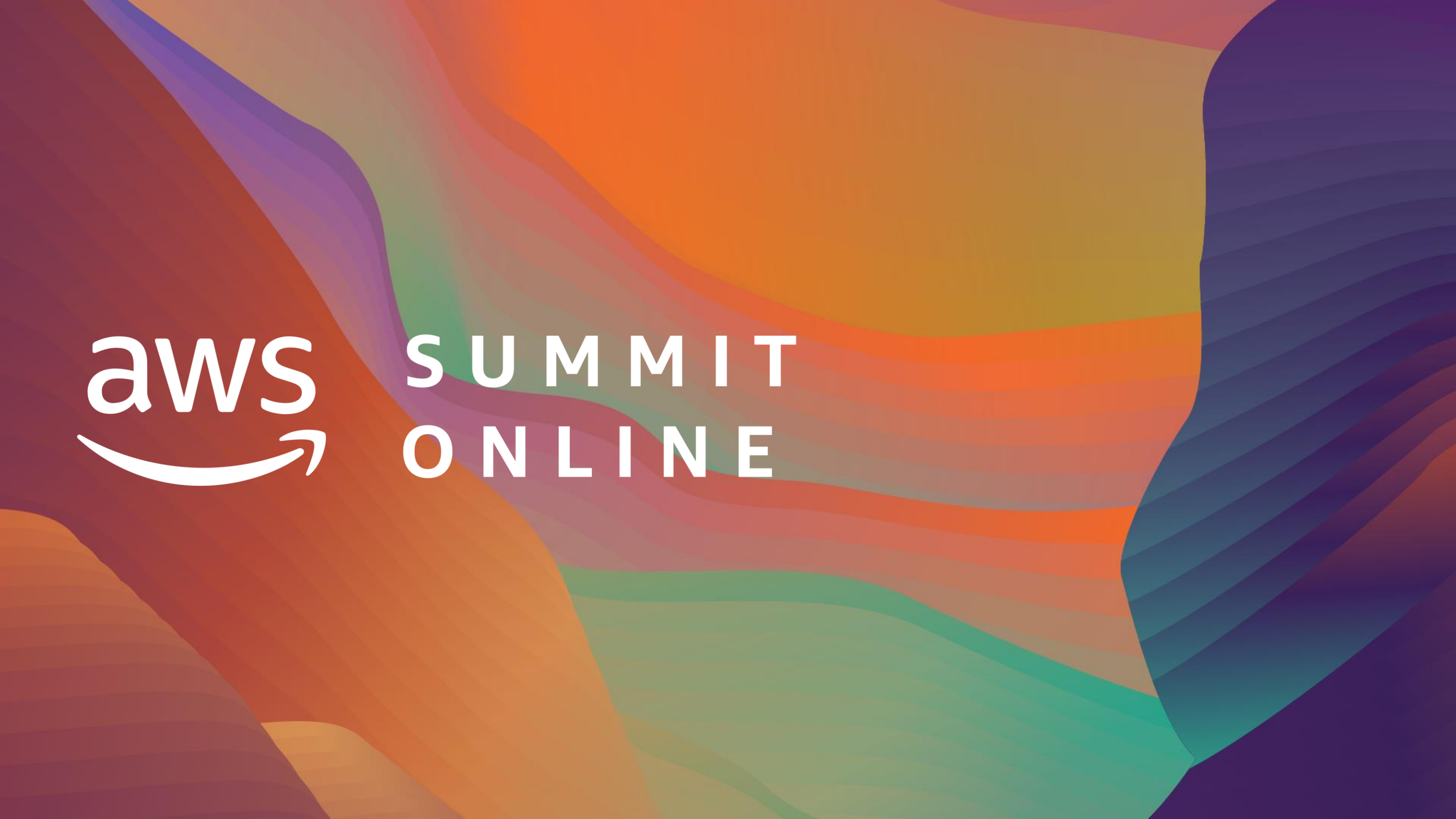
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Advanced VPC connectivity patterns

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Agenda

Connecting to AWS (AWS Direct Connect)

Routing within AWS (VPC Peering and AWS Transit Gateway)

Sharing services in AWS (AWS PrivateLink)

DNS (Amazon Route 53 Resolver)

Connecting to AWS

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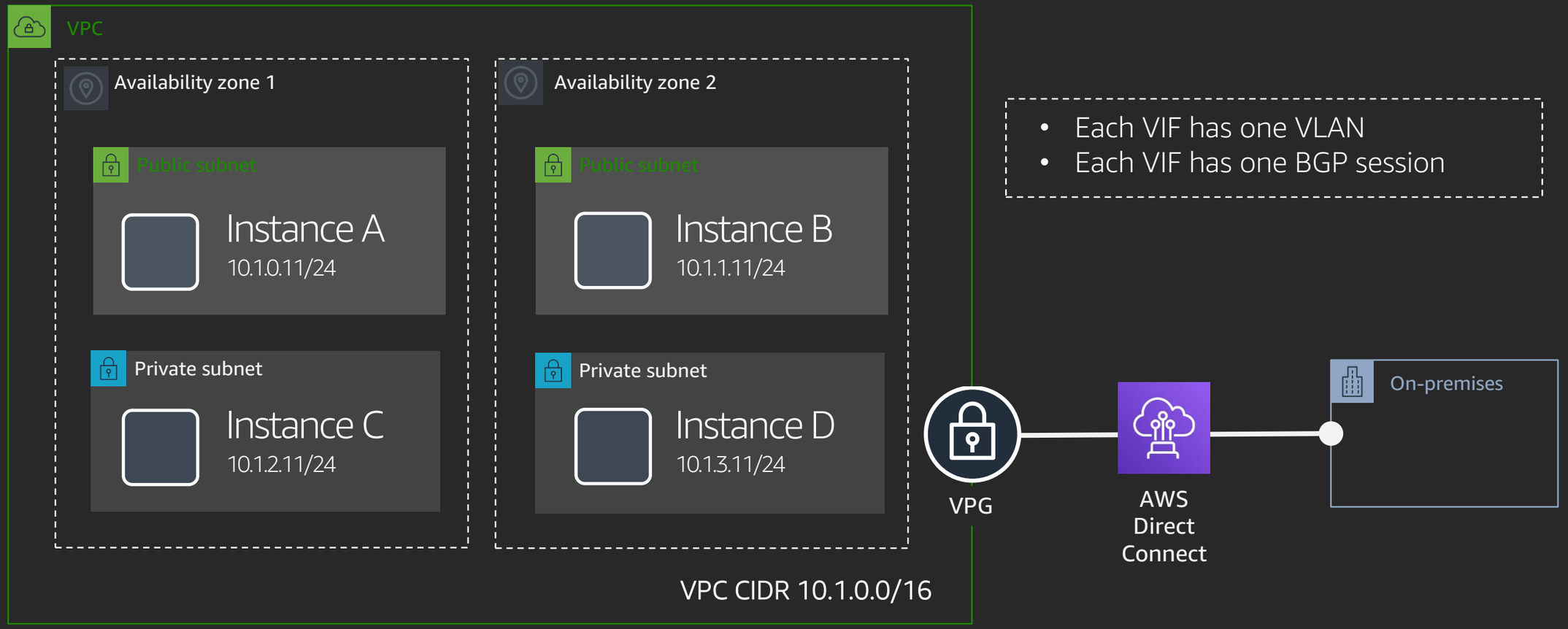
AWS Direct Connect

