

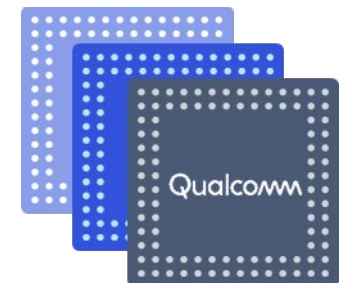
QCMobileAP Software Overview for SDX65 Chipsets

80-PV346-75 Rev. AA

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Revision History

Revision	Date	Description
AA	August 2021	Initial release

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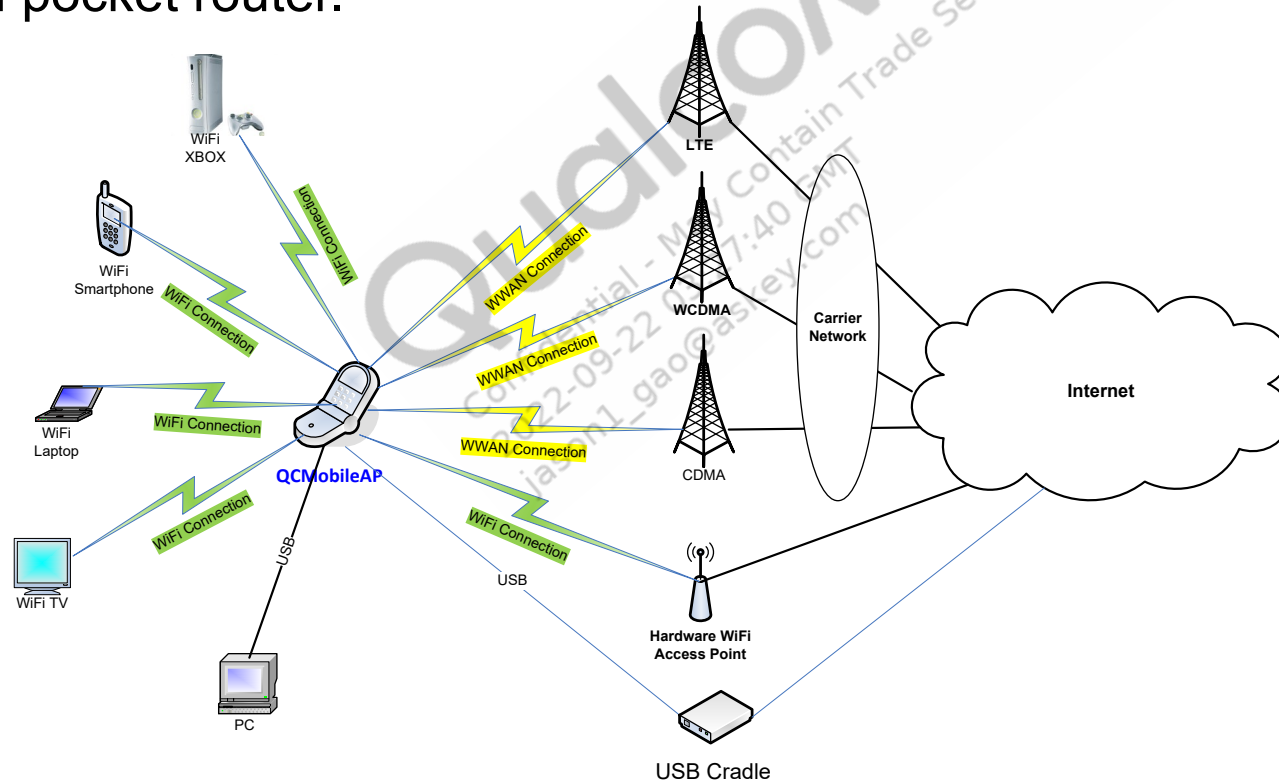
- QCMobileAP Overview
- Architecture Overview and Feature Set
- USB Tethering
- Ethernet Tethering
- Limitations
- Customer Premises Equipment (CPE) Overview
- References
- Questions?



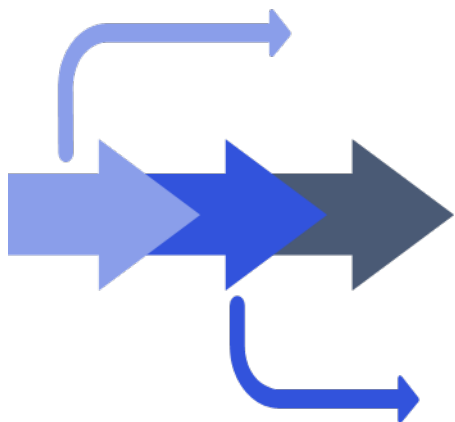
QCMobileAP Overview

Overview

- The user equipment (UE) acts as an access point (AP), which allows multiple clients to connect to the Internet over Wi-Fi.
- The QCMobileAP is also known as the SoftAP, mobile hotspot, Wi-Fi tethering, MiFi (Inseego trademarked), and pocket router.

