SDEWAN Central Controller

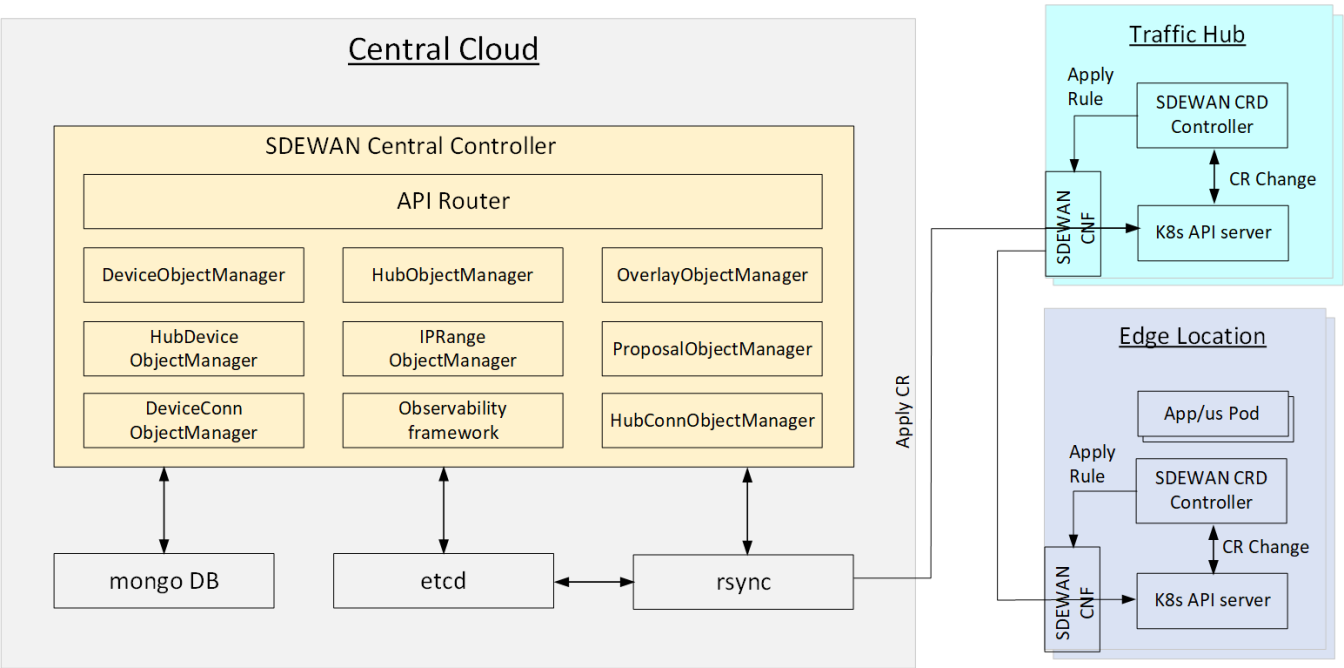
SDEWAN central controller provides central control of SDEWAN overlay networks by automatically configuring the SDEWAN CNFs located in edge location clusters and hub clusters:

- To create secure overlays where each overlay connects application and hub clusters together.
- To allow application connectivity with external entities and entities of other clusters.

System Architecture

The system includes the following micro-services as showed in below diagram:

- SDEWAN Central Controller:
  - API Router: provides REST API router for SDEWAN Central Controller
  - OverlayObjectManager: overlay registration, generate overlay root cert
  - HubObjectManager: hub registration and setup hub connection mesh
  - DeviceObjectManager: device/cluster registration and setup device connection mesh (if device has public IP)
  - HubDeviceObjectManager: setup connection between hub and device
  - IPRangeObjectManager: ip range registration and allocate/free overlay ip for device
  - ProposalObjectManager: proposal registration
  - DeviceConnManager: only support GET, query connection status of device
  - HubConnObjectManager: only support GET, query connection status of hub
  - Observability framework: system status monitoring, including connection status, CNF status etc.
- Rsync: a daemon service which accepts request from SDEWAN Central Controller (through RPC) then deploy relevant K8s CRs of SD-EWAN CNFs of various hubs and edges to establish the tunnels.
- Mongo DB: a database to store information such as edge clusters, hubs, overlays, ip addresses, application/services etc.
- Etcd: a metadata database to exchange configuration information between SDEWAN Central Controller and Rsync



