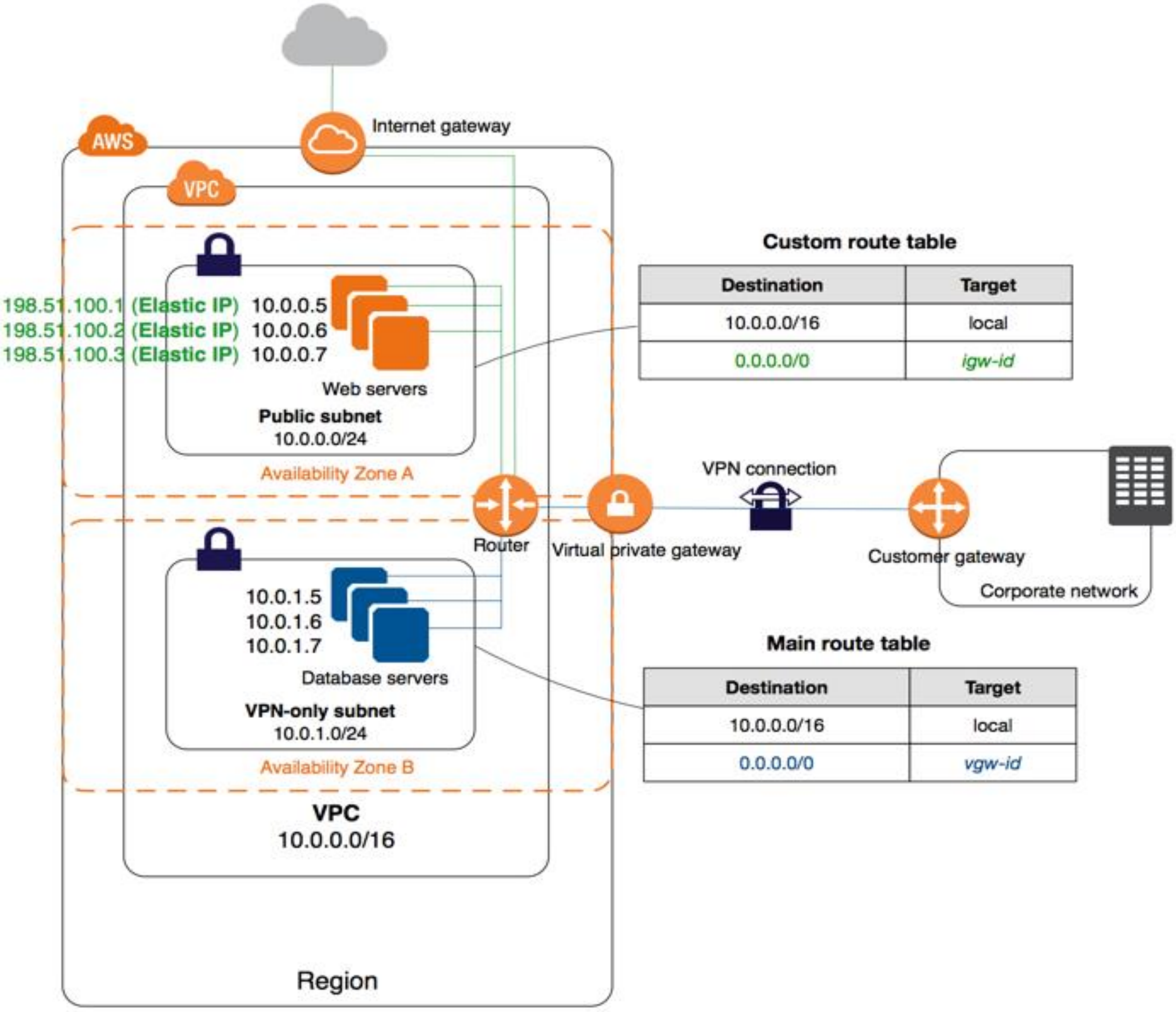
VIRUAL PRIVATE CLOUD (VPC)

