

LANforge Wi-Fi testbed with Cellular Network Emulator

The Candela Technologies Cell Emulator combines cellular and Wi-Fi test equipment to provide a testbed capable of testing APs that support cellular backhaul and User Endpoints (UEs) supporting cellular data connectivity. This testbed is useful for several tasks:

- Helping identify RF interference between Wi-Fi and cellular equipment.
- Testing failover between cellular and local network connectivity.
- Testing data throughput.

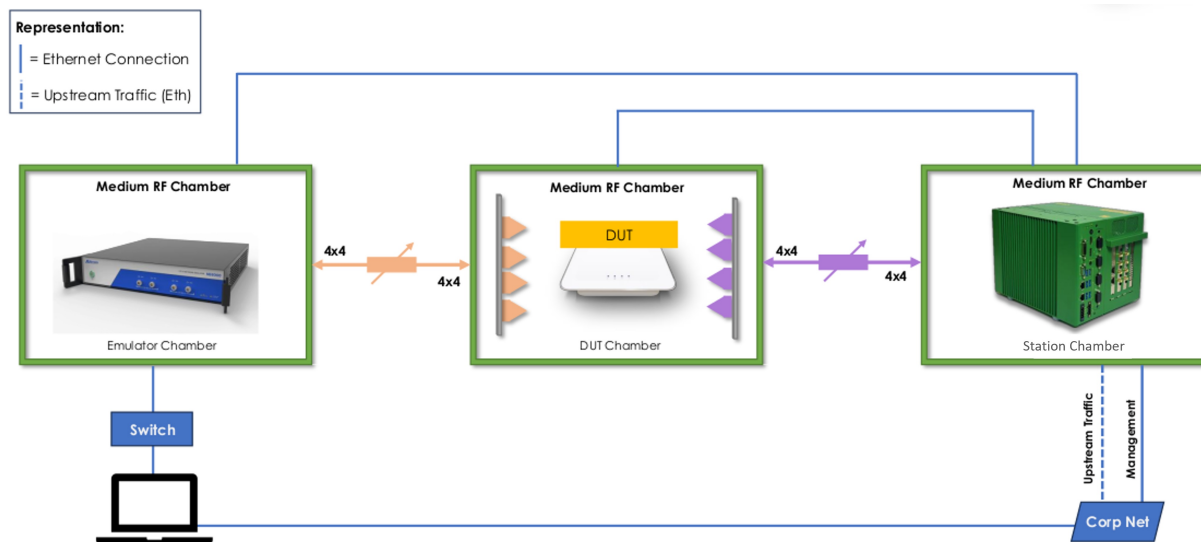
Presently, the Cell Emulator solution supports:

- Session failover validation
- Wi-Fi performance testing across 2.4GHz, 5GHz, and 6GHz bands
- Assessing cellular transition factors, including:
 - session continuity
 - recovery time
 - throughput stability during transitions

This test solution is designed for service providers developing Wi-Fi enabled Customer Premises Equipment (CPE). Equipment makers can use this to test CPE equipment during development and to qualify APs in the lab before deployment.

The Cell Emulator includes fully automated cellular emulator-based test scenarios, including pre-configured test cases. Customers can select from a list of available tests. Most tests can run fully automated, though some require user interaction.

Cell Emulator Testbed Wiring Diagram:



The Candela Cell Emulator equipment comes in a compact form factor. Multiple chamber options are available, including integrated chamber stacks and stand-alone chambers. This solution includes:

- Cellular emulator that acts as a cellular base station

- Candela CT523c chassis
 - Provides Wi-Fi Stations, APs, Sniffers, 10g Ethernet and WAN emulation
 - Controls the Cell Emulator
 - Generate test traffic and reports
- 2 medium RF chambers for the DUT and LANforge
- 1 larger RF chamber to hold the Cell Emulator