Private connections to VPCs

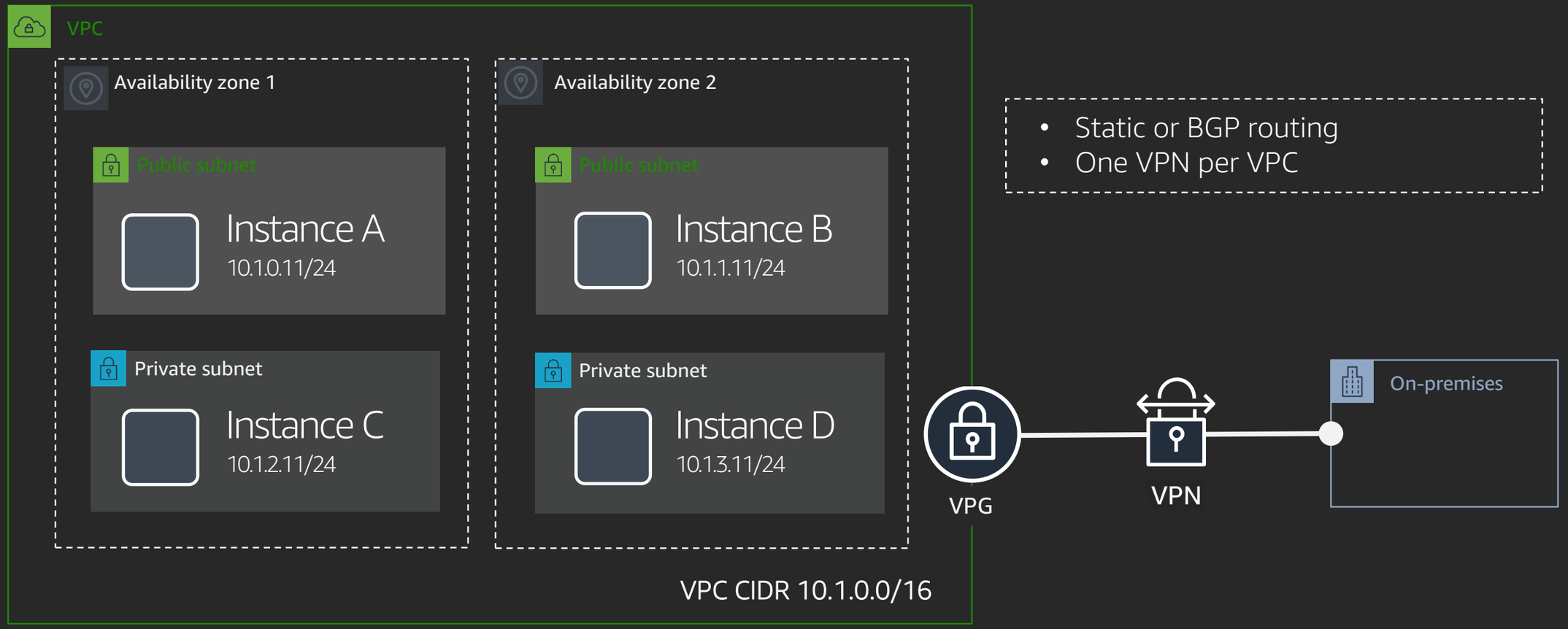
The original way: Private VIF



Sidenote: AWS site-to-site VPN

Managed private connections to VPCs

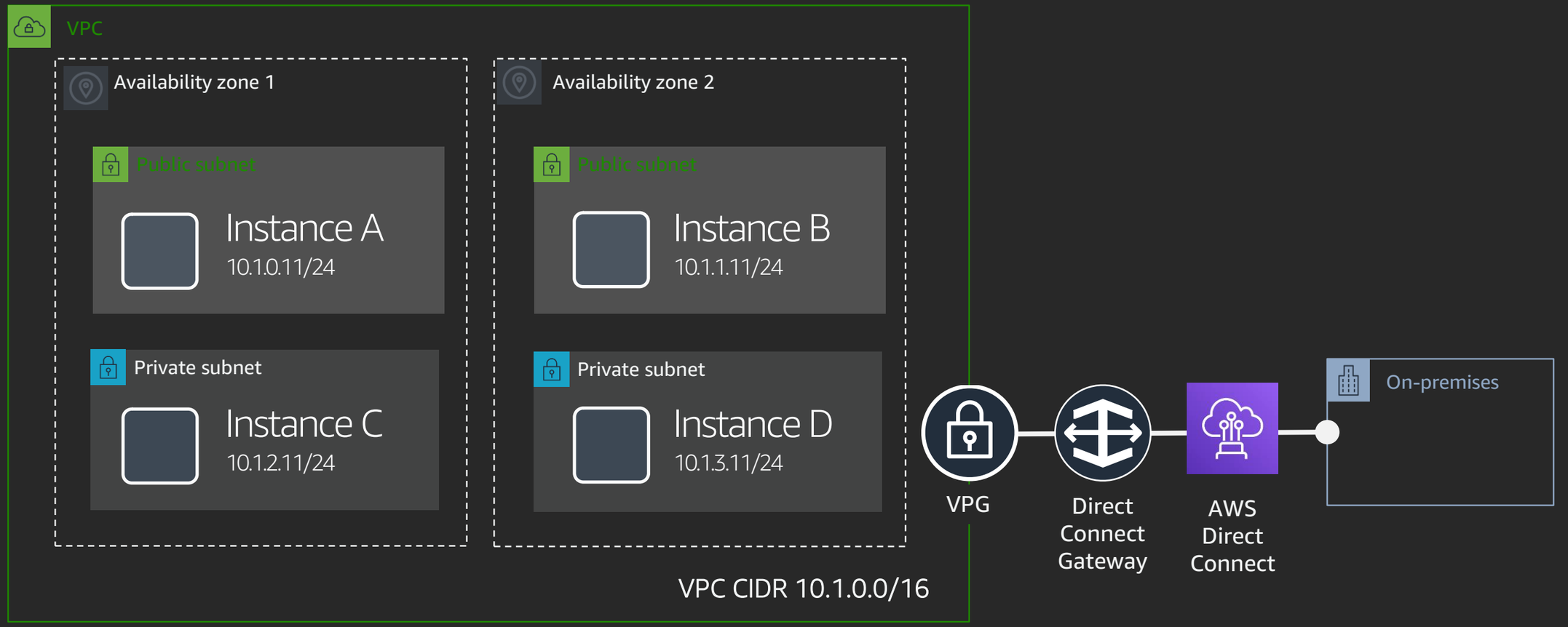
Primary or backup connection



AWS Direct Connect

Private connections to VPCs

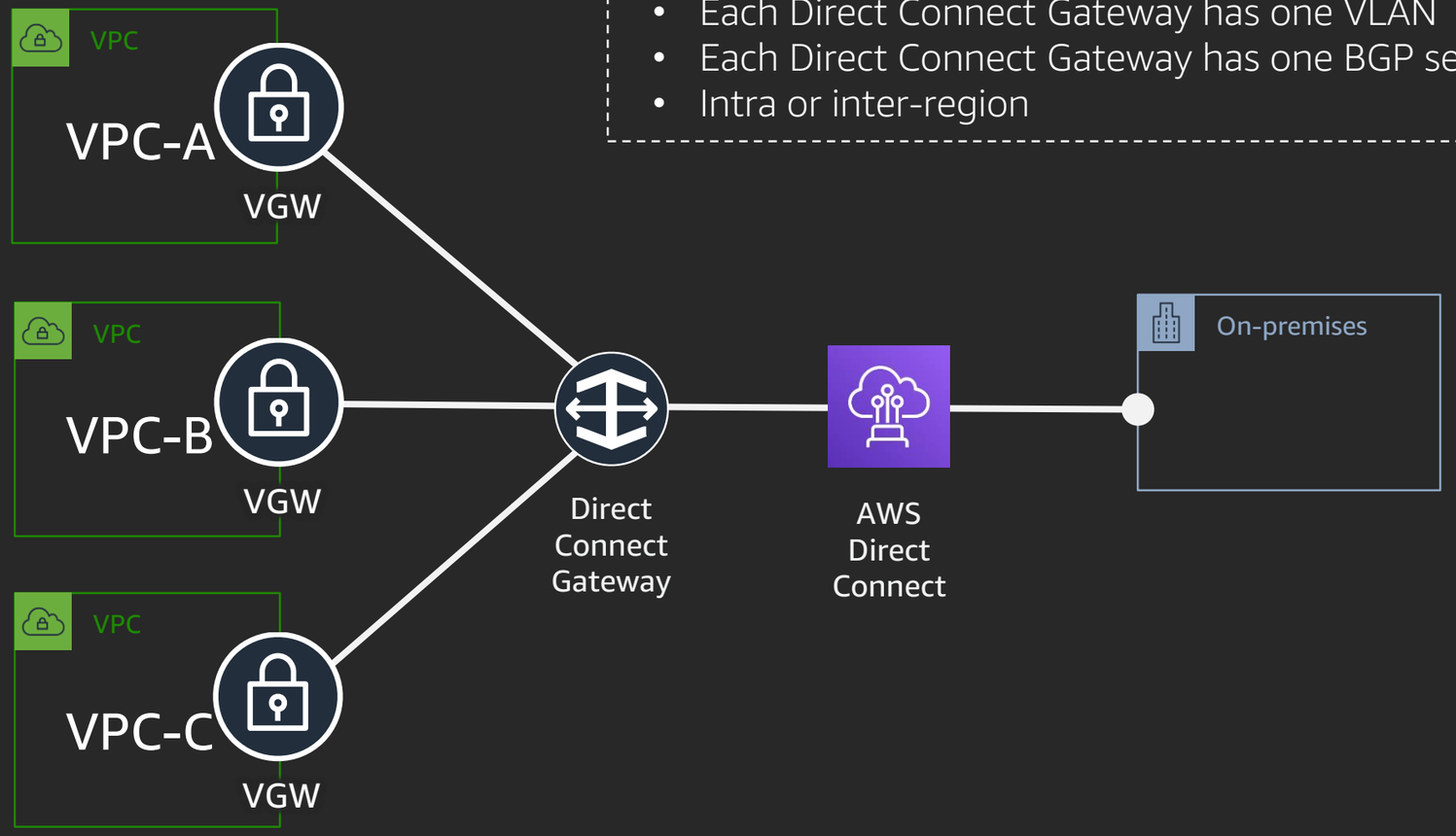
The newer way: AWS Direct Connect Gateway



AWS Direct Connect with Direct Connect Gateway

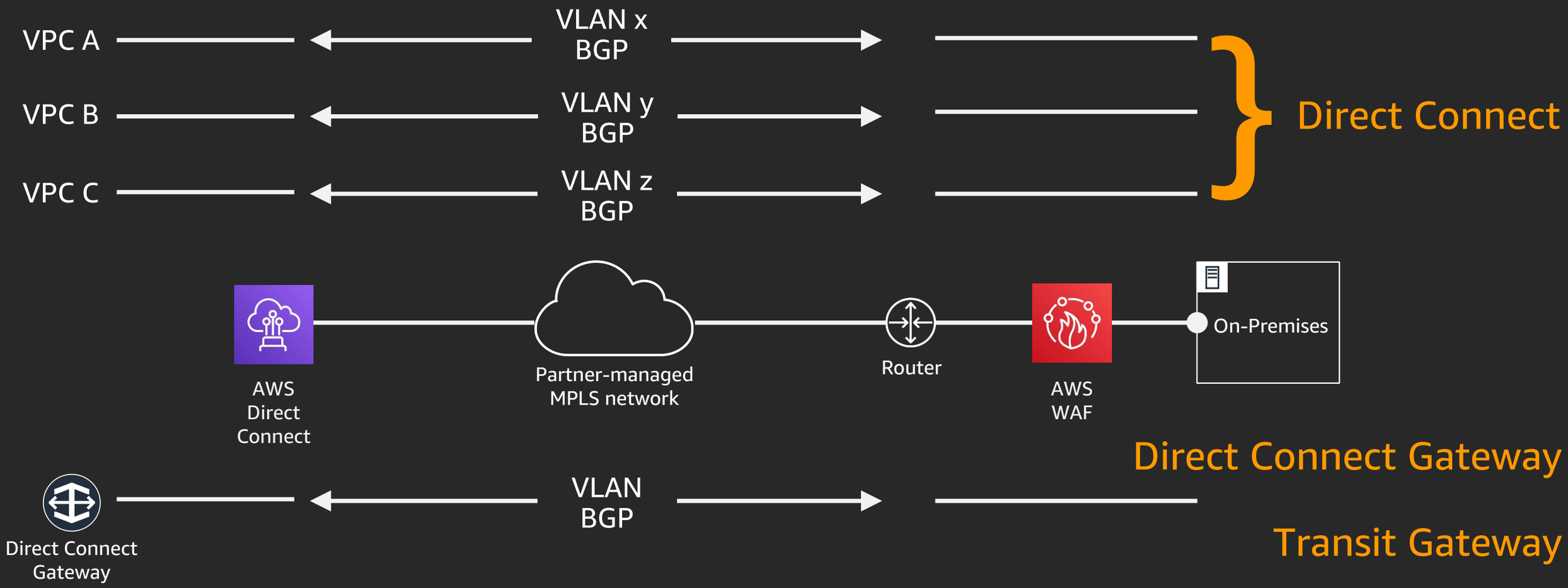
Private connections to VPCs

- Each Direct Connect Gateway has one VLAN
- Each Direct Connect Gateway has one BGP session
- Intra or inter-region



Sidenote: Customer premises equipment

Or: What do you need to do?



AWS Direct Connect

Public connections

Why have a public connection to AWS over a private network?

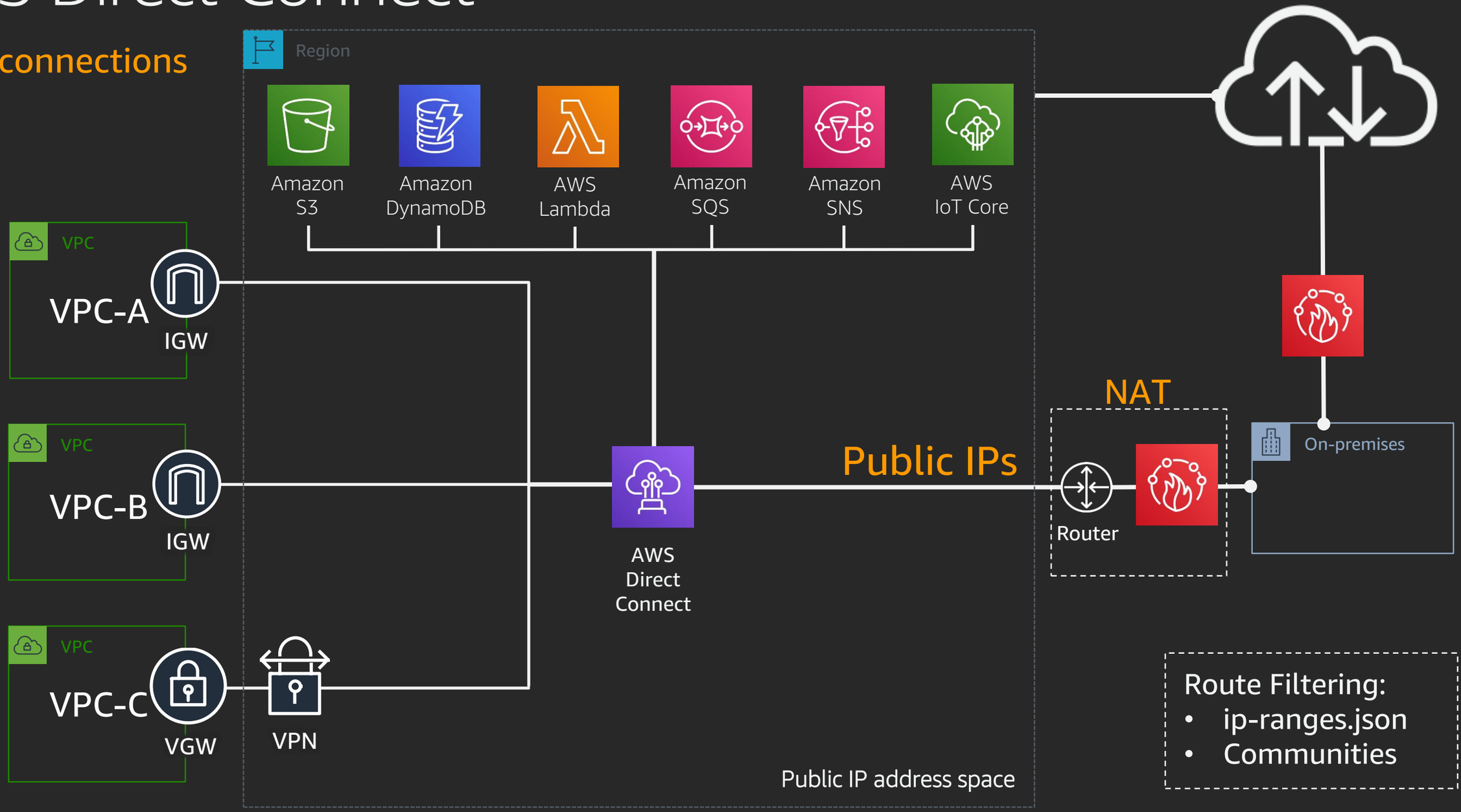
- Reduce congestion on existing Internet link
- Deliver guaranteed bandwidth
- Less latency variation (jitter)
- Encrypt traffic to VPC over Direct Connect using AWS VPN

Why not have a public connection to AWS over a private network?

