Comparative 5G Performance Report: Android Smartphones vs. iPhone 16e

May 2025

Conducted by

Cellular Insights, Inc

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Commissioned by Qualcomm Technologies, Inc

As the sole authors of this performance report, Cellular Insights fully stand by the methodology, results and the analysis that we provide in this paper.

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Executive Summary

This report presents a comparative evaluation of 5G performance between the iPhone 16e, equipped with Apple's first-generation C1 modem, and two Qualcomm-powered Android smartphones. Testing was conducted across a variety of real-world radio environments—near-, mid-, and far-cell—within New York City connected to T-Mobile's sub-6 GHz 5G Standalone (SA) network.

Across all RF scenarios, the Qualcomm-based Android devices consistently outperformed the iPhone 16e, revealing several key advantages:

- Tangible performance gains in both uplink and downlink throughput under all signal conditions
- Superior carrier aggregation capabilities, leveraging 4CC downlink and 2CC uplink carrier aggregation (ULCA) versus suspected 3CC downlink and no ULCA on the iPhone 16e
- Higher spectral efficiency and more consistent utilization of available bandwidth
- Performance gaps observed to be wider in sub-optimal RF conditions. This directly impacts user experience in typical use scenarios such as being deep indoors
- Greater platform maturity, with forward compatibility for features like FDD+FDD ULCA

Average Throughput Advantage (3 Locations, NYC):

- **Download speeds:** Android devices were **34.3% to 35.2% faster**
- **Upload speeds:** Android devices were **81.4% to 91.0% faster**

These findings underscore the performance gap between iPhone 16e powered by Apple's C1 modem and Android devices powered by Qualcomm's X75/X80 platforms, particularly in more demanding RF conditions and high-load network environments. For users seeking consistent, high-throughput 5G performance, Qualcomm-powered devices currently hold a clear edge.

Key Highlights

Cellular Insights conducted a performance report of 5G NR smartphones from two leading suppliers, powered by two different modem platforms. For this study, we included smartphones equipped with baseband chipsets from Qualcomm and Apple. Testing was performed on T-Mobile's sub-6 GHz Standalone (SA) 5G network in New York City, which utilizes a mix of low- and mid-band FDD and TDD spectrum. Devices tested:

- **iPhone 16e** powered by Apple's first-generation C1 modem priced at $599
- **Android A**, a 2025 flagship device powered by Snapdragon X80 5G Modem-RF System priced at $799
- **Android B**, a 2024 flagship device powered by Snapdragon X75 5G Modem-RF System priced at $619

Device Specification Comparison

Model	Price (USD)	Release Date	Modem
iPhone 16e	$599	Feb 2025	Apple C1
Android A	$799	Jan 2025	Snapdragon X80 5G Modem-RF System
Android B	$619	Jan 2024	Snapdragon X75 5G Modem-RF System

This study yielded several notable insights—some expected, others surprising. While all three devices delivered *somewhat* comparable 5G performance under ideal, near-cell conditions, performance deltas became increasingly pronounced as signal conditions deteriorated. In particular, when the network shifted from TDD to FDD as the Primary Component Carrier (PCC) in poor RF environments, the iPhone 16e struggled to match Android performance on both the downlink and uplink.

Due to the lack of chipset-level information on iOS, we were limited to analyzing application-layer throughput for the iPhone, whereas Android allowed full chipset-level access. Even with this limitation, the performance difference between Android devices and the iPhone 16e was tangible and observable.

A special thanks to Qtrun Technologies for providing AirScreen software for chipset-level analysis and Qualcomm for providing access to the Umetrix Data Server (Spirent Communications).

Network and Test Conditions

Testing was conducted on T-Mobile's commercial SA 5G network in Astoria, NY, during late April and early May 2025. The spectrum configuration included:

T-Mobile 5G SA Spectrum Configuration (NYC Market)

Band	Frequency Type	Bandwidth (MHz)	Band Type
n41 (1)	TDD	100	Mid-band
n41 (2)	TDD	50	Mid-band
n25	FDD	15	Mid-band
n71	FDD	15	Low-band

- **Mid-band FDD (n25 - 15 MHz)**
- **Mid-band TDD (n41 - 100 MHz + 50 MHz)**
- **Low-band FDD (n71 - 15 MHz)**

All devices were consistently connected to the SA network during testing. T-Mobile supports 4CC downlink and 2CC uplink Carrier Aggregation (CA) on its network, though only TDD+FDD ULCA (T+F) was active at the time of testing. In far-cell conditions where n25 or n71 became the PCC, ULCA was not available, and all devices relied on a single FDD uplink path. Android devices consistently outperformed the iPhone 16e in these conditions.

