Qualcomm
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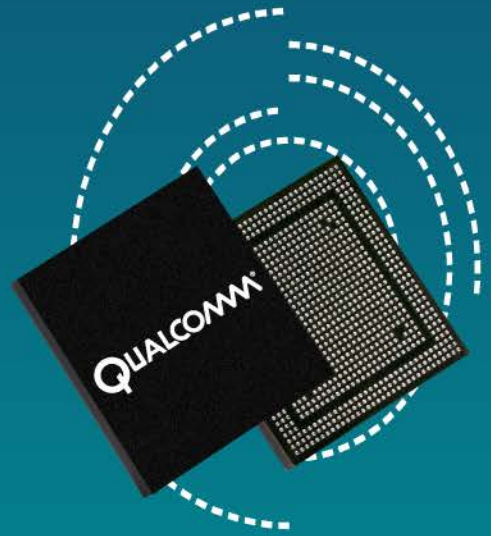

QCMobileAP Software Overview

MDM9x45 Chipsets

80-NP527-4 A

Confidential and Proprietary – Qualcomm Technologies, Inc.

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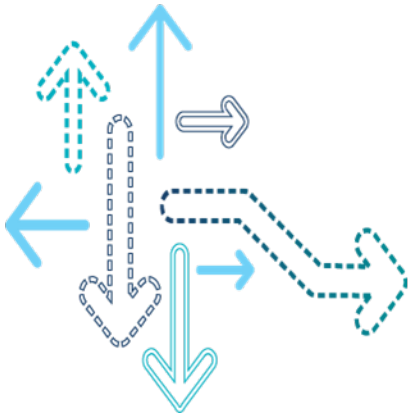
Revision History

Revision	Date	Description
A	Aug 2014	Initial release.