- Requires additional routed connections (VLANs and BGP)
- Requires customer-side firewall
- Not just AWS services – all AWS customer IPs are also advertised
- Most likely requires customer-side NAT

AWS Direct Connect

Public connections



Route Filtering:

- ip-ranges.json
- Communities

Routing within AWS

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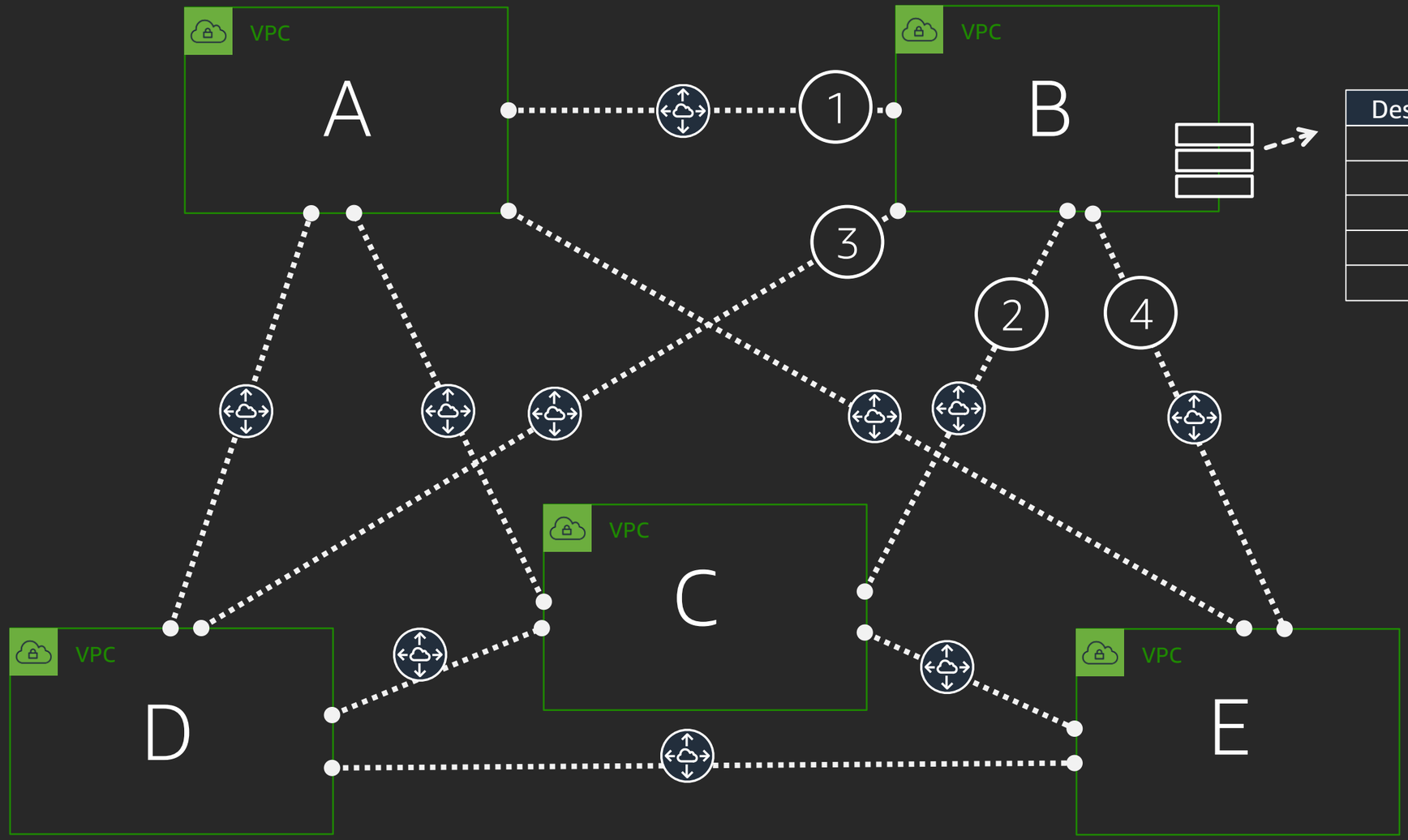
VPC peering

Or: Start simple, and then…



Destination	Target
B	Local
A	PCX-1
C	PCX-2
D	PCX-3
E	PCX-4

VPC peering

Q: How many peering connections do I need for a full mesh?

$$\frac{n(n-1)}{2}$$

VPC peering

Q: How many peering connections do I need for a full mesh?

$$\frac{10(10-1)}{2} = 45$$

VPC peering

Q: How many peering connections do I need for a full mesh?

$$\frac{100(100-1)}{2} = 4500$$

VPC peering

Why is this a problem?

Static routes per Amazon VPC route table

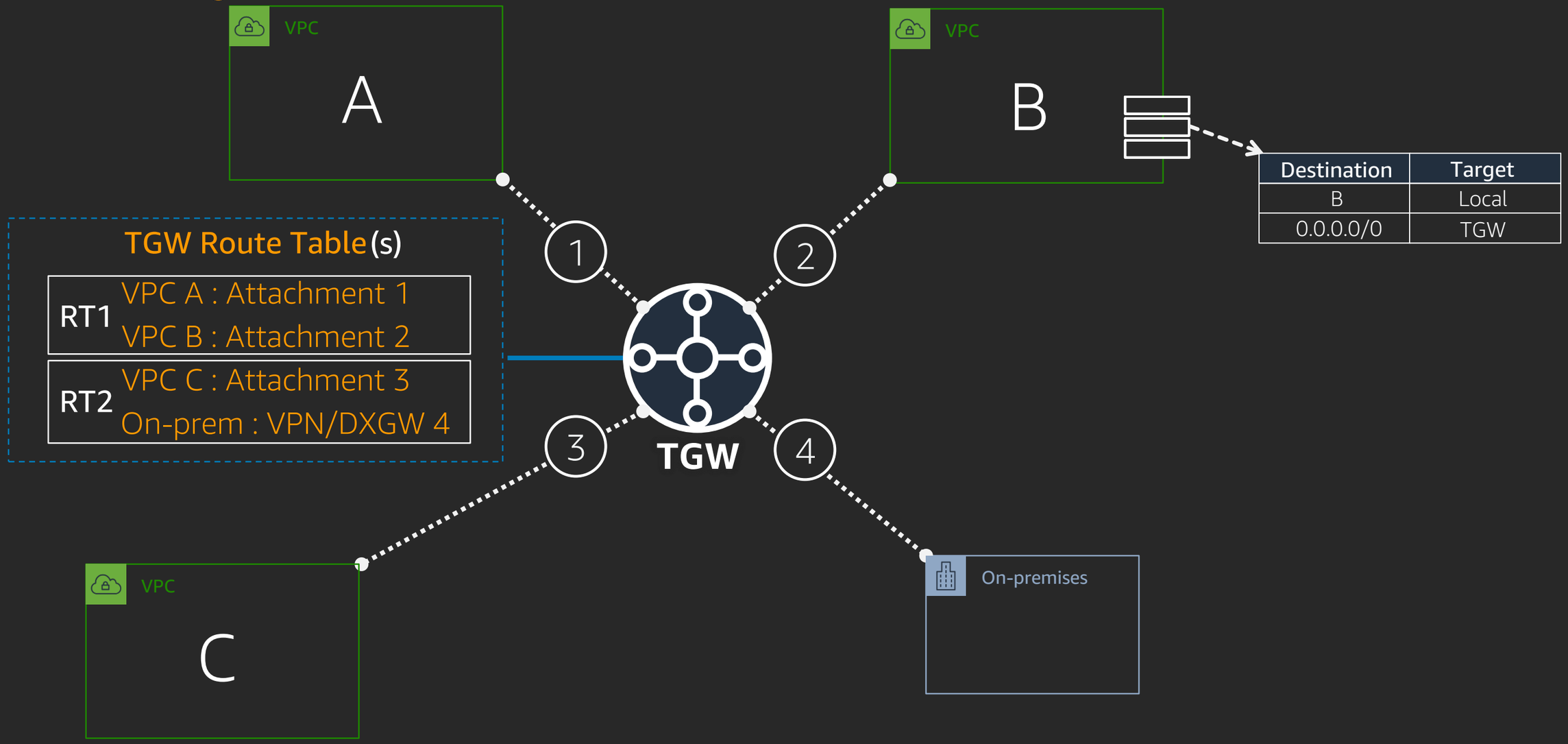
100

Amazon VPC Peering connections per Amazon VPC

125

AWS Transit Gateway

Cloud-scale routing



AWS Transit Gateway Terms

Attachment

The connection from a Amazon VPC, VPN or AWS Direct Connect to AWS Transit Gateway

