
MDM9x40 Throughput Dashboard Performance Data Summary

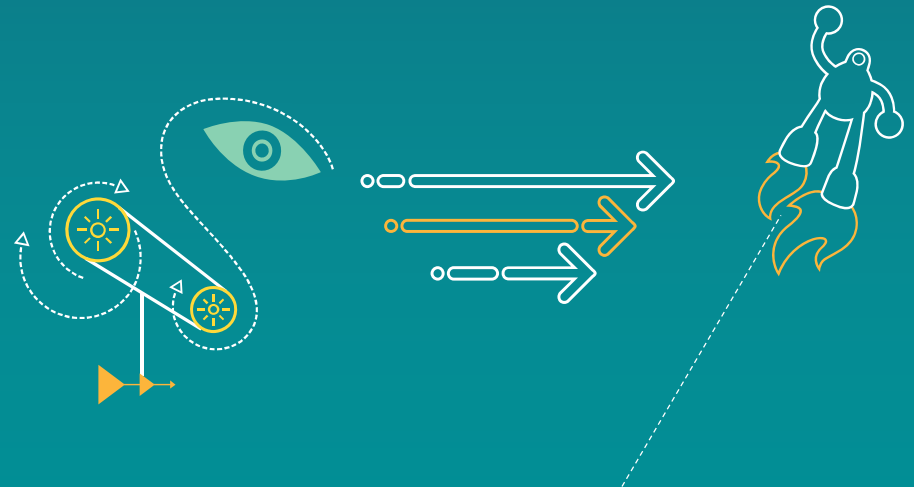


Qualcomm Atheros, Inc.

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Revision History

Revision	Date	Description
A	December 2014	Initial release
B	May 2015	Added throughput results for ODU/CPE WLAN-ETH and USB cradle LTE-ETH and updated dashboard throughout
C	September 2015	Updated and added projection values, and added CS measured values.

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Section 1

Introduction

Introduction

Purpose

- This document provides peak throughputs for MDM9x40 devices with a QCA6174A chip. The throughput achieved is highly dependent on software optimization.
- **Note:** Throughout this document, the term MDM refers to MDM9x40 chipsets.

Scope

- This document is intended for MDM customers who are going to use or are planning to use a MDM9x40 device. The document covers the high-level data use cases and expected throughputs under various scenarios as categorized by different sections.
- **Note:** Information provided in this document is subject to change, and comments are provided for informational use only. No commitments are expressed or implied.

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Section 2

Basic Assumptions

Basic Assumptions

The following slides cover basic assumptions applicable for all use cases. Scenario-specific assumptions are noted in their respective sections.

When making throughput measurements:

- The USB is assumed to be configured in USB 3.0 mode if it is not specified.
- Packet sizes of 1500 bytes for IPv4 and 1280 bytes for IPv6 are assumed. The throughput is reduced if smaller packet sizes are used.
- Unless specified, for LTE, projections are based on supported Physical (L1) rates.
- To account for protocol header overheads and other inefficiencies, the application layer throughput numbers are expected to be lower than projected by:
 - ~3% for IPv4
 - ~5% for IPv6
- CPU utilization numbers correspond to A7 running at 1.28 GHz.
- CPU usage numbers are preliminary projections and subject to change.
- For TCP, `delayed_ack = 2` is being considered for projections.
- All projections can have 2 to 3% margin of error.
- All throughput values projected in the following pages are in Mbps.
- LTE refers to FDD in this document.

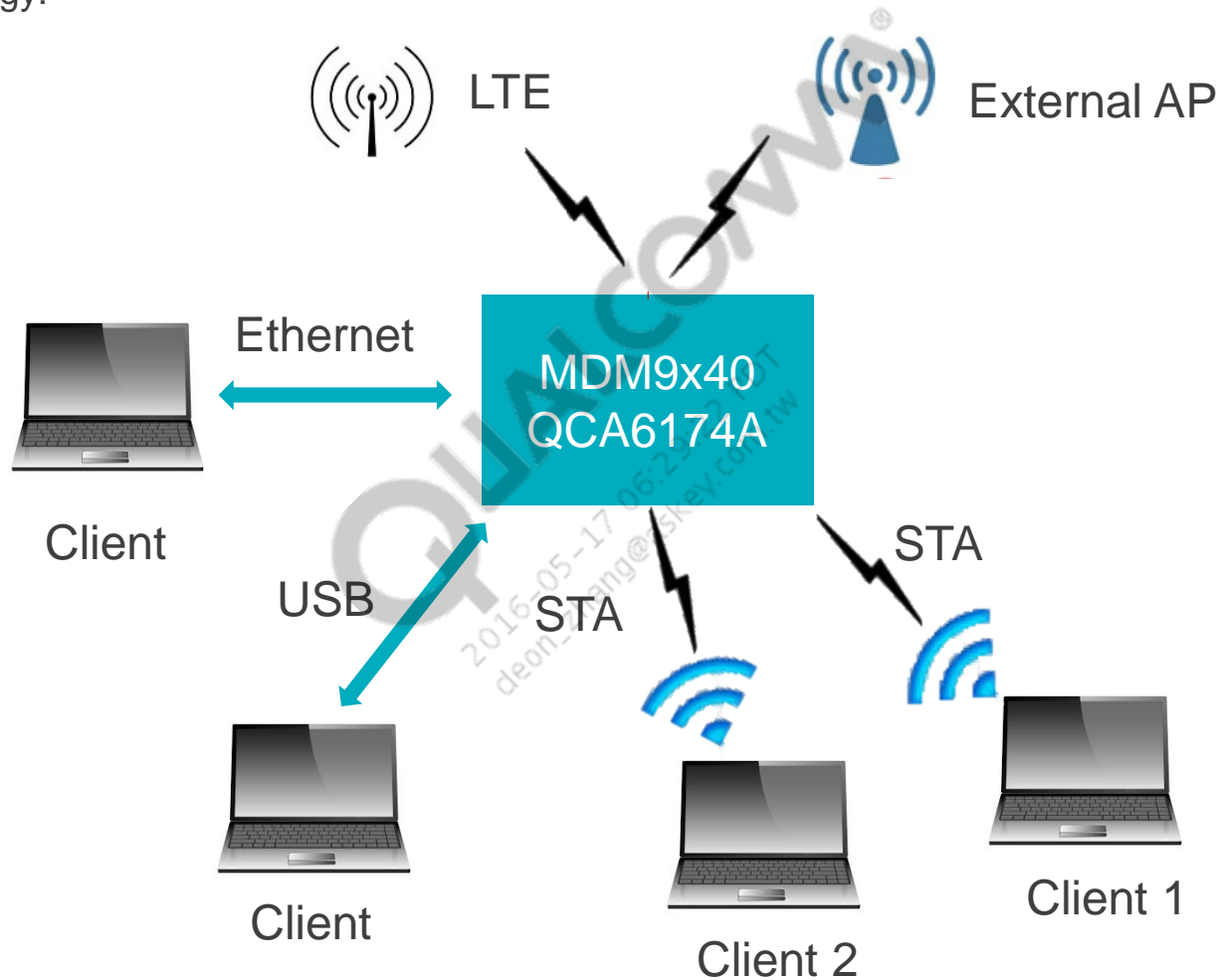
Basic Assumptions (cont.)

