CloudRouter®

SERVICE DESCRIPTION OF CLOUDROUTER®

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Note:

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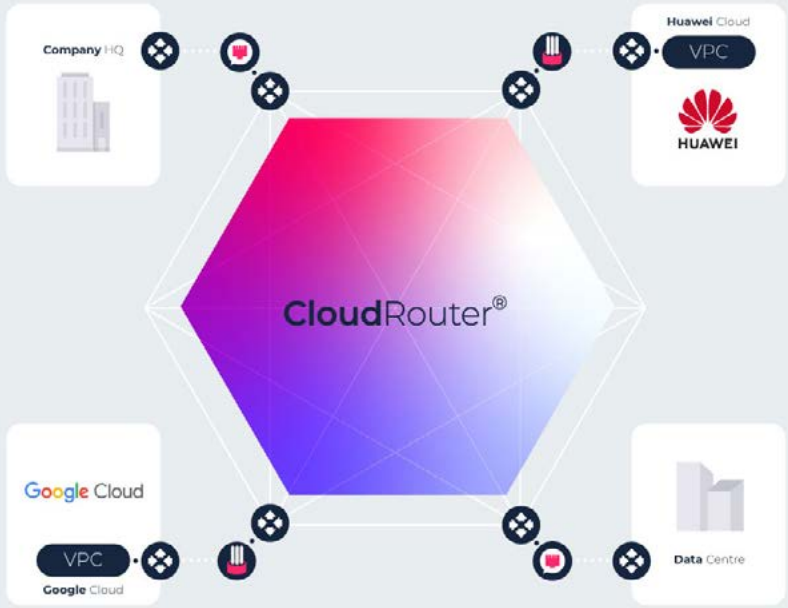
1. GENERAL DESCRIPTION

CloudRouter® is an MPLS VPN IP based infrastructure service which provides a private network connecting multiple locations globally for enterprises and service providers. Multiple applications can be supported on a single MPLS network with security and Quality of Service (QoS) equivalent to other Layer 2 technologies.

Short for Multi-Protocol Label Switching, MPLS is an Internet Engineering Task Force (IETF) initiative that integrates Layer 2 link layer protocol details (bandwidth, latency, utilization) into a Layer 3 (IP) network in order to simplify and improve IP packet delivery and exchange. MPLS provides customers with a great deal of flexibility by allowing their traffic to be assigned to different Classes of Service (CoS), inherently re-routes traffic around link failures and provides granular traffic management. Console Connect's MPLS VPN service initially adopted the IETF RFC 2547bis architecture and has kept pace with the technology improvements and standards offered with RFC 4364 to deliver a flexible, customizable, any-to-any private network that allows customers to connect to cloud SaaS, their headquarters, branch offices, data centers and other locations.

Typical MPLS VPN diagram



2. CLOUDROUTER® SERVICE COMPONENTS

Here we want to highlight that there are 2 different configurations for CloudRouter®: A cloud only one where there are no customer components. e.g. no CPE required and a hybrid option where they have a combination of non-cloud sites where they would then need the following components.

A CloudRouter® can connect two or more sites in a virtual network. A site can be either built from your Console Connect port or it can be connected to a supported Cloud/SaaS provider.

2.1. CloudRouter® components

Each CloudRouter® Cloud/SaaS site contains the following components, connecting the cloud into the VPN:

- An active CloudRouter®
- No infrastructure from customers required!

2.2 Site components

Each CloudRouter® site connecting to your Console Connect Access Port contains the following components, connecting the customer to their VPN:

- An active CloudRouter®
- Customer Premises Equipment (CPE)
- Access Circuit
- Console Connect port

2.2.1 Access Circuit and Console Connect Access Port

An Ethernet Access Circuit connects the customer's network to the CloudRouter® via an Ethernet port (UNI) at the PCCW Global PoP's PE router, with the following service parameters.

	Service Parameters	Service Requirements
1	Physical interface	**See the Console Connect Port Specification for available physical interface types.**
2	Default Ethernet & IP MTU size	Ethernet: 1522 bytes (802.1q tagged) IP: 1500 bytes
3	Encapsulation	802.1q (tagged)
4	Mode of operation	1Gbps/10Gbps full duplex

2.2.2 VLANs and Bandwidth Allocation

CloudRouter® sites support a physical UNI capable of carrying multiple Console Connect services. Each service is mapped to a specific VLAN on the Access Circuit between PE and UNI and has its own bandwidth allocation according to the service subscribed.

2.2.3 IP Addressing

As customer routing information is stored in a separated routing context (Virtual Routing Forwarding table), the IP addressing scheme of each customer is independent. Therefore, there is almost no restriction for customers to use their IP addressing scheme, except the IP assignment of a PE-CE WAN and a number of PCCW Global network monitoring service servers. If customers prefer using public IP addresses, it is acceptable but the customer has to ensure the used public IP addresses belong to him/her and can be verified in Internet Routing Registries.
Console Connect provides customer with a number of network management services such as router management service, customer reports (router status, traffic, QoS and application distribution). We need to uniquely identify each customer CE router in our network management platform. Thus, in order to avoid IP conflict, the IP assignment of PE-CE WAN is decided by Console Connect. For the same reason, those customers who use PCCW Global's network management services should avoid IP conflict with PCCW Global network management servers.