System Design

Assumption

IP

- Central Cloud has public IP as CIP
- Traffic Hub has public IP as HIP1 HIP2, ...
- Edge Location (Device) may have public IP in one edge node as EIP1, ... or don't have public IP (behind a gateway as EGIP1, ...)

Connection for control plane (e.g. central cloud to k8s API server):

- Central Cloud to Traffic Hub: Direct connection through Hub's public IP
- Central Cloud to Edge Location:
    - Edge location has public IP: Direct connection through Edge Location's public IP
    - Edge location does not have public IP: Using Edge Location owned hub's SDEWAN CNF as proxy

IPSec Tunnel mode for data plane (for data traffic)

- Edge to Edge: Host to host
- Edge to Hub: Host (edge) to Site (Hub, using edge's subnet as rightsubnet)
- Hub to Hub: Host to Host

Environment Setup (Pre-condition)

Central Cloud:

- K8s cluster is setup (by Kud)
- Web UI (Optional), API Server, Rsync backend, DB service are deployed (manually or through EMCO)

Traffic Hub:

- K8s cluster is setup (by Kud)
- Hub SDEWAN CRD Controller and CNF are deployed (through EMCO) with initial configuration (e.g. NAT: enable DNAT for k8s API service and Istio Ingress service).

Edge Location (With Public IP):

- K8s cluster is setup (by Kud)
- Edge SDEWAN CRD Controller and CNF are deployed (through EMCO) with initial configuration (e.g. NAT: enable DNAT for k8s API service and Istio Ingress service).

Edge Location (With Private IP):

- K8s cluster is setup (by Kud)
- Edge SDEWAN CRD Controller and CNF are deployed (through EMCO) with initial configuration (e.g. NAT: enable DNAT for k8s API service and Istio Ingress service; IPSec: as Initiator for Control plane - left: %any, leftsourceip:%config, right: Owned Hub's HIP, rightsubnet:0.0.0.0/0).

Restful API definition and Back-End flow

Resource	Description	URL	Fields	Back-End flow
Overlay	Define a group of edge location clusters (devices) and hubs, a overlay is usually owned by one customer and full mesh connections are setup automacally between hub-hub and device-device (with public IPs)	/scc/v1/overlays	• name • description • caid	Registration: • SCC requests a CA from cert-manager, the CA is used as root CA for this overlay • SCC save the caid in DB
Proposal	Define proposals which can be used for IPsec tunnel in this overlay	/scc/v1/overlays/{overlay-name}/proposals	• name • description • encryption • hash • dhgroup	Registration: • SCC saves the proposals information in DB

Hub	Define a traffic Hub in an overlay	/scc/v1/overlays/{overlay-name)/hubs	• name
			• description
			• publicIps
			• certificateId
			• kubeConfig
				Registration:
				• SCC checks hub's k8s API server access with kubeConfig for each ip in publicIps
				• For each registered hub in this overlay
				  ○ SCC requests cert-manager to generate a public/private key pair based on overlay CA
				  ○ SCC generates the IPsec CR for new hub and registered hub then call rsync to deploy CR to setup route based host-host IPsec tunnel (with BGP/OSPF enabled):
				  ▪ All proposals in this Overlay will be used as candidate proposals for IPsec configuration
				  ▪ Use the public/privite key pair generated in previous step as IPsec cert
				• SCC saves hub information in DB