While we could not directly confirm the iPhone 16e's support for 4CC downlink and 2CC uplink Carrier Aggregation due to diagnostic limitations on iOS, the throughput deltas observed across multiple test locations and RF conditions suggest a potential capability limitation that may be affecting real-world performance. In contrast, Android devices consistently leveraged 4CC downlink and 2CC uplink CA in most conditions verified with chipset-level information logged by AirScreen software by Qtrun Technologies.

Test Methodology

We tested at multiple fixed locations, capturing near-, mid-, and far-cell conditions, and used interleaving test runs to mitigate live network variability (e.g., time of day, local load). Each location required over five hours of testing, and over the span of several weeks, we generated more than 3TB of traffic across three devices. All tests used high-bandwidth UDP traffic: sustained 4,000 Mbps downlink and 600 Mbps uplink two-minute transfers. Umetrix Data captured application-layer performance, while AirScreen allowed for chipset-level logging on Android devices.

One noteworthy observation is the apparent PHY-layer throughput ceiling of approximately 2.5 Gbps per gNodeB, consistent across all tested locations throughout the market. The cause is unknown, but may stem from gNodeB licensing limits or backhaul constraints. Despite sufficient spectrum, resource blocks, and per-user AMBR, throughput plateaued below theoretical peak rates. It is reasonable to infer that in the absence of this network-imposed cap, Android devices would have demonstrated even higher peak downlink performance. These test conditions enabled us to capture meaningful device behavior across a variety of realistic deployment scenarios, providing a robust basis for comparative analysis.

T-Mobile 5G SA Network Characteristics and Observations

T-Mobile's Standalone (SA) 5G network is extensively deployed across the New York City metropolitan area, operating on a tightly spaced grid. Most sites that we've tested utilize a common deployment strategy: rooftop-mounted sectors on 4- to 5-story buildings spaced roughly every two city blocks. The network's primary capacity layer consists of a wide mid-band TDD allocation—100 MHz + 50 MHz on band n41—which consistently carries the bulk of the data traffic.

In nearly all observed scenarios, n41 TDD is scheduled as the Primary Component Carrier (PCC), while the two 15 MHz FDD channels—n25 (mid-band) and n71 (low-band)—are used as Secondary Component Carriers (SCCs). Even in many far-cell situations, both indoor and outdoor, the network continued to prioritize n41 as the PCC. Only in cases where RSRP drops below approximately -110 dBm does the network shift to an FDD carrier as the PCC, typically prioritizing n25 over n71. The latter is used as a last resort before handing the device over to LTE, typically band 12 (5 MHz), with band 2 (10MHz) and band 4/66 (20 MHz) often present as secondary carriers. By reproducing these edge-case FDD PCC conditions in a dense urban environment we've observed superior performance seen on Android devices, which provides better user experience in deeper indoor locations.

Standalone vs Non-Standalone Connectivity

Across all test locations, devices consistently remained connected to the 5G SA network, further underscoring the maturity of T-Mobile's standalone deployment. Non-Standalone (NSA) connections were observed only in extreme far-cell conditions, where RSRP levels were too weak to maintain SA connectivity. Quantifying the duration of SA versus NSA connectivity was limited by diagnostic constraints—specifically on iOS. On the iPhone 16e, the refresh rate of the built-in Field Test mode was often delayed by several seconds in reflecting handover transitions to LTE, making precise measurement of NSA time impossible.

Spectrum and ULCA Behavior

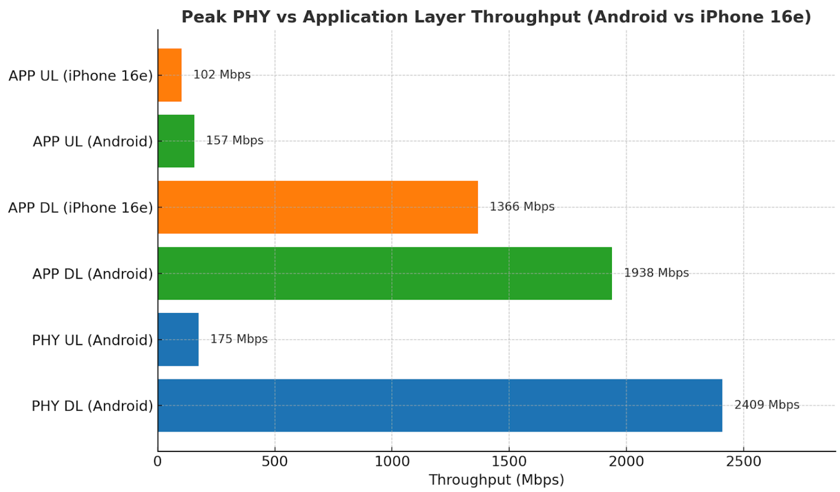
Notably, n41 coverage extended well beyond expectations, maintaining it as PCC even under mid- and some far-cell conditions. This makes sense considering the width and the spectrum properties, being an ideal layer for driving capacity and spectral efficiency of the network. Only in persistently suboptimal conditions did the network reassign the PCC role to n25, and, under more extreme conditions, to n71. While Android devices supported Uplink Carrier Aggregation (ULCA) in both TDD+FDD (T+F) and FDD+FDD (F+F) modes, only T+F was active on the T-Mobile network at the time of testing. This meant that ULCA was only functional when n41 was scheduled as PCC. In near- and mid-cell environments, this configuration produced uplink throughput gains of over 50% compared to using a single 100 MHz n41 uplink path. In far-cell scenarios, where the PCC shifted to n25 or n71, ULCA was unavailable, and uplink performance dropped accordingly. However, even without active F+F ULCA, Android devices still outperformed the iPhone as shown later.

