Catalyst SD-WAN AppQoE DRE - Topology, Configuration, Verification

Contents

Introduction
Background Information
DRE Optimization
Control Connections
Steps to Build an AppQoE DRE Setup with ISN and ESN
1. System (Interfaces and Hardware) and Topology
1.1. Topology and Interfaces
1.2. Disk Requirement
1.3. Adding Devices to SD-WAN Fabric
2. Branch: AppQoE ISN Configuration
3. DC/Hub: AppOoE ESN Configuration
4. DC/Hub: AppOoE SC Configuration
5. Centralized Traffic Data Policy
A. Branch ISN
B. DC/Hub SC
Verification - CLI
Branch ISN
DC/Hub SC
DC/Hub ESN
Verification - Dashboard
Branch ISN
DC/Hub SC
DC/Hub ESN

Introduction

This document describes how to create and configure a setup for Data Redundancy Elimination (DRE) optimization.

Background Information

This document aims to serve as a starting point for guidance on how to create and configure a setup for DRE which is part of an <u>Integrated Application Quality of Experience (AppQoE) Solution</u>, offering an End-to-End Consistent Policy Framework and Monitoring, for a Multitude of Deployment Use Cases.

Building blocks of AppQoE Solution:

- Forward Error Correction (FEC) and Packet Duplication (PD): Addresses Packet Loss issues. See for FEC.
- TCP optimization: Addresses WAN latency issues. See for a single-sided TCP Opt Use Case.

• DRE optimization: Addresses Low Bandwidth issues. Typically DRE Optimization is used together with TCP Optimization.

Existing CCO DRE documentation does not contain a full end-to-end process description. This document provides a step-by-step end-to-end description of the DRE solution.

A deep technical explanation of DRE functionality is out of the scope of this article. If you want to learn more about technical details and DRE functionality, please use <u>this documentation</u>.

DRE Optimization

DRE is a dual-sided solution that removes redundant data by caching previously seen patterns. Combined with the Lempel–Ziv–Welch (LZW) algorithm, which provides compression to reduce the amount of data over WAN, the DRE feature offers a fully secure and integrated solution with Unified Threat Defense (UTD) and Secure Sockets Layer (SSL) proxy.

It is Application and Protocol agnostic and is a Cloud-ready solution which offers around 60-90% WAN traffic reduction.

Different deployment scenarios are supported to achieve a scalable solution.

- The integrated solution provides a one-box solution for deploying branch services, termed as an Integrated Service node (ISN).
- External Service Nodes (ESN) are decoupled from intercepting edge routers or Service Controller (SC) in External Service Node deployment, typically at Data Centers and Hubs. Redirection of flows based on application traffic is achieved using a Data Policy.

Control Connections



Note: The ESN does not form any control connection with the Controller (formerly known as vSmart). The ESN has a control connection to the SD-WAN Manager.



Steps to Build an AppQoE DRE Setup with ISN and ESN

1. System (Interfaces and Hardware) and Topology

1.1. Topology and Interfaces

The ESN requires the following interfaces:

- A VPN0 Interface connectivity to the Controllers (Manager and Validator [transient]). Connectivity from ESN to Controllers can be directly or via SC. The recommendation is via SC since this avoids the need for an additional WAN circuit on the ESN.
- Another VPN0 Interface for connectivity to the Service Controller.
- Optional: A VPN512 Management interface.



1.2. Disk Requirement

For a lab setup, a 150GB disk is good enough, for the DRE optimization to work.

This holds good only for functional verification in a lab environment, and is not meant for production. For accurate disk and other recommendations, please check <u>this CCO link</u>.



Note: This additional disk requirement is only for the ISN and ESN. It is not required on SC.

1.3. Adding Devices to SD-WAN Fabric

- Using templates (available from 20.6/17.6 onwards): AppQoe Feature template which can be specified in the Device Template as an Additional Template.
- Using Configuration Groups (available from 20.14/17.14 onwards): AppQoE Feature parcel available in Service/LAN profile in Configuration Group.

1.4. C8000v Details

If you are using c8kv, please ensure to enable app-heavy CPU profile configuration. Useful article.

2. Branch: AppQoE ISN Configuration

Create an AppQoE feature template (using templates as shown here) for the device model.

Configuration			
Device Templates Feat	ure Templates		
Feature Template > AppQoE >	DRE-IntNode-template		
Device Type	C8000v		
Template Name	DRE-IntNode-template		
Description	Feature Template for Integrated Node		
 Control Components 	Service Node		
Control Components			
Integrated Service Node	e Enable		
Controller IP address	€ 192.168.2.1		
Service Node IP 1	€ 192.168.2.2		
Advanced			
DRE Optimization 🕕			
Resource Profile	default		
SSL Decryption (i)	Enable Enable		

Then, specify this Feature template in the Device template.