IP Addressing Scheme for PE-CE WAN assignment

The IP subnet 10.0.0.0/8 is used by Console Connect for PE-CE WAN assignment. If a customer has no preference on such an assignment, Console Connect will make its own assignment on behalf of the customer.

Each CloudRouter® site is delivered via an Access Subnet; a /31 IPv4 subnet used for the purpose of delivering the VPN service to the customer's equipment over the Access Circuit via the specified VLAN. The lowermost IP address in the Access Subnet is reserved for use on the provider side of the Access Link ("Console Connect Port IP Address"). The higher IP address in the Access Subnet is reserved for use on the customer side of the Access Circuit ("Customer Equipment IP Address").

2.2.4 Autonomous System (AS) Number

For CloudRouter® sites the customer can provide an ASN during the order process. Some ASNs are blocked from use by Console Connect, which are listed below:
AS# 65001 to AS#65011

2.2.5 Customer Premises Equipment (CPE)

The customer will either supply and operate their own router, or Console Connect can provide a Managed Router Service, sold and managed separately from the Console Connect CloudRouter® service.

2.3. Network Maximum Transfer Units (MTU)

UNI supports a default Ethernet MTU size of 1522 bytes (802.1q tagged Ethernet frames) with an IP MTU size of 1500 bytes. For jumbo frame support, kindly raise a feasibility request to a Console Connect representative.

3. CLASS OF SERVICE

PCCW Global has implemented three differentiated classes of service within its network. The classes are known as Gold, Silver Plus, Silver and Bronze (see table below):

Classes of Services	Characteristics	Applications
Gold	High priority with minimal delay and packet loss and with jitter guarantee	Jitter-intolerant application e.g. voice over IP, video conference, etc
Silver Plus	High transmission priority with bandwidth guarantee; can tolerate jitter	Business Critical application, e.g. SNA, SAP, etc
Silver	Priority traffic that still receives some bandwidth during congestion for transmission	Non-Business Critical application, e.g. email, etc
Bronze	Best effort with lower priority in the queue	General application with relatively lower priority, e.g. Intranet, file transfer, etc

The differentiation functions are performed at the ingress to the PCCW Global network and the interior of the network will deploy different queuing strategy accordingly.

a. Low Latency Queue (LLQ) is used for Gold service that can provide jitter-intolerant services with minimum jitter and latency.

b. Class-Based Weight-Fair-Queuing (CBWFQ) will be deployed to Silver service to provide with a "guaranteed bandwidth" service. This class is intended for customers and their users who require assurance that they will receive a minimum bandwidth allocation at all times, which effectively means during times of congestion. During times of congestion, this class will receive a more preferential access to the transmission resource than Bronze class traffic.

c. Bronze class traffic will map to the best effort queue under CBWFQ. In the presence of congestion on PE to P-Core connections, the Gold, Silver Plus and Silver classes will pre-empt Bronze class traffic.

The performance of these classes is relative. The admission function shall be enforced through policy statements whereby traffic marked with a "higher" class of service shall pre-empt traffic marked with a "lower" class of service.

Type	ToS	PE ingress QoS	PE egress QoS
Gold	5	LLQ, Prioritization	Committed Access Rate (CAR), POLICER
Silver Plus	4	CBWFQ	
Silver	3	CBWFQ	
Bronze	0	Best Efforts	

IP Addressing Scheme for PE-CE WAN assignment

Console Connect maps the IP Precedence bits (RFC 1122) as follows:

IP Precedence	Corresponding DSCP	MPLS EXP
5	EF	5
3	af3x	3
0	Best Effort	1

Console Connect uses this model to control ingress traffic classification from the CE to PE and likewise egress from PE to CE devices.

Any packets with IP Precedence values are out of the values stated in the above table being received from CE to PE will be mapped to the lowest subscribed class of service.

Processing excess traffic in each class of service

onsole Connect offers Hierarchical QoS (H-QoS). The customer is allowed to fully utilize the subscribed bandwidth for different class of service if there is vacant in a certain class for another. The details of arrangement will be handled in following manner:

CE Egress POLICY* (CE / PE)			
Type	ToS	Inside contract	Excess
Gold	5	Bonded with high priority	Drop
SilverPlus	4	Bonded	Take up the vacant bandwidth left over from other classes of service
Silver	3	Bonded	
Bronze	0	Bonded	

*Note: CE Egress POLICY will be set by Console Connect if the CE router is managed by us. Otherwise, customer is responsible to set her own CE Egress POLICY based on the above arrangement.