Thermal Management and Performance Impact on iPhone 16e

Thermal mitigation behavior was clearly observed on the iPhone 16e during outdoor testing at Test Location 1. The device frequently became noticeably hot to the touch and exhibited aggressive screen dimming within just 2-minute test intervals—suggesting active thermal mitigation mechanisms. While thermal throttling is strongly suspected, its direct impact on performance metrics could not be confirmed due to the lack of chipset-level diagnostic access on iOS.

Peak Throughput Observations

Despite the hardware differences, all devices were subject to what appeared to be a network-side PHY-layer throughput ceiling of approximately 2.5 Gbps, as discussed later.



These differences potentially highlight the performance limitations of the Apple C1 modem, particularly in aggregation flexibility and uplink handling, even when network-side constraints are present.

Location Selection and Far-Cell Conditions

To make a different RF conditions easier to understand for the average reader, we've simplified based on the reported RSRP value:

Simplified RF Condition Classification by RSRP

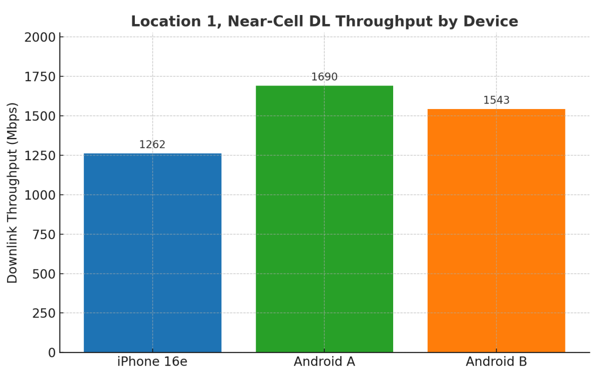
Condition	RSRP Range (dBm)	Signal Strength
Near-Cell	> -75	Strong
Mid-Cell	-75 to -100	Moderate
Far-Cell	< -100	Weak

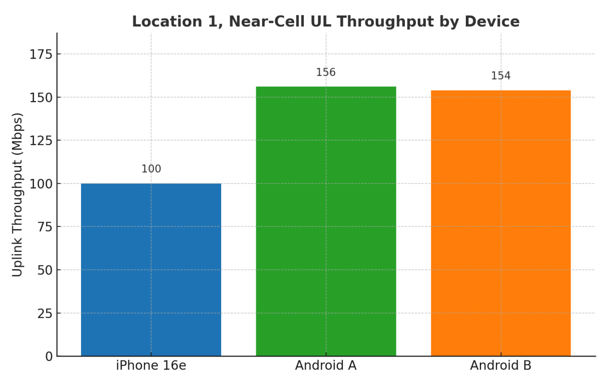
To emulate near-, mid-, and far-cell conditions within a dense urban deployment, we selected three consistently high-performing test locations, each situated within a one-mile radius. The observed T-Mobile network architecture followed a highly uniform design: rooftop deployments on 4-story buildings spaced approximately every two city blocks. The nature of the grid made it somewhat challenging to create controlled outdoor far-cell environments, specifically those where n41 signal levels consistently degraded below the -110 dBm threshold—typically required to trigger a fallback to n25 and even lower for n71 as the Primary Component Carrier (PCC). Test Location 2 was selected to mitigate this issue.

Test Location 1

This test location was situated in a residential area characterized by low overall user traffic and correspondingly low cell load. The serving sector was deployed on a low-rise rooftop atop a 3-story residential structure, oriented away from nearby high-traffic intersections. Due to the site's relatively low elevation and close proximity to the user equipment, RF conditions remained stable throughout testing. As a result, the location consistently delivered high and sustained throughput across all test iterations, making it ideal for baseline performance validation under low-congestion conditions.