Testbed Images



External photo



Internal photo
DUT chamber



Internal photo
LANforge chamber

Shelf Detail

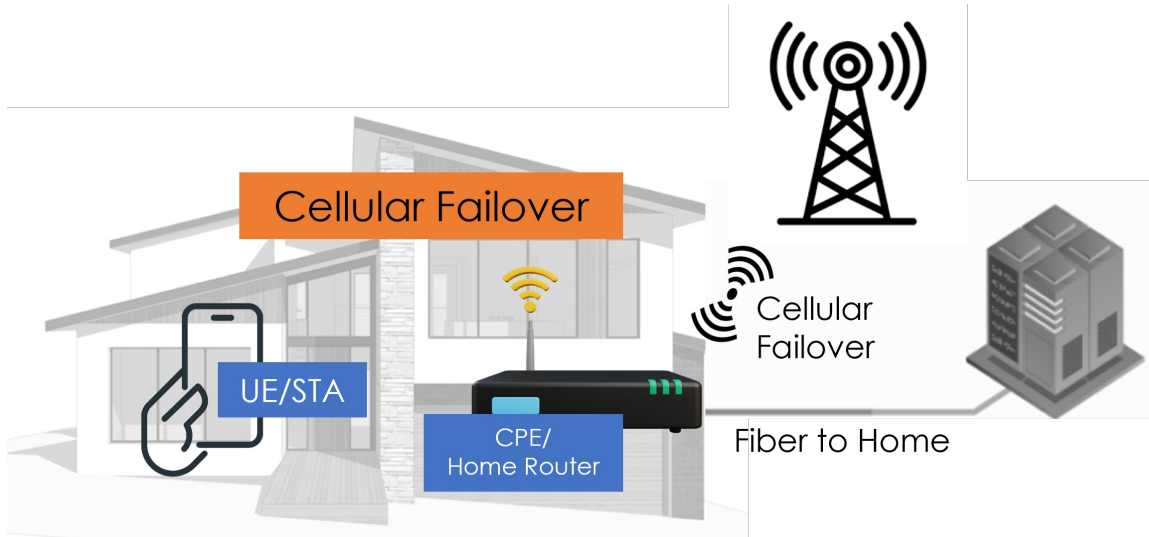
Supported Test Cases

The Candela LANforge software allows the customer to configure and control the Cell Emulator to run real world test scenarios, including:

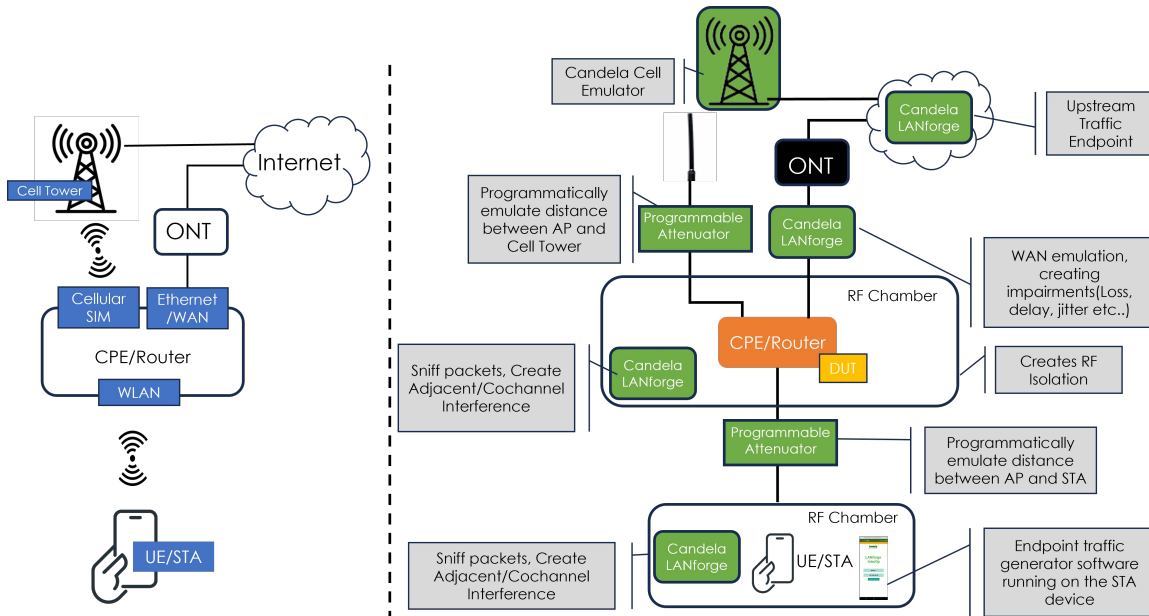
1. Wi-Fi CPE Testing - Fiber to cellular repeat backhaul failover
2. Wi-Fi CPE Testing - Pure cellular backhaul
3. Wi-Fi STA/UE – Handover Between Wi-Fi and cellular (Emulated or Real Networks)

