

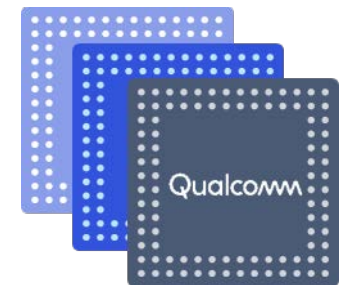
IP Passthrough Support

80-P6046-1 Rev. F

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Revision History

Revision	Date	Description
A	April 2016	Initial release
B	May 2016	Updated Slide 6 and 7
C	May 2017	Numerous changes were made in this document; it should be read in its entirety
D	July 2017	Updated VLAN changes: Slides 27-30
E	January 2021	Numerous changes were made in this document; it should be read in its entirety
F	December 2021	Numerous changes were made in this document; it should be read in its entirety.

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Objectives

- At the end of this presentation, you understand:
 - The requirements and design for IP Passthrough
 - Enabling and disabling IP Passthrough feature
 - Limitations associated with IP Passthrough

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Introduction

- What is IP Passthrough?
 - IP Passthrough is a feature to support the use of a global or WWAN IP address by a tethered client. The global or WWAN IP address comes from the modem data stack and is dynamically assigned by the network operator.
- There are two main flavors supported for IP Passthrough: With network address translation (NAT) and without NAT.
 - NAT describes whether the device uses a different IP address space that is assigned to clients. IP Passthrough is supported in cases with NAT and without NAT; however, the behavior is slightly different between the two cases.
- Since the main IP involved in this feature comes from the WWAN, in cases where it is not available, or the UE is not yet connected to the mobile network:
 - If IP Passthrough feature mode is with NAT: USB, Ethernet, or WLAN client gets a private IP address
 - If IP Passthrough feature mode is without NAT: USB, Ethernet, or WLAN gets a private IP address if connected to default bridge. For on-demand bridges, client does not get private IP address as dnsmasq process does not run on the on-demand bridges.

IP Passthrough – Requirements

- Set IP Passthrough feature mode to, with NAT or without NAT.
- Set IP Passthrough configuration.
- When WWAN is connected, the USB or Ethernet or WLAN client gets the WWAN IP address.
- When WWAN connect or disconnect transition occurs, cable unplug/re-plug is simulated to trigger the DHCP renew. This enables the USB or Ethernet or WLAN client to get the corresponding IP address.
- The USB or Ethernet or WLAN tethering is applicable for wlan0/rndis0/ecm0/eth0 interfaces.
- The USB or Ethernet or WLAN client always accesses the web UI at the gateway IP address (for example, 192.168.225.1). In IP Passthrough without NAT bridge does not have private gateway IP address. They must access the web UI through public gateway IP address. For which they need to enable software path filter for a particular port.
- First connected device option:
 - In without NAT configuration, IP Passthrough is enabled for first connected device (optional MAC address configuration). There is no DHCP reservation, so the first connected device (first device that sends the DHCP Negotiation) gets the public IP and that device becomes the IP Passthrough device.

Note: If IP Passthrough device must be changed, current IP Passthrough must be disabled and re-enabled. Dynamic switching is not supported, that is just removing the current device and connecting a new device.

IP Passthrough – Requirements (cont.)

- The embedded application on applications processor subsystem software (APSS) shares the same data profile with the USB or Ethernet or WLAN client for WWAN access.
- Concurrency with embedded applications is supported using the source NAT (SNAT). The SNAT entry is added on the outgoing WWAN interface. WWAN interface (RmNet interface) is assigned a private IP. Embedded application uses this IP for external communication. This is not supported in IP Passthrough without NAT configuration.
- IP Passthrough is only supported for WWAN backhaul. Switching to different backhaul, disables IP Passthrough and connected clients get private IPs.
- ALG processing is not supported in IP Passthrough. To route traffic through software path in IP Passthrough mode, software path filters (port-protocol-IP based filters) are configured.

Note: IP Passthrough with NAT/without NAT for all the scenarios is supported from SDX55.LE.1.3 onwards and software path filters are supported from SDX65.LE.1.0 onwards.