- A virtual private cloud is a virtual network that closely resembles a traditional networking that you operate in your own data center, with the benefits of using the scalable infrastructure of AWS.
- VPC is a virtual network of data center inside AWS for one client.
- It is logically isolated from other virtual network in the AWS cloud.
- Maximum 5 VPC can be created in one region and 200 subnets in 1 VPC.
- We can allocate maximum 5 Elastic IP.
- Once we created VPC, DHCP, NACL and security group will automatically create.
- A VPC is confined to an AWS region and does not extend between regions.
- Once the VPC is created you cannot change its CIDR block range.
- If you need a different CIDR size create a new VPC.
- The different subnets within a VPC cannot overlap.
- You can however expand your VPC CIDR by adding new/extra IP address ranges (except GovCloud and AWS China)



Custom route table

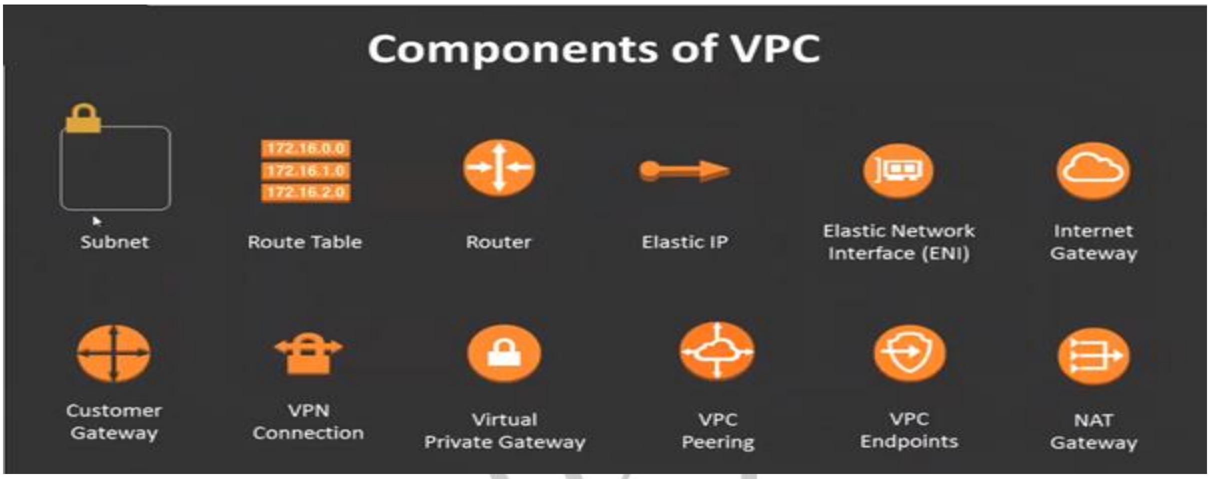
Destination	Target
10.0.0.0/16	local
0.0.0.0/0	*igw-id*

Main route table

Destination	Target
10.0.0.0/16	local
0.0.0.0/0	*vgw-id*

❖ Components of VPC

A. CIDR and IP address subnets
B. Implied Router and Routing table
C. Internet Gateway
D. Security Group
E. NACL
F. Virtual Private Gateway
G. Peering Connectors
H. Elastic IP



❖ Types of VPC

- **VPC is of 2 types:**
  1. Default VPC,
  2. Custom VPC

I. Default VPC:

- ➢ Created in each AWS region when an AWS account is created.
- ➢ Has default CIDR, security group, NACL and route table settings.
- ➢ Has an internet gateway by default

II. Custom VPC:

- ➢ It is a VPC and AWS account owner creates.
- ➢ AWS user creating the Custom VPC can decide the CIDR.
- ➢ It has its own default security group, NACL and route tables.
- ➢ It doesn’t have an internet gateway by default, one needs to be created if needed.

A. CIDR and IP address subnets: -

Public Subnet: if a subnet’s traffic is routed to an internet gateway, the subnet is known as public subnet. If you want your instance in a public subnet to communicate with the internet over IPV4, it must have a public IPV4 address or an Elastic IP address.

Private Subnet: if a subnet doesn't have a route to the internet gateway, the subnet is known as private subnet. When you create a VPC you must specify an IPV4 CIDR block for the VPC. The allowed blocks size is between /16 to /28 networks. The first four and last IP address of subnet cannot be assigned. The instances in the public subnet can send outbound traffic directly to the internet, but instances in private subnet can't.

For e.g.: 10.0.0.0- network address
10.0.0.1- reserved by AWS for the VPC router
10.0.0.2- reserved by AWS the IP address of DNS server
10.0.0.3 -reserved for future use
10.0.0.255- broadcast address
Note: AWS do not support broadcast in a VPC but reserve this address.