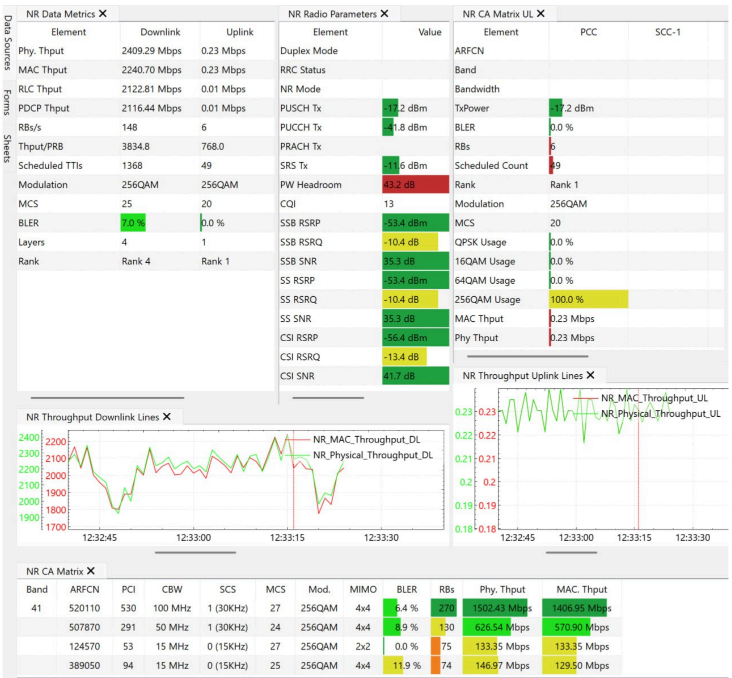
In near-cell conditions: **Android A outperformed the iPhone 16e by ~34% on DL** and **56% on UL**. **Android B exceeded the iPhone 16e by ~22% on DL** and **54% on UL**, closely matching Android A's uplink advantage.





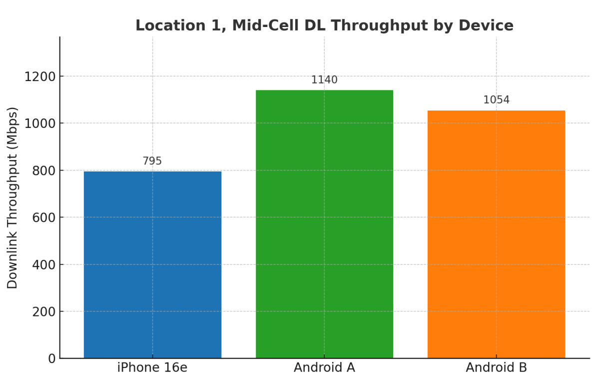
The location presented a relatively unique combination of test conditions: low cell load, minimal user traffic, and close proximity to the serving sector. Under these circumstances, we were able to consistently observe the network-imposed PHY-layer throughput ceiling of approximately 2.5 Gbps per user or perhaps the gNodeB. This is consistent with our late-night testing across the market. Despite ample available spectrum, sufficient resource block allocation, and high per-user AMBR, throughput plateaued well below the theoretical maximum.

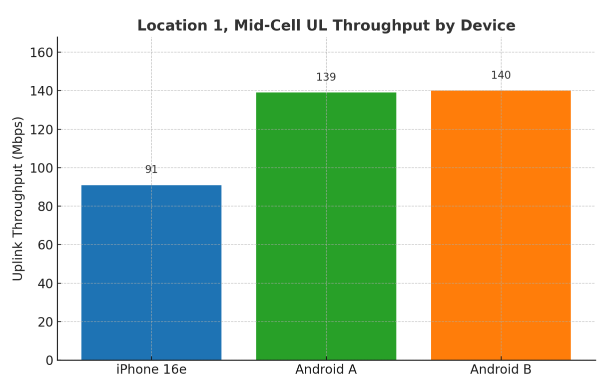
Diagnostics captured via AirScreen confirmed that while the TDD carriers (n41) continued to handle the majority of the traffic, the FDD carriers (n25, n71) consistently exhibited lower-than-expected bandwidth utilization. This suggests that the limiting factor was not spectral or scheduling capacity, but rather a bandwidth limitation likely applied at the gNB or transport level. This network-side constraint impacted the higher performing devices (Android A and B) while the iPhone 16e under-utilized the available link capacity and resources.



It's also worth mentioning that at this location, thermal mitigation behavior was observed on the iPhone 16e during this outdoor testing. The device frequently became uncomfortably hot to the touch and exhibited aggressive screen dimming within short, two-minute test intervals—indicative of active thermal management. While thermal throttling is strongly suspected, its direct impact on throughput performance could not be conclusively quantified due to the absence of chipset-level instrumentation on iOS.