IP Passthrough Design

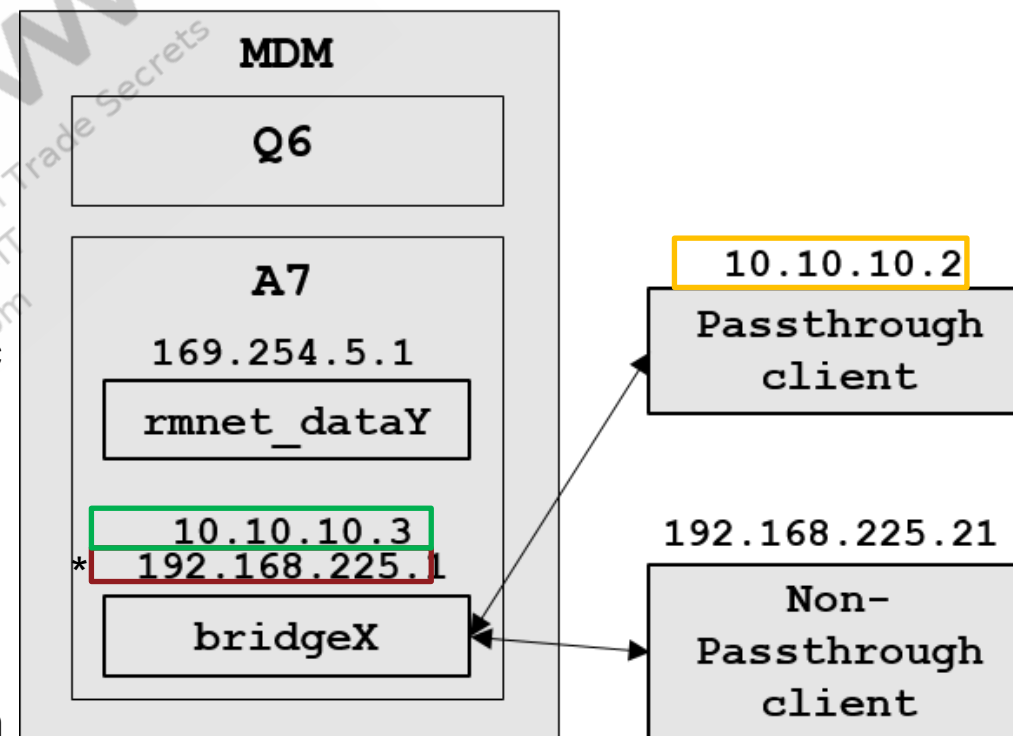
- IP Passthrough is enabled for USB, Ethernet, or WLAN (wireless LAN) devices.
- IP Passthrough is only enabled for one device per public data network (PDN). If IP Passthrough feature mode is with NAT, other connected devices to that PDN keep their private IPs. If it is without NAT, other connected devices to that PDN lose their private Ips. That is, only IP Passthrough device remains connected to that PDN.
- IP Passthrough for USB and Ethernet supports multi virtual LAN (VLAN) and multi-PDN configuration. Maximum such 15 PDNs are supported. IP Passthrough for WLAN is only supported on the default PDN as VLANs are not supported for WLAN.
- IP Passthrough with NAT or without NAT is a device level configuration.
 - The same mode is applicable across all PDNs. IP Passthrough with NAT on one PDN and without NAT on another PDN is not supported.
 - The default mode for IP Passthrough is with NAT.
 - If without NAT configuration is required, the IP Passthrough mode must be set accordingly. Backhauls on all the PDNs should be in disconnected state while changing the IP Passthrough feature mode.

IP Passthrough Design (cont.)

- Dynamic host configuration protocol (DHCP) reservations are used to reserve the public IP for the IP Passthrough device.
 - For USB client, DHCP reservation mapped to its hostname.
 - For Ethernet or WLAN client, DHCP reservation is mapped to its MAC address.
- When multiple VLANs are mapped to a PDN, IP Passthrough is only enabled for one VLAN. In IP Passthrough with NAT mode, other VLANs continue to have private IPs. In IP Passthrough without NAT, only passthrough client has a public IP address and other VLANs lose their private IPs.
- Data path for the IP Passthrough client is supported through the IPA hardware. IPA offload is supported if the VLAN itself supports IPA offload. IPA configuration manager (IPACM) is notified of the Passthrough feature, so that it takes necessary actions to enable data path for IP Passthrough client.
- Whenever an IP Passthrough is enabled or disabled, the existing connections with public IP and WWAN private IP are flushed.