- The term *aggregate* in the table stands for the sum of DL and UL throughput streams in the Bi-Dir column. For dual SSID cases, it also stands for the sum of all streams in different SSID interfaces.
- Qualcomm mux and aggregation protocol (QMAP) aggregates IP packets and has its own header format.
- CPU usage numbers are preliminary projections and subject to change.

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Basic Assumptions (cont.)

Network topology:



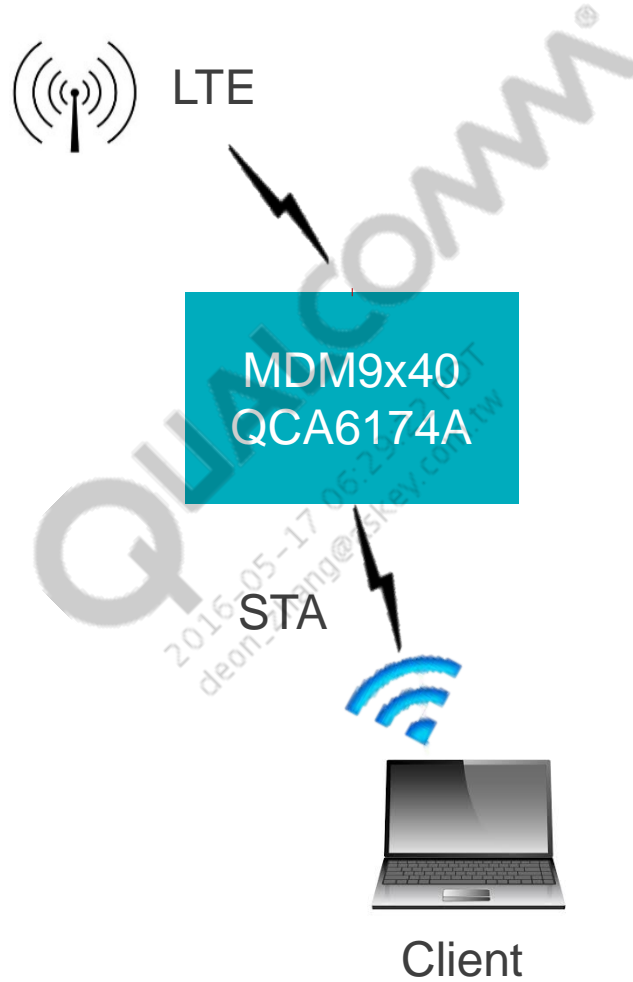


Section 3

Throughput – LTE-WLAN

Throughput – LTE-WLAN

Network topology:



Throughput – LTE-WLAN (cont.)

- Test case – LTE Cat 9 FDD ↔ WLAN QCMobileAP mode for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	450	50/450	50	450	50/450
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	49.5	439	46.3/438	49.9	443	49.9/443
CPU idle	97.3%	97.8%	97.1%	97.14%	98%	97.5%

Note: WLAN VHT80 5 GHz. UL/DL are from the WLAN perspective.

Throughput – LTE-WLAN (cont.)

- Test case – LTE Cat 11 FDD ↔ WLAN QCMobileAP mode for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	587	50/587	50	587	50/587
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	49.3	560	43/560	49.9	566	49.4/566
CPU idle	95%	95%	95%	95%	95%	95%

Note: WLAN VHT80 5 GHz. UL/DL are from the WLAN perspective.

Throughput – LTE-WLAN (cont.)

- Test case – LTE DL/UL Cat 12/13 FDD ↔ WLAN QCMobileAP mode for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	587	620* aggregate	150	587	680** aggregate
CPU idle	95%	95%	95%	95%	95%	95%

Note: WLAN VHT80 5 GHz. UL/DL are from the WLAN perspective. The value is for the LE 2.0 CS release.

* Due to Q6 MIPS limitation.