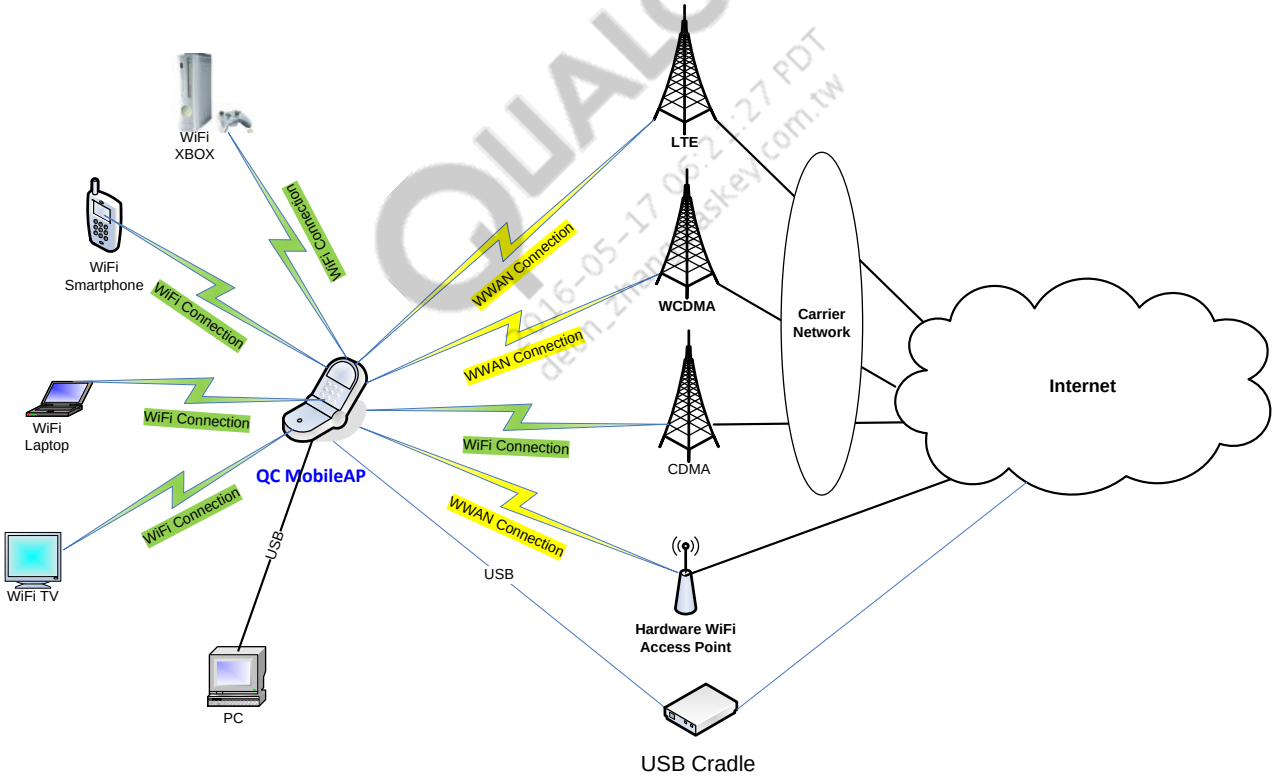
Contents

QCMobileAP Overview



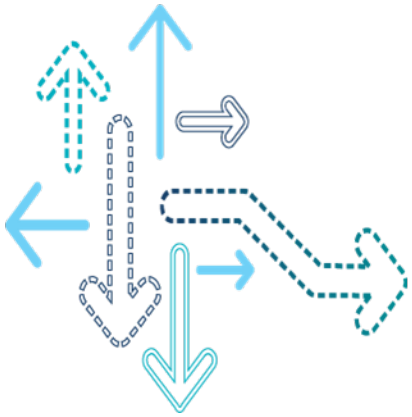
QCMobileAP Overview

- The User Equipment (UE) acts as an Access Point (AP) which allows multiple clients to connect to the Internet over Wi-Fi®.
- MobileAP is also commonly known by other names, e.g., SoftAP, Mobile Hotspot, Wi-Fi Tethering, MiFi® (Novatel trademarked), Pocket Router.