IP Passthrough with NAT Address Assignment

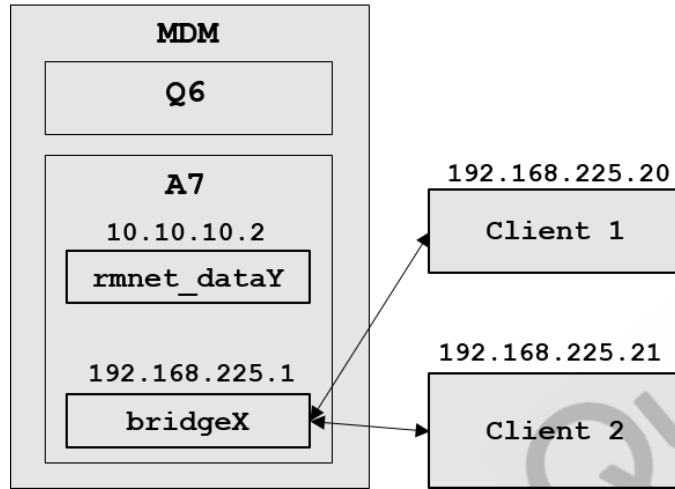
- When IP Passthrough gets enabled, IP Passthrough client gets the public IP and bridge is assigned a **public gateway IP**. This public gateway IP is dummy (given by modem) and there might be an actual node in the network having the same IP address.
- Bridge has two IP addresses, one is **private gateway IP address**, and second is the **dummy public gateway IP address**. Having a private gateway IP address makes sense in the IP Passthrough with NAT mode as there might be clients connected having a private IP address; but it does not make sense in IP Passthrough without NAT as there is only one client with a public IP address.
- Since the public gateway IP is dummy and is present in the network, the traffic destined to this IP should ideally be sent to the network and not get consumed by the bridge. There is an exception to this when packets are destined to the bridge. For example, DHCP packets. Since this is the public gateway IP, IP Passthrough client sends unicast DHCP requests to this IP when the lease time is expired.



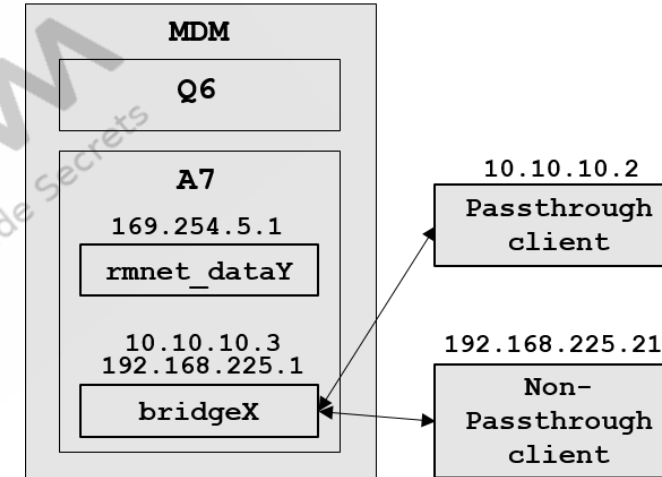
Note: Private gateway IP address is not present in the without NAT scenario.

Sample Address Assignment in Passthrough Scenario

Backhaul is connected

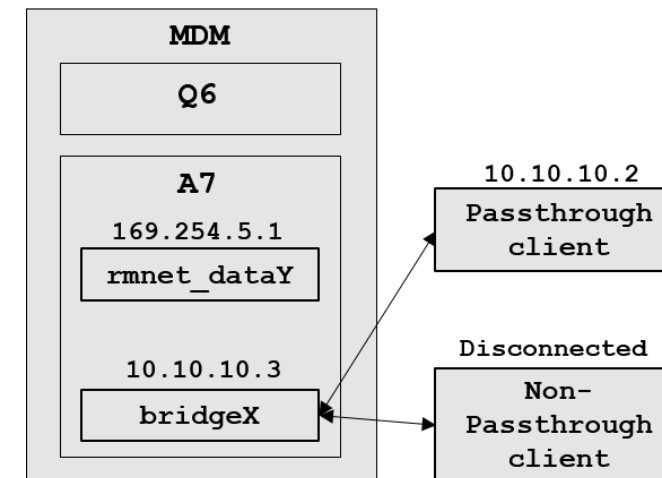


IP Passthrough with NAT



- 10.10.10.2: Network-assigned public IPv4 address
- 10.10.10.3: Modem-generated dummy GW public IPv4 address
- 169.254.5.1: QCMAP-assigned link-local IPv4 address to rmnet_dataY
- 192.168.225.20, 192.168.225.21: QCMAP-configured private IPv4 address