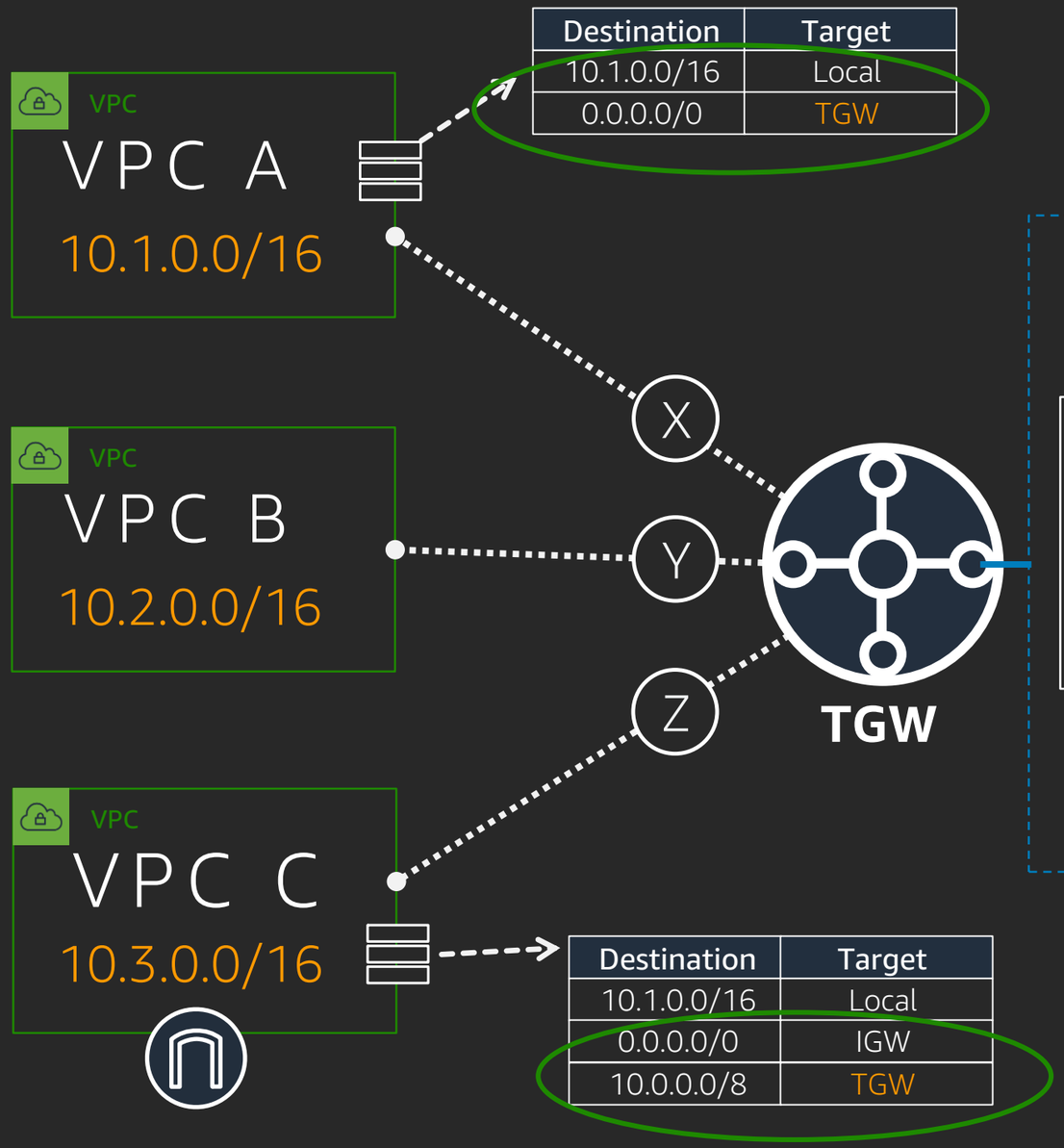
Association

The route table used to route packets coming from an attachment (from an Amazon VPC and VPN)

Propagation

The route table where the attachment’s routes are installed

AWS Transit Gateway example



Transit Gateway Route Table (s)

	Associations	Propagations	Routes
RT1	VPC A from X	VPC A from X	10.1.0.0/16 via X
	VPC B from Y	VPC B from Y	10.2.0.0/16 via Y
	VPC C from Z	VPC C from Z	10.3.0.0/16 via Z

With propagation turned off, you can still statically configure routes

AWS Transit Gateway

Other advantages

Can create multiple Transit Gateway route tables

- Use these to create isolated sets of VPCs
- For example:
  - Production VPCs can use Direct Connect and communicate with each other and on-premises
  - Dev/Test VPCs can use Direct connect and communicate with each other and on-premises
  - Production and Dev/Test cannot communicate with each other

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VPCs with overlapping CIDR blocks can use the same Transit Gateway

- But they must communicate through NAT
- Transit Gateway does not fix fundamental routing problems

Sharing services in AWS

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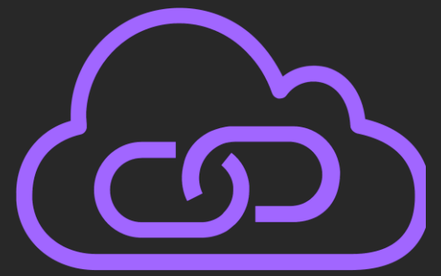
AWS PrivateLink



What is it?

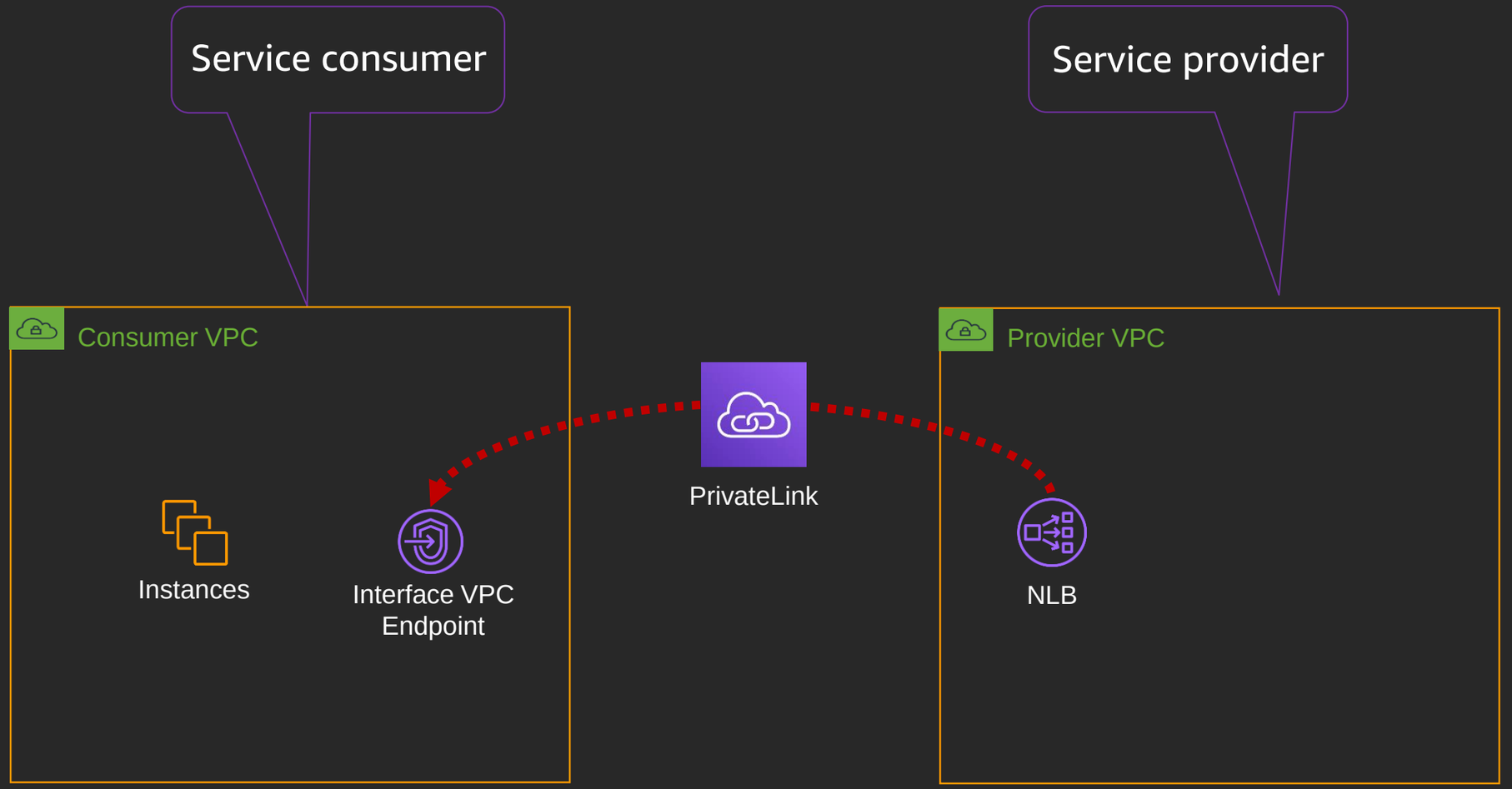
Reach resources in another VPC, AWS Services, On-premises

- Eliminate the exposure of data to the public Internet
- Without peering or routing
- Resources appear as a local IP

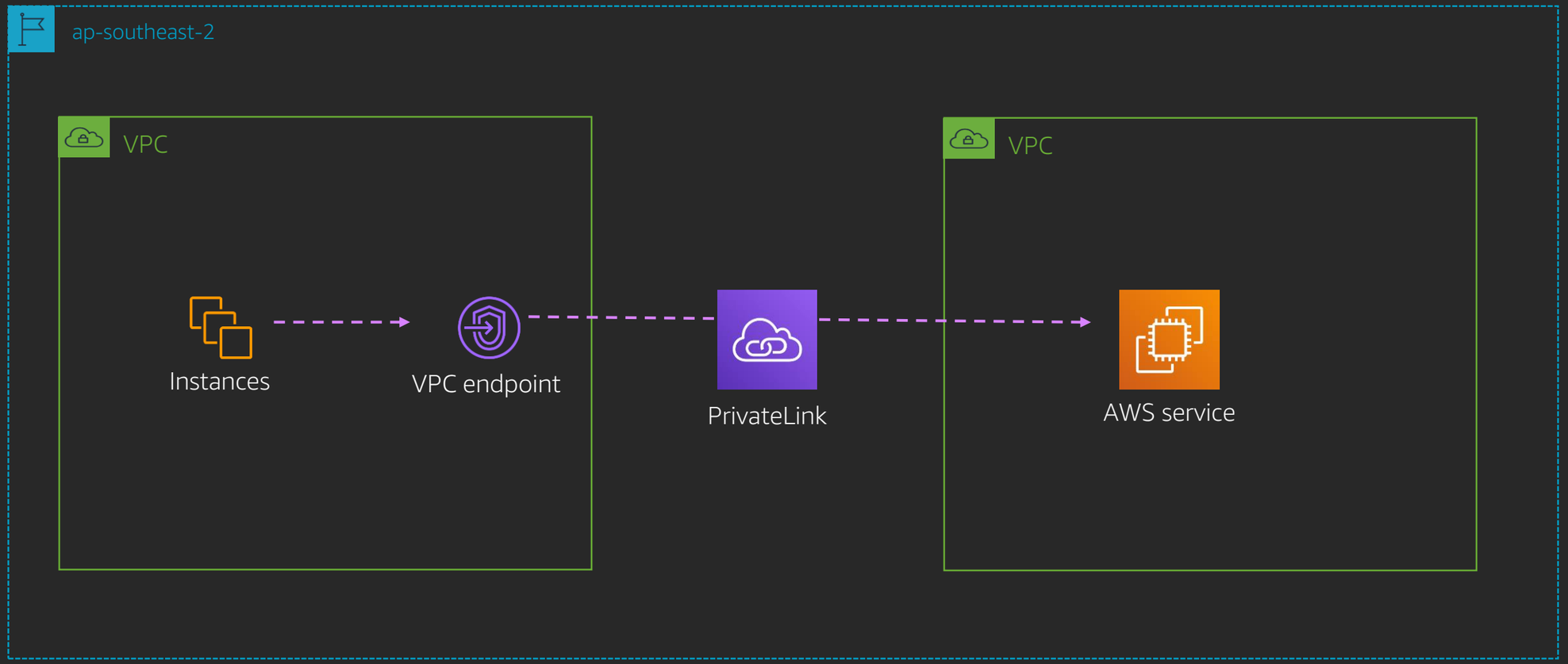
Bonus:

- IP ranges in each VPC can overlap
- AWS PrivateLink performs double-sided NAT for you

