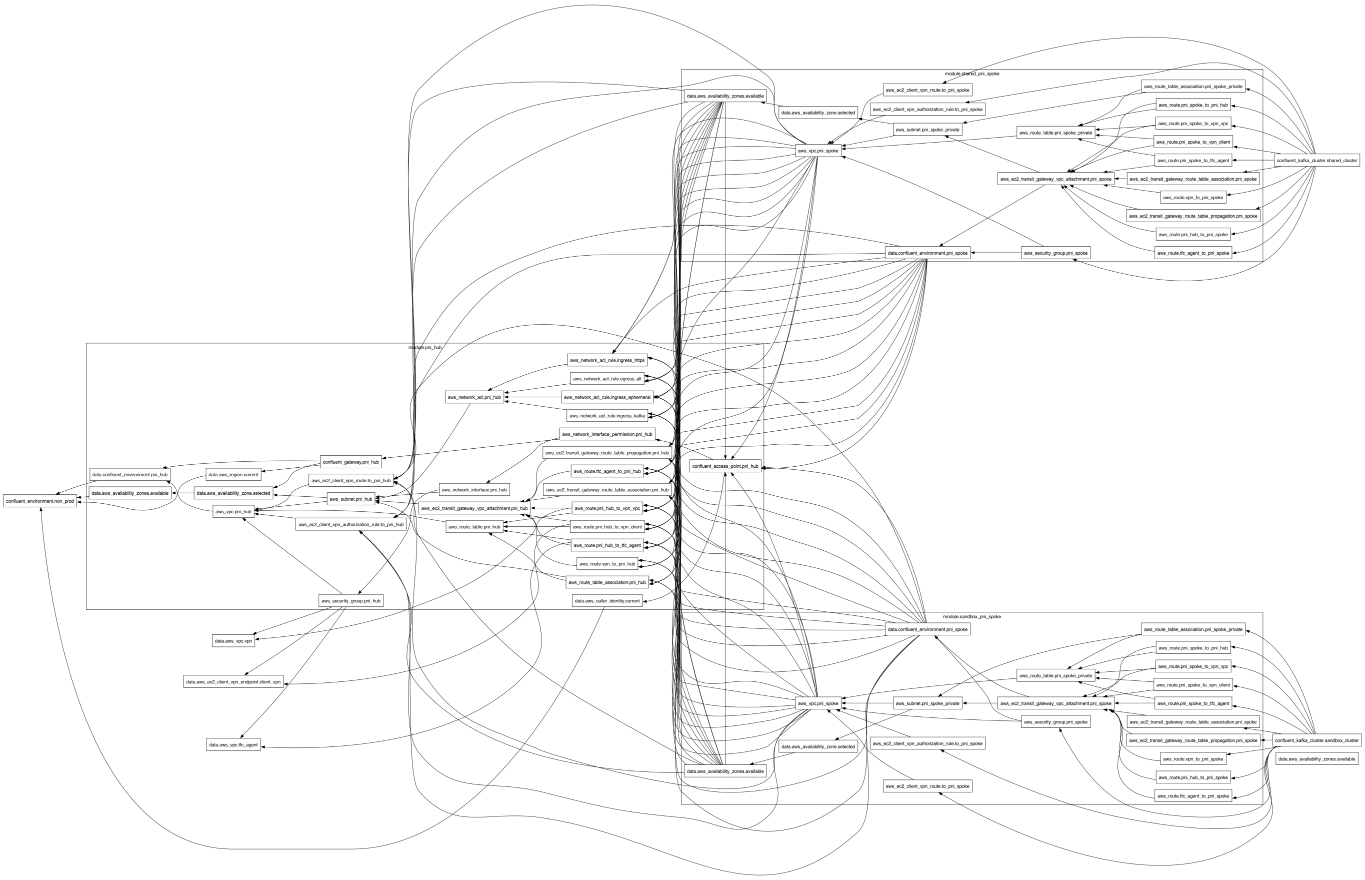
IaC Confluent Cloud AWS Private Network Interface (PNI), Infrastructure and Networking Example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aws_subnet.pni_spoke_private
aws_vpc.pni_spoke
aws_route_table.pni_spoke_private
aws_route_table_association.pni_spoke_private
aws_route.pni_spoke_to_pni_hub
aws_route.pni_spoke_to_vpn_vpc
aws_route.pni_spoke_to_vpn_client
aws_route.pni_spoke_to_tfc_agent
confluent_kafka_cluster.shared_cluster
aws_ec2_transit_gateway_vpc_attachment.pni_spoke
aws_ec2_transit_gateway_route_table_association.pni_spoke
aws_route.vpn_to_pni_spoke
aws_ec2_transit_gateway_route_table_propagation.pni_spoke
aws_route.pni_hub_to_pni_spoke
data.confluent_environment.pni_spoke
aws_security_group.pni_spoke
aws_route.tfc_agent_to_pni_spoke
module.pni_hub
aws_network_acl_rule.ingress_https
aws_network_acl_rule.egress_all
aws_network_acl.pni_hub
aws_network_acl_rule.ingress_ephemeral
aws_network_acl_rule.ingress_kafka
aws_network_interface_permission.pni_hub
aws_ec2_transit_gateway_route_table_propagation.pni_hub
confluent_access_point.pni_hub
confluent_gateway.pni_hub
aws_route.tfc_agent_to_pni_hub
data.confluent_environment.pni_hub
data.aws_region.current
aws_ec2_client_vpn_route.to_pni_hub
aws_network_interface.pni_hub
aws_ec2_transit_gateway_route_table_association.pni_hub