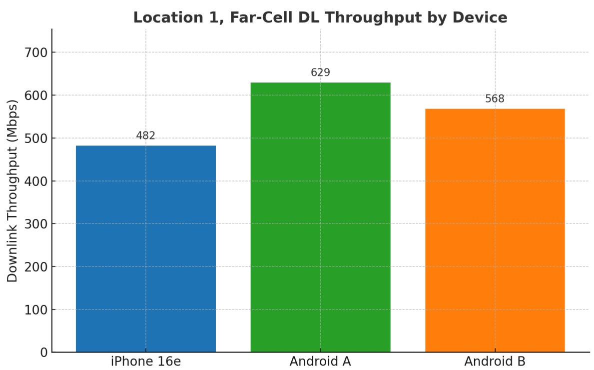
As signal strength declined to -75 dBm and below near the end of the block, the performance gap between the Android devices and the iPhone 16e continued to widen, Android devices demonstrated increasingly superior performance in worse RF signal conditions.

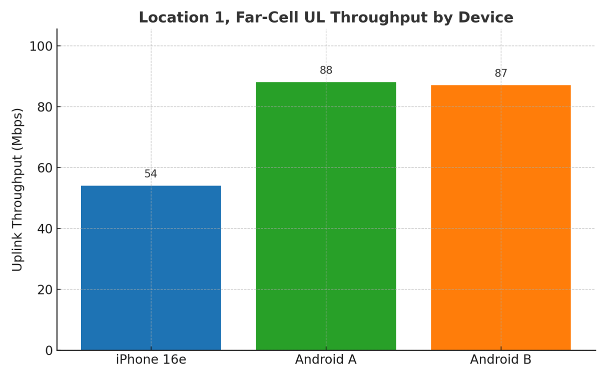




Android A outperformed iPhone 16e by ~43% on DL and **~53% on UL** in mid-cell conditions. **Android B exceeded iPhone 16e by ~33% on DL** and **~54% on UL**, again showing strong uplink advantage.

Due to the dense cell grid and tight sector spacing, signal strength typically remained above fallback thresholds. However, through targeted test route planning and careful selection of environmental obstructions, we were able to identify and sustain a location where RSRP values consistently stayed below -100 dBm for extended periods. This allowed us to validate device and network behavior under prolonged far-cell conditions despite the inherently coverage-rich urban layout.



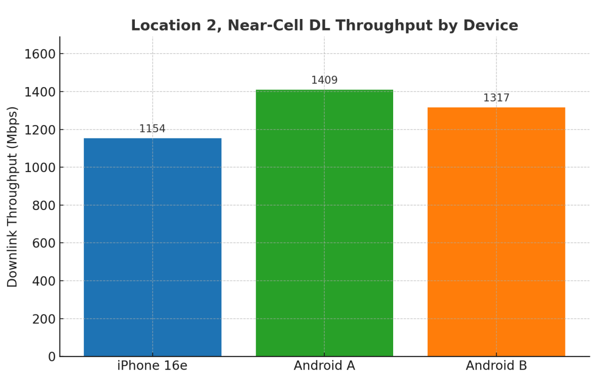


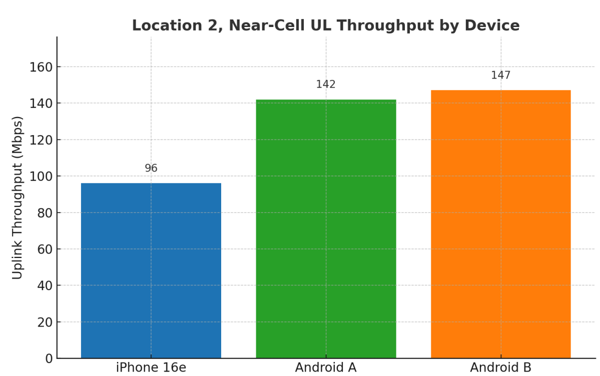
Android A outperformed the iPhone 16e by ~30.5% on DL and **63% on UL** in far-cell conditions. **Android B exceeded iPhone 16e by ~17.8% on DL** and **~61% on UL**, performing slightly below Android A but still significantly better than the iPhone 16e.

Test Location 2

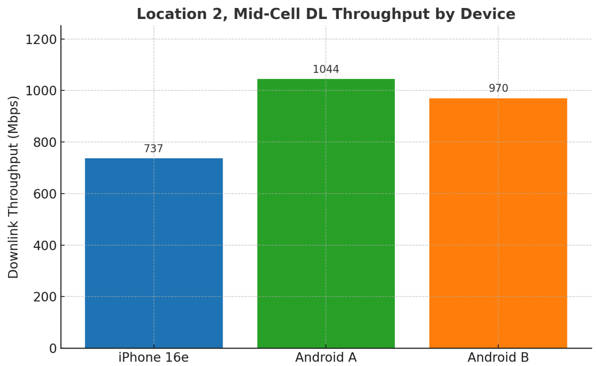
In order to better reproduce and control far-cell conditions within a densely deployed urban grid, one of the selected test environments was a commercial storage facility featuring metal-reinforced construction. The structural shielding introduced substantial RF attenuation, particularly impacting mid-band frequencies. This allowed us to induce signal degradation independent of physical distance, enabling consistent and repeatable reproduction of far-cell scenarios—critical for evaluating device performance under edge-of-cell conditions in a controlled manner.