B. Implied Router and Routing Table:

- It is the central routing function.
- It connects the different AZ together and connects the VPC to the internet gateway.
- You can have up to 200 route tables per VPC.
- You can have up to 50 routes entries per route table.
- Each subnet must be associated with only one route table at any given time only.
- If you don't specify a subnet to route table association, the subnet will be associated with the default VPC route table.
- You can also edit the main route table if you need but you cannot delete the main route table.
- However, you can make a custom route table manually become the main route table then you can delete the former main as it is no longer a main route table.
- You can associate multiple subnets with the same route table.

C. Internet Gateway:

- An internet gateway is a virtual router that connects a VPC to the internet.
- Default VPC is already attached with an internet gateway.
- If you create a new VPC then you must attach the internet gateway in order to access the internet.
- Ensure that your subnet's route table points to the internet gateway.
- It performs NAT between your private and public IPV4 address.
- It supports both IPV4 and IPV6.

- **NAT Gateway:**

- You can use a network address translation gateway to enable instances in a private subnet to connect to the internet or other AWS services but prevent the internet from initiating a connection with those instances.
- You are charged for creating and using a NAT gateway in your account. NAT gateway hourly usage and data processing rates apply. Amazon EC2 charges for data transfer also apply.
- To create a NAT gateway, you must specify the public subnet in which the NAT gateway should reside.
- You must also specify an elastic IP address to associate with NAT gateway create it.
- No need to assign public IP address to your private instance.
- After you have created a NAT gateway you must update the route table associated with one or more of your private subnets to point internet bound traffic to the NAT gateway.

This enables instances in your private subnet to communicate with internet.

- Deleting a NAT gateway, disassociates its elastic IP address, but does not release the address from your account.

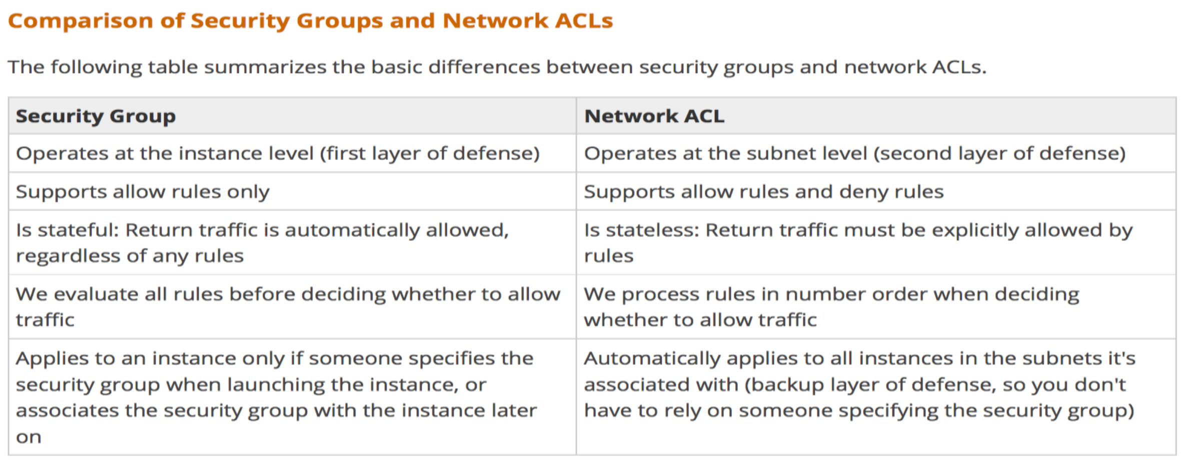
D. Security Group:

- It is a virtual firewall works at ENI level.
- Up to 5 security groups per EC2 instance interface can be applied.
- Can only have permit rules, cannot have deny rules.
- Stateful, return traffic of allowed inbound traffic is allowed even if there are no rules to allow it.