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data.aws_availability_zone.selected
aws_subnet.pni_hub
aws_ec2_transit_gateway_vpc_attachment.pni_hub
aws_route.pni_hub_to_vpn_vpc
aws_vpc.pni_hub
aws_ec2_client_vpn_authorization_rule.to_pni_hub
aws_route_table.pni_hub
aws_route.pni_hub_to_vpn_client
aws_route.pni_hub_to_tfc_agent
aws_route.vpn_to_pni_hub
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aws_security_group.pni_hub
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data.aws_vpc.vpn
data.aws_ec2_client_vpn_endpoint.client_vpn
data.aws_vpc.tfc_agent
module.sandbox_pni_spoke
data.confluent_environment.pni_spoke
aws_route_table_association.pni_spoke_private
aws_route.pni_spoke_to_pni_hub
aws_route.pni_spoke_to_vpn_vpc
aws_route_table.pni_spoke_private
aws_route.pni_spoke_to_vpn_client
aws_vpc.pni_spoke
aws_subnet.pni_spoke_private
aws_ec2_transit_gateway_vpc_attachment.pni_spoke
aws_route.pni_spoke_to_tfc_agent
aws_security_group.pni_spoke
aws_ec2_transit_gateway_route_table_association.pni_spoke
aws_ec2_transit_gateway_route_table_propagation.pni_spoke
confluent_kafka_cluster.sandbox_cluster
data.aws_availability_zone.selected
aws_ec2_client_vpn_authorization_rule.to_pni_spoke
aws_route.vpn_to_pni_spoke
data.aws_availability_zones.available
aws_route.pni_hub_to_pni_spoke
data.aws_availability_zones.available
aws_ec2_client_vpn_route.to_pni_spoke
aws_route.tfc_agent_to_pni_spoke