Test Case Details

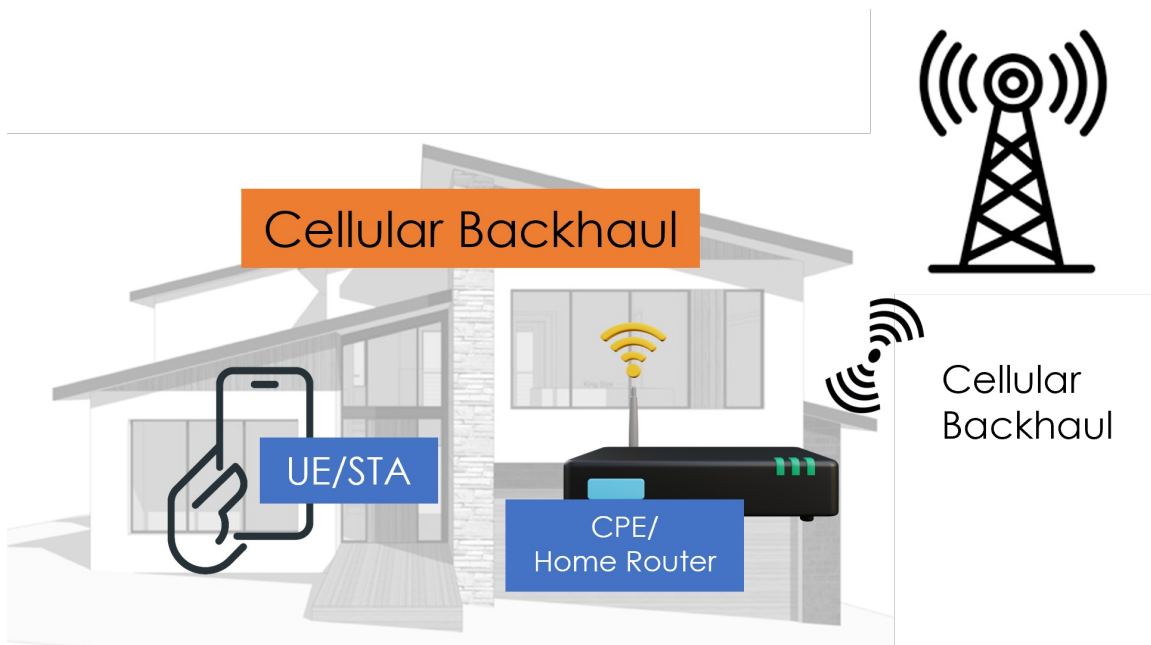
1. Wi-Fi AP Testing - Normal backhaul to cellular backhaul failover