IP Passthrough without NAT



IP Passthrough – Additional Feature Support

- Supporting application hosting:
 - If there is IP Passthrough with NAT, the bridge has a private gateway IP address. So, if customers want to host any application (for example, web server), they use this IP to access that application.
 - If there is IP Passthrough without NAT where bridge is only going to have a public gateway IP address, this application traffic also needs to be consumed on the bridge. Hence, handling is needed for other user configurable ports; like the way DHCP packets are handled.
- Supporting port-protocol-IP based filter:
 - Since the public gateway IP is dynamically assigned to the bridge when IP Passthrough is activated, IP Passthrough is expected to be enabled before the filter is configured in iptables.
 - All traffic destined to this IP, takes software path irrespective of the configured ports. IPA adds an exception rule for this IP and not for the individual ports.
 - The ports in this filter are for the traffic to be consumed on the bridge; which is solely handled by QCMAP using iptables just the way DHCP packets are handled currently. Maximum of five such filters are configured per PDN.

Enable IP Passthrough

Prerequisites:

- Mobile access point (AP) is enabled
- Backhaul/WWAN is configured

To enable IP Passthrough:

1. Decide whether IP Passthrough is to be enabled with or without NAT and set the configuration accordingly.
2. Decide whether IP Passthrough is over the default bridge or in a multi-VLAN multi-PDN setup.
3. Decide whether the first connected device is enabled (Supported only in without NAT configuration)
4. Enable IP Passthrough through QCMAP API, or the QCMAP CLI utility.

Set IP Passthrough Feature with NAT

XML (Do not change)	QCMAP CLI	QCMAP API [Q1]
<pre><system xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSch <MobileAPCfg> <IPPassthroughFeatureWithNAT>1 </IPPassthroughFeatureWithNAT></pre>	<p>Option 1 – Mobile AP configuration Option 17 – Set the feature mode List of feature modes supported: 1. IP Passthrough 2. DHCP LAN options Enter the choice: 1 Feature modes supported for IP Passthrough: 1. IP Passthrough with NAT 2. IP Passthrough without NAT Enter choice: 2 Successfully set the feature mode.</p>	<pre>bool SetFeatureMode (uint64 features, qcmmap_client_feature_mode_conf ig *feature_mode_config, qmi_error_type_v01 *qmi_err_num);</pre>

Note: The QCMAP CLI and API modify the XML and the modifications are reflected in XML. Do not modify the XML directly.

QCMAP CLI Configuring IP Passthrough to Enable and Disable

- Prerequisites:
 - VLAN is configured and mapped to a profile.
 - When the bridge VLAN context is matched with the VLAN ID, VLAN IP Passthrough is to be enabled on.
 - Switch the WWAN profile to the profile, which the VLAN is mapped.

Note: If enable IP Passthrough is done with “First connected device” then public IP address is assigned from the DHCP server for whatever client sends the DHCP request first.

Note: If the client needs to be changed then IP Passthrough must be enabled and disabled after the original client is disconnected for the change to take place

QCMAP CLI Commands	
Enable IP Passthrough	Disable IP Passthrough
<p>To enable IP Passthrough configuration: Option 6: Backhaul configuration Option 2: Backhaul WWAN Option 14: Set IP Passthrough configuration (Set IP Passthrough flag: (1 – Enable/0-Disable): 1 Do you want to enable Passthrough with a new configuration (1 – Yes/0 – No): 1 1. Enter specific details for IP Passthrough device. 2. First connected device (optional MAC address) Enter your choice: 1 Enter the device type (0 – USB/1 – ETH/2-Wi-Fi): 1 Input the MAC address: aa:bb:cc:dd:ee:ff Set IP Passthrough status successful. Once the backhaul is up, IP Passthrough gets activated. User also brings-up backhaul first and configure IP Passthrough later.</p>	<p>To disable IP Passthrough configuration: Option 6: Backhaul configuration Option 2: Backhaul WWAN Option 14: Set IP Passthrough configuration (Set IP Passthrough Flag: (1-Enable/0-Disable): 0 Set IP Passthrough status successful OR User disables the backhaul and the IP Passthrough also gets disabled.</p>

QCMAP CLI Configuring IP Passthrough for Port-Protocol-IP-based IP Passthrough Filters

- Prerequisites:
 - VLAN is configured and mapped to a profile.
 - When the bridge VLAN context is matched with the VLAN ID, VLAN IP Passthrough is to be enabled on.
 - Switch the WWAN profile to the profile, which the VLAN is mapped.