> **Terraform-managed, hub-and-spoke Private Network Interface (PNI) connectivity between AWS VPCs and Confluent Cloud Enterprise Kafka clusters — deployed via Terraform Cloud.**

Table of Contents

1.0 Overview

This repo provisions a complete, production-grade private networking topology that connects AWS workload VPCs to Confluent Cloud Enterprise Kafka clusters using **Private Network Interface (PNI)**, Confluent's next-generation private connectivity model that replaces PrivateLink with customer-owned ENIs placed directly in your VPCs.

The architecture follows a **Hub-and-Spoke** pattern:

- A **PNI Hub VPC** owns the ENIs registered with Confluent Cloud and serves as the centralized private connectivity anchor.
- **PNI Spoke VPCs** (sandbox, shared) each host a Confluent Cloud Enterprise Kafka cluster and peer connectivity through the hub via AWS Transit Gateway.
- All VPCs are stitched together through an existing **AWS Transit Gateway (TGW)**, enabling a VPN-connected developer/operator to reach Confluent Cloud endpoints without traversing the public internet.

2.0 Architecture

```
flowchart TD
    subgraph VPN["VPN VPC (existing)"]
        CVE["AWS Client VPN Endpoint"]
    end

    subgraph TFC_AGENT["TFC Agent VPC (existing)"]
        AGENT["Terraform Cloud Agent"]
    end

    TGW["AWS Transit Gateway\n+ Route Table"]

    subgraph PNI_HUB["PNI Hub VPC — 10.3.0.0/20"]
        direction TB
        SG["Security Group\n(ports 443, 9092 ingress only)"]
        NACL["Network ACL\n(443, 9092, ephemeral)"]
        ENI1["ENI — AZ-a"]
        ENI2["ENI — AZ-b"]
        ENI3["ENI — AZ-c"]
        TGW_ATT_HUB["TGW Attachment"]
        GW["confluent_gateway\n(AWS PNI Gateway)"]
        AP["confluent_access_point\n(PNI Access Point)"]
        SG --> ENI1 & ENI2 & ENI3
        ENI1 & ENI2 & ENI3 --> AP
        AP --> GW
    end

    subgraph SANDBOX_SPOKE["Sandbox PNI Spoke VPC — 10.0.0.0/20"]
        TGW_ATT_SB["TGW Attachment"]
        SK_CLUSTER["confluent_kafka_cluster\nsandbox_cluster\n(Enterprise, HIGH availability)"]
    end

    subgraph SHARED_SPOKE["Shared PNI Spoke VPC — 10.1.0.0/20"]
        TGW_ATT_SH["TGW Attachment"]
        SH_CLUSTER["confluent_kafka_cluster\nshared_cluster\n(Enterprise, HIGH availability)"]
    end

    subgraph CONFLUENT_CLOUD["Confluent Cloud"]
        ENV["Environment: non-prod\n(Stream Governance: ESSENTIALS)"]
        GW --> ENV
        SK_CLUSTER --> ENV
        SH_CLUSTER --> ENV
    end

    CVE -->|"routes via TGW"| TGW
    AGENT -->|"routes via TGW"| TGW
    TGW <-->|"attach + propagate"| TGW_ATT_HUB
    TGW <-->|"attach + propagate"| TGW_ATT_SB
    TGW <-->|"attach + propagate"| TGW_ATT_SH
    TGW_ATT_HUB --> PNI_HUB
    TGW_ATT_SB --> SANDBOX_SPOKE
    TGW_ATT_SH --> SHARED_SPOKE
```

3.0 Module Structure

```
.
├── main.tf                          # Root: environment, cluster resources, module calls
├── data.tf                          # Data sources: VPCs, VPN endpoint, AZs
├── variables.tf                     # Root-level input variables
├── outputs.tf                       # PNI gateway & access point IDs
├── versions.tf                      # Provider version pins (AWS 6.33,
Confluent 2.62, TFE 0.73)
├── provider.tf                      # Provider configuration
├── deploy.sh                        # Bootstrap / teardown script (AWS
SSO + TF env vars)
└── modules/
    ├── aws-vpc-confluent-pni-hub/   # PNI Hub module
    │   ├── setup-confluent-pni-hub.tf            # Gateway, access point,
VPC, subnets, ENIs, SG
    │   ├── setup-aws-vpc-tgw-private_routing.tf  # TGW attachment,
associations, routes
    │   ├── setup-aws-vpc-security_group_rules.tf # NACL rules
    │   ├── setup-aws-network-permissions.tf      # ENI permissions for
Confluent's AWS account
    │   ├── data.tf                               # Module-level data
sources
    │   ├── variables.tf                          # Module inputs
    │   ├── outputs.tf                            # Gateway/access point
IDs exposed to root
    │   └── versions.tf                           # Module provider
constraints
    └── aws-vpc-confluent-pni-spoke/              # PNI Spoke module
(sandbox, shared)
        ├── main.tf
        ├── data.tf
        ├── variables.tf
        ├── outputs.tf
        └── versions.tf
```