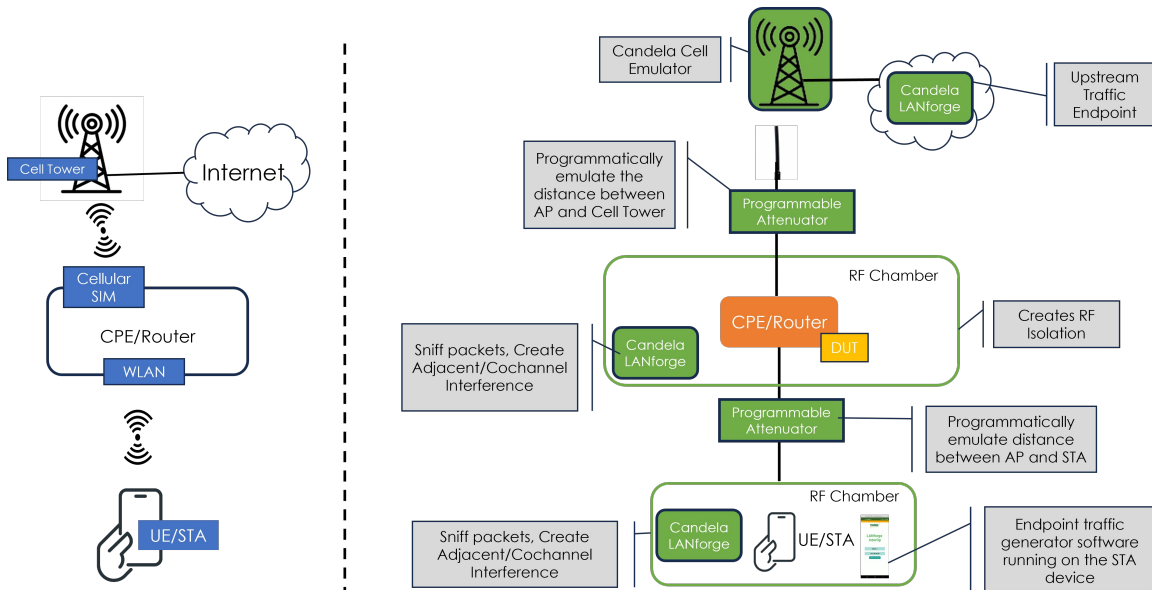
This tests the router's ability to handle repeated failover events by alternately degrading the normal and cellular backhaul links. The goal is to assess how effectively the DUT switches between connections, maintains service continuity, and avoids unnecessary back-and-forth transitions. Key metrics include failover duration, session continuity, and time to recover stable service.



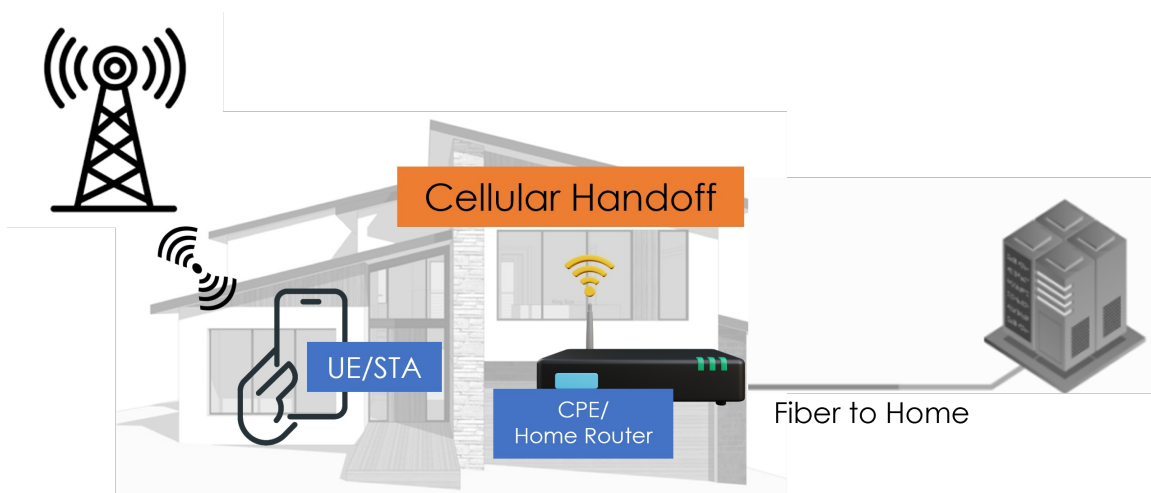
2. Wi-Fi AP Testing - Cellular backhaul throughput