IPRange	Define the overlay IPrange which will be used as OIP of devices	/scc/v1/overlays/{overlay-name}/ipranges	• name • description • subnet • minIp • maxIp	Registration: • SCC save ip range information in DB

Device	Define a edge location device information which may be a CNF, VNF or PNF	/scc/v1/overlays/{overlay-name}/devices	• name
			• description
			• publicIps
			• forceHubConnectivity
			• proxyHub
			• proxyHubPort
			• useHub4Internet
			• dedicatedSFC
			• certificateId
			• kubeConfig
				Registration:
				• If has publicIps and forceHubConnection==false:
				  ○ SCC checks device's k8s API server access with kubeConfig for each ip in publicIps
				  ○ For each registered device of this overlay:
				  ▪ SCC requests cert-manager to generate a public /private key pair based on overlay CA
				  ▪ SCC generates the IPsec CR for new device and registered device then call rsync to deploy CR to setup host-host IPsec tunnel:
				  • All proposals in this Overlay will be used as candidate proposals for IPsec configuration
				  • Use the public/privite key pair generated in previous step as IPsec cert
				• else
				  ○ (Assumption) Kud configures device as Initiator to proxyHub
				  ○ SCC find 1 available OIP from overlay's IPRange, configure then deploy (through rsync) IPsec CR for proxyHub as Responder with OIP as the only 1 candidate ip for Initiator
				  ▪ Expectation: the IPsec tunnel between proxyHub and device should setup up and the device will get the assigned OIP
				  ○ SCC creates DNAT CR (dst: HIP, dst_port: proxyHubPort change to dst: OIP, dst_port: 6443) then deploy to proxyHub (SCC will auto geterate a proxyHubPort if not provided)
				  ○ SCC checks device's k8s API server access with kubeConfig for proxyHub:proxyHubPort
				  ○ For each registered device with public ip and forceHubConnection==false:
				  ▪ SCC requests cert-manager to generate a public /private key pair based on overlay CA
				  ▪ SCC generates the IPsec CR for new device and registered device (with public IP) then call rsync to deploy CR to setup host-host IPsec tunnel:
				  • All proposals in this Overlay will be used as candidate proposals for IPsec configuration
				  • Use the public/privite key pair generated in previous step as IPsec cert
				• SCC saves device information in DB

Hub-device connection	Define a connection between hub and device	/scc/v1/overlays/{overlay-name}/hubs/{hub-name}/devices/{device-name}	• N/A	Create: • SCC find 1 available OIP from overlay's IPRange, configure then deploy (through rsync) IPsec CR for hub as Responder with OIP as the only 1 candidate ip for Initiator • SCC configure the deploy IPsec CR as Initiator to Hub for device ○ Expectation: the IPsec tunnel between hub and device should setup up and the device will get the assigned OIP **Todo**: Confirm "ip route" rule for OIP in this hub and all other hub are setup automatically or need new CR to execute linux shell in host

Error handling

DB Schema

Module Design

Task Breakdowns

Tasks	Due	Owner	Status	Description
Scheduler Manager				
-- Overlay: Setup tunnels for hubs and edges				Generates relevant K8s CRs of SD-EWAN CNFs of various hubs and edges to establish the tunnels
-- IP Address manager				Assigns/frees IP addresses from "overlay IP ranges" and dedicates them to that cluster
-- Application connectivity scheduler				Creates K8s resources required to be pushed into the edges and corresponding traffic hubs to facilitate the connectivity
-- Resource Synchronizer				
-- CNF				
API Server				
-- Rest API Backend				Rest API server framework

-- DB Backend				Proxy to DB
-- Application Cluster management				
-- Hub management				
-- Overlay management				
-- Status monitoring management				
-- logging				
Web UI				
-- Web UI framework				
-- Application Cluster Registration				
-- Hub Registration				
-- Overlay				
-- Application/Service Registration				
-- Status tracking				
EMCO plugin for SDEWAN				
E2E Integration				Integration test of overall system