** Limited by WLAN max supported rates.

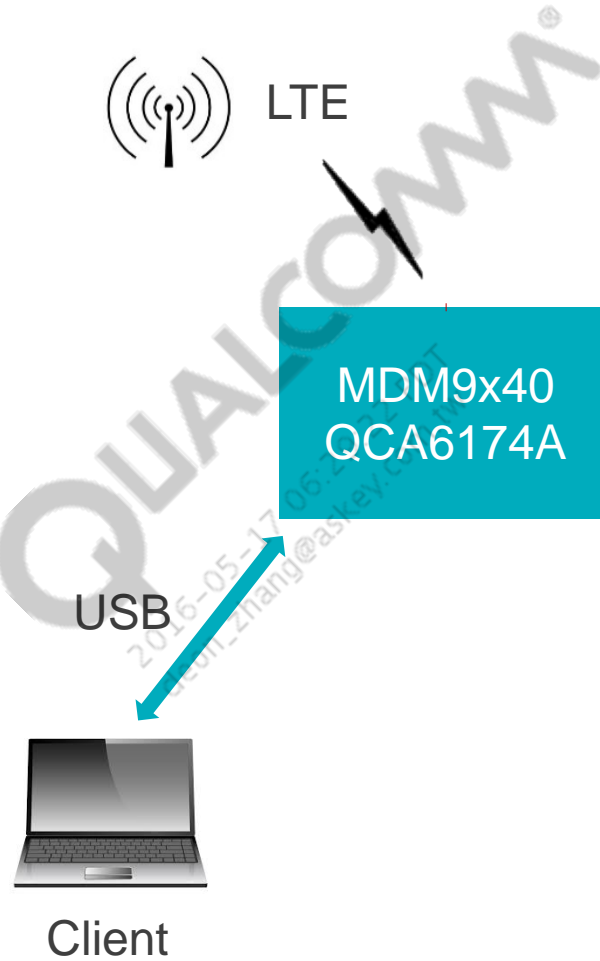


Section 4

Throughput – LTE-USB

Throughput – LTE: USB

Network topology:



Throughput – LTE: USB (cont.)

- Test case – LTE Cat 9 FDD ↔ USB SS tethering (ECM, RNDIS, RMNET, MBIM) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	450	50/450	50	450	50/450
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	49.5	439	47.1/438	49.9	443	49.9/443
CPU idle	97.9%	98.4%	98.1%	98.88%	97.3%	98.1%

Note: UL/DL are from the USB perspective.

Throughput – LTE: USB (cont.)

- Test case – LTE Cat 11 FDD ↔ USB SS tethering (ECM, RNDIS, RMNET, MBIM) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	587	50/587	50	587	50/587
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	49.3	560	46.1/560	49.9	566	49.4/566
CPU idle	95%	95%	95%	95%	95%	95%

Note: UL/DL are from the USB perspective.

Throughput – LTE: USB (cont.)

- Test case – LTE DL/UL Cat 12/13 FDD ↔ USB SS tethering (ECM, RNDIS, RMNET, MBIM) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	587	620* aggregate	150	587	150/587
CPU idle	95%	95%	95%	95%	95%	95%

Note: UL/DL are from the USB perspective. The value is for the LE 2.0 CS release.

* Due to Q6 MIPS limitation.

Throughput – LTE: USB (cont.)

- Test case – LTE Cat 11 FDD ↔ USB HS tethering (ECM, RNDIS, RMNET, MBIM) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	320	320 aggregate	50	320	330 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	49.5	319	48.1/275	49.9	329	49.9/280
CPU idle	95.83%	96.3%	97.1%	96.1%	97.1%	97.3%

Note: Tethering is over the USB 2.0 port (EHCI) operating in high speed. UL/DL are from the USB perspective.

Throughput – LTE: USB (cont.)

- Test case – LTE DL/UL Cat 12/13 FDD ↔ USB HS tethering (ECM, RNDIS, RMNET, MBIM) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	320*	320* aggregate	150	320*	330* aggregate
CPU idle	95%	95%	95%	95%	95%	95%

Note: Tethering is over the USB 2.0 port (EHCI) operating in high speed. UL/DL are from the USB perspective. The value is for the LE 2.0 CS release.

* Max throughput supported in HS-USB mode.