4.0 Prerequisites

This project assumes you have the following prerequisites in place:

- Client VPN, Centralized DNS Server, and Transit Gateway
- Terraform Cloud Agent

4.1 Client VPN, Centralized DNS Server, and Transit Gateway

```
%%{init: {'theme': 'base', 'themeVariables': { 'primaryColor': '#1a73e8',
'primaryTextColor': '#fff', 'primaryBorderColor': '#1557b0', 'lineColor':
'#5f6368', 'secondaryColor': '#34a853', 'tertiaryColor': '#fbbc04'}}}%%

flowchart TB
    subgraph USERS["👤 Remote Users"]
        VPNClient["VPN Client
(OpenVPN/AWS Client)"]
    end

    subgraph AWS["☁ AWS Cloud"]
        subgraph VPN_VPC["Client VPN VPC
var.vpn_vpc_cidr"]
            VPNEndpoint["AWS Client VPN
Endpoint"]
            VPNSubnets["VPN Subnets
(Multi-AZ)"]
            VPNSG["Security Group
client-vpn-sg"]
            VPNResolver["Route53 Outbound
Resolver Endpoint"]
            VPNEndpoint --> VPNSubnets
            VPNSubnets --> VPNSG
            VPNSubnets --> VPNResolver
        end

        subgraph TGW["Transit Gateway
signalroom-tgw"]
            TGWCore["TGW Core
ASN: 64512"]
            TGWRouteTable["Custom Route
Tables"]
            TGWCore --> TGWRouteTable
        end

        subgraph DNS_VPC["DNS VPC (Centralized)
var.dns_vpc_cidr"]
            R53Inbound["Route53 Inbound
Resolver Endpoint"]
            R53PHZ["Private Hosted Zones
*.aws.confluent.cloud"]
            R53Inbound --> R53PHZ
        end

        subgraph TFC_VPC["TFC Agent VPC
var.tfc_agent_vpc_cidr"]
            TFCAgent["Terraform Cloud
Agent"]
        end

        subgraph WORKLOAD_VPCs["Workload VPCs"]
            subgraph WL1["Workload VPC 1"]
                VPCE1["VPC Endpoint
(PrivateLink)"]
            end
            subgraph WL2["Workload VPC N..."]
                VPCEN["VPC Endpoint
(PrivateLink)"]
            end
        end

        ACM["ACM Certificates
(Server & Client)"]
        CWLogs["CloudWatch Logs
VPN & Flow Logs"]
    end
    subgraph CONFLUENT["☁ Confluent Cloud"]
        PrivateLinkService["PrivateLink Service
Endpoint"]
        Kafka["Kafka Cluster
(Private)"]
        PrivateLinkService --> Kafka
    end

    %% Connections
    VPNClient -->|"Mutual TLS
Authentication"| VPNEndpoint
    ACM -.->|"Certificate Auth"| VPNEndpoint

    VPN_VPC -->|"TGW Attachment"| TGW
    DNS_VPC -->|"TGW Attachment"| TGW
    TFC_VPC -->|"TGW Attachment"| TGW
    WL1 -->|"TGW Attachment"| TGW
    WL2 -->|"TGW Attachment"| TGW

    VPNResolver -->|"DNS Forwarding
Rule"| R53Inbound
    R53PHZ -->|"Returns Private
Endpoint IPs"| VPCE1

    VPCE1 -->|"AWS PrivateLink"| PrivateLinkService
    VPCEN -->|"AWS PrivateLink"| PrivateLinkService

    VPNEndpoint -.->|"Logs"| CWLogs
    TGW -.->|"Flow Logs"| CWLogs

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    classDef confluentStyle fill:#f3e8fd,stroke:#9334e6,stroke-width:2px
    classDef serviceStyle fill:#fff,stroke:#5f6368,stroke-width:1px

    class USERS userStyle
    class VPN_VPC,TFC_VPC,WORKLOAD_VPCs,WL1,WL2 vpcStyle
    class TGW tgwStyle
    class DNS_VPC dnsStyle
    class CONFLUENT confluentStyle
```