E. NACL:

- It is a function performed on the implied router.
- NACL is an optional layer of security for your VPC that acts as a firewall for controlling traffic in and out of one or more subnets.
- Your VPC automatically comes with a modifiable default NACL. By default, it allows all inbound and outbound IPV4 traffic and if applicable IPV6 traffic.
- You can create a custom NACL and associate it with a subnet. By default, each NACL denies all inbound and outbound traffic until you add rules.
- Each subnet in your VPC must be associated with a NACL. If you don't explicitly associate a subnet with a NACL, the Subnet is automatically associated with the default NACL.
- You can associate a NACL with multiple subnets; however, a subnet can be associated with only one NACL at a time. When you associate a NACL with a subnet the previous association is removed.
- A NACL contains a numbered list of rules that we evaluate in order starting with the lowest numbered rule.
- The highest number that you can use for a rule is 32766. Recommended that you start by creating rules with rule numbers that a multiple of 100, so that you can insert new rules where you need later.
- It functions at the subnet level.
- NACL are stateless, outbound traffic for an allowed inbound traffic must be explicitly allowed too.
- You can have permit and deny rules in a NACL.

❖ <u>Difference between security group and NACL.</u>

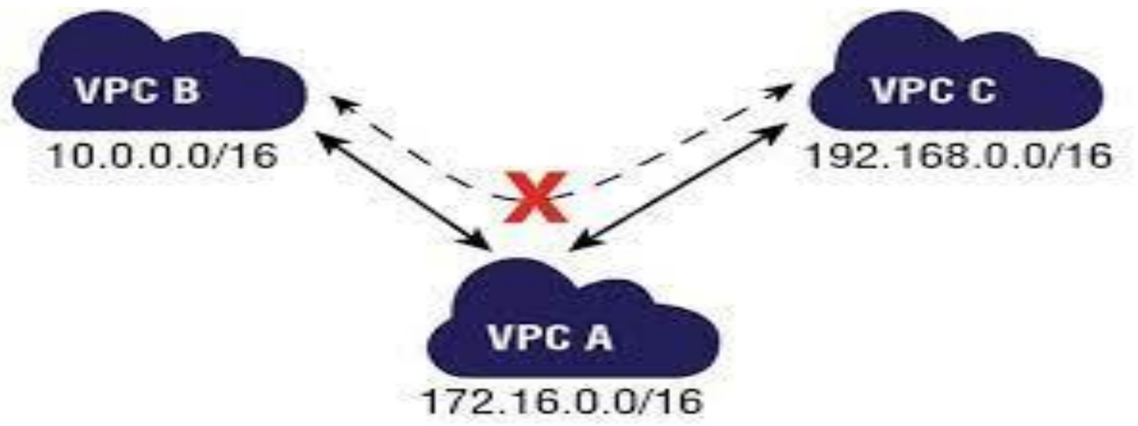


Comparison of Security Groups and Network ACLs

The following table summarizes the basic differences between security groups and network ACLs.

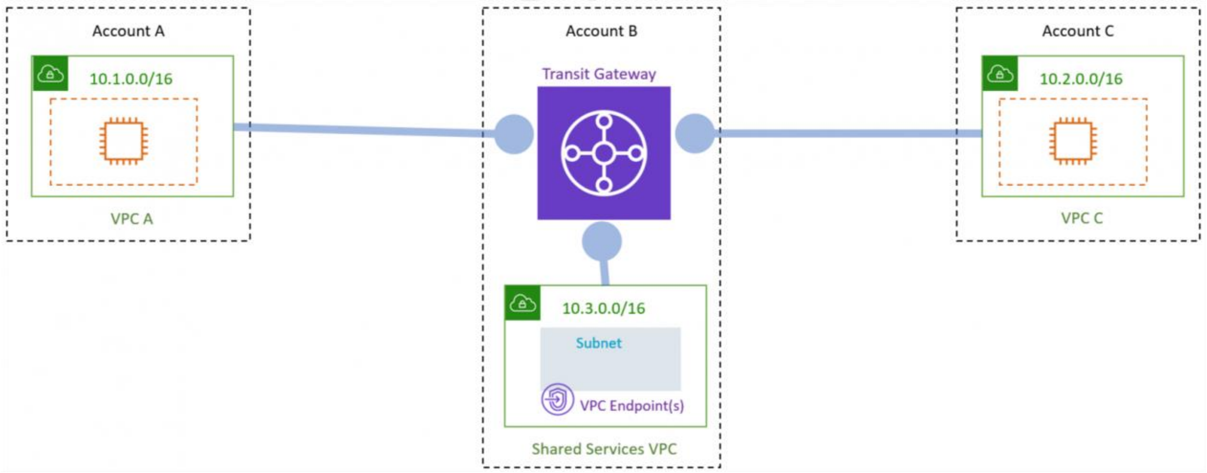
Security Group	Network ACL
Operates at the instance level (first layer of defense)	Operates at the subnet level (second layer of defense)
Supports allow rules only	Supports allow rules and deny rules
Is stateful: Return traffic is automatically allowed, regardless of any rules	Is stateless: Return traffic must be explicitly allowed by rules
We evaluate all rules before deciding whether to allow traffic	We process rules in number order when deciding whether to allow traffic
Applies to an instance only if someone specifies the security group when launching the instance, or associates the security group with the instance later on	Automatically applies to all instances in the subnets it's associated with (backup layer of defense, so you don't have to rely on someone specifying the security group)