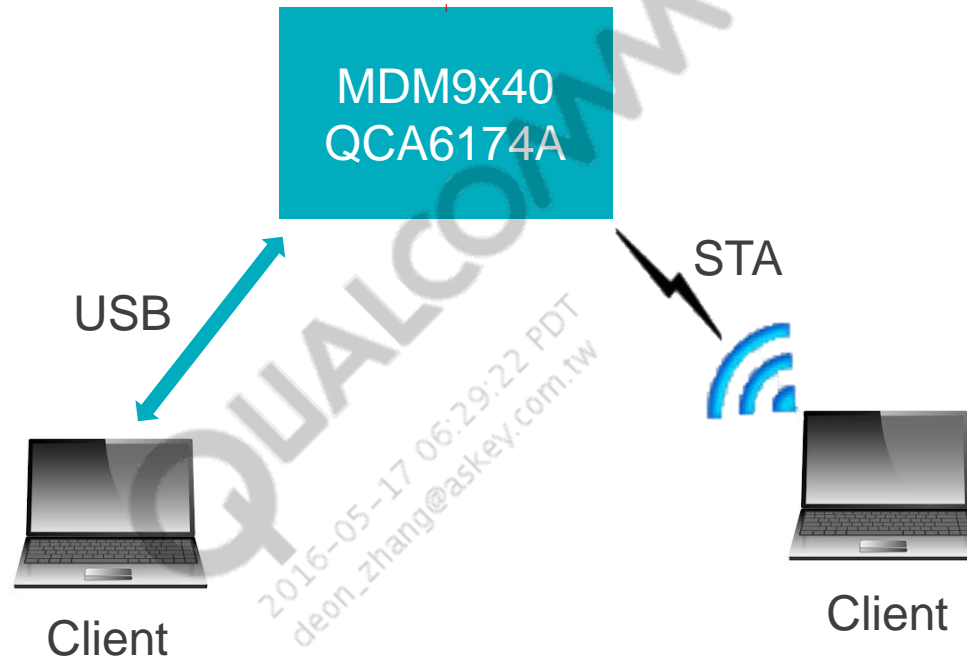


Throughput – WLAN QCMobileAP Mode: USB

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Throughput – WLAN QCMobileAP Mode: USB

Network topology:



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Throughput – WLAN QCMobileAP Mode: USB (cont.)

- Test case – WLAN QCMobileAP mode ↔ USB SS (RNDIS) for local data Tx

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	650	650	650 aggregate	700	600*	700 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	651	663	678	704	601	700
CPU idle	97%	97%	97%	97%	97%	97%

Note: WLAN VHT80 5 GHz. UL/DL are from the WLAN perspective.

* Microsoft host network stack for RNDIS does not support aggregation for UDP UL from the USB client perspective. It does support for TCP UL. This is causing the UDP throughput to be low for the USB (RNDIS) → MDM → WLAN direction as compared to TCP.

Throughput – WLAN QCMobileAP Mode: USB (cont.)

- Test case – WLAN QCMobileAP Mode ↔ USB HSUSB (RNDIS) for local data Tx

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	320	320	320 aggregate	320	320	330 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	332	313	325	350	187*	331
CPU idle	94.5%	97%	97%	97%	97%	97%

Note: WLAN VHT80 5 GHz. Tethering is over the USB 2.0 port (EHCI) operating in high speed. UL/DL are from the WLAN perspective.

* Limitation on Microsoft side due to lack of aggregation.

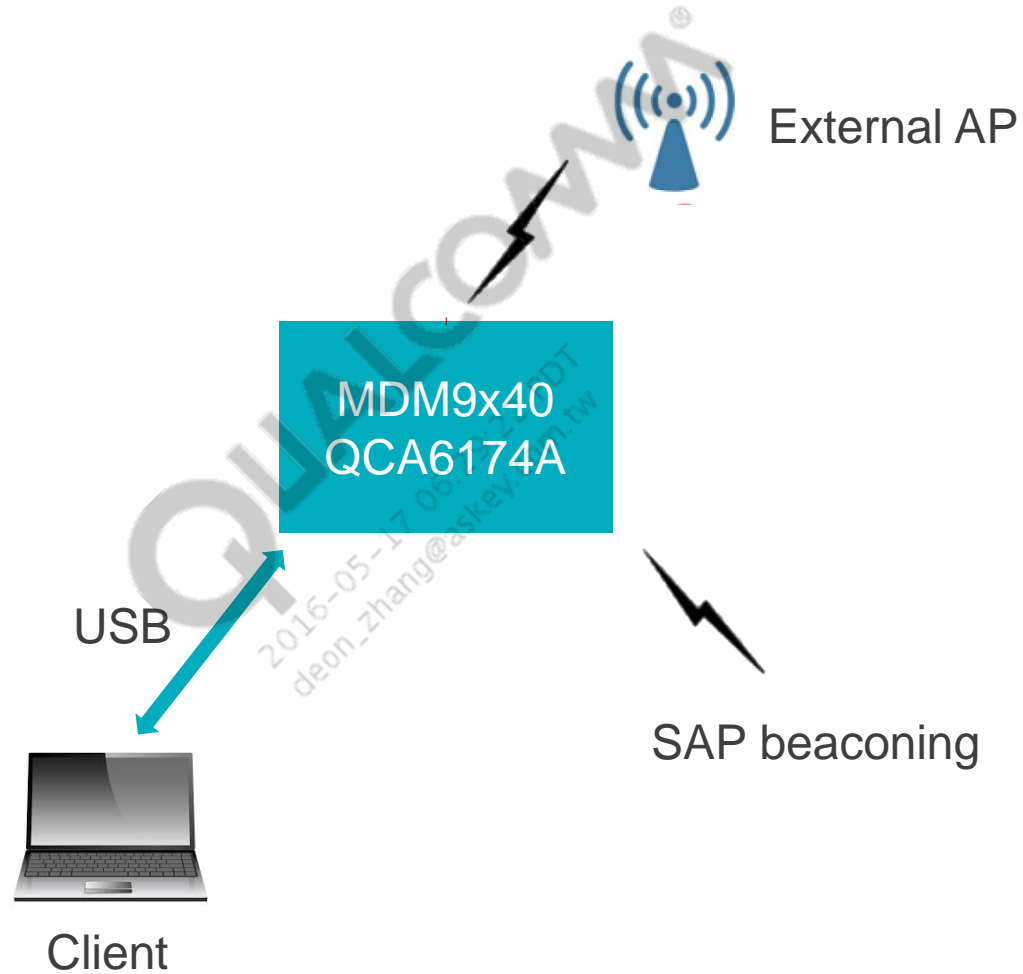


Throughput – WLAN STA Mode: USB

Section 6

Throughput – WLAN STA Mode: USB

Network topology:



Throughput – WLAN STA Mode: USB (cont.)