PE Ingress POLICY (CE / PE)			
Type	ToS	Inside contract	Excess
Gold	5	Bonded with high priority	Drop
SilverPlus	4	Bonded	Transmit and compete with the lowest subscribed class of service up to the vacant bandwidth
Silver	3	Bonded	
Bronze	0	Bonded	

PE Egress (CE / PE)			
Type	ToS	Inside contract	Excess
Gold	5	Bonded with high priority	Drop
SilverPlus	4	Bonded	Take up the vacant bandwidth left over from other classes of service
Silver	3	Bonded	
Bronze	0	Bonded	

Example 1:

Customer subscribes 40Mbps port with 10Mbps Gold, 10Mbps Silver Plus, 10Mbps Silver and 10Mbps Bronze

The lowest subscribed class of service is Bronze.

a. When customer traffic goes into the network with 15Mbps Silver Plus, 15Mbps Silver and 10Mbps Bronze (total 40Mbps), the excess 5Mbps Silver Plus and 5Mbps Silver will be transmitted as Bronze in the network.

b. When customer traffic goes into the network with 10Mbps Gold, 20Mbps Silver Plus, 15Mbps Silver and 10Mbps Bronze (total 55Mbps), it implies overall traffic exceeds Subscribed bandwidth.

10Mbps Gold, 10Mbps Silver Plus, 10Mbps Silver and 10Mbps Bronze will be transmitted as committed. The excess 10Mbps Silver Plus and 5Mbps Silver will be treated as Bronze and competes with each other for the remaining bandwidth available. All traffic exceeds 40Mbps will be dropped and the drop sequence is random.

Example 2:

Customer subscribes 1Gbps site with 200Mbps Gold, 400Mbps Silver Plus and 400Mbps Silver; no Bronze is being subscribed

The lowest subscribed class of service is Silver.

a. When customer traffic goes into the network with 500Mbps Silver Plus and 500Mbps Silver (total 1Gbps), the excess 100Mbps Silver Plus and 100Mbps Silver will be transmitted as "Silver" in the network.

b. When customer traffic goes into the network with 100Mbps Gold, 500Mbps Silver Plus and 500Mbps Silver (total 1.1Gbps), it implies overall traffic exceeds Subscribed bandwidth.

100Mbps Gold, 400Mbps Silver Plus and 400Mbps Silver will be transmitted as committed. The excess 100Mbps Silver Plus will compete with 100Mbps Silver traffic for the remaining bandwidth. All traffic exceeds 1Gbps will be dropped and the drop sequence is random.

Example 3:

Customer subscribes 100Mbps site with 50Mbps Gold, 50Mbps Silver; no Silver Plus and Bronze are being subscribed

The lowest subscribed class of service is Silver.

a. When customer traffic comes out of the network with 30Mbps Gold, 30Mbps Silver Plus, 30Mbps Silver and 10Mbps Bronze (total 100Mbps), 30Mbps Gold traffic and 30Mbps Silver traffic will be transmitted as committed; 30Mbps Silver Plus and 10Mbps Bronze will take up the vacant bandwidth and transmitted to customer site.

b. When customer traffic comes out of the network with 30Mbps Silver Plus, 50Mbps Silver and 30Mbps Bronze (total 110Mbps), it implies overall traffic exceeds Subscribed bandwidth.

50Mbps Silver will be transmitted as committed. The remaining 30Mbps Silver Plus & 30Mbps Bronze will compete with each other to take up the vacant bandwidth and all traffic exceeds 100Mbps will be dropped. The drop sequence is random.

4. COS TRANSPARENCY

An important feature to consider in the connection of a Partner network is the transport of CoS mapping for an end-to-end transparent service. As Console Connect has pre-arranged agreements with partners, Console Connect will make all efforts to ensure the CoS transparency is adhered too.

5. ROUTING PROTOCOL BETWEEN CE AND PE

For the PE-CE connection, the IP routing protocols that Console Connect supports are:

- BGP
- Static (coming soon)

6. RESTRICTIONS IN THE NUMBERS OF ROUTES BY VRF

By default, the number of routes supported by each Virtual Routing Forwarding Table (VRF) is 500. If additional routes are required, they have to go through a feasibility check to get confirmed. Please note: for cloud sites the number of allowed routes will vary based on the cloud provider's limits.

7. MULTICAST SUPPORT

Service Parameters	Setting
Multicast Routing Protocol	PIM Sparse Mode (PIM-SM)
PIM-SM Variants	Any Source Multicast (ASM) and Source Specific Multicast (SSM)
ASM RP Mapping/ Distribution	PIM Bootstrap Router (BSM), Anycast RP, Multicast Source Discovery Protocol (MSDP), Static RP
Data Multicast Distribution Tree (MDT) Switchover Threshold	1 kbps
Number of Data MDTs allowed per VRF	255 (Data MDTs will be reused if exceeded)
Multicast Prefix Limit per VRF	500 (independent to unicast)
MTU	Same rules apply as for unicast
Class of Service	Same rules apply as for unicast

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Tokyo 100-0005 | Japan

South Africa
Building 12 | 1 Woodmead Drive | Woodmead | Johannesburg 2191 | South Africa

UAE
Office 504 & 505 | Level 5 | Arjaan Business Tower| Dubai Media City | Dubai

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www.consoleconnect.com
Talk to us: sales@consoleconnect.com