4.1.1 Key Features Required for Confluent PNI to Work

4.1.1.1 Hub-and-Spoke Network Architecture via Transit Gateway

- Transit Gateway serves as the central routing hub connecting all VPCs
- Disabled default route table association/propagation for explicit routing control

- DNS support enabled on the TGW (`dns_support = "enable"`)
- Custom route tables for fine-grained traffic control between VPCs

4.1.1.2 Client VPN Integration

- Mutual TLS authentication using ACM certificates (server + client)
- Split tunnel configuration for routing only Confluent traffic through VPN
- Authorization rules controlling which CIDRs VPN clients can access
- Routes added to VPN endpoint for all workload VPC CIDRs via Transit Gateway

4.1.1.3 Cross-VPC Routing

- TGW attachments for: VPN VPC, DNS VPC, TFC Agent VPC, and all Workload VPCs
- Route tables in each VPC with routes to other VPCs via TGW
- Workload VPC CIDRs aggregated and distributed to VPN client routes

4.1.1.4 Security & Observability

- Dedicated security groups per component (VPN endpoint, etc.)
- VPC Flow Logs and TGW Flow Logs to CloudWatch
- VPN connection logging for audit trails
- IAM roles with least-privilege for flow log delivery

4.2 Terraform Cloud Agent

```
%%{init: {'theme': 'base', 'themeVariables': { 'primaryColor': '#1a73e8',
'primaryTextColor': '#fff', 'primaryBorderColor': '#1557b0', 'lineColor':
'#5f6368', 'secondaryColor': '#34a853', 'tertiaryColor': '#fbbc04'}}}%%

flowchart TB
    subgraph TERRAFORM_CLOUD["☁ Terraform Cloud (HCP)"]
        TFC["Terraform Cloud
API & Workspaces"]
        AgentPool["Agent Pool
(signalroom)"]
    end

    subgraph AWS["☁ AWS Cloud"]
        subgraph TFC_AGENT_VPC["TFC Agent VPC
var.vpc_cidr"]
            subgraph PUBLIC_SUBNETS["Public Subnets (Multi-AZ)"]
                IGW["Internet
Gateway"]
                NAT1["NAT Gateway
AZ-1"]
                NAT2["NAT Gateway
AZ-2"]
            end

            subgraph PRIVATE_SUBNETS["Private Subnets (Multi-AZ)"]
```

```
                subgraph ECS["ECS Fargate Cluster"]
                    TFCAgent1["TFC Agent
Container"]
                    TFCAgent2["TFC Agent
Container"]
                end

                subgraph AWS_ENDPOINTS["AWS VPC Endpoints"]
                    VPCE_SM["Secrets Manager
Endpoint"]
                    VPCE_CW["CloudWatch Logs
Endpoint"]
                    VPCE_ECR["ECR API/DKR
Endpoints"]
                    VPCE_S3["S3 Gateway
Endpoint"]
                end

                CONFLUENT_SG["Confluent PrivateLink
Security Group"]
            end

            DHCP["DHCP Options
(Custom DNS)"]
            TFC_AGENT_SG["TFC Agent
Security Group"]
        end

        subgraph TGW["Transit Gateway
signalroom-tgw"]
            TGWCore["TGW Core"]
            TGWRT["Route Table"]
        end

        subgraph DNS_VPC["DNS VPC (Centralized)
var.dns_vpc_cidr"]
