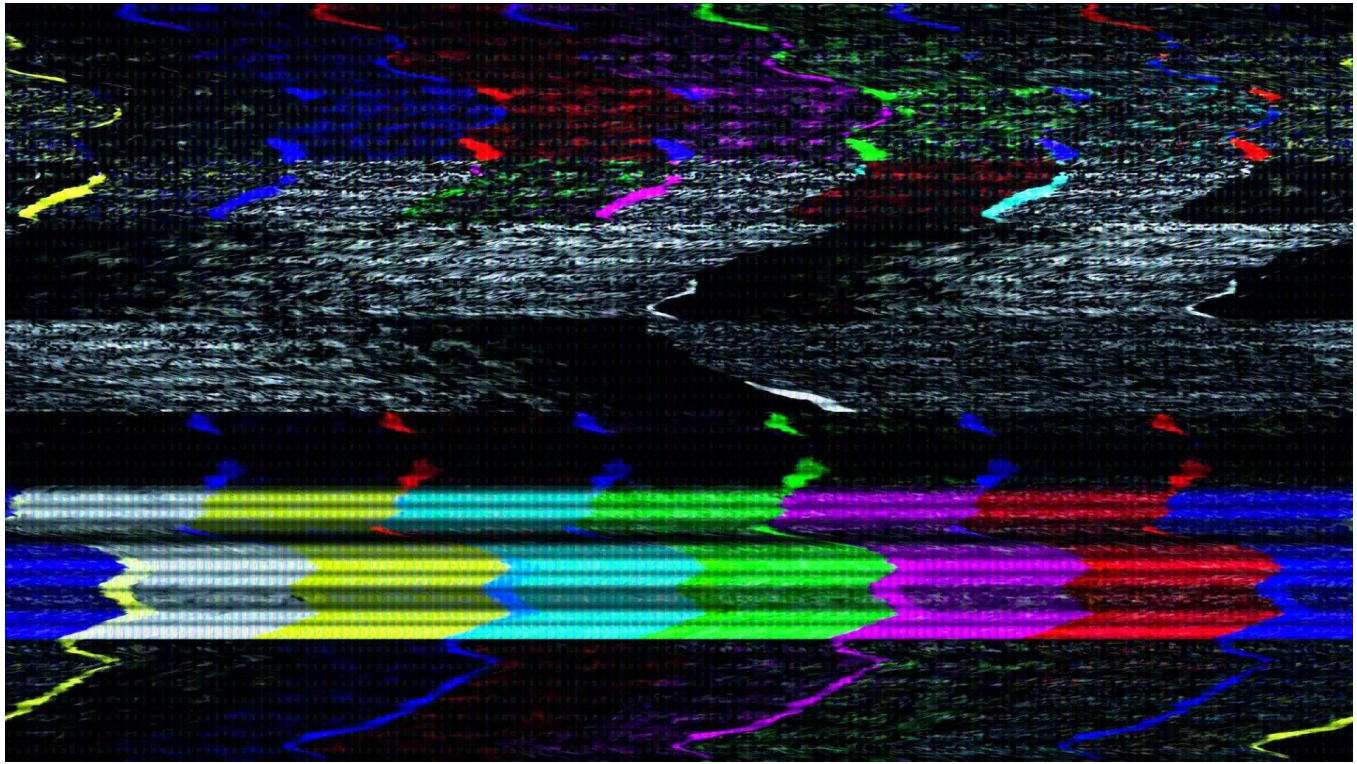
It's all about the $$$

AWS					
Connection Type	Egress Costs		Runtime Costs	Total $ (Monthly)	
	@1TB/month	@10TBs/Month	N/A	@1TB/month	@10 TBs/Month
AWS Direct Connect †	$20.48	$204.80	$144.00 (AWS) + $250.00 (I2)	$414.48	$598.80
AWS VPN Tunnel *	$92.16	$921.60	$72.00	$170.10	$993.60
GCP					
Connection Type	Egress Costs		Runtime Costs	Total $ (Monthly)	
	@1TB/month	@10TBs/Month	N/A	@1TB/month	@10TBs/Month
GCP Interconnect	$20.48	$204.80	$124.99(GCP) + $250 (I2)	$395.47	$579.79
GCP VPN Tunnel	$112.64	$1,264.00	$72.00	$184.64	$1336.00