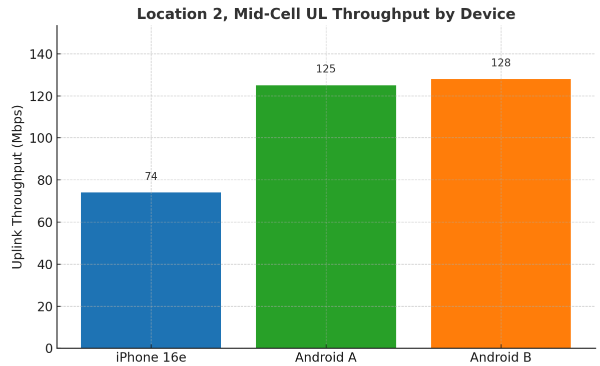
The distance between the test location and the serving sector was 366 feet line-of-sight. At the near cell, **Android** devices outperformed the iPhone 16e by **22.1% and 14.1% on the downlink and 47.9% and 53.1% on the uplink.**





RF conditions measured at the building's exterior—specifically the loading dock—qualified as mid-cell, with signal levels ~ -80dBm on the 2500 MHz (n41) channels. Under these conditions **Android A** outperforms the iPhone 16e by **~42% on DL** and nearly **69% on UL**, while **Android B** surpasses the iPhone 16e by **~32% on DL** and **~73% on UL**

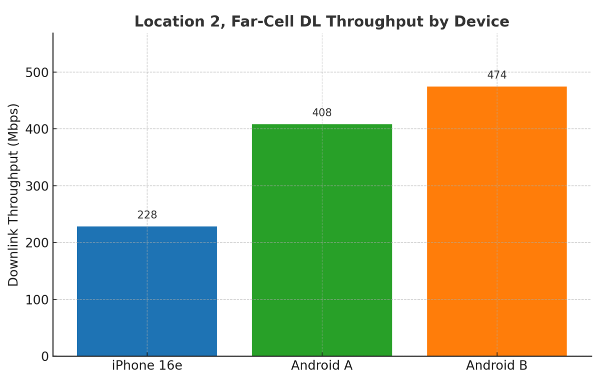


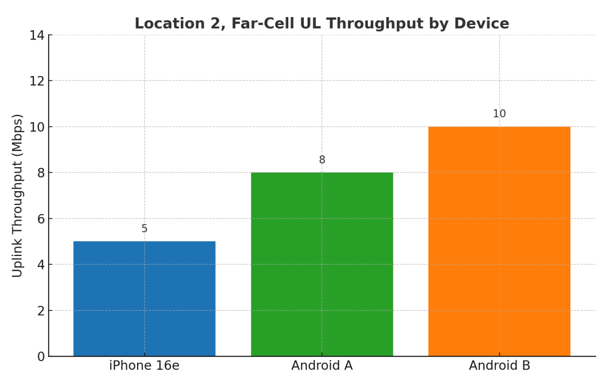


However, as testing moved deeper into the structure, rapid signal attenuation was observed, particularly on the higher-frequency TDD spectrum.

This degradation consistently triggered a fallback to 1900 MHz (n25) when RSRP values on the n41 PCC dropped below approximately -110 dBm. The behavior highlights the susceptibility of mid-band TDD to indoor path loss and underscores the importance of FDD layers for maintaining session continuity in challenging environments.

At the far-cell test location, Reference Signal Received Power (RSRP) for the Primary Component Carrier (PCC), in this case n25, remained consistent between -100 dBm and -108 dBm, as measured by Android devices. Signal metrics on the iPhone 16e, observed via iOS Field Test tool, indicated comparable conditions.



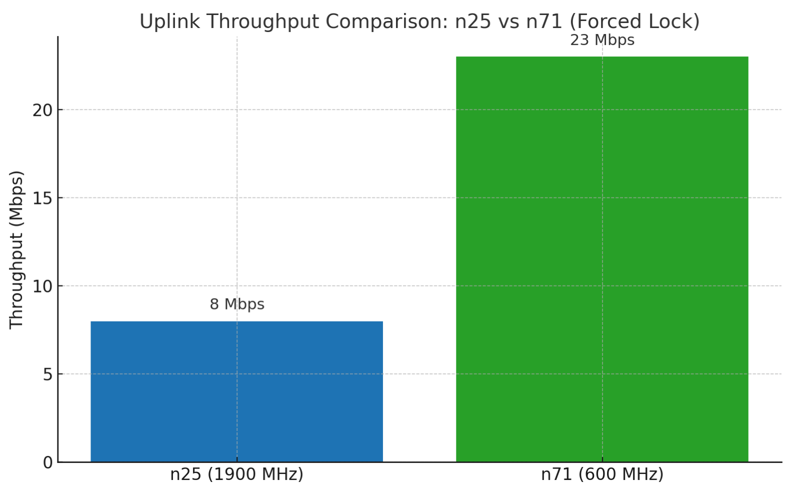


Android A delivers ~79% higher DL and **60% higher UL throughput** compared to the iPhone 16e under far-cell conditions. **Android B delivers ~108% higher DL** and **100% higher UL throughput** than the iPhone 16e in the same far-cell scenario. This 1.6X - 2X difference in UL performance has a significant impact on user experience for indoor coverage such as voice and video calls. The last year's flagship performance is admirable, suggesting excellent antenna tuning and RF-front-end performance under low signal strength.