PrivateLink quick overview

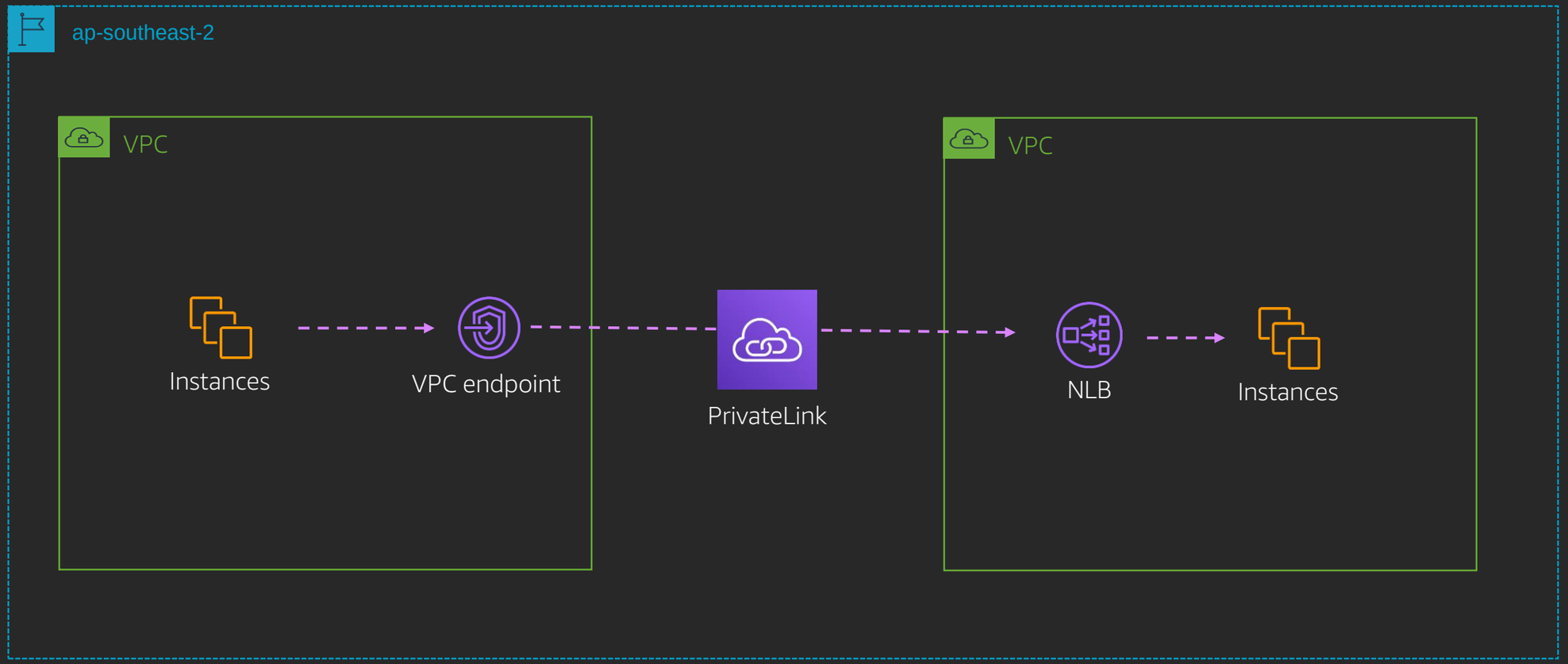


PrivateLink interface endpoints – AWS services



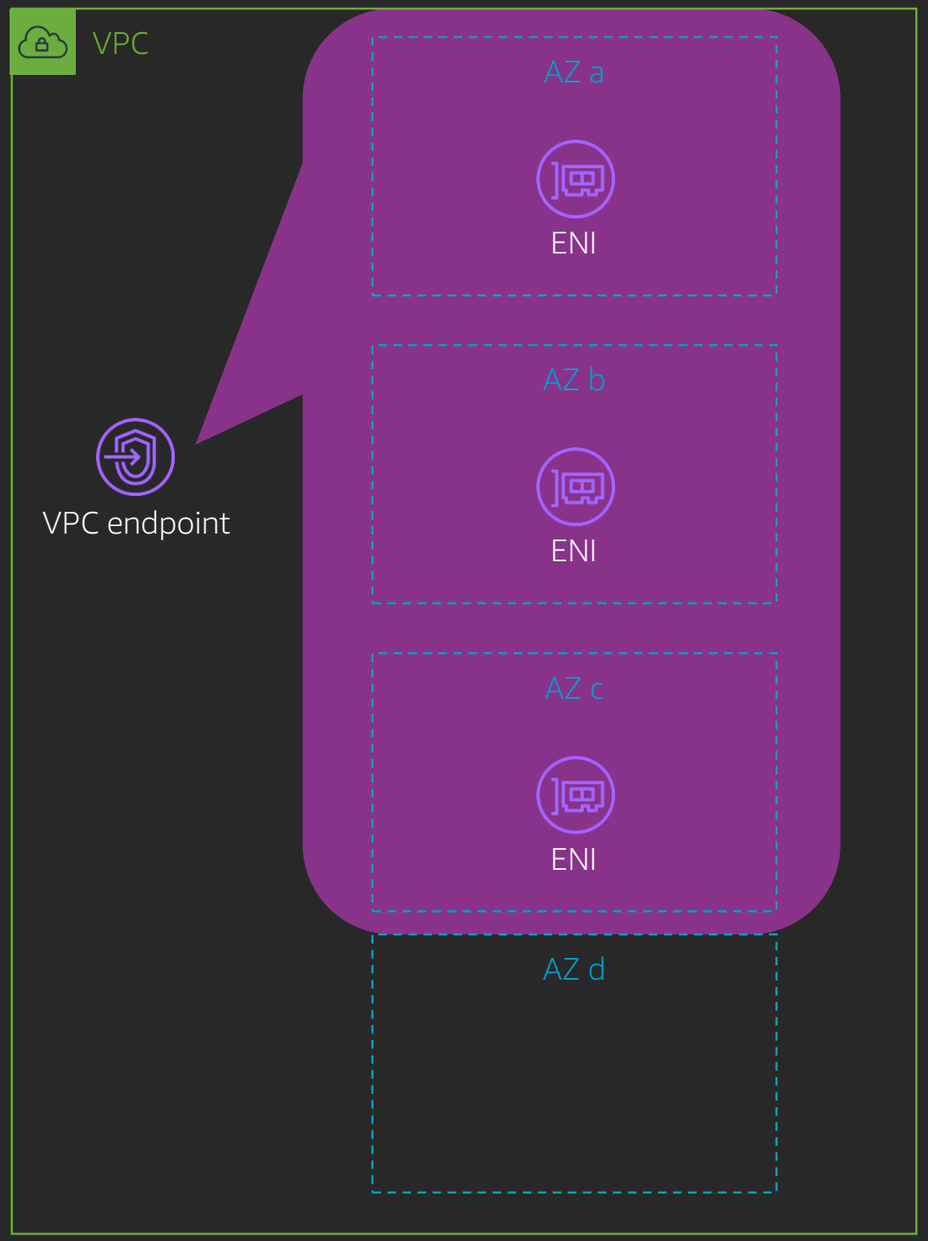
PrivateLink interface endpoints

Endpoint services and SaaS

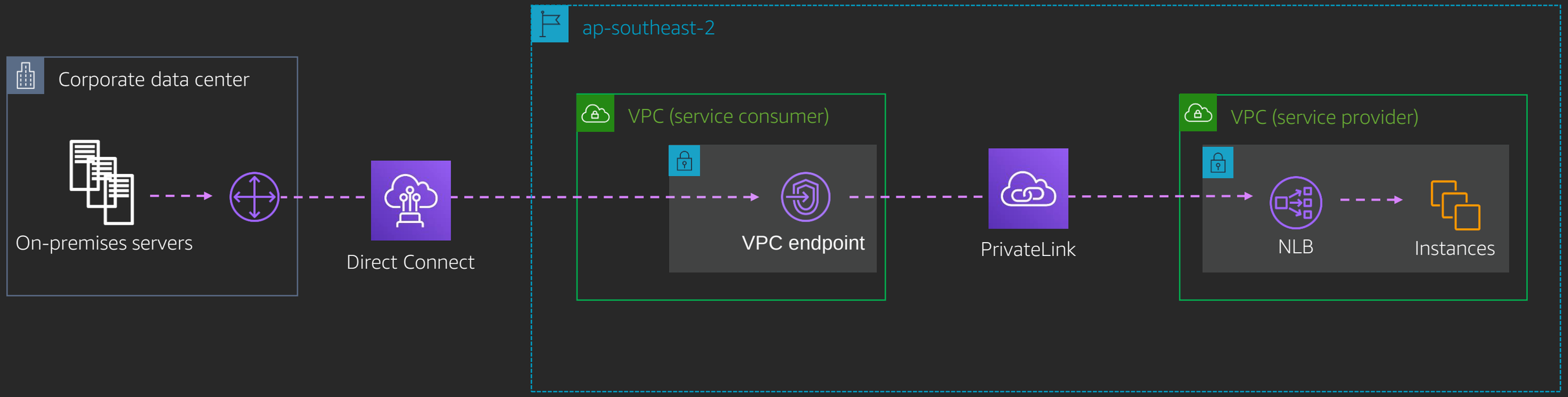


VPC endpoints and ENIs

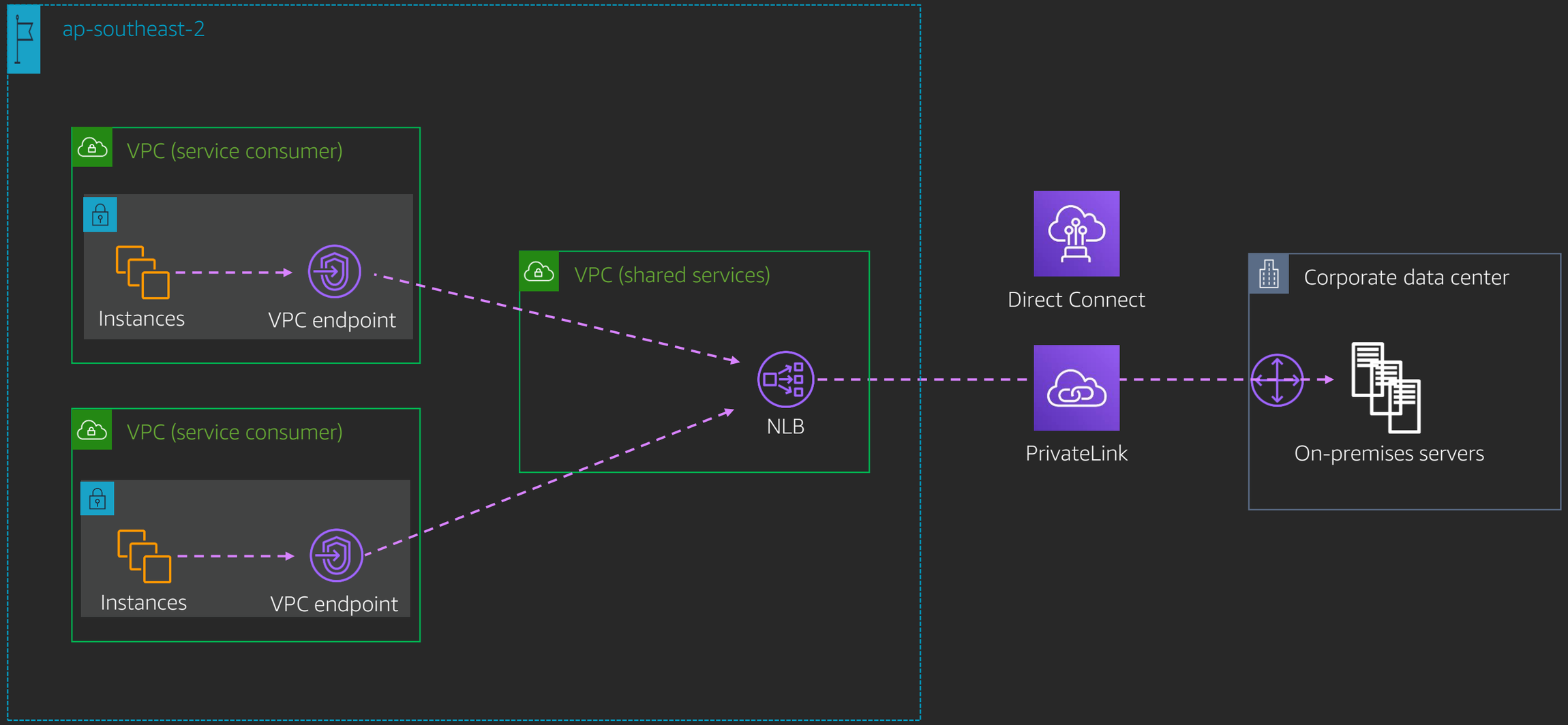
- A VPC endpoint is a collection of ENIs spanning subnets
- Within a subnet, a VPCE is represented as an ENI
    - At most one ENI per AZ
    - An ENI is used to connect to a PrivateLink enabled service