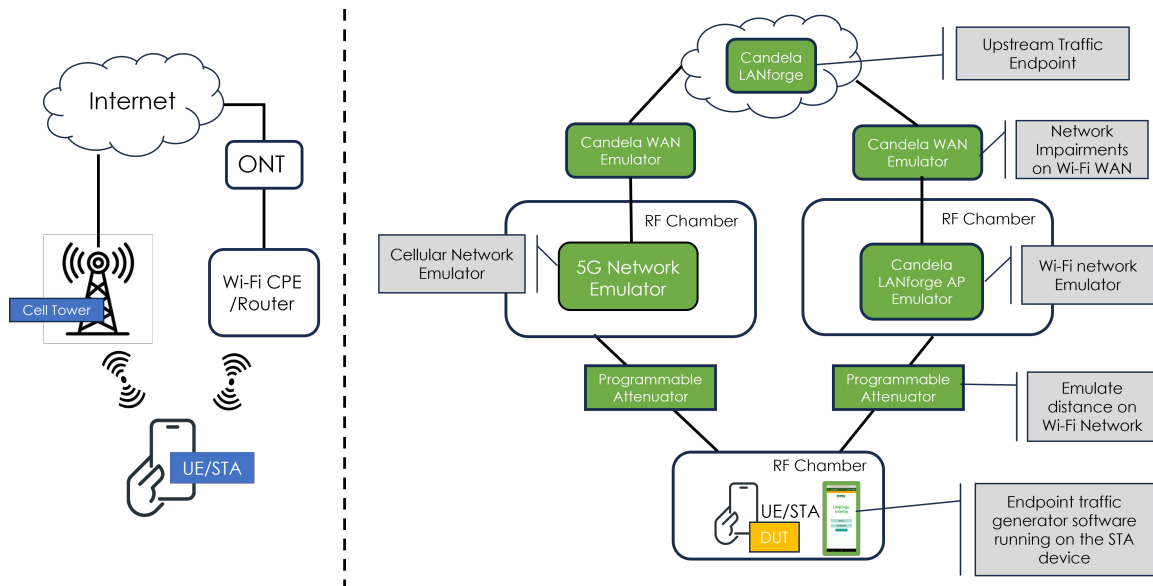


This scenario evaluates the performance of the router when operating primarily on a cellular backhaul. Metrics such as throughput, latency, and stability are measured under varying signal conditions.



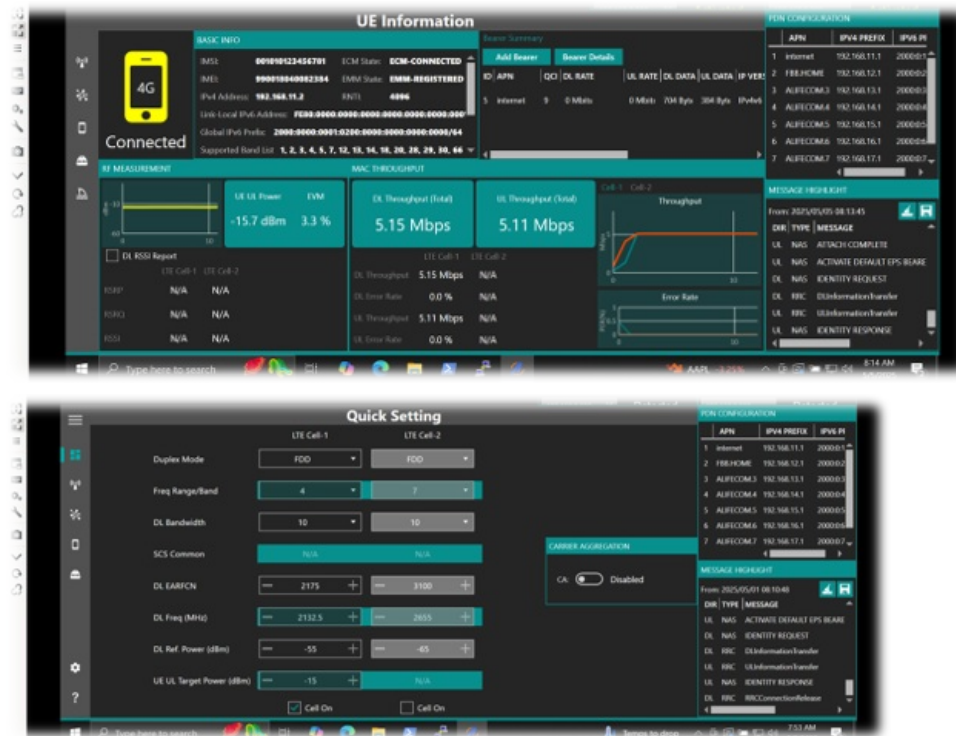
3. Wi-Fi User Endpoint Testing - Handoff between cellular and Wi-Fi network connectivity (emulated cell network)





Cell Emulator UI:

Candela currently integrates with a commercial cell emulator from ALifecom. Additional cell emulators will be supported soon. The user may configure the cell emulator using its native UI, save the configuration to a file, and then have LANforge automate loading the different cell emulator configurations.