            R53Inbound["Route53 Inbound
Resolver"]
            PHZ["Private Hosted Zones
*.aws.confluent.cloud"]
        end

        subgraph CLIENT_VPN_VPC["Client VPN VPC
var.client_vpn_vpc_cidr"]
            VPNEndpoint["Client VPN
Endpoint"]
        end

        subgraph WORKLOAD_VPCs["Workload VPCs
(Confluent PrivateLink)"]
            subgraph WL1["Workload VPC 1"]
                VPCE1["PrivateLink
Endpoint"]
            end
            subgraph WL2["Workload VPC N"]
                VPCEN["PrivateLink
Endpoint"]
            end
        end

        SecretsManager["AWS Secrets Manager
(TFC Agent Token)"]
        CloudWatch["CloudWatch Logs"]
        ECR_Registry["ECR Registry
(hashicorp/tfc-agent)"]
    end

    subgraph CONFLUENT["☁ Confluent Cloud"]
        PrivateLinkSvc["PrivateLink
Service"]
        Kafka["Kafka Cluster
(Private)"]
    end

    %% External Connections
    TFC <-->|"HTTPS/443
via NAT"| TFCAgent1
    TFC <-->|"HTTPS/443
via NAT"| TFCAgent2
    AgentPool -.->|"Agent Registration"| TFCAgent1

    %% Internal VPC Connections
    TFCAgent1 --> TFC_AGENT_SG
    TFCAgent2 --> TFC_AGENT_SG
    TFCAgent1 --> VPCE_SM
    TFCAgent2 --> VPCE_CW

    VPCE_SM -.->|"Private DNS"| SecretsManager
    VPCE_CW -.->|"Private DNS"| CloudWatch
    VPCE_ECR -.->|"Private DNS"| ECR_Registry

    NAT1 --> IGW
    NAT2 --> IGW
    TFCAgent1 -->|"0.0.0.0/0"| NAT1
    TFCAgent2 -->|"0.0.0.0/0"| NAT2

    %% DHCP & DNS Flow
    DHCP -->|"DNS Servers:
VPC + Centralized"| TFCAgent1
    TFCAgent1 -->|"DNS Query:
*.confluent.cloud"| R53Inbound

    %% Transit Gateway Connections
    TFC_AGENT_VPC -->|"TGW Attachment"| TGW
    DNS_VPC -->|"TGW Attachment"| TGW
    CLIENT_VPN_VPC -->|"TGW Attachment"| TGW
    WL1 -->|"TGW Attachment"| TGW
    WL2 -->|"TGW Attachment"| TGW
    %% Route Propagation
    TGWCore --> TGWRT

    %% DNS Resolution
    R53Inbound --> PHZ
    PHZ -->|"Returns Private IPs"| VPCE1

    %% PrivateLink Connections
    VPCE1 -->|"AWS PrivateLink"| PrivateLinkSvc
    VPCEN -->|"AWS PrivateLink"| PrivateLinkSvc
    PrivateLinkSvc --> Kafka

    %% TFC Agent to Workload VPCs
    TFC_AGENT_SG -->|"HTTPS/443
Kafka/9092"| CONFLUENT_SG
    CONFLUENT_SG -->|"via TGW"| VPCE1
    CONFLUENT_SG -->|"via TGW"| VPCEN

    %% Styling
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    classDef dnsStyle fill:#e6f4ea,stroke:#34a853,stroke-width:2px
    classDef confluentStyle fill:#f3e8fd,stroke:#9334e6,stroke-width:2px
    classDef endpointStyle fill:#fce8e6,stroke:#ea4335,stroke-width:1px
    classDef ecsStyle fill:#fff3e0,stroke:#ff9800,stroke-width:2px

    class TERRAFORM_CLOUD tfcStyle
    class TFC_AGENT_VPC,CLIENT_VPN_VPC,WORKLOAD_VPCs,WL1,WL2 vpcStyle
    class TGW tgwStyle
    class DNS_VPC dnsStyle
    class CONFLUENT confluentStyle
    class AWS_ENDPOINTS,VPCE_SM,VPCE_CW,VPCE_ECR,VPCE_S3 endpointStyle
    class ECS ecsStyle
```