- Test case – WLAN STA mode ↔ USB SS (RNDIS) for internet Tx

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	585	585	585 aggregate	600*	630	630 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	604	632	624	580	644	625
CPU idle	96%	96%	96%	96%	96%	96%

Note: WLAN VHT80 5 GHz. UL/DL are from the USB perspective.

* Microsoft host network stack for RNDIS does not support aggregation for UDP UL from the USB client perspective. It does support for TCP UL. This is causing the UDP throughput to be low for the USB (RNDIS) → MDM → WLAN direction as compared to TCP.

Throughput – WLAN STA Mode: USB (cont.)

- Test case – WLAN STA mode ↔ USB HSUSB (RNDIS) for internet Tx

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	320	320	320 aggregate	320	320	330 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	310	332	325	187*	351	330
CPU idle	97%	94.5%	96%	97%	97%	97%

Note: WLAN VHT80 5 GHz. Tethering is over the USB 3.0 port (xHCI) operating in super speed. UL/DL are from the USB perspective.

* Limitation on Microsoft side due to lack of aggregation.

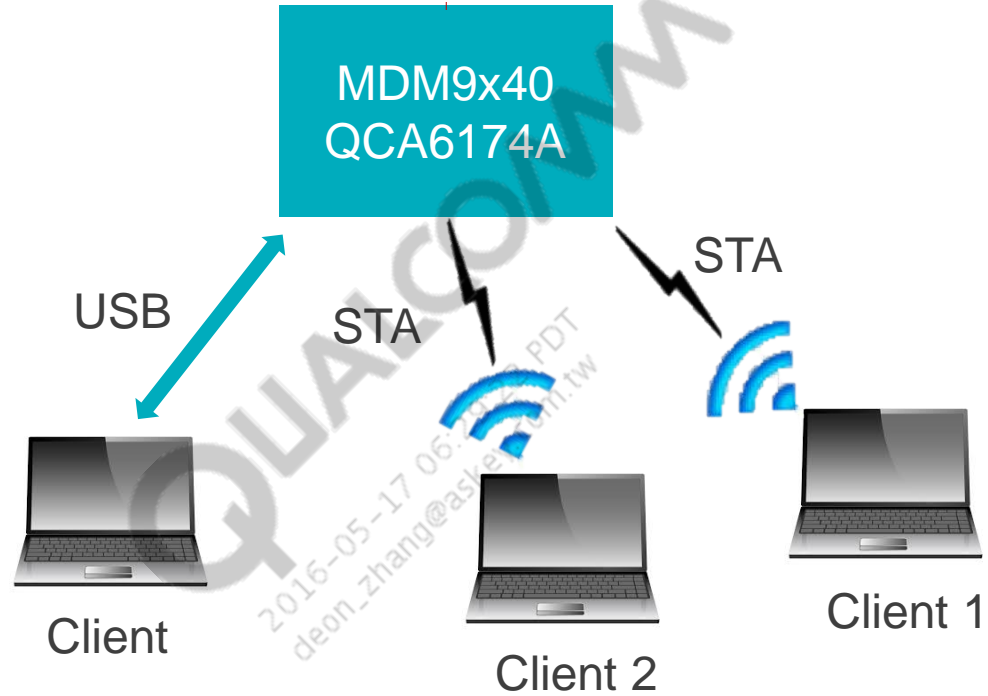


Throughput – WLAN Dual SSID

Section 7

Throughput – WLAN Dual SSID

Network topology:



Throughput – WLAN Dual SSID (cont.)

- Test case – WLAN QCMobileAP mode dual SSID SCC ↔ USB RNDIS

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	590 aggregate	590 aggregate	480 aggregate	630 aggregate	540 aggregate	580 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	627	661	580	670	590	600
CPU idle	95%	95%	95%	95%	95%	95%

Note: WLAN VHT80 5 GHz. UL/DL are from the WLAN perspective. Tethering is over the USB 3.0 port (xHCI) operating in super speed.

Throughput – WLAN Dual SSID (cont.)

- Test case – WLAN QCMobileAP mode dual SSID MCC ↔ USB RNDIS

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	300 aggregate	300 aggregate	324 aggregate	450 aggregate	450 aggregate	344 aggregate
CPU idle	35%	30%	25%	10%	15%	0%
LE 1.0 CS measured value						
Throughput	383	360	330	502	600	450
CPU idle	52%	40%	30%	64%	36%	25%

Note: WLAN VHT80 5 GHz. WLAN intraband MCC. UL/DL are from the WLAN perspective. Tethering is over the USB 3.0 port (xHCI) operating in super speed. Use the IPA-WLAN software bridge data path.