LANforge Cell Emulator UI:

The LANforge GUI provides integrated configuration and automation control of the Cell Emulator and other testbed components. It executes the test execution logic and generates a report when the test completes.

Cell Emulator Test (cv-inst-0)

Individual Test Configuration

General Configuration

RF Configuration

DUT Config

Report Configuration

Cell Emulator

Settings

Virtual Sta Radios

Single-Sta Radios

Single-Sta Radios 2

Selected DUT 2G:

AP 204-cell-emulator-ap 38:f8:f6:75:ca:94 (1)

Selected DUT 5G:

AP 204-cell-emulator-ap 38:f8:f6:75:ca:9a (2)

Selected DUT 6G:

AP 204-cell-emulator-ap 38:f8:f6:75:ca:96 (3)

WL-AP Upstream Port:

1.1.2 AP-WAN

WL-AP endp A transfer rate:

10 Gbps (10,000,000,000)

WL-Cell endp A transfer rate:

10 Gbps (10,000,000,000)

Upstream Port:

1.1.5 WAN-UPSTREAM

Emulator (4G):

Emulator (5G):

WL-Cell Upstream Port:

1.1.4 CELL-WAN

WL-AP endp B transfer rate:

1 Gbps (1,000,000,000)

WL-Cell endp B transfer rate:

1 Gbps (1,000,000,000)

Refresh Ports + DUTs

☐ Skip 2.4Ghz Tests
☐ Skip 5Ghz Tests
☒ Skip 6Ghz Tests
☒ Skip MLO Tests
☐ Skip N/A/C Tests
☐ Skip AX Tests
☐ Skip BE Tests

Cell Emulator Tests to Run:

Estimated Test Duration: 30 m

☐ Verify Single-Sta Radios
☐ Verify Virt-Sta Radios
☐ Verify Group Throughput

☐ Calibrate Single-Sta Attenuators
☐ Calibrate Virt-Sta Attenuators
☐ Calibrate Mesh Sta to Root Attenuators

☒ 6.1.1 Fail Over

Start

Skip

Another Iteration

Pause

Cancel

Cell Emulator Test (cv-inst-0)

Individual Test Configuration

General Configuration

RF Configuration

DUT Config

Report Configuration

Cell Emulator

Settings

Virtual Sta Radios

Single-Sta Radios

Single-Sta Radios 2

☒ Prefer Group 0
☐ Prefer Group 1
☐ Prefer Group 2

☐ Extra TxStatus
☐ Extra RxStatus
☐ TXS All

☒ Adjust UL Atten with STA TxPower
☐ Adjust UL Atten with DUT TxPower

2.4GHz Channel

AUTO (-1 Mhz)

5GHz Channel

AUTO (-1 Mhz)

6GHz Channel

AUTO (-1 Mhz)

Default NSS

CH 0-1 (2x2)

2.4GHz 2m RSSI

-25 (Issue-3 default) (-25)

5GHz 2m RSSI

-30 (Issue-2/3) (-30)

Attenuation Adjustment

0

Extra Download Path-loss

0 (0)

STA TX Power:

20 dBm (20)

DUT AP Expected TX Power-2.4G:

30 dBm (Issue-3) (30)

DUT AP Expected TX Power-5G:

30 dBm (Issue-3) (30)

Virt-Sta Rotation 2.4GHz

0

Virt-Sta Rotation 5GHz

0

Virt-Sta Rotation 6GHz

0 (0)

AX Rotation 2.4GHz

0

AX Rotation 5GHz

0

AX Rotation 6GHz

0 (0)

Start

Skip

Another Iteration

Pause

Cancel

Cell Emulator Test (cv-inst-0)

Individual Test Configuration General Configuration RF Configuration DUT Config Report Configuration Cell Emulator