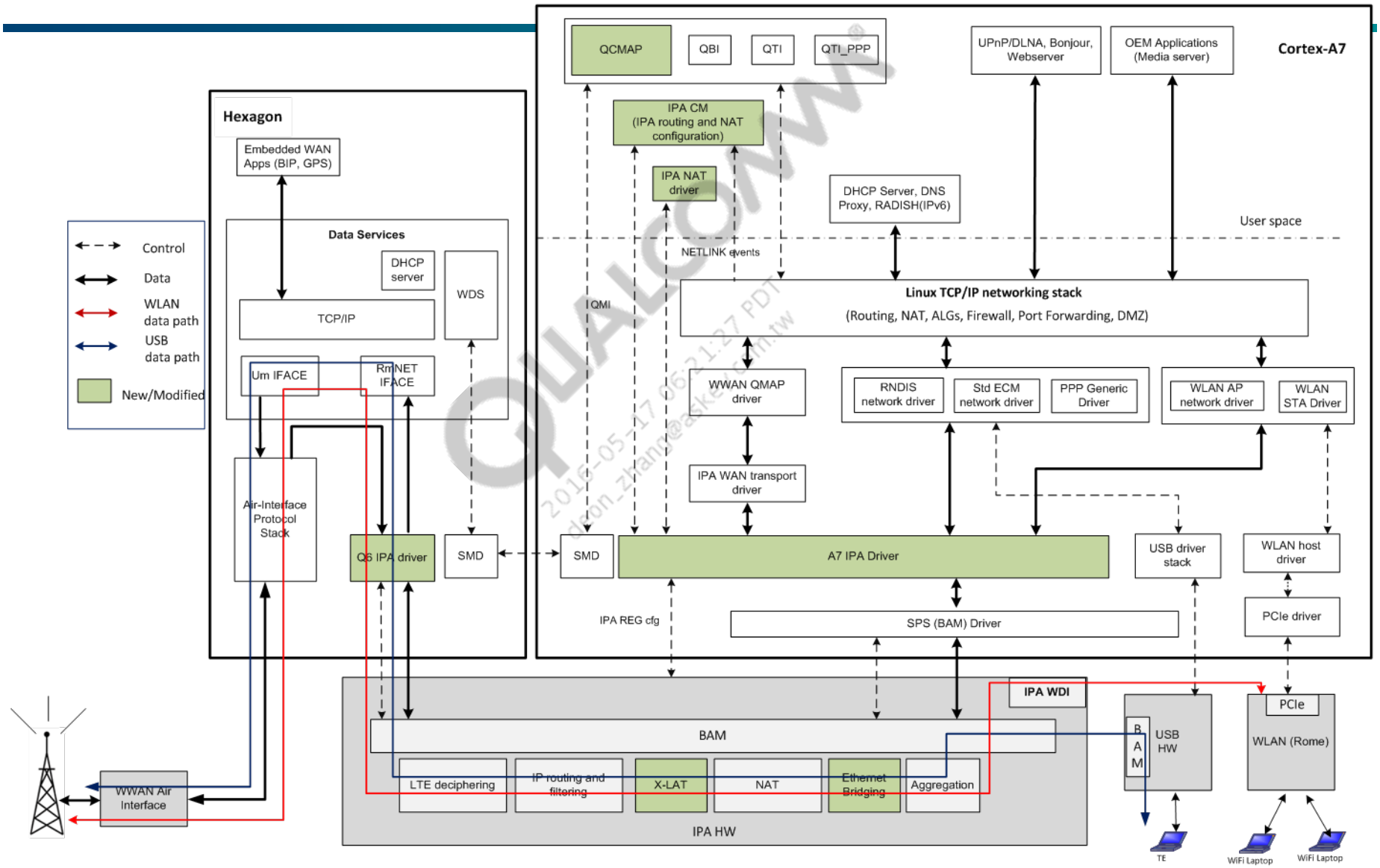


Note: only one USB port is supported, it can be configured either in WAN mode (connected to USB Cradle) or LAN mode (connected to PC)

Architecture Overview and Feature Set



MDM9x45 System Architecture



Architecture Overview

- Apps side (ARM® Cortex®-A7)
  - QCMobileAP provides API to connect with the Connection Manager daemon.
    - Provides an interface to turn QCMobileAP mode on and off
    - Provides an interface to configure network policy for WWAN network selection
    - Brings up and tears down the WWAN connection
    - Configures the DHCP server
    - Invokes Linux® kernel utilities, i.e., IP tables to configure Linux side NAT, routing, and firewall
    - Provides NAT, routing, and firewall functionalities on Cortex-A7
    - Provides an interface to turn concurrent AP+STA Router/Bridge mode on and off
    - Provides an interface to turn USB WAN mode on and off, while connected to a cradle device, providing data backhaul connectivity
    - Provides an interface to turn AP+AP mode (dual-SSID) on and off
  - Cortex-A7 embedded Applications can bring up a data call on additional PDNs using the data management APIs or on same PDN as for QCMobileAP data call.
  - QCMobileAP Connection Manager service interfaces with clients like QTI Tethering Interface to provide hostless tethering functionality.
  - Linux kernel handles routing between Cortex-A7 embedded apps, WLAN clients, and USB Terminal Equipment (TE).

Architecture Overview (cont.)

- IP Accelerator (IPA) – Enables hardware-accelerated datapath for IP packets to provide high data rates and to save Cortex-A7 CPU use; key features are:
  - Filtering – Once the IP packets are available, based on the filtering rules configured, IPA selectively filters out traffic to be sent to different endpoints, which helps to achieve functionalities like Application Level Gateway (ALG) and firewall.
  - Network Address Translation (NAT) – The IPA can do both source and destination NAT.
  - Routing – Based on the output of the NAT block for WWAN data and on the source/destination address/port, the routing block routes the IP packets to either the modem address space or to one of the several BAM endpoints, each of which is dedicated for a specific destination.
  - Header insertion – Based on the rule that matches, the IPA can prepend a transfer with a header; it can also attach a header on a per-IP packet basis.
  - IPA performs aggregation/deaggregation of IP frames.
  - LTE deciphering

Architecture Overview (cont.)