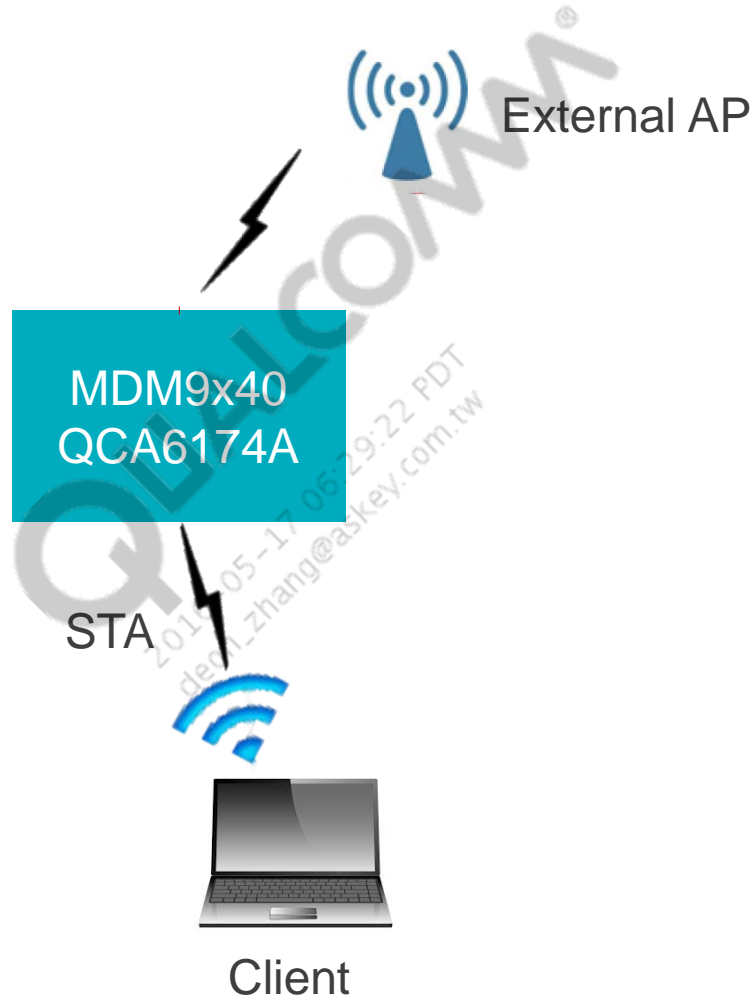


Throughput – AP+STA

Section 8

Throughput – AP+STA

Network topology:



Throughput – AP+STA (cont.)

- Test case – WLAN QCMobileAP ↔ WLAN STA SCC end-to-end throughput

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	250 aggregate	250 aggregate	210 aggregate	300 aggregate	300 aggregate	245 aggregate
CPU idle	95%	95%	95%	95%	95%	95%
LE 1.0 CS measured value						
Throughput	251	258	241	300	300	280
CPU idle	96%	96%	96%	96%	96%	96%

Note: WLAN VHT80 5 GHz. UL/DL are from the MDM WLAN perspective.

Throughput – AP+STA (cont.)

- Test case – WLAN QCMobileAP ↔ WLAN STA MCC end-to-end throughput

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	120 aggregate	120 aggregate	110 aggregate	190 aggregate	190 aggregate	165 aggregate
CPU idle	70%	70%	50%	45%	48%	40%
LE 1.0 CS measured value						
Throughput	141	138	112	201	200	185
CPU idle	73%	74%	58%	54%	58%	48%

Note: WLAN intraband MCC. WLAN VHT80 5 GHz. UL/DL are from the MDM WLAN perspective. Use the IPA-WLAN software bridge data path.

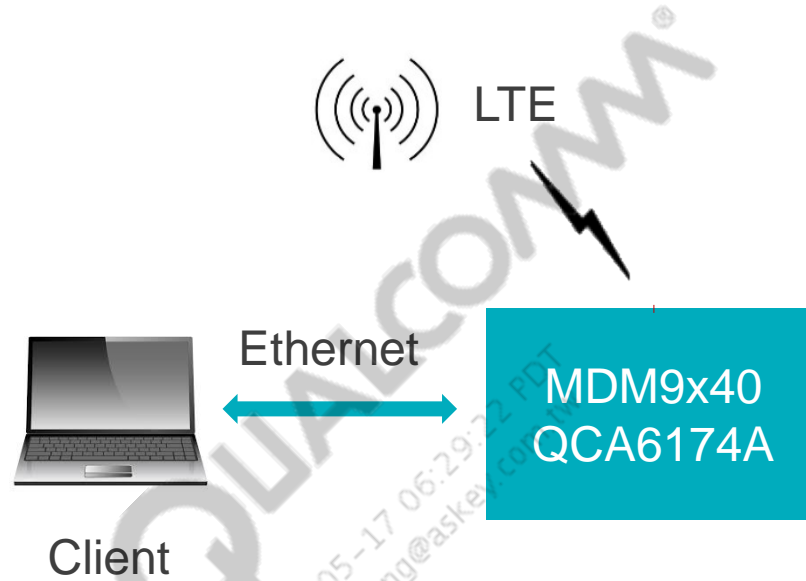


Throughput – ODU/CPE LTE-ETH

Section 9

Throughput – ODU/CPE LTE-ETH

Network topology:



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Throughput – ODU/CPE LTE-ETH (cont.)

- Test case – ODU/CPE: LTE Cat 9 FDD ↔ ETH (PCIe) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	450	50/450	50	450	50/450
CPU idle	65%	35%	30%	80%	45%	30%

Note: UL/DL is from the ETH perspective. PCIe ETH card used is AR8151. Projection is using the IPA-AR8151 software bridge data path. The value is for the LE 1.1 CS release.

Throughput – ODU/CPE LTE-ETH (cont.)

- Test case – ODU/CPE: LTE Cat 11 FDD ↔ ETH (PCIe) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	600	50/600	50	600	50/600
CPU idle	65%	30%	25%	80%	40%	30%

Note: UL/DL is from the ETH perspective. PCIe ETH card used is AR8151. Projection is using the IPA-AR8151 software bridge data path. The value is for the LE 1.1 CS release.

Throughput – ODU/CPE LTE-ETH (cont.)

- Test case – ODU/CPE: LTE DL/UL Cat 12/13 FDD ↔ ETH (PCIe) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	587	620* aggregate	150	587	150/587
CPU idle	60%	30%	15%	70%	40%	20%

Note: UL/DL is from the ETH perspective. PCIe ETH card used is AR8151. Projection is using the IPA-AR8151 software bridge data path. The value is for the LE 2.0 CS release.