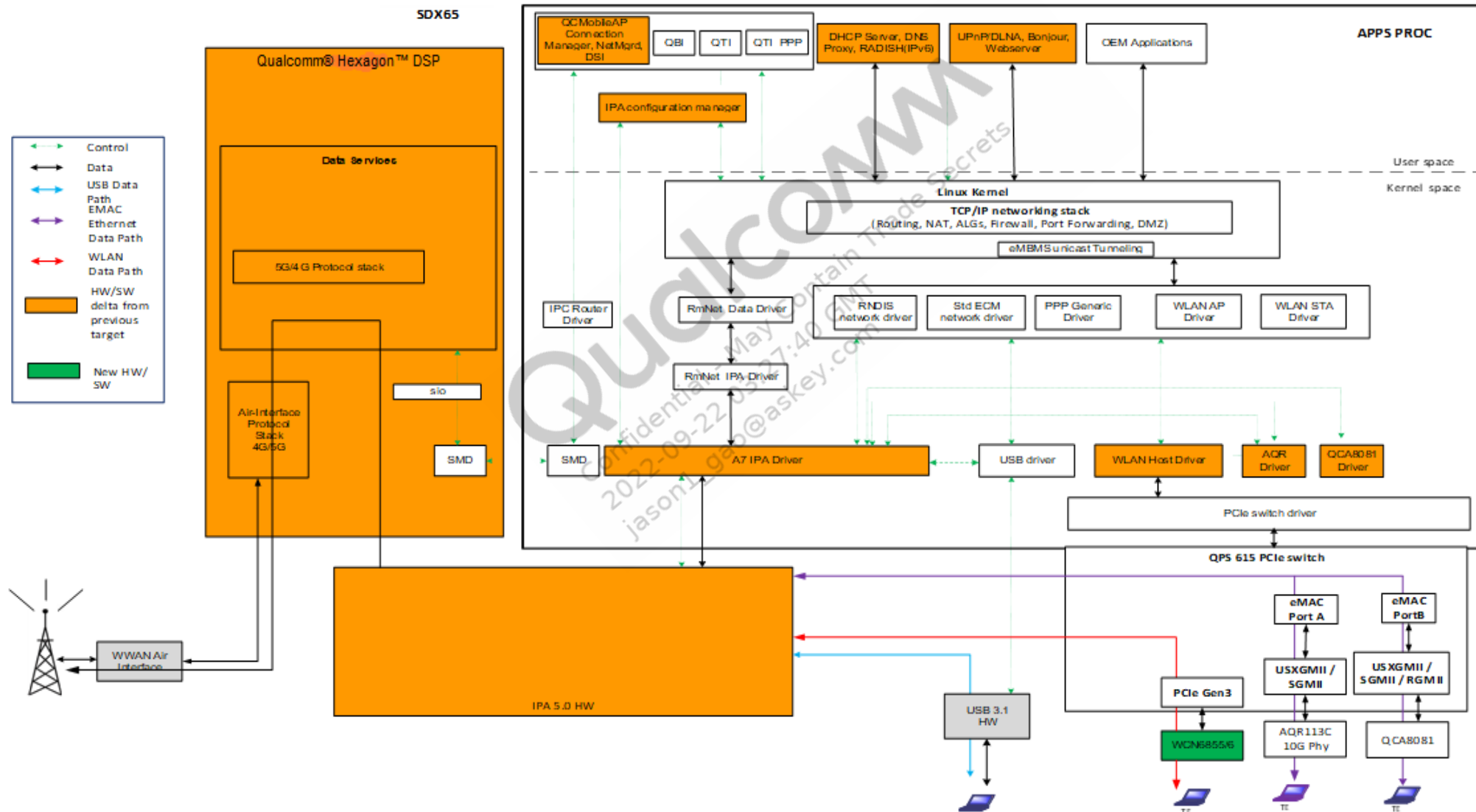


Note: only one USB port is supported, it can be configured either in WAN mode (connected to USB Cradle) or LAN mode (connected to PC)