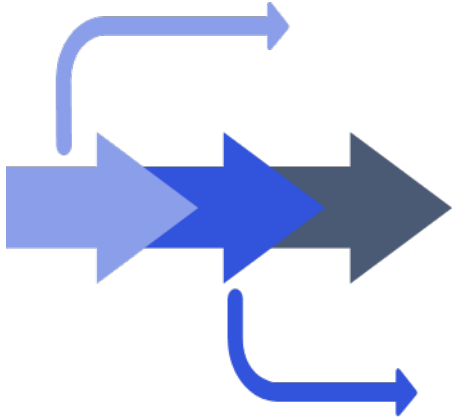
QCMAP CLI Commands	
Add Filter	Delete Filter
<p>To add filter: QCMAP_CLI → 6 → 2 → 35 → 2 → 1</p> <p>-----</p> <p>IP Passthrough Port-Protocol-IP-based software path filter configuration</p> <p>-----</p> <p>Traffic destined to the public gateway IP of the LAN gateway interface (bridge) takes software path irrespective of destination port and protocol. Traffic destined to the public gateway IP of the bridge with configured destination port range and protocol is consumed on the bridge.</p> <p>-----</p> <p>No filters are configured</p> <p>What operation do you want to perform? 1: Add, 2: Delete, 3: Exit: 1</p> <p>Please provide the port range: Start Port: 7001 End Port (must be equal to or greater than Start Port): 7001</p> <p>Please provide the protocol (1: TCP, 2: UDP): 1 Successfully configured IP passthrough software path filters</p> <p>To get filters: QCMAP_CLI → 6 → 2 → 36 → 2</p> <p>-----</p> <p>IP Passthrough Port-Protocol-IP Based Software Path Filters</p> <p>-----</p> <p>Currently 1 filters are configured: Public Gateway IP is not set, as IP Passthrough is not enabled yet [1]. Port: 7001, Protocol: TCP</p>	<p>To add filter: QCMAP_CLI → 6 → 2 → 35 → 2 → 2</p> <p>-----</p> <p>IP Passthrough Port-Protocol-IP based software path filter configuration</p> <p>-----</p> <p>Traffic destined to the public gateway IP of the LAN gateway interface (bridge) takes software path irrespective of destination port and protocol. Traffic destined to the public gateway IP of the bridge with configured destination port range and protocol is consumed on the bridge.</p> <p>-----</p> <p>Currently 1 filters are configured:</p> <p>Public Gateway IP: 172.21.119.5 [1]: Port: 7001, Protocol: TCP</p> <p>What operation do you want to perform? 1: Add, 2: Delete, 3: Exit: 2</p> <p>Please provide the index number of the filter to delete: 1 Successfully configured IP passthrough software path filters</p> <p>To get filters: QCMAP_CLI → 6 → 2 → 36 → 2</p> <p>-----</p> <p>IP Passthrough Port-Protocol-IP-Based Software Path Filters</p> <p>-----</p> <p>No filters are configured</p>

Limitations

- For IP Passthrough without NAT:
 - There is no embedded-app concurrency.
 - Only one tethered host is supported.
- For IPA offload:
 - VPN data traffic with IP in IP is not offloaded via IPA. For example, GRE or ESP traffic.
- For VLAN + multi-PDN IP Passthrough:
 - Each PDN has a single public IP address so that there is only one VLAN per PDN that uses IP Passthrough even if multiple VLANs are mapped to the PDN.
 - If a PDN is torn down in the multi-PDN scenario, the UE toggles the physical link associated with that passthrough client, this in turn causes a data interruption on all VLAN clients that are connected to that physical link.
- For first connected device option:
 - The first client to send a DHCP request is set as the IP Passthrough client.
 - This feature is primarily for supporting the use case where there is only one client connected
 - If the client needs to be changed, then IP Passthrough feature must be toggled after the original client is removed.

References

Acronyms	
Acronym or term	Definition
AP	Access point
ALG	Application layer gateway
APSS	Applications processor subsystem software
CLI	command-line interface
DHCP	Dynamic host configuration protocol
IPACM	IPA configuration manager
IPPT	IP Passthrough
NAT	Network address translation
PDN	public data network
QCMAP	Qualcomm mobile access point
QMAP	Qualcomm mobile access point
SLAAC	Stateless address autoconfiguration
SNAT	Source network address translation
TE	Test equipment
USB	Universal serial bus
VLAN	Virtual local area network
WLAN	Wireless local area network
WWAN	Wireless wide area network



Questions?

<https://createpoint.qti.qualcomm.com>