* Due to Q6 MIPS limitation.

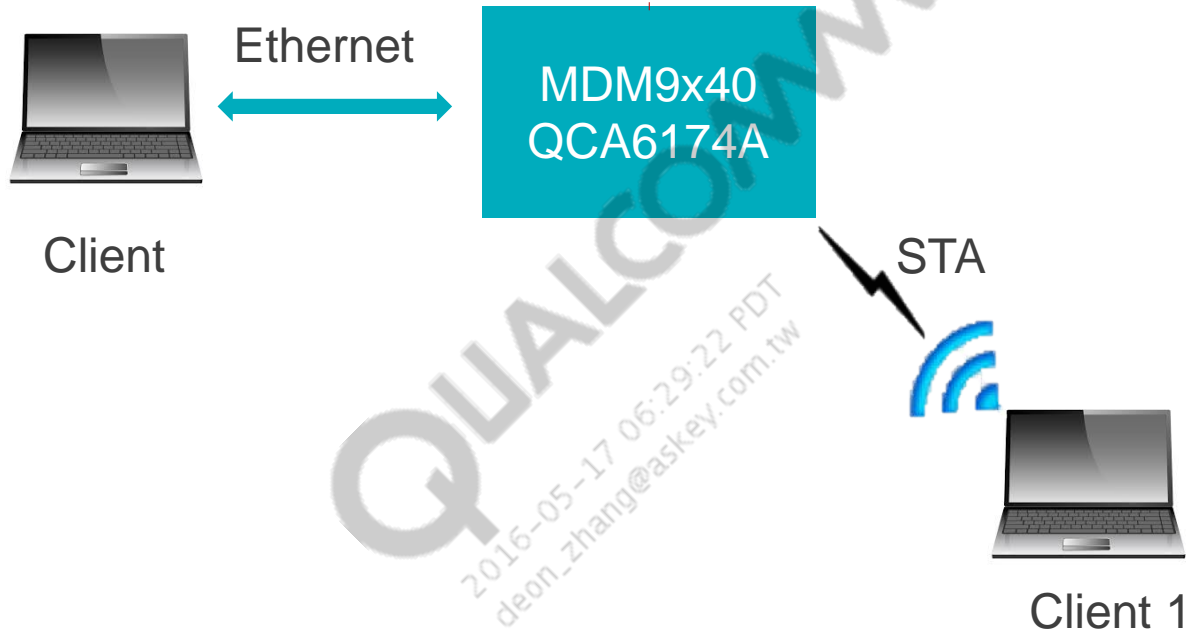


Throughput – ODU/CPE WLAN-ETH

Section 10

Throughput – ODU/CPE WLAN-ETH

Network topology:



Throughput – ODU/CPE WLAN-ETH (cont.)

- Test case – ODU/CPE: WLAN QCMobileAP mode ↔ ETH (PCIe) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	420	380	410 aggregate	515	480	460 aggregate
CPU idle	10%	5%	0%	10%	5%	0%

Note: UL/DL is from the ETH perspective. PCIe ETH card used is AR8151. Projection is using the IPA-AR8151 software bridge data path and a Pericom switch. The value is for the LE 1.1 CS release.

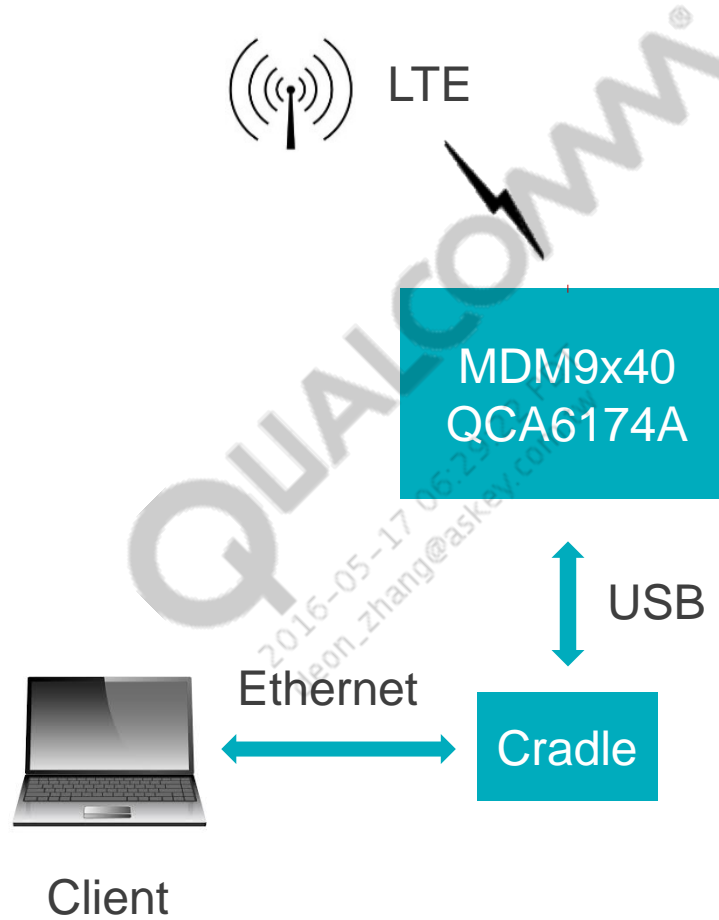


Throughput – USB Cradle LTE-ETH

Section 11

Throughput – USB Cradle LTE-ETH

Network topology:



Throughput – USB Cradle LTE-ETH (cont.)