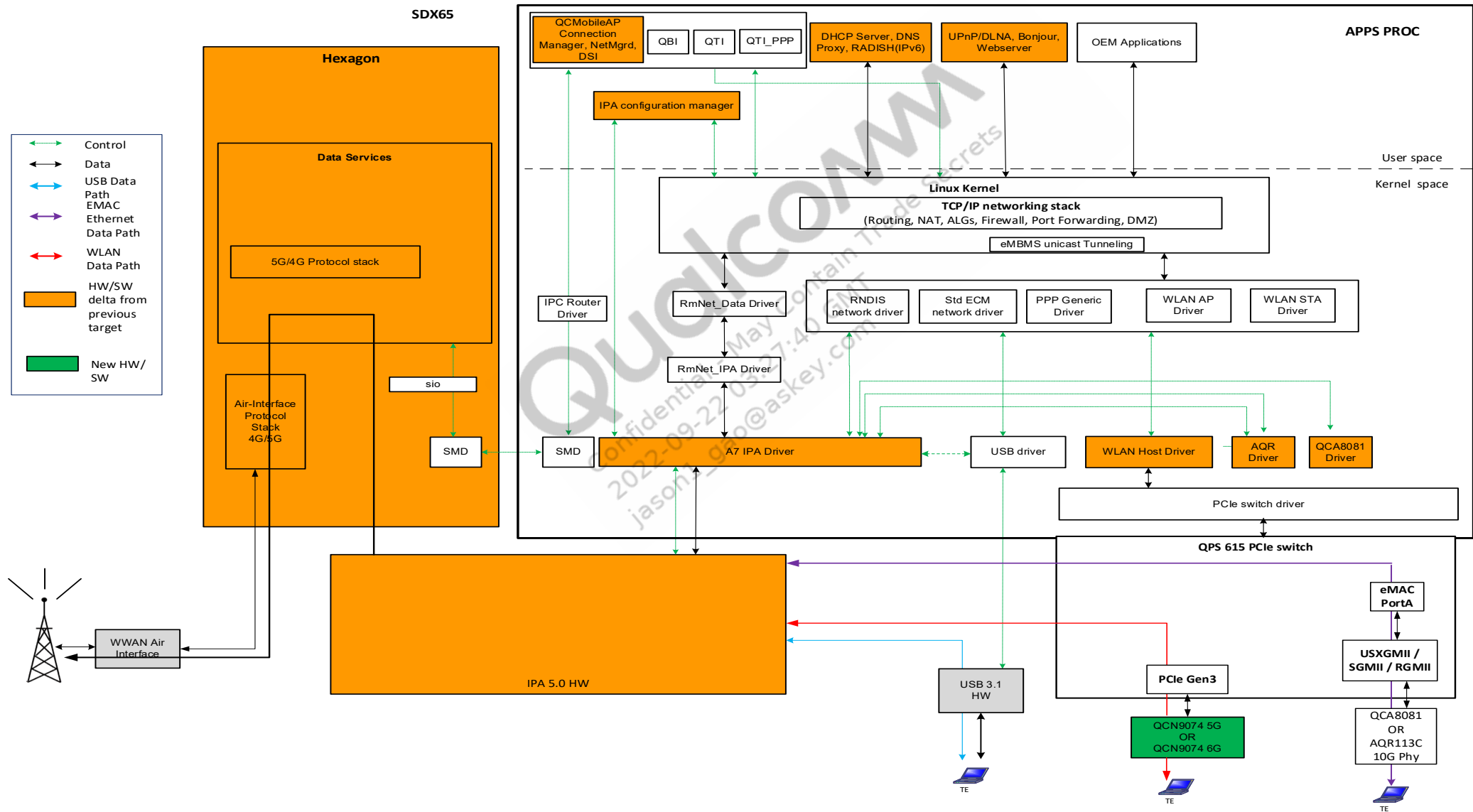


Architecture Overview and Feature Set

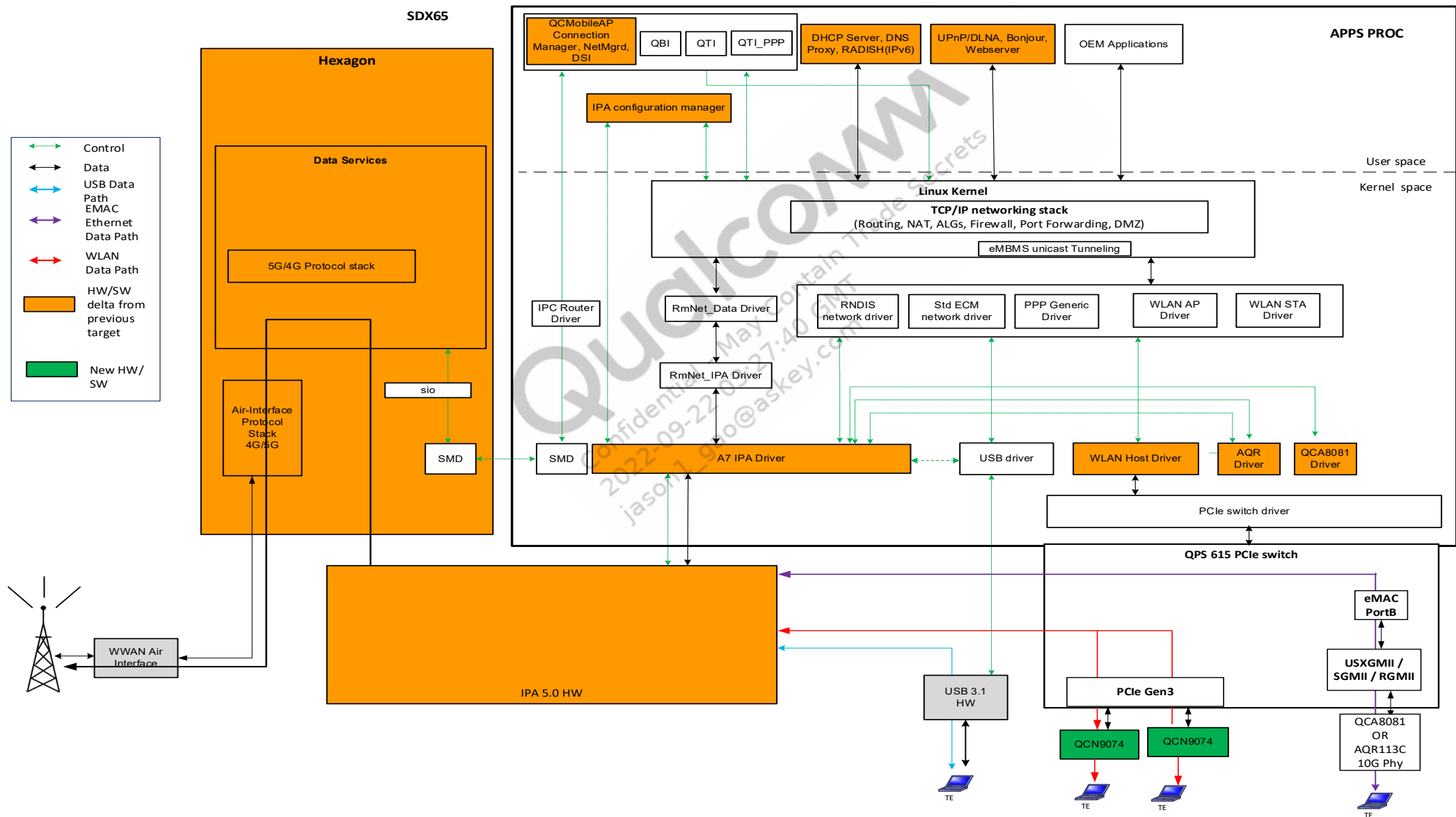
SDX65 System Architecture – QPS615 + QCA8081 + AQR