On-premises service consumers

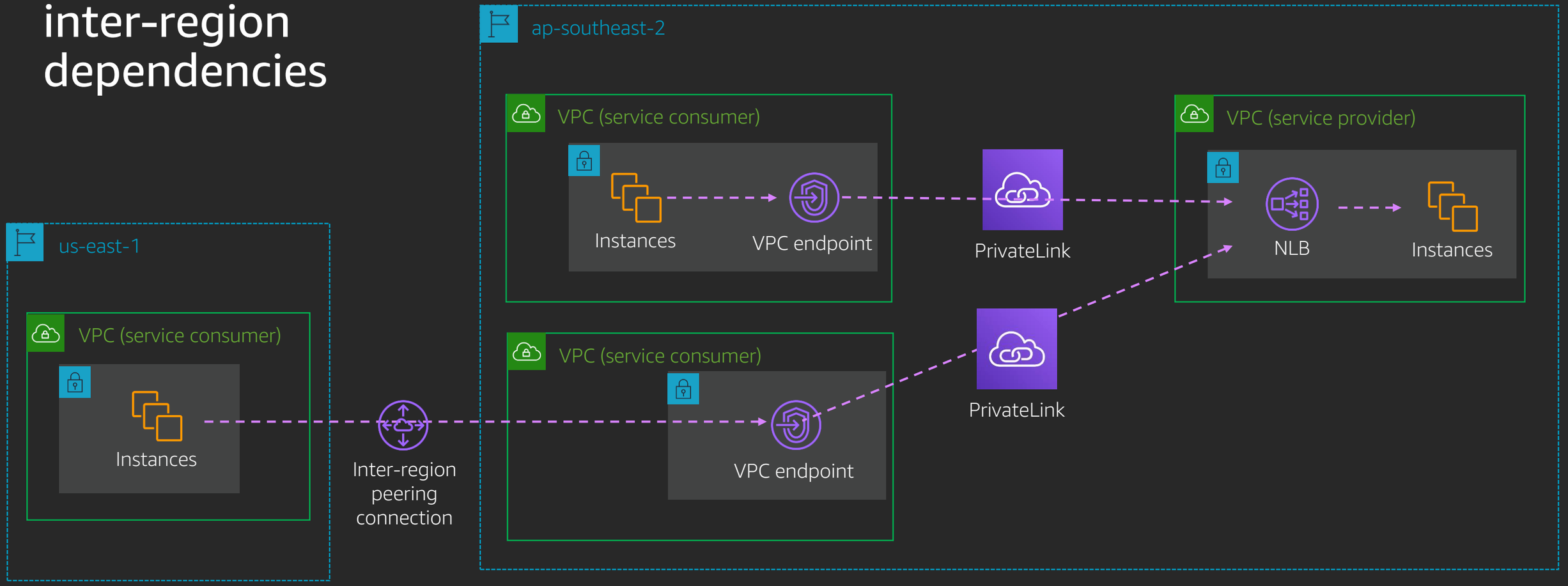


On-premises service providers



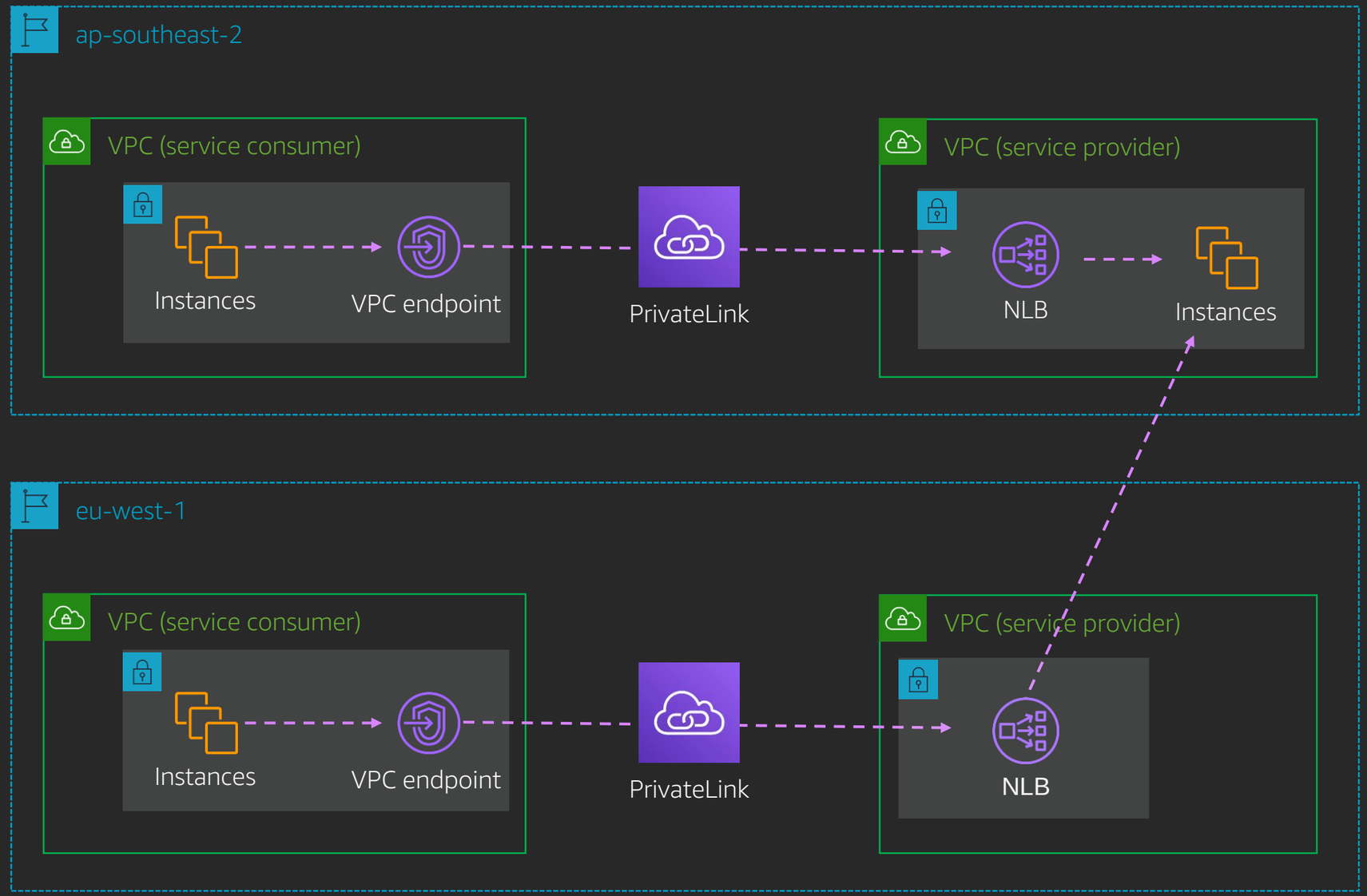
Cross-region connectivity to cervices

Note: Avoid inter-region dependencies

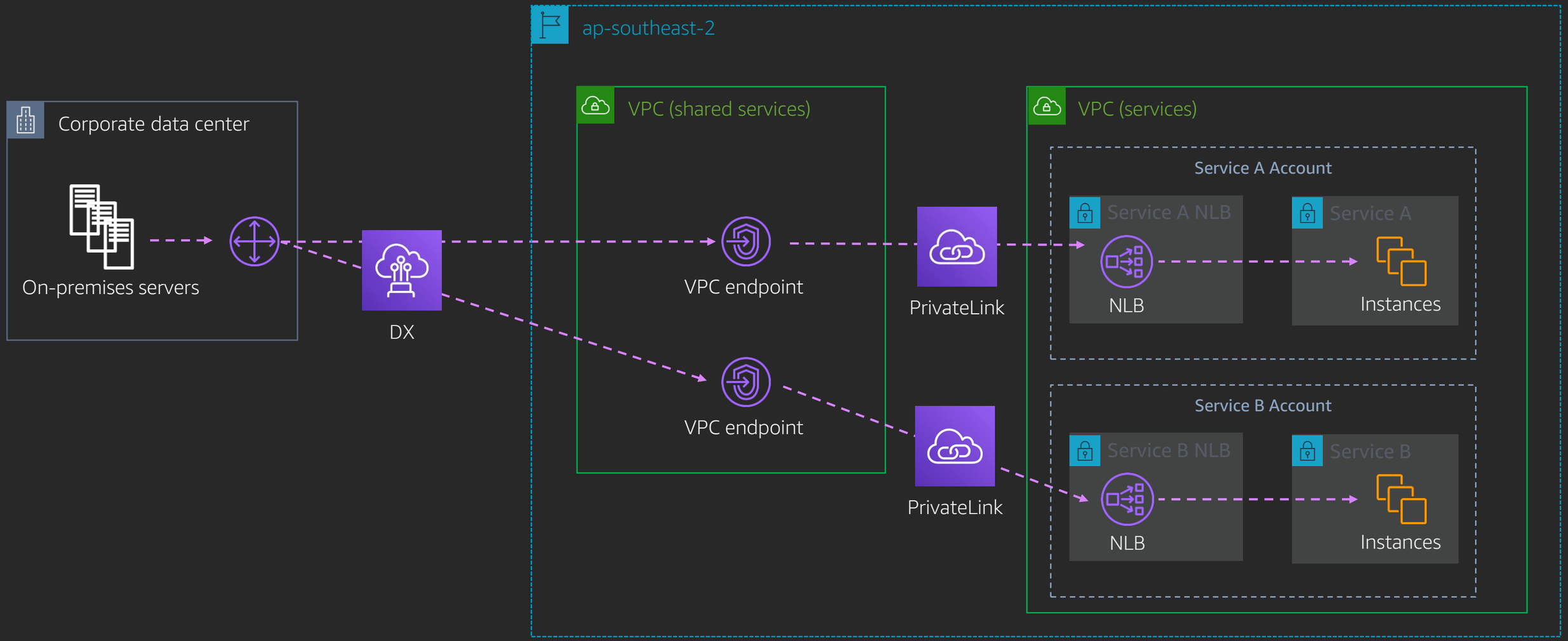


Presenting services in another region

Note: Avoid inter-region dependencies



Shared VPC services



AWS PrivateLink

- Use at least two ENIs per VPCE
- Consider DNS infrastructure to meet your needs
- Ensure service provider NLB has ENI in each AZ
  - Cross-zone load balancing if don’t have service in each AZ
- Avoid building inter-region dependencies

DNS

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Amazon Route 53 in VPC

DNS in VPC known as:

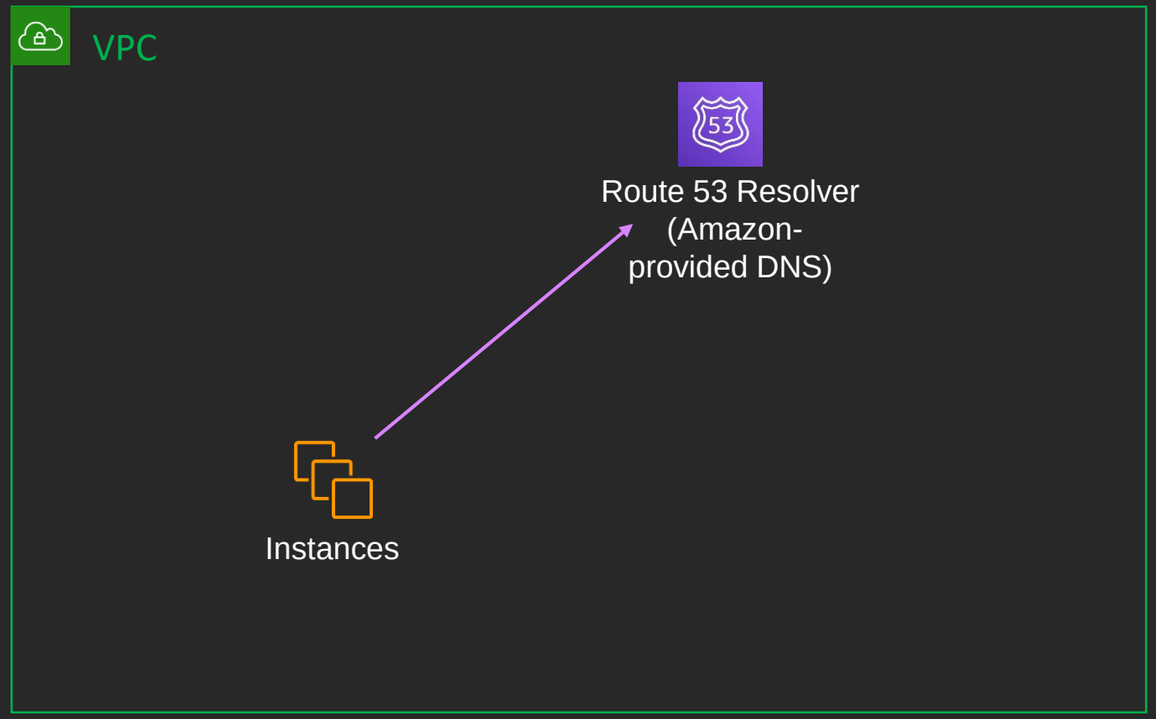
- AmazonProvidedDNS
- VPC Resolver
- +2 Resolver
- .2 Resolver
- EC2 DNS Resolver

The EC2 DNS Resolver needed an official name

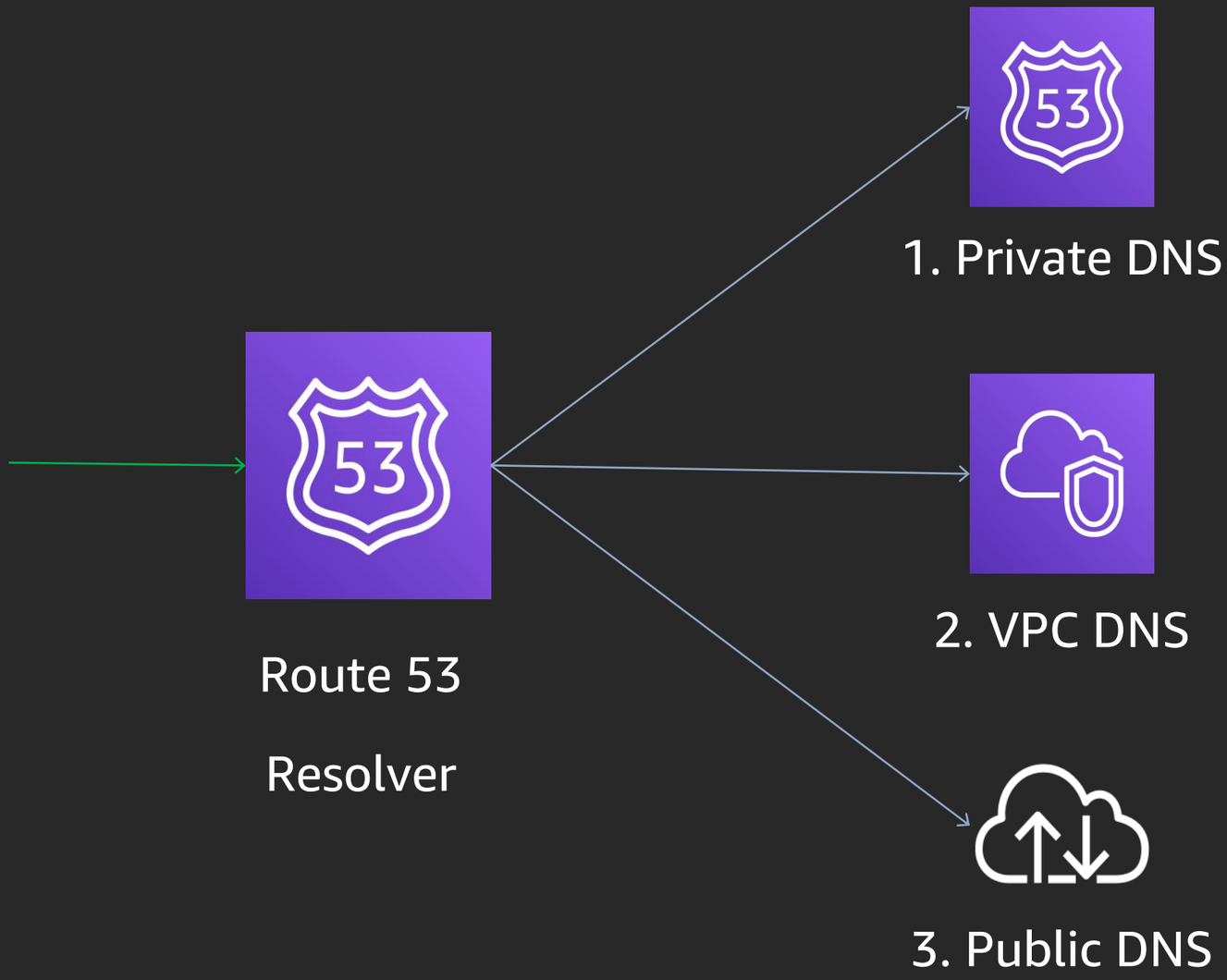
Amazon Route 53 Resolver

Route 53 Resolver – VPC view

- Recursive DNS server
- +2 IPs from VPC CIDR
- Built-in redundancy

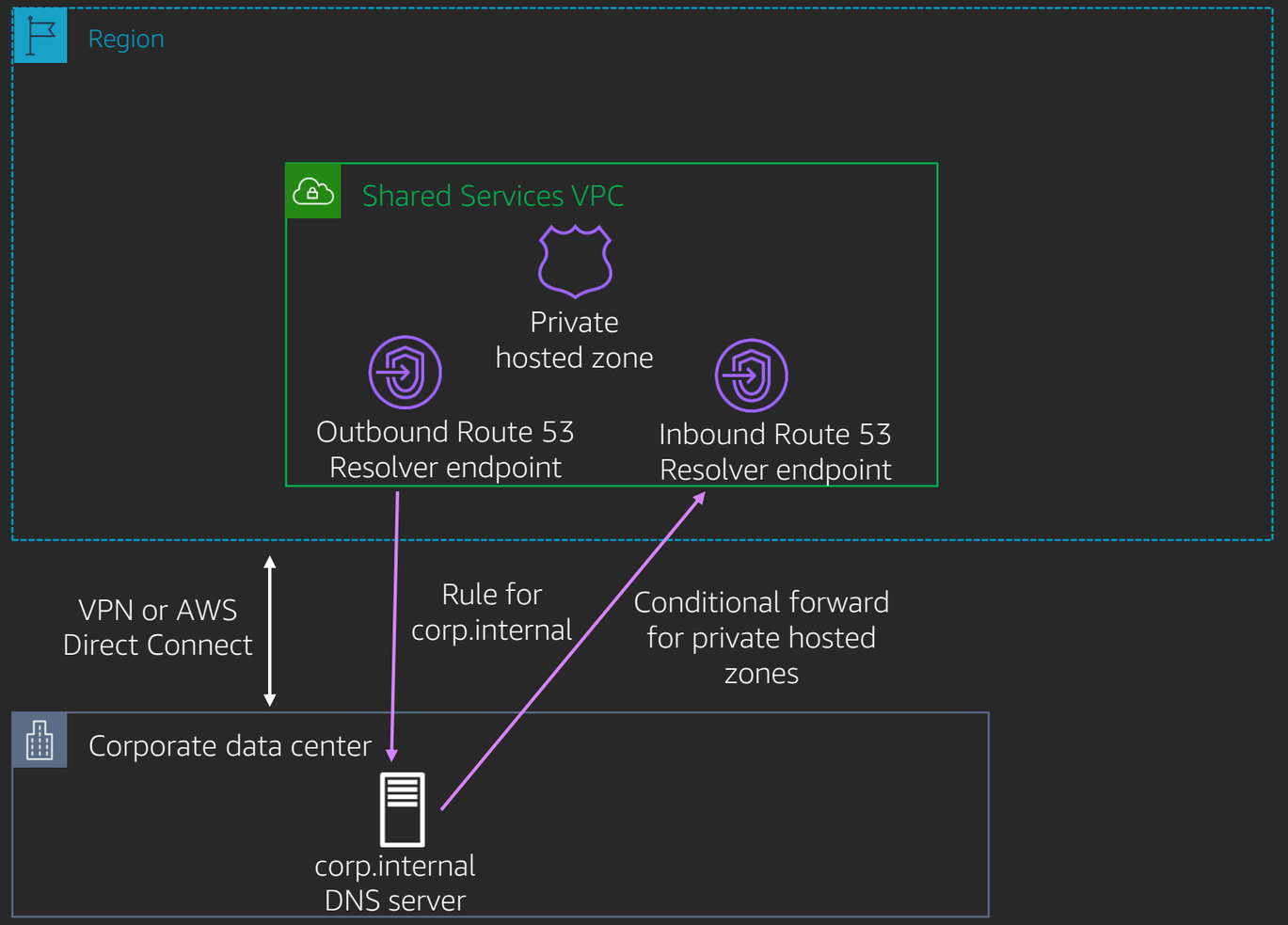


Route 53 Resolver



Route 53 Resolver endpoints

- Inbound endpoint:
  - Share VPC DNS view
- Outbound endpoint:
  - Share Corporate DNS view
- Built-in redundancy
- Nomenclature:
  - One “endpoint” == Multiple ENIs
- 10,000 QPS per ENI