† Based on 500Mbps Direct Connect Connection

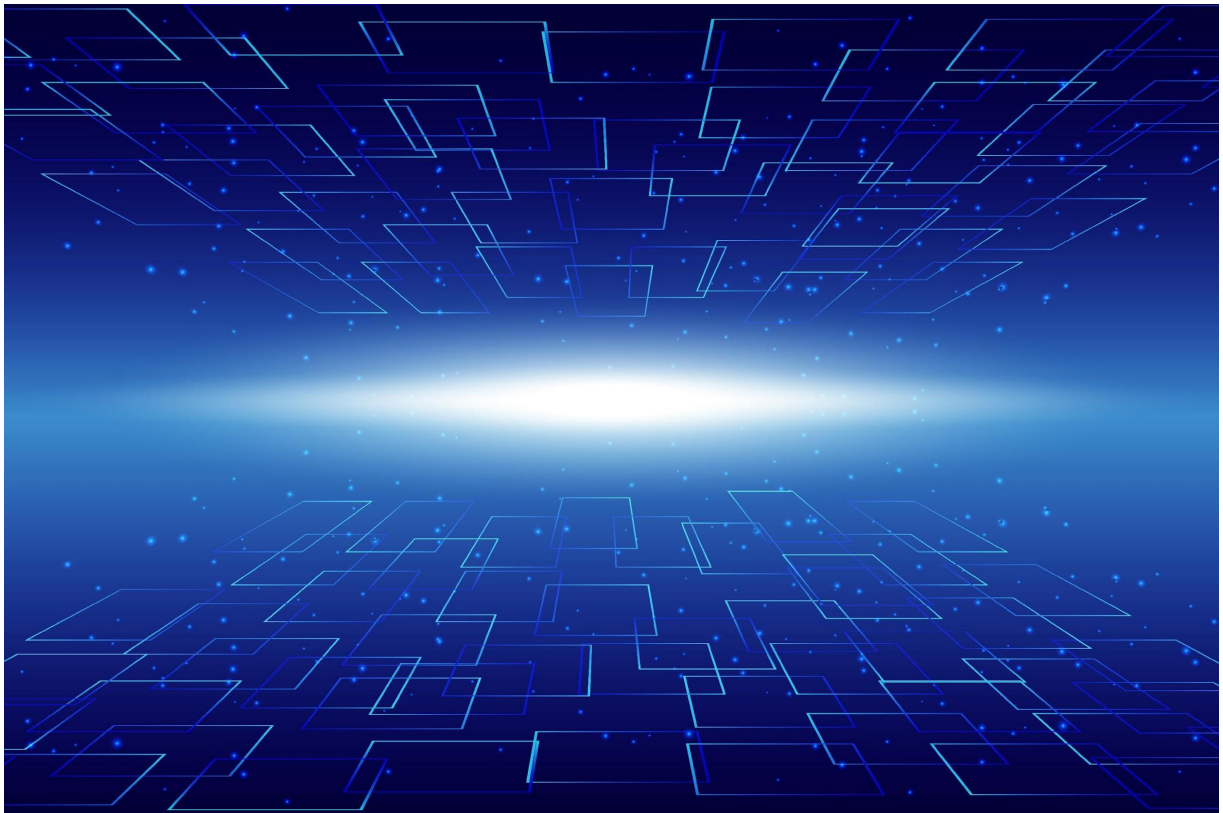
* Hyperlinks point to connection pricing

Project Issue



I2IC Provisioning Issue

Future of Project



Questions