SDX65 System Architecture – QPS 615 + Single WCN6855/6 (Wi-Fi)



SDX65 System Architecture – QPS615 + Dual WCN6855/6 (Wi-Fi)



Architecture Overview

- On the hardware (HW), the following features are added in SDX65:
 - The QPS 615 switch for connecting the (wireless local area network) WLAN and the ETH to the SDX65.
 - The WCN6855/6 WLAN chip support connected to QPS 615 switch.
- On the application processor, QCMobileAP performs the following tasks:
 - Provides APIs to connect with the connection manager daemon.
 - Provides an interface to turn on and turn off QCMobileAP mode.
 - Provides an interface to configure the network policy for WWAN network selection.
 - Brings up and tears down the WWAN connection.
 - Configures the dynamic host configuration protocol (DHCP) server.
 - Invokes Linux kernel utilities. For example, IP tables to configure network address translation (NAT), routing, and firewall of the Linux environment.
 - Provides NAT, routing, and firewall functionalities on the application processor.
 - Provides support to bring up backhauls in IPv4 only, IPv6 only, and IPv4v6 modes.
 - Provides backhaul ((wireless wide area network) (WWAN), AP+STA, USB cradle) priority configuration support.
 - Provides an interface to turn on and turn off the concurrent AP+STA or AP+AP+STA router/bridge mode.
 - Provides an interface to turn on and turn off the USB cradle router/bridge mode while connected to a cradle device, providing data backhaul connectivity.
 - Provides an interface to turn on and turn off the AP+AP (dual subsystem ID (SSID)) and the AP+AP+AP (triple SSID) mode.
 - Provides an interface to configure and enable or disable the IP passthrough.

Architecture Overview (cont.)

- Provides an interface to make the MDM a WAN router using the ETH as backhaul
- Interfaces with clients like the QTI tethering interface to provide a host-less tethering functionality
- Enables the Linux kernel to handle routing between embedded applications of the application processor, WLAN clients, and the USB terminal equipment (TE)
- Provides an interface to fetch packet statistics per LAN client for end-to-end connections with the WWAN/LTE backhaul only
- Provides an interface to enable or disable tracking of packet statistics per the LAN client feature
- Provides an interface to configure and enable or disable multiple packet data network (multi-PDN)
- Provides an interface to perform multi-PDN to VLAN mapping.
- Provides an interface to perform multi-VLAN to PDN mapping see [D1]
- Supports SELinux and SystemD.
- Supports dual-band, dual-concurrent (DBDC) with Wi-Fi card
- Supports 5G
- Supports dual ETH network interface card (NIC) configuration
- Replaces Sysvinit with systemd as init system
- Enables embedded applications of the application processor to bring up a data call on:
 - Additional PDNs using the data management APIs or
 - Same PDN as for a QCMobileAP data call

IPv6 Architecture on Application Processor

- Radish acts as a multicast forwarder and forwards the following multicast packets between the IPv6 WWAN network interface and the LAN interfaces:
 - Router advertisement (RA)
 - Router solicitation (RS)
 - Neighbor advertisement (NA)
 - Neighbor solicitation (NS)
- When an IPv6 call is brought up, the modem sends the RA, which is forwarded through the LAN interfaces to Wi-Fi and the USB clients via Radish.
- On the new Wi-Fi client connection, Radish forwards the RS to the modem (Hexagon) and receives the RA, which is then propagated to the interfaces.
- The Router mode and Bridge mode backhaul configurations (AP+STA, AP+AP+STA, ethernet, and USB Cradle) are supported in IPv6-only mode as well.

QCMobileAP Feature Set

Feature	Description
See connection manager on the application processor	Provides reference to the connection manager that handles the QCMobileAP configuration and WWAN connectivity
Data forwarding to and from the 4G/3G network	All the WWAN RAT types are supported – LTE, GW, and 1xEV-DO
NAT support	IPv4 NAT (symmetric NAT, full cone NAT, address restricted cone NAT, port restricted cone NAT)
DHCP server	Supports multiple clients
Proxy DNS	DNS proxy for NATed clients
IP firewall	Firewall-based on configured rules
VPN passthrough	IPSec, PPTP, and L2TP
Connection management	Automatic WWAN connection management
Port forwarding	Static NAT entries
Configuration API	Used to configure NAT tables, firewalls, DHCP address range, and so on
ALGs	FTP, PPTP, SIP, RTSP, H.323, IRC, UDPLITE, and AMANDA
DMZ	If no NAT match is found, forwards all the downlink packets to a preset client address.
Enable or disable roaming autoconnect	Provides a configuration function to enable or disable autoconnect during roaming

QCMobileAP Feature Set (cont.)