4.2.1 Key Features Required for Confluent PNI to Work (TFC Agent Configuration)

4.2.1.1 Custom DHCP Options for DNS Resolution

- DHCP Options Set configured with **dual DNS servers**: VPC default DNS (`cidrhost(vpc_cidr, 2)`) AND centralized DNS VPC resolver IPs
- Region-aware domain name configuration (`ec2.internal` for us-east-1, `{region}.compute.internal` for others)
- Associates TFC Agent VPC with custom DHCP options to route Confluent domain queries to the central DNS infrastructure

4.2.1.2 Transit Gateway Connectivity

- TFC Agent VPC attached to shared Transit Gateway with DNS support enabled

- Explicit route table association and route propagation (not using TGW defaults)
- Routes added from private subnets to: DNS VPC, and Client VPN VPC
- Flattened route map pattern (`for_each`) ensures routes are created for every workload VPC CIDR

4.2.1.3 Security Group Configuration for Kafka Traffic

- **TFC Agent Security Group** with egress rules for:
  - HTTPS (443) and Kafka (9092) to each workload VPC CIDR
  - DNS (UDP/TCP 53) to DNS VPC CIDR specifically
  - General HTTPS/HTTP for Terraform Cloud API and package downloads

4.2.1.4 AWS VPC Endpoints for Private Service Access

- **Interface endpoints** with private DNS enabled for: Secrets Manager, CloudWatch Logs, ECR API, ECR DKR
- **S3 Gateway endpoint** (required for ECR image layer pulls)
- Dedicated security group for VPC endpoints allowing HTTPS from within VPC
- Eliminates NAT Gateway dependency for AWS service calls

4.2.1.5 ECS Fargate Deployment Pattern

- TFC Agents run in private subnets with `assign_public_ip = false`
- NAT Gateways per AZ for outbound internet (Terraform Cloud API communication)
- Agent token stored in Secrets Manager, fetched via VPC Endpoint
- Container health checks and deployment circuit breaker for reliability

4.2.1.6 IAM Permissions for Infrastructure Management

- Task role with Transit Gateway, VPC, Route53 Resolver, and Client VPN management permissions
- Execution role with Secrets Manager access for agent token retrieval
- KMS permissions scoped to Secrets Manager service for encryption/decryption

4.2.1.7 Network Architecture Summary

- **Hub-and-spoke model**: TGW connects TFC Agent VPC → DNS VPC → Workload VPCs

---

5.0 Configuration

All sensitive values are passed as environment variables (never stored in `.tfvars`). The `deploy.sh` script handles setting `TF_VAR_*` exports automatically after AWS SSO authentication.

5.1 Key Input Variables

Variable	Description
`tgw_id`	Existing Transit Gateway ID
`tgw_rt_id`	Transit Gateway Route Table ID

Variable	Description
`vpn_vpc_id`	VPN VPC ID
`vpn_vpc_rt_ids`	Comma-separated VPN VPC route table IDs
`vpn_endpoint_id`	AWS Client VPN Endpoint ID
`vpn_target_subnet_ids`	Comma-separated VPN associated subnet IDs
`tfc_agent_vpc_id`	Terraform Cloud Agent VPC ID
`tfc_agent_vpc_rt_ids`	Comma-separated TFC Agent VPC route table IDs
`eni_number_per_subnet`	Number of ENIs per subnet (default: `17`)
`aws_region`	AWS region for all resources

5.2 CIDR Allocations

Network	CIDR
PNI Hub VPC	`10.3.0.0/20`
Sandbox Spoke VPC	`10.0.0.0/20`
Shared Spoke VPC	`10.1.0.0/20`

All VPCs use 3 subnets across 3 AZs with `/4` new bits of sub-netting.