Additional Templates	
AppQoE	DRE-IntNode-template -

3. DC/Hub: AppQoE ESN Configuration

Create an AppQoE Feature Template for the device model.

Configuration			
Device Templates Fea	ature Templates		
Feature Template > AppQoE	> DRE-feature-template		
Device Type	C8000v		
Template Name	DRE-feature-template		
Description	Feature Template for DRE		
Control Components Service Node	Service Node		
External Service Node	Enable		
Advanced			
DRE Optimization Resource Profile	i default		
SSL Decryption	D Enable		

Then, specify this Feature template in the Device template.

Additional Templates

AppQoE *

DRE-feature-template

4. DC/Hub: AppQoE SC Configuration

Create an AppQoE Feature Template for the device model.

Configuration Device Templates Feat	re Templates
Feature Template > AppQoE	DRE-DC2-ServContr-Template
Device Type	:8000v
Template Name	DRE-DC2-ServContr-Template
Description	DRE AppQoE Template for DRE Service Controller
Control Components	Service Node
Control Components	
Integrated Service Nod	Enable
Controller IP address	⊕ 10.115.1.5
Service VPN	115
Service Nodes	
Service Node Group Na	Service Node IP Addresses
SNG-APPQO	1 Service Node IP Addresses
	10.115.1.10

Then, specify this Feature template in the Device template.

Additional Templates

AppQoE

DRE-DC2-ServContr-...

5. Centralized Traffic Data Policy

- Two different policies are required: one for the Internal Service Node (ISN) and the second for the Service Controller (SC). See the difference below.
- The Policy direction must be "All" for both
- The Service-node-group must be blank for ISN and specified for the SC.
- DRE optimization is typically used along with TCP optimization.

In this example, a Web Client on a Branch location is defined and a Web Server on the DC site, you might want to adjust it for your traffic of interest accordingly.

A. Branch ISN

UI - Template

Sequence 1 - from Client 10.107.1.10 to Server 10.109.1.10:

2 Custom		C
Sequence Rule Drag and drop to re-arrange rules		
Protocol IPv4 Accept O Drop VPN Next Hop Policer Redirect DNS	ions S Service	Service Chain AppQoE Optimization Loss Correction TLOC
Match Conditions		Actions
Source Data Prefix List	×	Accept Enabled
Select a data prefix list		AppQoE Optimization ×
Source: IP Prefix		TCP Optimization
10.107.1.10/32		DRE Optimization
Destination Data Prefix List	×	Service Node Group Example: SNG-APPQOE<1-31>
Select a data prefix list		
Destination: IP Prefix		
10.109.1.10/32		
		Canaal Save Match and Action
		Gancel Save Match and Actions

Sequence 2 - from Server back to Client:

Custom		Dat
Sequence Rule Drag and drop to re-arrange rules Match Action Protocol IPv4 Protocol Source Data Prefix Source Port Destination	ns Data Prefi	Destination Region Destination Port TCP Traffic To
Match Conditions Source Data Prefix List Select a data prefix list Source: IP Prefix	×	Actions Accept Enabled AppQoE Optimization × TCP Optimization
10.109.1.10/32 Destination Data Prefix List Select a data prefix list	×	C DRE Optimization Service Node Group Example: SNG-APPQOE<1-31>
Destination: IP Prefix 10.107.1.10/32		
		Cancel Save Match and Actions

CLI:

ISN# show sdwan policy from-vsmart

```
from-vsmart data-policy _CorpVPN_DRE-data-policy-ISN-2
direction all
vpn-list CorpVPN
 sequence 1
  match
    source-ip 10.107.1.10/32
   destination-ip 10.109.1.10/32
  action accept
    tcp-optimization
    dre-optimization
 sequence 11
  match
    source-ip 10.109.1.10/32
   destination-ip 10.107.1.10/32
  action accept
    tcp-optimization
    dre-optimization
 default-action accept
from-vsmart lists vpn-list CorpVPN
vpn 1
```

B. DC/Hub SC

UI - Template

Sequence 1:

Match Conditions Actions Source Data Prefix List * Select a data prefix list Accept 10.109.110/32 ApQoE Optimization Destination: IP Prefix * Select a data prefix list * Destination: IP Prefix SNG-APPQOE	Custom Custom Drag and drop to re-arrange rules Match Action Protocol IPv4 CAccept O Drop VPN Next Hop Policer Redirect DNS	s Service	D Ce Service Chain AppQoE Optimization Loss Correction TLOC
	Match Conditions Source Data Prefix List Select a data prefix list Destination Data Prefix List Select a data prefix list Destination: IP Prefix 10.107.110/32 10.107.110/32	×	Actions Accept Enabled AppQoE Optimization × Image: Complex

Sequence 2:

Match Conditions Actions Source Data Prefix List × Select a data prefix list Accept Dotsination Data Prefix List × Select a data prefix list × Destination: IP Prefix SNG-APPQOE	Custom Custom Drag and drop to re-arrange rules Protocol IPv4 Protocol Source Data Prefix	Match Actions x Source Port Destination Data Prefix	Destination Region Des	tination Port TCP Traffic	Dat
	Match Conditions Source Data Prefix List Select a data prefix list 10.107.1.10/32 Destination Data Prefix List Select a data prefix list Destination: IP Prefix 10.109.1.10/32	×	Actions Accept AppQoE Optimization C TCP Optimization C DRE Optimization Service Node Group	Enabled SNG-APPQOE	×

CLI:

SC# show sdwan policy from-vsmart
from-vsmart data-policy _CorpVPN_DRE-data-policy-SC_ESN-2
direction all
vpn-list CorpVPN
sequence 1
match
source-ip 10.107.1.10/32
destination-ip 10.109.1.10/32
action accept
tcp-optimization
dre-optimization
service-node-group SNG-APPQOE
sequence 11

```
match
  source-ip 10.109.1.10/32
  destination-ip 10.107.1.10/32
  action accept
  tcp-optimization
  dre-optimization
  service-node-group SNG-APPQOE
default-action accept
```

```
from-vsmart lists vpn-list CorpVPN vpn 1
```

Verification - CLI

Branch ISN

ISN# show sdwan appqoe dreopt status

DRE ID	: 52:54:dd:2a:74:d7-018eafaa99e1-f9ff51aa				
DRE uptime	: 04:10:59:59				
Health status	status : GREEN				
Health status change reason : None					
Last health status change time : 04:10:59:59					
Last health status notification	sent time : 1 second				
DRE cache status	: Active				
Disk cache usage	: 2%				
Disk latency	: 25 ms				
Active alarms:					
None					
Configuration:					
Profile type	· S				
Maximum connections	. 5				
Maximum fanout	: 35				
Disk size	: 60 GB				
Memory size	: 2048 MB				
CPU cores	:1				
Disk encryption	: ON				
• •					
ISN# show sdwan approve flow					
	F				
1.1Cl, 5.55L, 0.01D, D.D.					
Flow ID VPN ID Source	e IP Port Destination IP Port Tx Bytes Rx Bytes				
54382538667 1 10.107	.1.10 55340 10.109.1.10 80 263663268 640416				
ISN# show sdwan appqoe dree	ppt statistics				
Total connections :	4				
Wax concurrent connections : 1					
Current active connections	:1				
Total connection resets	:0				

: 3570 MB

: 1633 MB

Total original bytes Total optimized bytes Services

TD

Overall reduction ratio	: 54%
Disk size used	: 2%
Cache details:	
Cache status	: Active
Cache Size	: 59132 MB
Cache used	: 2%
Oldest data in cache	: 01:22:02:49
Replaced(last hour): size	: 0 MB

DC/Hub SC

SC# show service-insertion type appqoe service-node-group Service Node Group name : SNG-APPQOE Service Context : appqoe/1 Member Service Node count : 1

Service Node (SN)	: 10.115.	1.10
Auto discovered	: No	
SN belongs to SNG	: SNG-4	APPQOE
Current status of SN	: Alive	
System IP	: 10.1.90.2	
Site ID	: 90	
Time current status wa	s reached	: Sat Apr 6 07:26:16 2024

Cluster protocol VPATH version: 2 (Bitmap recvd: 3)Cluster protocol incarnation number: 1Cluster protocol last sent sequence number: 1714282683Cluster protocol last received sequence number: 1931795Cluster protocol last received ack number: 1714282682

Health Markers:

AO Load State

tcp GREEN 0% ssl RED/NOT AVAILABLE dre GREEN 0% http RED/NOT AVAILABLE utd chnl RED/NOT AVAILABLE

DC/Hub ESN

ESN# show sdwan appqoe dreopt st	tatus
DRE ID :	52:54:dd:c3:40:17-018eb15f4fc3-49ee2d0f
DRE uptime	: 04:11:28:50
Health status	: GREEN
Health status change reason	: None
Last health status change time	: 04:11:28:50
Last health status notification sent t	ime : 1 second
DRE cache status	: Active
Disk cache usage	: 2%