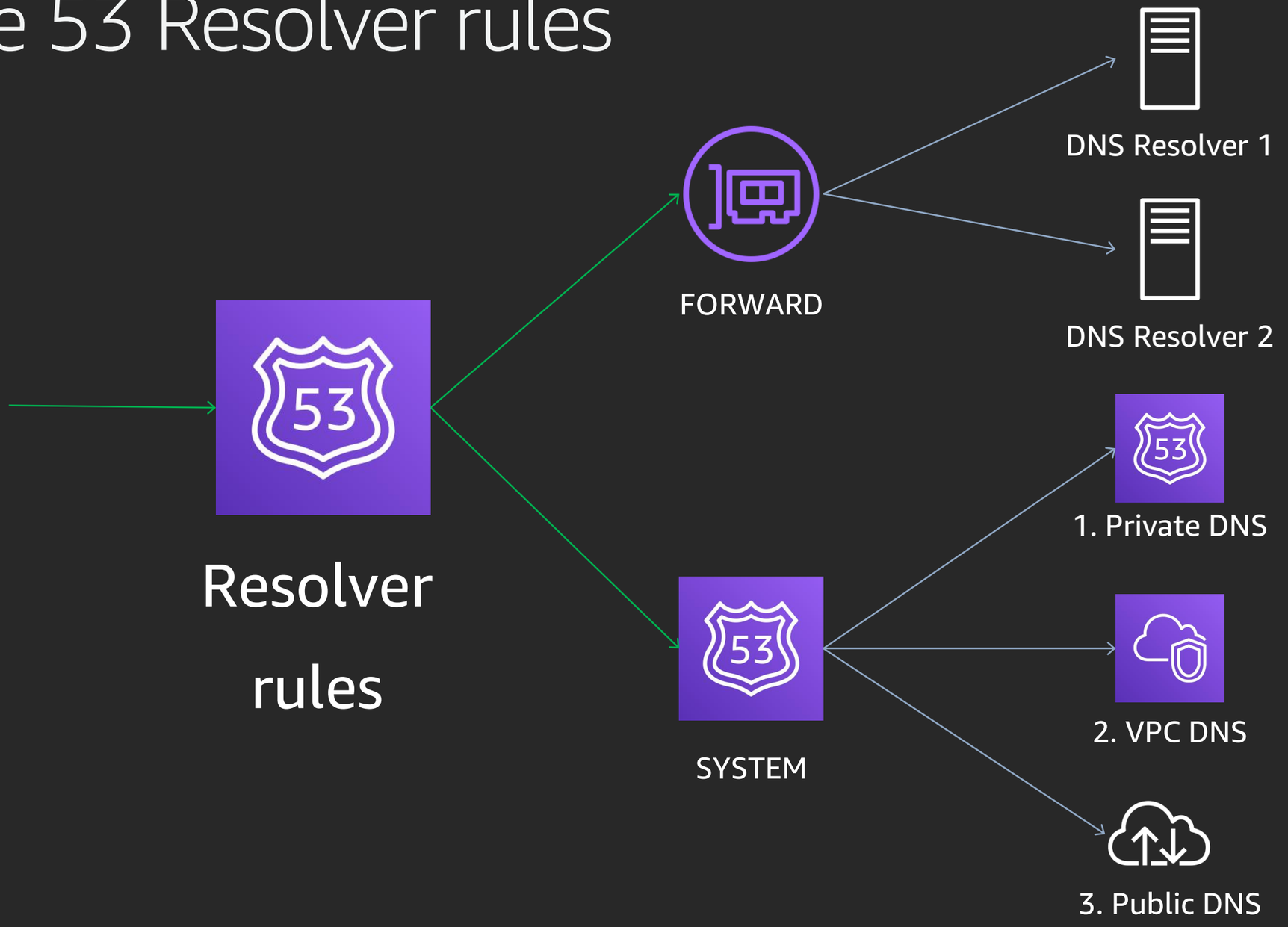


Route 53 Resolver – resolver rules

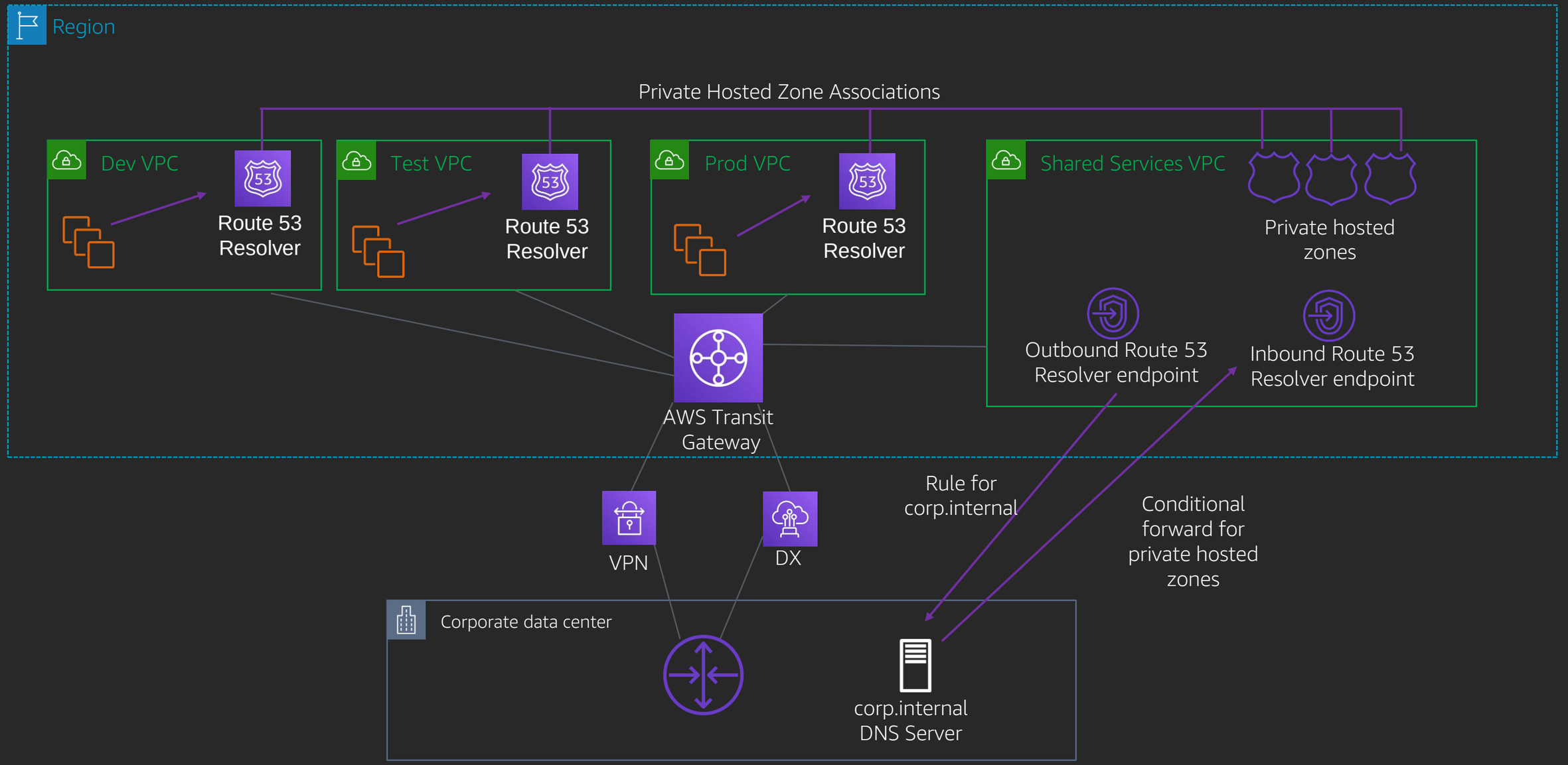
Configure how Route 53 Resolver makes queries

Two types: FORWARD and SYSTEM

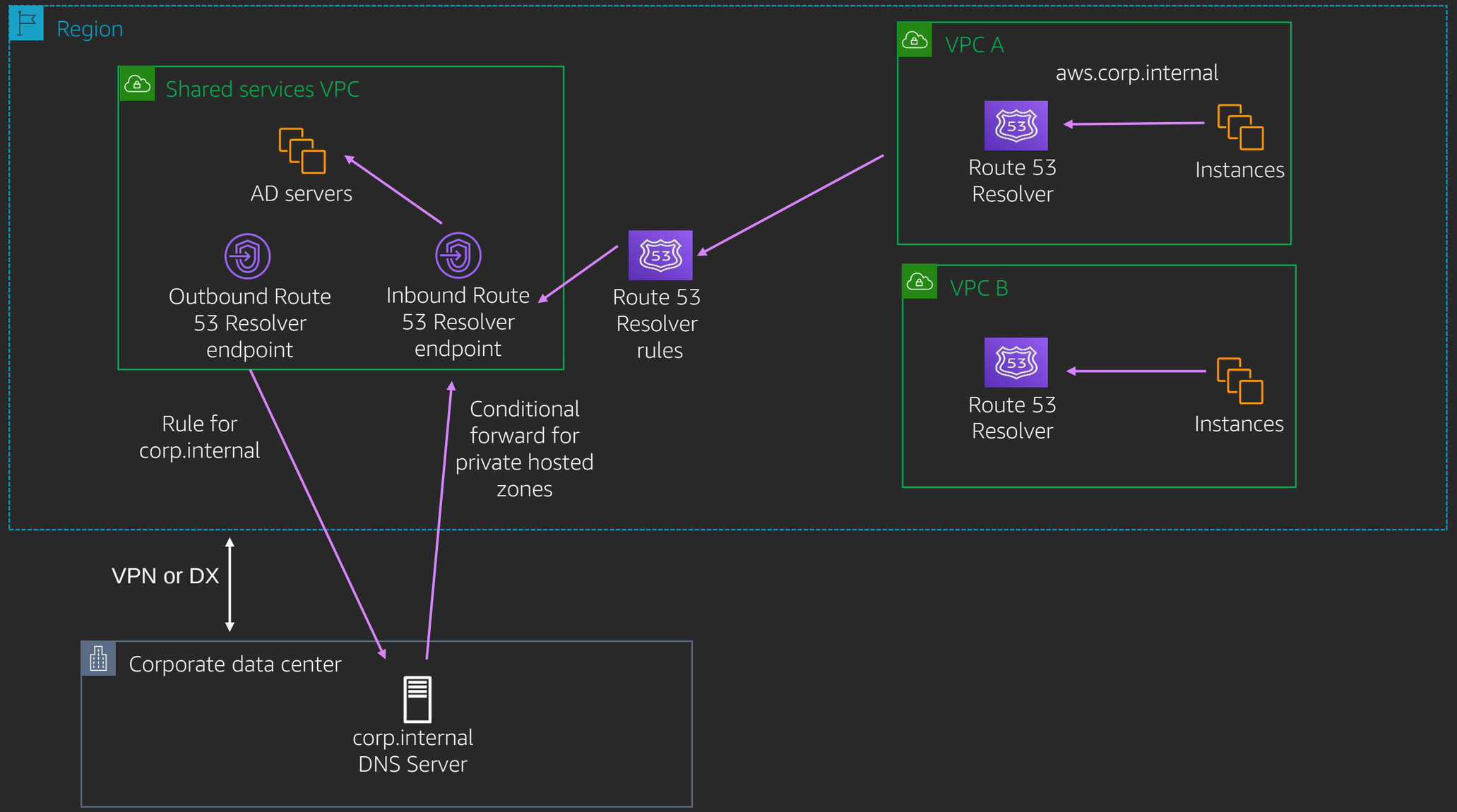
Route 53 Resolver rules



Sharing resolver VPC endpoints



Active directory hybrid DNS



Route 53 best practices

- Within a VPC use the “.2” Route 53 Resolver
- Always use resolver endpoint ENIs in multiple Availability Zones
- Use conditional forwarding for on-premises
- Avoid A records to VPCE ENIs
  - Alias record or CNAME
- Avoid pointing outbound endpoints at inbound endpoints
  - *Limit: 10,000 QPS per ENI*
- Set CloudWatch alarms on resolver endpoints approaching QPS limits

Route 53 best practices

Inbound endpoints:

- Use a retrying DNS resolver on-premises
- Specify your IPs

Outbound endpoints:

- Use forwarding sparingly
- Maintain fixed IPs as targets

Key takeaways

- AWS PrivateLink endpoints are highly available
- Amazon Route 53 is highly available and fault tolerant
- AWS PrivateLink and Amazon Route 53 allow you to create novel data flows

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- AWS Direct Connect gateway makes changing VPCs easy
- Public VIFs are useful but you are connected to everything
- AWS Transit Gateway is better than VPC peering for 99% of use cases

Bonus slides: AWS Outposts

AWS Outposts connectivity

- AWS Direct Connect or AWS VPN
- 1, 10, 40, or 100 Gb/s networking
  - 2 x connections to local network
  - Each connection can be a single link or LAG
  - Two local VLANs (service and local data connectivity)
    - /30 or /31 required for local traffic (private IPs are ok)
    - /26 required for service VLAN (public or NATable range required)
- Local Gateway (connects to your on-premises network)
  - Needs additional /26 or larger for 1:1 NAT to local subnet
- VPC is stretched to AWS Outposts using a subnet (same as AZ)
- Cannot use AWS Outposts as transit to region

Thank you!

Brett Looney

brettski@amazon.com

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