- Test case – USB cradle: LTE Cat 9 FDD ↔ ETH (USB SS) for IPv4

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	450	50/450	50	450	50/450
CPU idle	55%	20%	18%	75%	25%	20%

Note: UL/DL is from the ETH perspective. Adapter is a AX88179 (USB 3.0 ETH controller). The value is for the LE 1.1 CS release.

Throughput – USB Cradle LTE-ETH (cont.)

- Test case – USB cradle: LTE Cat 11 FDD ↔ ETH (USB SS) for IPv4

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	587	565 aggregate	50	587	50/600
CPU idle	55%	10%	10%	75%	15%	10%

Note: UL/DL is from the ETH perspective. Adapter is a AX88179 (USB 3.0 ETH controller). The value is for the LE 1.1 CS release.

Throughput – USB Cradle LTE-ETH (cont.)

- Test case – USB cradle: LTE DL/UL Cat 12/13 FDD ↔ ETH (USB SS) for IPv4

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	587	565* aggregate	150	587	650* aggregate
CPU idle	40%	10%	10%	60%	15%	10%

Note: UL/DL is from the ETH perspective. Adapter is an AX88179 (USB 3.0 ETH controller). The value is for the LE 2.0 CS release.

* Limited by A7 CPU.

Throughput – USB Cradle LTE-ETH (cont.)

- Test case – USB cradle: LTE Cat 9 or 11 FDD ↔ ETH (USB HS) for IPv4

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	50	250	50/215	50	250	50/230
CPU idle	55%	33%	30%	75%	40%	30%

Note: UL/DL is from the ETH perspective. Adapter is a LAN7500 (USB 2.0 ETH controller). The value is for the LE 1.1 CS release.

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Throughput – USB Cradle LTE-ETH (cont.)

- Test case – USB cradle: LTE DL/UL Cat 12/13 FDD ↔ ETH (USB HS) for IPv4

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	150	250*	260* aggregate	150	250*	280* aggregate
CPU idle	40%	33%	30%	60%	40%	30%

Note: UL/DL is from the ETH perspective. Adapter is a LAN7500 (USB 2.0 ETH controller). The value is for the LE 2.0 CS release.

* Limited by HSUSB adapter.

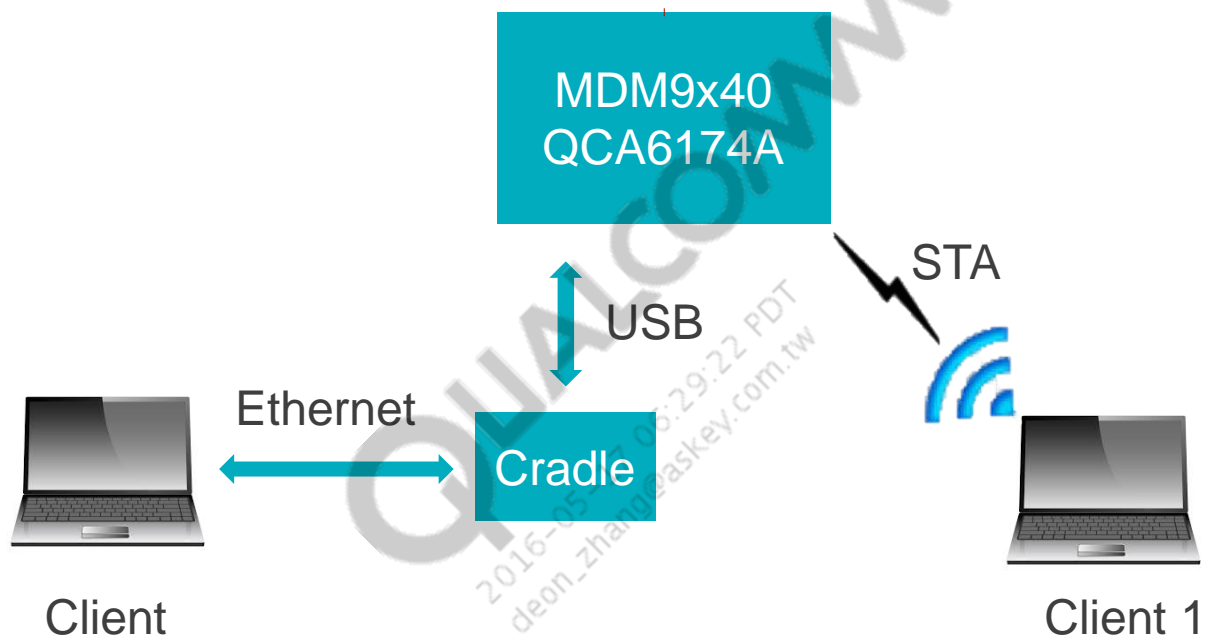


Throughput – USB Cradle WLAN-ETH

Section 12

Throughput – USB Cradle WLAN-ETH

Network topology:



Throughput – USB Cradle WLAN-ETH (cont.)

- Test case – USB cradle: WLAN QCMobileAP mode ↔ ETH (USB SS) for IPv4 and IPv6

Projection value						
Item	TCP UL	TCP DL	TCP Bi-Dir	UDP UL	UDP DL	UDP Bi-Dir
Throughput	521	509	509 aggregate	595	605	550 aggregate
CPU idle	20%	10%	10%	30%	20%	5%

Note: UL/DL is from the ETH perspective. Adapter is an AX88179 (USB 3.0 ETH controller). The value is for the LE 1.1 CS release.

Questions?

You may also submit questions to: <https://support.cdmatech.com>