❖ VPC Peering



- A VPC peering connection is a network connection between two VPC that enables you to route traffic between them using private IPV4 addresses or IPV6 addresses.
- Instances in either VPC can communicate with each other as if they are within the same network.
- You can create a VPC peering connection between your own VPC or with a VPC in another AWS account. The VPC can be in different region.

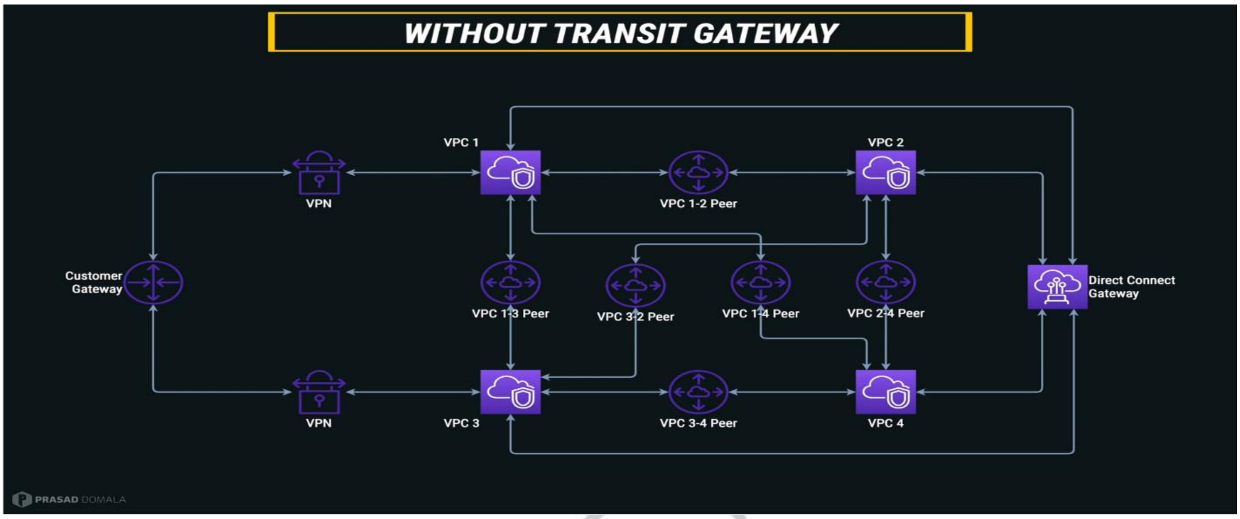
❖ VPC Endpoint



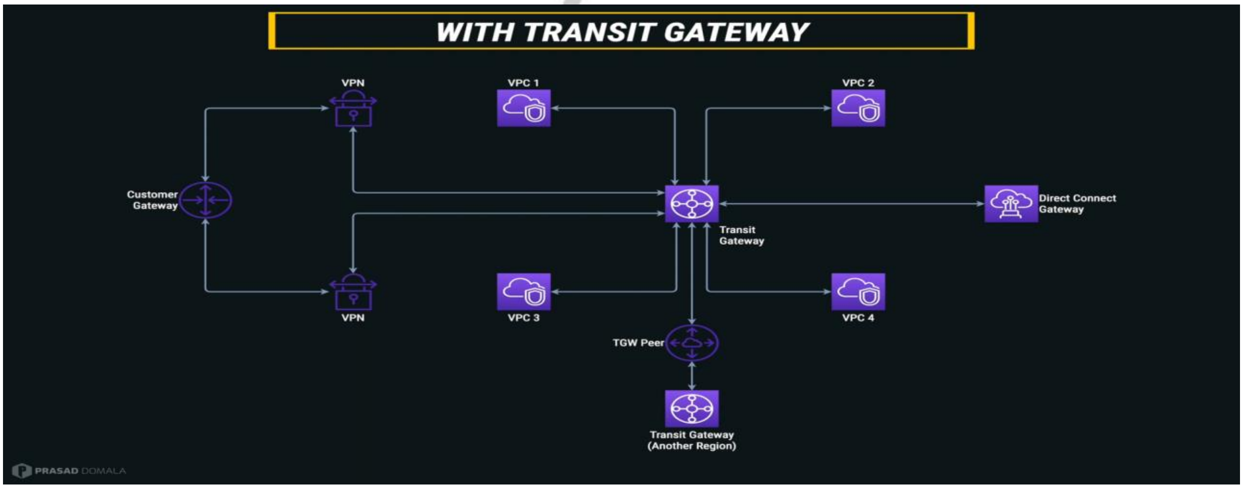