  - XLAT for IPv4 to IPv6 translation – Support RFC 6877 – 464XLAT: Combination of Stateful and Stateless Translation (new to MDM9x45)
  - Ethernet bridging in IPA – Support IPA hardware accelerated datapath for USB ↔ WLAN and WLAN ↔ WLAN (Inter-BSSID) use cases (new to MDM9x45)
- Initial NATing and routing are performed in the Apps Cortex-A7 Linux stack. Once the dynamic Conntrack table entry is created, all subsequent NATing and routing gets performed in IPA (optimized hardware-accelerated path).
- WLAN datapath offloads to IPA (new to MDM9x45)

MDM9x45 QCMobileAP Architecture – IPv6 Architecture

- On Cortex-A7 side
  - RADISH acts as a multicast forwarder. It forwards multicast packets (Router Advertisement (RA), Router Solicitation (RS), Neighbor Advertisement (NA), Neighbor Solicitation (NS)) between the IPv6 WWAN network interface and the LAN interfaces.
  - When an IPv6 call is brought up, the modem sends RA, which is forwarded through the LAN interfaces to Wi-Fi and USB clients via RADISH.
  - On the new Wi-Fi client connection, RADISH forwards RS to the modem (Hexagon™) and receives RA, which is then propagated to the interfaces.

Feature Set

QCMobileAP features	Comments
Reference Connection Manager on Application Processor	Provides reference connection manager that handles QCMobileAP configuration and WWAN connectivity
Data forwarding to and from 4G/3G network	All RAT types supported: LTE, GW, 1xEV-DO
IPv4 NAT (Symmetric NAT, Full Cone NAT, Address Restricted Cone NAT, Port Restricted Cone NAT)	NAT support
DHCP Server	Supports multiple clients
Proxy DNS	DNS proxy for NATed clients
IP Firewall	Firewalling based on configured rules
VPN Passthrough	IPSec, PPTP, and L2TP
Connection Management	Automatic WWAN connection management
Port Forwarding	Static NAT entries
Configuration API	API to configure NAT tables, firewalls, DHCP address range, etc.

Feature Set (cont.)

QCMobileAP features	Comments
ALGs	FTP, PPTP, SIP, RTSP; work in progress for enabling more ALGs, i.e., H.323, IRC, UDPLITE, AMANDA, NETBIOS, SNMP, TFTP
DMZ	Forwards all downlink packets to a preset client address if no NAT match found
Enable/Disable Roaming Autoconnect	Provides configuration function that enables/disables autoconnect during roaming
QCMobileAP IPv6	Supports IPv6 over QCMobileAP
AP+STA mode	Operates as Wi-Fi AP as well as Wi-Fi client and makes external Wi-Fi hotspot as 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 QCMobileAP Wi-Fi clients to access the same WWAN concurrently
UPnP and DLNA	Enables UPnP IGD v1 device class and DLNA media server
Bonjour	Enables Bonjour (mDNS resolver) for device and service discovery
HTTP/HTTPS Reference Webserver	Enables reference webserver for web-based QCMobileAP configuration
Concurrent DUN+MobileAP	Enables USB connected DUN TE and QCMobileAP Wi-Fi clients to communicate to the same WWAN PDN

Feature Set (cont.)

QCMobileAP features	Comments
IMS Voice over 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	Provides support for saving the configuration file and to reset to default configuration
IPv6 Prefix Delegation	Allows granting LTE-delegated IPv6 prefixes to the LAN clients
USB Cradle Mode	Supports QCMobileAP device connection to external modem (cradle) over USB and provides data backhaul
AP+STA Bridging Mode	Enables bridging between LAN interfaces (Wi-Fi AP and USB interface) and the Wi-Fi STA interface in concurrent WLAN AP+STA mode
AP+AP+STA Mode	Combination of AP+AP and AP+STA; STA gets configured as the backhaul
ODU Device Enablement	MDM device acts as an Outdoor Data Unit (ODU) and provides connectivity over Ethernet to the home
CPE Device Enablement	MDM device works as a low-cost home router and has Wi-Fi as well as Ethernet connections
eMBMS over SoftAP and ODU	Supports eMBMS traffic management and forwarding to LAN eMBMS clients

Feature Set (cont.)