: 10 ms Disk latency Active alarms: None Configuration: Profile type : S Maximum connections : 750 Maximum fanout : 35 Disk size : 60 GB Memory size : 2048 MB CPU cores :1 Disk encryption : ON

ESN# show sdwan appqoe flow active T:TCP, S:SSL, U:UTD, D:DRE

Flow ID	VPN ID	Source IP	Port Destination IP	Port	Tx Bytes	Rx Bytes	Services
20022800299	1	10.107.1.10	55340 10.109.1.10	80	2998777	1074725760	TD

ESN# show sdwan appqoe	dreopt statistics
Total connections	: 4
Max concurrent connection	ns : 1
Current active connections	:1
Total connection resets	: 0
Total original bytes	: 4294 MB
Total optimized bytes	: 1634 MB
Overall reduction ratio	: 61%
Disk size used	: 2%
Cache details:	
Cache status	: Active
Cache Size	: 59132 MB
Cache used	: 2%
Oldest data in cache	: 01:22:04:08
Replaced(last hour): size	: 0 MB

Verification - Dashboard

To view the AppQoE DRE data in the SD-WAN Manager Device dashboard, ensure the following:

- Controllers and Devices time is synchronized by configuring Network Time Protocol (NTP). You can also use the Clock set command to set the clock manually.
- Add these CLIs to the Device configuration (ISN/SC/ESN):

```
policy ip visibility features multi-sn enable
policy ip visibility features dre enable
policy ip visibility features sslproxy enable - (for SSL traffic)
```



Note: On-demand Troubleshooting should be enabled to view these dashboards. Note that the dashboard screens shown here do not show real-time information.

To get the latest data, you might want to navigate to Tools > On Demand Troubleshooting, select the appropriate Device and "DPI" as Data Type and retrieve the DPI statistics for the last 3 hours as shown here:

10 % X ef	Monitor Configuration Tools Maintenance	BR7-DRE-IntNode-70.27.1-vedge v Select Data Type ^ Inguration Data Backfill Time Period DPI ConnectionEvents ConnectionEvents s Start Date Start time Internance Start time End Date Internance Internance End time								
2o	Administration								_	
۰Ð	Workflows								Save	Clear
	Reports	Q Search Table								7
dd.	Analytics							As of: Apr 18	8, 2024 05:48 P	63 M
Ø	Explore	ID	Device ID	Data Type	Creation Time	Expiration Time	Data Backfill Start Time	Data Backfill End Time	Status	Action
		1d7c7605-0e17-43d3-97e8-59c69ec6ac12	1.1.1.222	ConnectionEvents	Feb 15, 2022, 12:36:05 AM	Feb 15, 2022, 3:36:05 AM	Feb 14, 2022, 11:36:05 PM	Feb 15, 2022, 12:36:05 AM	COMPLETED	
		a92e3d95-9ac9-4a87-a36d-311012d9c0f9	70.7.7.1	DPI	Apr 18, 2024, 5:44:33 PM	Apr 18, 2024, 8:44:33 PM	Apr 18, 2024, 2:44:33 PM	Apr 18, 2024, 5:44:33 PM	COMPLETED	
		2 Records					Item	s per page: 25 👻 1 - 2 of 2	14 4	> >1

Branch ISN

Approximately 900MB of data was downloaded (3 x 200MB files and 3 x 100MB files) - Original Traffic (YELLOW).

The optimization resulted in only 8.07MB of traffic sent over the WAN, around 90% bandwidth usage reduction - Optimized Traffic (BLUE).

Select Device 💙	BR7-DRE-IntNode 70.7.71 Site Name 70 Device Model: C8000v 🕢	
APPLICATIONS SAIE Applications	Data Backfill Start Time: Wed Apr 17 2024 13:54:41 GMT-0400 and Data Backfill End Time: Wed Apr 17 2024 16:54:41 GMT-0400 Chart Options	
Interface	Optimized Traffic Application	
Tracker		1h 3h 6h 12h 24h 7days C
QoS	Controller Service Node	
ON-DEMAND TROUBLESHOOTING	Expert	Legend
FEC Recovery Rate		Optimized Traffic Original Traffic
SSL Proxy	715.26 MB	
AppQoE TCP Optimization	Apr 17, 16:35:00	
AppQoE DRE Optimization	Oppmizzo trans: 6.47 MB Original Traffic: 939.36 MB	
Connection Events	© 470.04 MD	
WAN Throughput		
Flows	238.42 M0	
Top Talkers		
WAN	0 B Apr 17, 14:00 Apr 17, 14:15 Apr 17, 14:30 Apr 17, 14:45 Apr 17, 15:00 Apr 17, 15:15 Apr 17, 15:30 Apr 17, 15:45 Apr 17, 16:00 Apr 17, 16:15 Apr 17, 16:30	Apr 17, 16:45
TLOC		
Tunnel	Q Search	V
Managed Cellular Activation - eSIM	M I)
	1 Rows Selected	Total Dours 1 11 (6)
SECURITY MONITORING		1010111011011011
SECURITY MONITORING Firewall	Service Node IP System IP Site Id Status TCP Status/Load DRE Status/Load SSL Pro	oxy Status/Load Error