A VPC endpoint enables you to privately connect your VPC to supported AWS services, instances in your VPC do not require public IP address to communicate with resources in the service. Endpoints are virtual devices.

❖ VPC Transit Gateway

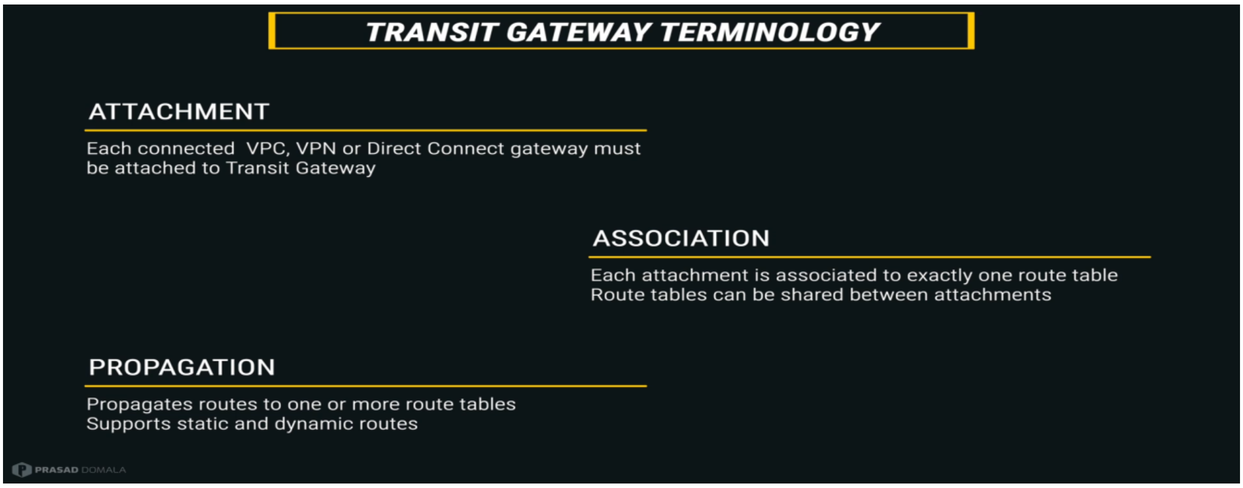
- Connect VPC s and on-prem network to a single gateway
- Transitive networking
- Elastic scaling based on network traffic
- Operates in layer 3 of OSI model



WITHOUT TRANSIT GATEWAY



WITH TRANSIT GATEWAY



TRANSIT GATEWAY TERMINOLOGY

ATTACHMENT

Each connected VPC, VPN or Direct Connect gateway must be attached to Transit Gateway