6.0 Deployment

6.1 Create

```
./deploy.sh create --profile=<SSO_PROFILE_NAME> \
                   --confluent-api-key=<CONFLUENT_API_KEY> \
                   --confluent-api-secret=<CONFLUENT_API_SECRET> \
                   --tfe-token=<TFE_TOKEN> \
                   --tgw-id=<TGW_ID> \
                   --tgw-rt-id=<TGW_RT_ID> \
                   --tfc-agent-vpc-id=<TFC_AGENT_VPC_ID> \
                   --tfc-agent-vpc-rt-ids=<TFC_AGENT_VPC_RT_IDs> \
                   --vpn-vpc-id=<VPN_VPC_ID> \
                   --vpn-vpc-rt-ids=<VPN_VPC_RT_IDs> \
                   --vpn-endpoint-id=<VPN_ENDPOINT_ID> \
                   --vpn-target-subnet-ids=<VPN_TARGET_SUBNET_IDs> \
                   --pni-hub-vpc-cidr=<PNI_HUB_VPC_CIDR>
```

The script will:

1. Authenticate to AWS SSO and export temporary credentials.
2. Export all `TF_VAR_*` environment variables.

3. Run `terraform init`, `terraform plan`, prompt for confirmation, then `terraform apply`.
4. Generate a Terraform graph visualization at `docs/images/terraform-visualization.png`.

6.2 Destroy

```
./deploy.sh destroy --profile=<SSO_PROFILE_NAME> \
                    --confluent-api-key=<CONFLUENT_API_KEY> \
                    --confluent-api-secret=<CONFLUENT_API_SECRET> \
                    --tfe-token=<TFE_TOKEN> \
                    --tgw-id=<TGW_ID> \
                    --tgw-rt-id=<TGW_RT_ID> \
                    --tfc-agent-vpc-id=<TFC_AGENT_VPC_ID> \
                    --tfc-agent-vpc-rt-ids=<TFC_AGENT_VPC_RT_IDs> \
                    --vpn-vpc-id=<VPN_VPC_ID> \
                    --vpn-vpc-rt-ids=<VPN_VPC_RT_IDs> \
                    --vpn-endpoint-id=<VPN_ENDPOINT_ID> \
                    --vpn-target-subnet-ids=<VPN_TARGET_SUBNET_IDs> \
                    --pni-hub-vpc-cidr=<PNI_HUB_VPC_CIDR>
```

Destroy runs `terraform destroy -auto-approve` and regenerates the visualization.

7.0 Outputs

Output	Description
`confluent_pni_hub_gateway_id`	ID of the `confluent_gateway` resource (PNI Hub)
`confluent_pni_hub_access_point_id`	ID of the `confluent_access_point` resource

8.0 Security Design

Security Group (PNI ENIs): Ingress-only on ports `443` (HTTPS/REST/Schema Registry) and `9092` (Kafka), sourced from the PNI Hub VPC CIDR, TFC Agent VPC CIDR, VPN VPC CIDR, and Client VPN CIDR. **No egress rules are defined**, which causes Terraform to revoke AWS's default `0.0.0.0/0` egress — intentionally mirroring PrivateLink's unidirectional behavior and preventing Confluent-initiated connections into the customer network.

Network ACL: Allows TCP ingress on `443`, `9092`, and ephemeral ports `1024–65535`. Allows all egress.

ENI Permissions: `aws_network_interface_permission` grants Confluent's AWS account `INSTANCE-ATTACH` permission on each customer-owned ENI. This is the core PNI handshake — Confluent attaches its broker VMs to your ENIs without your traffic ever leaving the AWS backbone.

9.0 How PNI Differs from PrivateLink

Aspect	PrivateLink	PNI

Aspect	PrivateLink	PNI
ENI ownership	Confluent's account	**Customer's account**
DNS	Requires PHZ + VPC associations	Confluent manages DNS
Connectivity model	VPC Interface Endpoint	ENIs registered via `confluent_access_point`
Egress control	Unidirectional by design	Explicit empty egress on SG required
Port 53 (DNS) rules	Required in SG	**Not needed**

10.0 Resources

- Confluent PNI Documentation
- Confluent PNI FAQ
- AWS Multi-VPC ENI Attachment
- confluent_gateway Terraform resource
- confluent_access_point Terraform resource