Feature	Description
QCMobileAP IPv6	Supports IPv6 over QCMobileAP
AP+STA mode	Operates as a Wi-Fi AP and as a Wi-Fi client that uses the external Wi-Fi hotspot as the backhaul
AP+AP mode (dual SSID)	Supports Guest AP mode and provides configuration to control access for the guest AP clients
RNDIS/Std-ECM and Wi-Fi AP concurrency	Enables USB-tethered clients and the QCMobileAP Wi-Fi clients to access the same WWAN concurrently
DLNA	Enables the DLNA media server. Note: Certification testing is not supported.
Bonjour	Enables bonjour (mDNS resolver) for device and service discovery
HTTP/HTTPS reference web server	Enables the reference web server for web-based QCMobileAP configuration
Concurrent DUN+QCMobileAP	Enables USB-connected DUN TE and QCMobileAP Wi-Fi clients to communicate to the same WWAN PDN
IMS voiceover QCMobileAP	Supports IMS VoIP Wi-Fi clients to communicate over LTE network (IMS and Internet on the same PDN)
Connected devices display	Shows the IP and MAC addresses of the LAN devices connected over Wi-Fi/USB
Configuration storage and factory reset	Supports the following: <ul style="list-style-type: none">▪ Save the configuration file▪ Reset to the default configuration

QCMobileAP Feature Set (cont.)

Feature	Description
IPv6 prefix delegation	Enables granting LTE-delegated IPv6 prefixes to the LAN clients
USB Cradle mode	Supports the QCMobileAP device connection to external modem (cradle) over the USB and provides data backhaul
USB host mode	The USB Host mode is supported to provide ethernet tethering
AP+STA Bridging mode	Allows bridging between the LAN interfaces (Wi-Fi AP and USB) and the Wi-Fi STA interface in concurrent WLAN AP+STA mode
ODU device enablement	MDM device: <ul style="list-style-type: none">▪ Acts as an outdoor data unit (ODU)▪ Provides connectivity over ethernet to the home
CPE device enablement	MDM device: <ul style="list-style-type: none">▪ Works as a low-cost home router▪ Has Wi-Fi and ethernet connections
Dynamic DNS	Dynamically updates the DNS records on the upstream name servers with active DNS configuration of hostnames, URLs, and addresses of hosts connected to QCMobileAP
eMBMS over ODU	Supports eMBMS traffic management and forwarding to home gateway
eMBMS over QCMobileAP – optimized data path	Supports optimized unicast tunneling within the kernel of eMBMS traffic to LAN clients

QCMobileAP Feature Set (cont.)

Feature	Description
UPnP IGDv2	<ul style="list-style-type: none">▪ Enables IGD version 2, IPv6 support, and firewall pinholes▪ Allows single application through a restricted firewall▪ Provides pinhole statistics▪ Provides actions for port forwarding range control
Tiny proxy support	HTTP/HTTPs proxy support
IP support	Support for IPv4 only, IPv6 only, and IPv4v6 modes for all WAN router backhauls (WWAN, AP+STA, AP+AP+STA, ethernet and USB cradle) as well as bridge configurations in AP+STA, AP+AP+STA and USB Cradle modes.
Active backhaul priority	WAN backhaul priority for the WWAN, Wi-Fi, and USB Cradle Router modes
Dual Wi-Fi	Enables DBDC configuration using a dual MAC WLAN card
AP+AP+STA mode	One of the AP acts as a Wi-Fi AP and STA as a Wi-Fi client that uses the external Wi-Fi hotspot as the backhaul. The other AP supports Guest AP mode.
AP+AP+STA Bridging mode	Allows bridging between the LAN interfaces (Wi-Fi AP and USB) and the Wi-Fi STA interface in concurrent WLAN AP+AP+STA mode
AP+AP+AP mode (triple SSID)	Supports two Guest AP modes and provides configuration to control access for the Guest AP
ETH backhaul	Tethered clients connected to an MDM can access the internet through ETH backhaul
IP pass-through	Provides a public IP to a USB/ETH-tethered client over the WWAN backhaul. Note: This feature is only applicable to WWAN backhaul.

QCMobileAP Feature Set (cont.)

Feature	Description
IP passthrough without NAT	<p>QCMAP supports IP passthrough for clients without the NAT. The device for which IP passthrough is enabled gets the public IP. Other devices do not get IPs or lose the IPs. Only the IP passthrough device is connected. IPA offload is supported for the client for which IP passthrough is enabled.</p> <p>Note: This feature:</p> <ul style="list-style-type: none">▪ Is only applicable to WWAN backhaul▪ Supports optional MAC address; in which case the first client gets the public IP▪ Supports multi-PDN
IP passthrough over Wi-Fi	<p>Extended to any WLAN clients. Supported WLAN mode is AP, AP+AP, AP+AP+AP. The IP passthrough for WLAN clients is based on the MAC address. The IPA offload is supported for the WLAN client with the IP passthrough.</p>
Multiple client management per PDN	<p>Add reference (ref) count within the QCMAP to maintain the call count per PDN. PDN call is torn down when ref count is zero and auto-connect is not enabled.</p>
DHCP option 100/101 support	<p>Upon receiving the DHCP option 100 and/or 101 DHCPREQUEST from clients, the 5G FWA device returns the DHCP ACK with configured DHCP option 100 and/or 101 with the local time zone info received from the network.</p>
DHCP option 43/60 support	<p>Applicable when the 5G NR FWA device is operating in Bridge or IP passthrough mode. Upon receiving the DHCP REQUEST with option 60 and VCI 5G data from the router, the 5G modem matches the VCI and return a DHCP ACK with configured DHCP option43 with the vendor-specific information (VSI) values corresponding to the VCI requested. If the 5G NR FWA device receives DHCP request option 60 with an unmatched VCI value, the 5G FWA device should ignore the request and not send any VSI or DHCP ACK using option 43 to the requester DHCP client.</p>
SoftAP support for MAC filtering for parental control	<p>QCMAP invokes the API to route the traffic to software or hardware for the specified MAC address. When parental control is enabled, received traffic on configured MAC address list is routed to software, and the OEMs can install rules according to their requirements.</p>

QCMobileAP Feature Set (cont.)