QCMobileAP features	Comments
UPnP IGDv2	Enables IGD ver 2, IPv6 support, firewall pinholes, allows single application through restricted firewall, statistics for pinhole, actions for control of port forwarding ranges
Dynamic DNS	Dynamically updates DNS records on the upstream name servers with active DNS configuration of hostnames, URLs, addresses of hosts connected to QCMobileAP
Standalone STA Mode	Enables standalone STA mode on the WLAN chip to enable embedded applications running on Cortex-A7 to set up connections through the external Wi-Fi hotspot

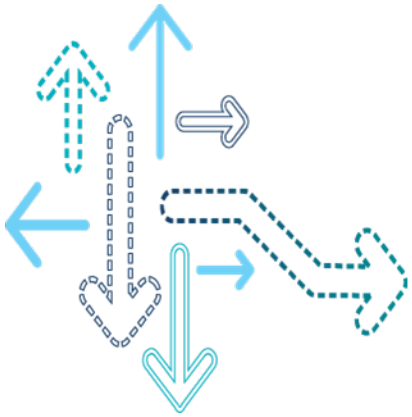
Concurrency for Hexagon/Cortex-A7/Tethered Applications

- QCMobileAP concurrency
  - 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 with a public IP address assigned by the network on Cortex-A7.
  - Embedded applications on Cortex-A7 can use the Internet PDN network interface brought up by QCMobileAP. Alternatively, Applications running on the Cortex-A7 can bring up data calls on different PDNs, e.g., Admin PDN. And the corresponding network interface can be used by setting up appropriate routing rules.

Concurrency for Hexagon/Cortex-A7/Tethered Applications (cont.)

- QCMobileAP concurrency (cont.)
  - Supported concurrencies
    - Apps on Hexagon communicating over WWAN using the same PDN as QCMobileAP, e.g., GPS using Internet PDN
    - Apps on Hexagon communicating over WWAN using a PDN different from what is used by QCMobileAP, e.g., BIP using Admin PDN
    - Apps on Cortex-A7 communicating over WWAN using the same PDN as QCMobileAP, e.g., media client using Internet PDN
    - Apps on Cortex-A7 communicating over WWAN using a PDN different from what is used by QCMobileAP, e.g., OTADM using Admin PDN
    - Apps on Cortex-A7 communicating with LAN clients including USB (RNDIS/Std ECM/DUN) TE and WLAN clients, e.g., Cortex-A7 apps like web server, media server, 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

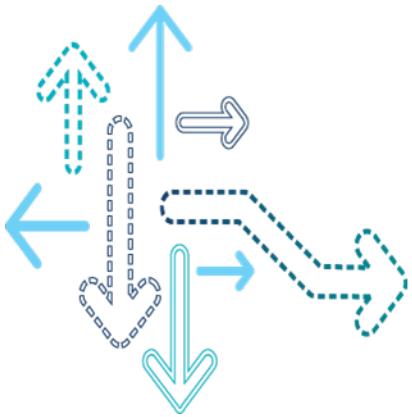
USB Tethering



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.
    - Private IP address is assigned to the TE
    - Supported concurrently with QCMobileAP
  - MBIM
    - Microsoft-promoted tethering used on Windows 8 and above
    - Network-assigned address handed to the TE
    - No concurrent support with QCMobileAP

Limitations



Limitations

- Seamless transition among a WWAN network, a WLAN external hotspot, and 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 Cortex-A7 are no longer maintained and are disconnected abruptly. Fresh connections must be re-established.

References

Ref.	Document	
Qualcomm Technologies		
Q1	*Application Note: Software Glossary for Customers*	CL93-V3077-1

Questions?

https://support.cdmatech.com