DC/Hub SC

If there are multiple ESNs, then the Controllertab shows the cumulative data and the Service Nodetab shows the individual ESN data.

Devices > AppQoE Service C	auronar	
Select Device 👻	BR9-DRE-ServContr 90.1.90.1 Site Name SITE_90 Device Model: C8000v	
APPLICATIONS	Data Backfill Start Time: Wed Apr 17 2024 13:55:37 GMT-0400 and Data Backfill End Time: Wed Apr 17 2024 16:55:37 GMT-0400	
SAIE Applications	Chart Options 🗸	
Interface	Optimized Traffic Application	
Tracker		1h 3h 6h 12h 24h 7days Custor
QoS	Controller Service Node	
ON-DEMAND TROUBLESHOOTING	Expert	Legend
FEC Recovery Rate	476.64 MB	 Optimized Traffic Original Traffic
SSL Proxy AppQoE TCP Optimization	Apr 17, 16:35:00 381.47 MB • Optimized Traffic: 4.54 MB	
AppQoE DRE Optimization	Unginal rame: 531.52 MB	
Connection Events	C 200.1 MO	
WAN Throughput	190.73 MB	
Flows	95.37 MB	
Top Talkers	08	
WAN	Apr 17, 14:00 Apr 17, 14:15 Apr 17, 14:30 Apr 17, 14:45 Apr 17, 15:00 Apr 17, 15:15 Apr 17, 15:30 Apr 17, 15:45 Apr 17, 16:45 Apr 17, 16:15 Apr 17, 16:16 Apr 17, 16:16 Apr 17, 16:45 Apr	17
TLOC		
Tunnel	Q Search	V
Managed Cellular Activation - eSIM	1 Rows Selected	
SECURITY MONITORING		Total Rows: 1 📢 🚱
Firewall	Service Node IP System IP Site Id Status TCP Status/Load DRE Status/Load SSL Proxy Status/Lo	ad Error
Intrusion Prevention		
URL Filtering		-

DC/Hub ESN

Devices > AppQoE Service №	lode				
Select Device 👻	BR9-DRE-ExtNode 90.1.90.2 Site Name 6	0 Device Model: C8000v ()			
APPLICATIONS	Data Backfill Start Time: Wed Apr 17	2024 13:55:31 GMT-0400 and Data B	ackfill End Time: Wed Apr 17 202	4 16:55:31 GMT-0400	
SAIE Applications	Chart Options 🗸				
Interface		01	otimized Traffic Application		
Tracker					1h 3h 6h 12h 24h 7days Custom
QoS			Service Node Controll	ler	
ON-DEMAND TROUBLESHOOTING	Export				Legend
FEC Recovery Rate				Ν	 Optimized Traffic Original Traffic
SSL Proxy	470.04 M0			Apr 17, 16:40:00	
AppQoE TCP Optimization	381.47 MB			 Optimized Traffic: 3.52 MB Original Traffic: 425.86 MB 	-
AppQoE DRE Optimization	286.1 MB				
WAN Throughput	190.73 MB				
Flows					
Top Talkers	95.37 MB				
WAN	0 B Apr 17, 14:00 Apr 17, 14:15	Apr 17, 14:30 Apr 17, 14:45 Apr 17, 15:00 Apr 1	7, 15:15 Apr 17, 15:30 Apr 17, 15:45 Apr	17, 16:00 Apr 17, 16:15 Apr 17, 16:30	Apr 17, 16:45 Apr 17,
TLOC					
Tunnel	Q Search				V
Managed Cellular Activation - eSIM	1 Rows Selected				
SECURITY MONITORING	THOM OUTCOM				Total Rows: 1 📢 🍪
Firewall	Service Controller IP	Service Controller System IP	Service Controller Site Id	Service Node IP	Error
Intrusion Prevention	2 10.115.1.5	90.1.90.1	90	10.115.1.10	
URL Filtering					