Feature	Description
VLAN	Supports VLAN
Packet statistics per LAN client	<ul style="list-style-type: none">▪ The QCMobileAP accumulates and maintains data statistics of the LAN clients (uplink and downlink) from the time the LAN client is connected until it is disconnected.▪ The QCMobileAP notifies data statistics to the LAN clients upon disconnection or whenever the LAN clients request data statistics. Note: This feature is only supported for the WWAN/LTE backhauls.
Delay setting up IPA NAT rules	Support for delaying the NAT setting rules into the IPA. Delay is based on the number of initial packets to be processed in the software path after connection is established. This feature is useful if an OEM-owned application wants to perform content filtering, parental control, and so on.
Multi-PDN support	Supports multiple PDN bring up/down
MPDN ↔ VLAN mapping	Allows mapping the PDN to a specific VLAN
SELinux support	Add SELinux policies to support the SELinux on SDX65 in enforcing mode for all QTI domains.
Deprivilege root processes	Used appropriate UID and GID for all QTI processes and resources.
SystemD based Initialization	Used SystemD based initialization scheme in Linux distribution to bootstrap the user space and manage all processes subsequently.

QCMobileAP Feature Set (cont.)

Feature	Description
MACSec Support (IEEE 802.1 AE)	Provides integrity and confidentiality protections for data transmitted over IEEE 802 LAN. Establishes secure link between ODU and IDU by encrypting the packet on the ethernet link.
Multi-VLAN – PDN mapping	Allows multiple VLANs to be mapped to a single PDN
Additional IPA offload support	Supports the IPA offload for MPDN<->VLAN XLAT scenarios for tethering cases
Modem throughput estimation API	New API allows users to gauge estimated throughput the modem can achieve. [Q2]
IPv4 address collision mitigation	The QCMAPI detects the IPv4 address conflicts dynamically for non-disruption in the E2E path with already connected clients for single and multiple PDNs.
Different MTU for dual IP use-case	Different MTUs can be configured for the IPv4 and the IPv6 calls on an interface
DNSMASQ upgrade	DNSMAQ is upgraded to v 2.81 from upstream package
Miniupnpd upgrade	Miniupdnpd utility is upgraded to v 2.2.0 RC1
Port trigger feature	Support multiple ports (user configured) when an uplink packet is sent
Boot KPI optimization	Boot the KPI has been optimized to have better performance on Olympic LE platforms vs previous platforms

QCMobileAP Feature Set Available from Future releases

Feature	Description
Dual ETH NIC configuration (LE 1.1)	Add support to attaching two PCIe ethernet controller NICs. The QCMAp supports LAN+LAN/LAN+WAN ethernet configuration
GRE encapsulation IPA offload support (LE 1.1)	Supports the IPA offload for ethernet GRE encapsulation for the IPv4 and the IPv6 traffic
SAP+SAP+SAP+SAP support (LE 1.2)	Quad-AP support. (quadruple SSID)
Dual MACSec support (LE 1.2)	<ul style="list-style-type: none">• Support for the QCA8081 ETH and dual NIC to the QPS615• Support for AQR113C attached to QPS615
Dual Wi-Fi management (LE 1.2)	Support for single or dual WLAN chips.

Concurrency for Hexagon/Application Processor/Tethered Applications

- A single instance of the DHCP server assigns IP addresses to all hosts including WLAN clients and USB TE; therefore, all the clients get IP addresses allocated from the same subnet and address range.
- QCMobileAP brings up a WWAN call and enumerates the interface on the application processor with a public IP address, which is assigned by the network.
- Embedded applications on the application processor can use the Internet PDN network interface brought up by QCMobileAP.
- Alternatively, applications running on the application processor can bring up data calls on different PDNs, for example, admin PDN, and the corresponding network interface can be used by setting up appropriate routing rules.

Concurrency for Hexagon/Application Processor/Tethered Applications (cont.)

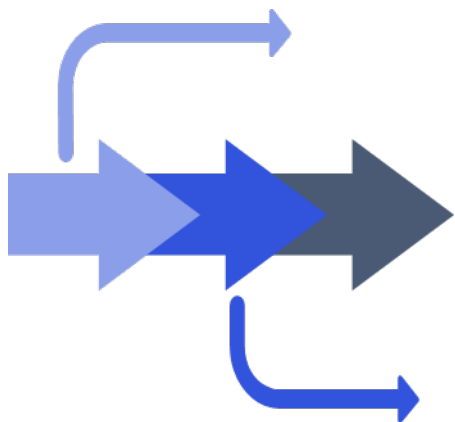
- Supported concurrencies
 - Applications on Hexagon communicating over WWAN using the same PDN as QCMobileAP, for example, GPS using Internet PDN
 - Applications on Hexagon communicating over WWAN using a PDN different from what is used by QCMobileAP, for example, BIP using admin PDN
 - Applications on the application processor communicating over WWAN using the same PDN as QCMobileAP, for example, media client using Internet PDN
 - Applications on the application processor communicating over WWAN using a PDN different from what is used by QCMobileAP, for example, OTADM using an admin PDN
 - Applications on the application processor communicating with LAN clients including USB (RNDIS/Standard (Std) ECM/DUN) TE and WLAN clients, for example, application processor apps, such as web server, media server, and file storage
 - USB (RNDIS/Std ECM/DUN) TE, WLAN clients, and embedded clients communicating with each other
 - USB (RNDIS/Std ECM/DUN) TE, WLAN clients, and embedded clients communicating with WWAN