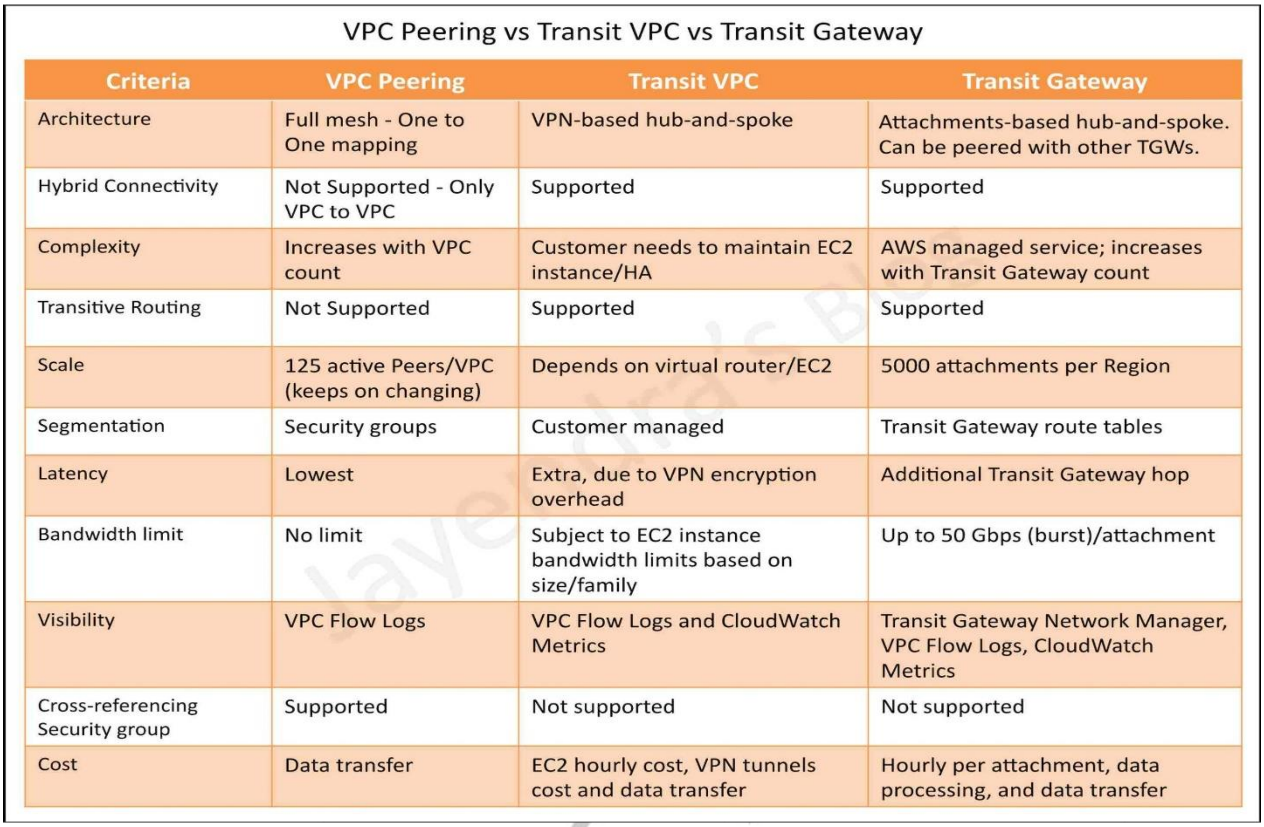
ASSOCIATION

Each attachment is associated to exactly one route table
Route tables can be shared between attachments

PROPAGATION

Propagates routes to one or more route tables
Supports static and dynamic routes

PRASAD DOMALA



VPC Peering vs Transit VPC vs Transit Gateway

Criteria	VPC Peering	Transit VPC	Transit Gateway
Architecture	Full mesh - One to One mapping	VPN-based hub-and-spoke	Attachments-based hub-and-spoke. Can be peered with other TGWs.
Hybrid Connectivity	Not Supported - Only VPC to VPC	Supported	Supported
Complexity	Increases with VPC count	Customer needs to maintain EC2 instance/HA	AWS managed service; increases with Transit Gateway count
Transitive Routing	Not Supported	Supported	Supported
Scale	125 active Peers/VPC (keeps on changing)	Depends on virtual router/EC2	5000 attachments per Region
Segmentation	Security groups	Customer managed	Transit Gateway route tables
Latency	Lowest	Extra, due to VPN encryption overhead	Additional Transit Gateway hop
Bandwidth limit	No limit	Subject to EC2 instance bandwidth limits based on size/family	Up to 50 Gbps (burst)/attachment
Visibility	VPC Flow Logs	VPC Flow Logs and CloudWatch Metrics	Transit Gateway Network Manager, VPC Flow Logs, CloudWatch Metrics
Cross-referencing Security group	Supported	Not supported	Not supported
Cost	Data transfer	EC2 hourly cost, VPN tunnels cost and data transfer	Hourly per attachment, data processing, and data transfer