Settings Virtual Sta Radios Single-Sta Radios Single-Sta Radios 2

Calibration **Fail Over** Max Tput

6.2.1 Fail Over

AP Settle Time: 1-min (1 min)

Wanlink Degredation Settings:

Max Packet Drop: 100% (100) Min Packet Drop: 0% (0) Packet Drop Step Interval: 10% (10)

Max Delay: 100 ms (100) Min Delay: 0 ms (0) Delay Step Interval: 10% (10)

Max Jitter: 100 ms (100) Min Jitter: 0 ms (0) Jitter Step Interval: 10% (10)

Repeat Fail Over Test Settings:

Repeat Fail Over Iterations: 5 (5) Repeat Fail Over Degrade Percent: 100% (100)

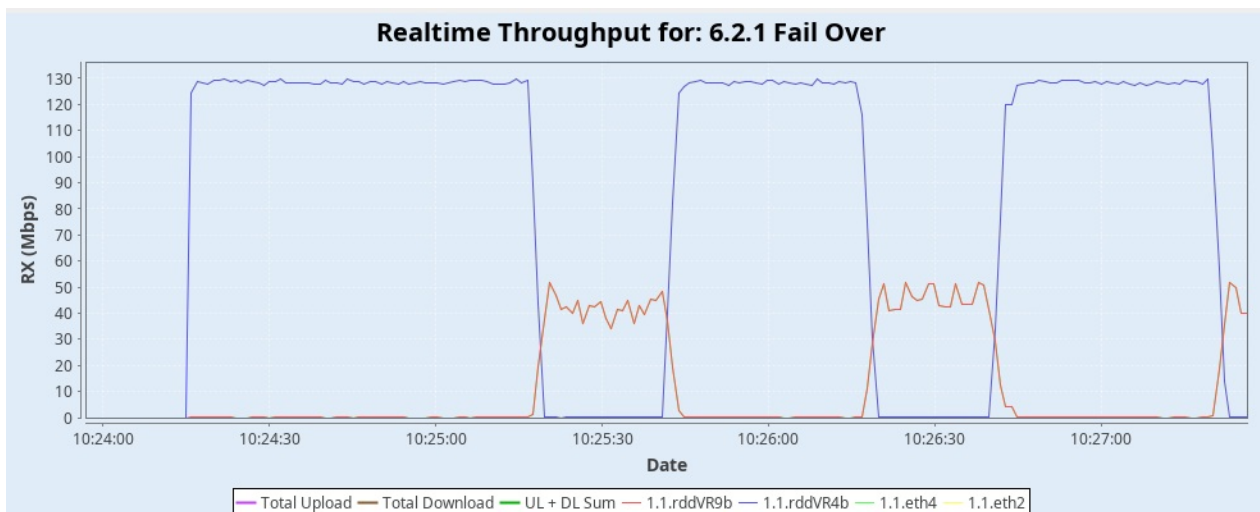
Fail Over Test Type(s) to Run:

☒ Test Packet Drop ☐ Test Delay ☐ Test Jitter ☐ Test Repeat Fail Over

Start
Skip
☐ Another Iteration
☐ Pause
Cancel

Sample Test Results:

The graph below shows that the cellular network (red line) is used as a backup upstream route whenever the Wi-Fi network (blue line) fails.



Key Measurements

- CPE/Router failover time and its effect on user experience
- UE Handoff time between cellular and Wi-Fi
- UE Handoff process (decision, initiation, execution) and its effects on user experience
- Performance over distance for both access links and backhaul links when Wi-Fi is access and cellular is

backhaul

- Connection time, security, seamless authentication, open roaming, Hotspot 2.0
- VoLTE over Wi-Fi testing
- End to end throughput over Wi-Fi and cellular and during handover

Lead Times and Support:



Please contact support@candelatech.com if you need any assistance.

Lead Times: Six to eight weeks.

TaaS/Onsite Support: Customers with only occasional test needs can use our Test as a Service option. Candela engineers can do the testing for you in our fully equipped test lab and provide a detailed test report with recommendations.

For more information, please contact sales@candelatech.com or give us a call at: 1-360-380-1618

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