USB Tethering

USB Tethering

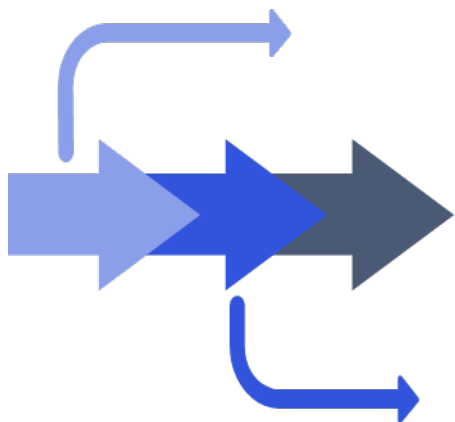
- Supported USB tethering mechanisms
 - RmNet
 - QTI-proprietary tethering
 - Network-assigned address handed to the TE
 - No concurrent support with QCMobileAP
 - RNDIS
 - Microsoft-promoted tethering used on Windows XP/7/8 and some Linux distributions
 - Private IP address is assigned to the TE
 - Supported concurrently with QCMobileAP
 - Std ECM
 - Used by MAC OS and many Linux distributions
 - Private IP address is assigned to the TE
 - Supported concurrently with QCMobileAP
 - DUN
 - Used by all operating systems
 - Network-assigned address handed to the TE
 - Supported concurrently with QCMobileAP
 - Private IP address is assigned to the TE
 - MBIM
 - Microsoft-promoted tethering used on Windows 8 and later versions
 - Network-assigned address handed to the TE
 - No concurrent support with QCMobileAP



Ethernet Tethering

Ethernet Tethering

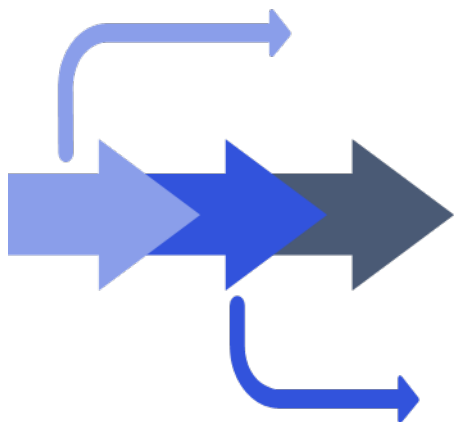
- Supported ethernet tethering mechanisms are as follows:
 - Provides up to 10 G ethernet link via QPS615 PCIe switch
 - Dual NIC support
 - Supports USXGMII/SGMII/RGMII interfaces
 - Port A: USXGMII/SGMII (Ref Phy: AQR113C 10 G)
 - Port B: USXGMII/SGMII/RGMII (Ref PHY: QCA8081 10 M/100 M/1 G/2.5 G)
 - QCMAP supports the following configurations in the Dual NIC mode:
 - LAN+LAN
 - LAN+WAN
 - Macsec modes
 - LAN (MACsec)+LAN
 - LAN(MACsec)+LAN (MACsec)
 - LAN(MACsec)+WAN



Limitations

Limitations

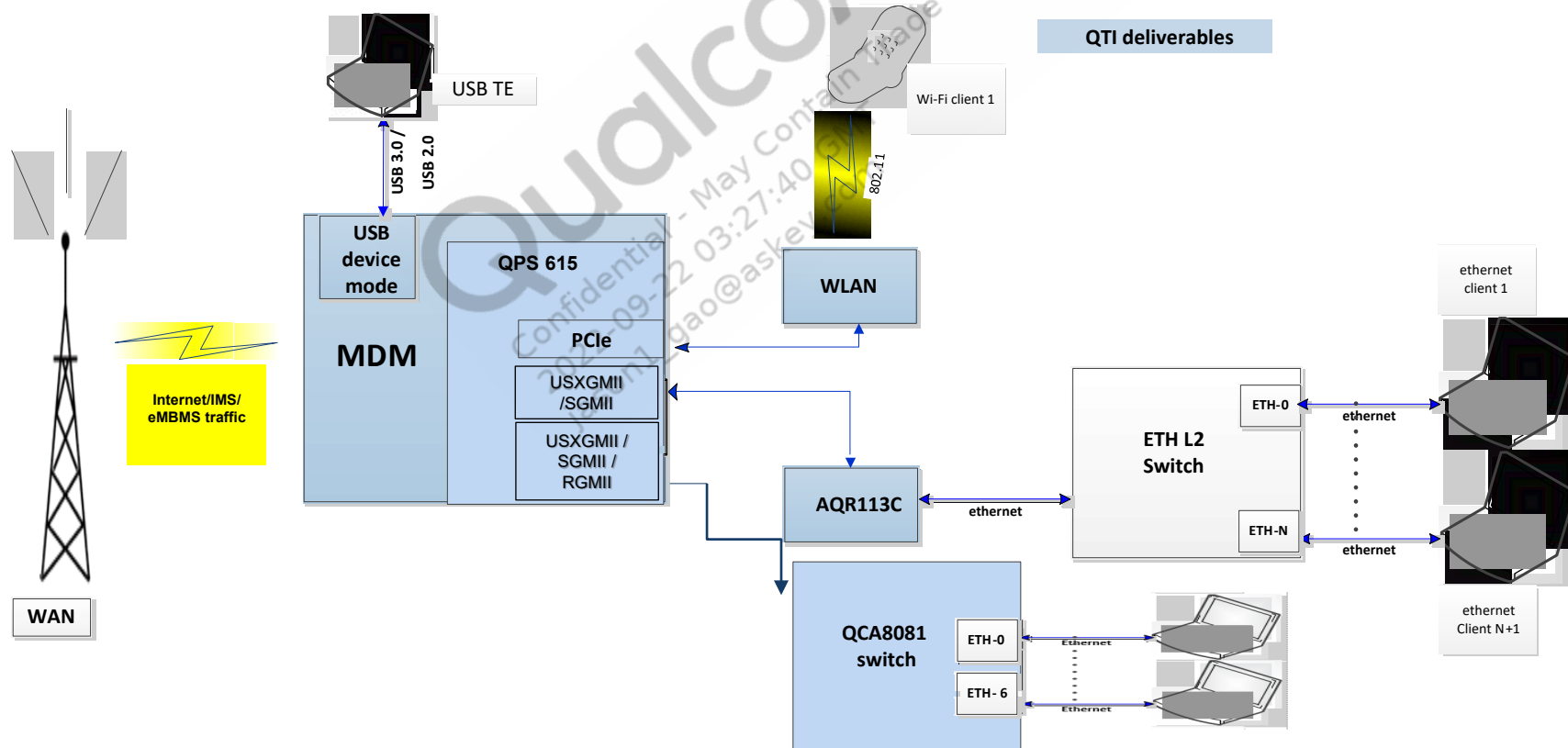
- Seamless transition among a WWAN network, a WLAN external hotspot, and a USB backhaul is not supported.
- When switching to concurrent AP+STA or USB backhaul mode, existing data sessions of LAN clients and embedded application on the application processor are no longer maintained and are disconnected abruptly. Fresh connections must be re-established.
- Use the same WWAN profile index (single PDN) for both IPv4 and IPv6 data calls, intended for Internet or default PDN.
- IP-PASSTHROUGH feature
 - This feature is supported with only one configured client (ethernet or USB). LAN-related functionalities are impacted.
 - The dynamic link functionality will only work for the first client, to update the client, IP-Passthrough needs to be enabled / disabled after removing the existing client.
 - In IP passthrough without NAT there is a limited of no embedded-app concurrency and no more than one tethered host at a time.
- Uplink Firewall feature addition, under whitelisting (packets accept) case for IPv6 – Whenever a firewall rule is added in one direction (uplink/downlink), then the corresponding firewall rule in the other direction (downlink/uplink) must be added to pass the connection.
 - Assumption – Connmark of value 0x35 is used to mark packets in firewall settings. OEM software should refrain using this value for marking packets.
- WCN6855/6 only supports one radio operating in one change in one band.



CPE Overview

CPE Overview

- Customer premises equipment (CPE) is an MDM chipset and an ethernet port integrated within the platform over an USXGMII/ SGMII/RGMII interface.
- QCMobileAP exposes user space functionality to configure a CPE platform.
- Either QCA8081 or AQR113C is connected to RGMII via the QPS 615 PCIe switch.





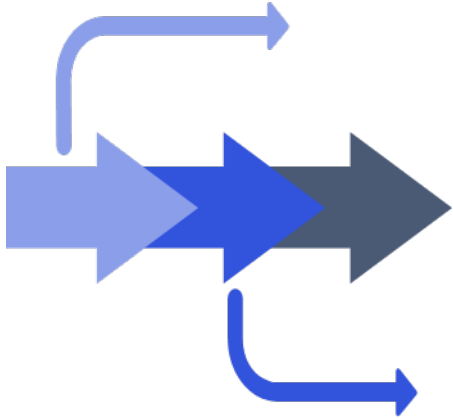
References

References

Documents	
Title	Number
Qualcomm Technologies, Inc.	
SDX24 ethernet (RGMII) I/F Overview	80-PD082-22
Modem Throughput Estimation API	80-P6046-1
Standards	
464XLAT: Combination of Stateful and Stateless Translation	RFC 6877
Acronyms	
Acronym or term	Definition
ALG	Application-level gateway
AP	Access point
CDI	Connected device information
CPE	Customer premises equipment
DBDC	Dual-band, dual-concurrent
DHCP	Dynamic host configuration protocol
DUN	Dial-up networking
ECM	ethernet control model
ETH	ethernet
GiGe	Gigabit ethernet
GSI	Generic software interface

References (cont.)

Acronyms	
Acronym or term	Definition
IPA	IP packet accelerator
L1SS	L1 sub state
L2TP	Layer 2 tunneling protocol
LE	Linux enabled
MBIM	Mobile broadcast interface model
Multi-PDN	Multiple packet data network
NAT	Network address translation
ODU	Outdoor data unit
QCMobileAP	Qualcomm mobile AP
RGMII	Reduced gigabit media independent interface
RNDIS	Remote network driver interface specification
SSID	Subsystem ID
TE	Terminal equipment
VLAN	Virtual LAN
VSI	Vendor-specific information
WLAN	Wireless LAN



Questions?

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