Despite the degraded RF environment, both Android devices continued to aggregate all four carriers—two FDD and two TDD—utilizing the full 180 MHz of available DL spectrum, occasionally dropping one of the two TDD carriers if the RF conditions degrade. However, due to reduced signal quality, both devices exhibited a drop in modulation order and MIMO rank, consistent with lower spectral efficiency under these conditions which contributed to the overall throughput.

During testing, we observed continued network prioritization of the mid-band FDD carrier (n25) over low-band (n71), even in increasingly attenuated indoor conditions. It wasn't until the device moved substantially deeper into the facility—well beyond the front-facing wall—that n71 took over as the PCC, typically when n25 RSRP fell well below -110 dBm. This prioritization had a noticeable impact on uplink performance. It's worth noting that under these conditions the iPhone 16e would often drop to NSA and LTE instead, at least according to the built-in Field Test mode.

To quantify the effect further, we've returned to the original far-cell position and manually locked Android A device to n71. As a result, uplink throughput increased nearly 3X from 8 Mbps to 23 Mbps under identical conditions. This uplift underscores the potential gains in far-cell uplink performance, particularly once T-Mobile enables FDD+FDD ULCA (F+F) across its sub-6 GHz spectrum layers.

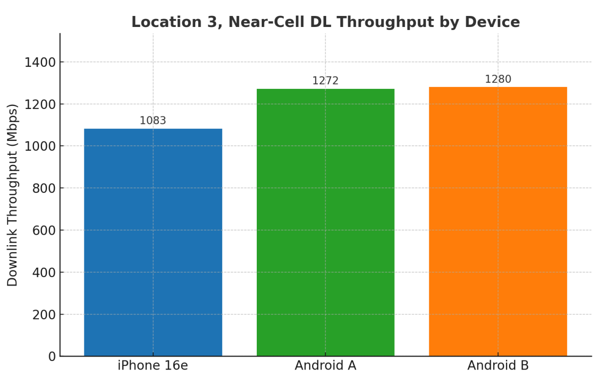


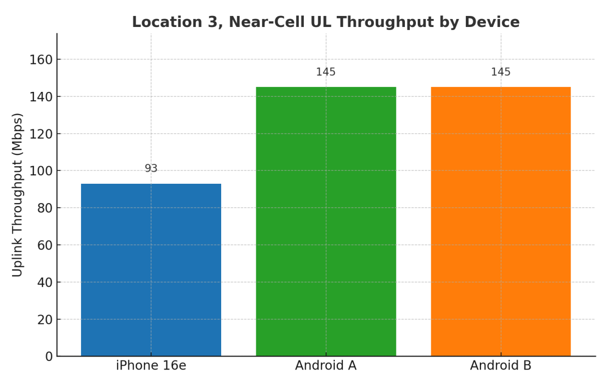
Uplink throughput comparison chart showing the performance difference when locking the device to n25 versus n71. As shown, throughput increased nearly 3x when using n71 under the same far-cell physical conditions.

Test Location 3

In addition to proximity to a nearby train station, the selected cell site also serves a major intersection leading into a heavily trafficked expressway. As a result, overall cell load and user density at this site were notably higher than at other test locations. This environment was specifically chosen to evaluate network and device performance under sustained high-load conditions, simulating real-world urban congestion scenarios.

Under these conditions where the overall network ceiling is lower, iPhone tends to perform better than at the other two locations:

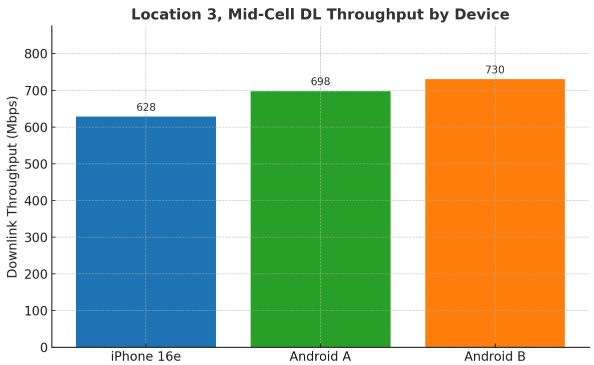


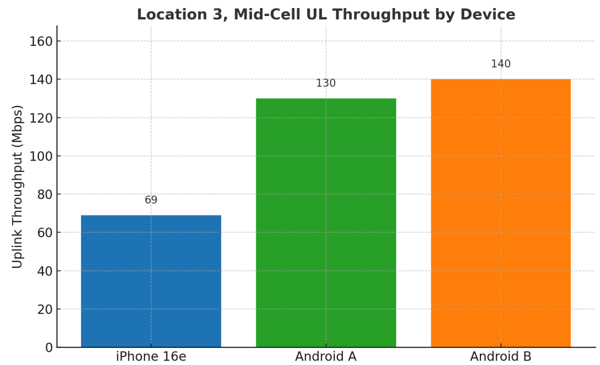


The majority of user traffic across all devices was observed to be carried by the 150 MHz wide TDD mid-band spectrum, which seems to fall within the presumed upper limits of the iPhone's chipset capability. Combined with the consistently observed PHY-layer throughput cap across the network (~2.5 Gbps per gNodeB), and elevated cell load which translates to less available network resources at this particular site, the overall performance ceiling was effectively pulled down. As a result, performance differentials between devices were diminished under near-cell conditions, creating a more level playing field despite underlying hardware differences.

Android A outperformed the iPhone 16e by ~17.5% on DL and **~56% on UL** at near-cell proximity. **Android B outperformed the iPhone 16e by ~18.2% on DL** and also **~56% on UL**, nearly identical to Android A in uplink performance.

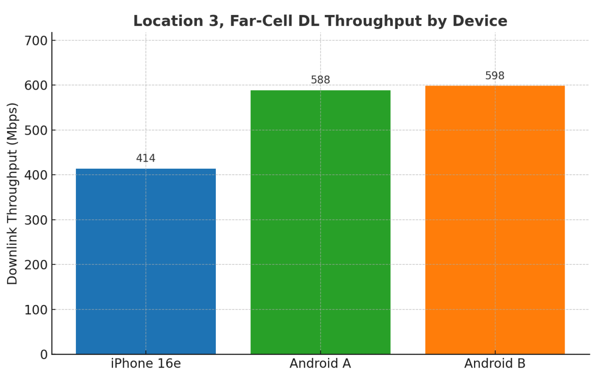
At the mid-cell test location, the iPhone demonstrated improved downlink performance, narrowing the throughput gap relative to Android devices. However, the uplink delta widened significantly, with Android devices clearly outperforming. This behavior highlights the tangible benefits of Uplink Carrier Aggregation (ULCA), which remains unsupported or inactive on the iPhone. It also reinforces the critical role of ULCA in sustaining uplink capacity under moderate RF conditions.

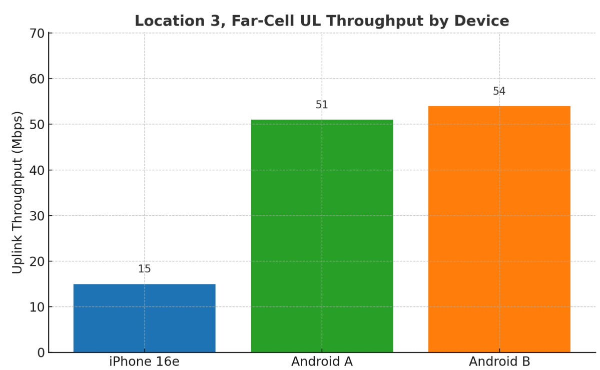




Android A outperformed iPhone 16e by ~11% on DL and a substantial **~88% on UL** in mid-cell conditions. **Android B surpassed iPhone 16e by ~16.2% on DL** and over **100% on UL**, indicating **double the uplink performance**.

While the far-cell location was an indoor environment, we were unable to consistently replicate RF conditions degraded enough to force a Primary Component Carrier (PCC) switch from n41 to n25. Throughout testing, n41 RSRP values remained near -106 dBm—just above the typical handover threshold. As a result, the network continued to prioritize n41 as PCC, allowing for far-cell ULCA utilization on Android devices.





Android A outperformed the iPhone 16e by ~42% on DL and **240% on UL**—more than **triple the uplink performance**. **Android B exceeded iPhone 16e by ~44% on DL** and a striking **260% on UL**, showing **nearly quadruple** the uplink performance with the DL 4CC CA and ULCA capabilities on full display.

Conclusion: Android Phones A and B Offer Tangible Real-World Advantages over the iPhone 16e powered by Apple C1

Our extensive benchmarking across multiple locations, RF conditions, and traffic environments revealed a consistent and measurable performance gap between smartphones powered by Qualcomm's X75 and X80 modems and Apple's first-generation C1 modem. While the iPhone 16e did exhibit thermal management issues under load, it occasionally narrowed the performance gap under ideal near-cell conditions—particularly in downlink throughput. However, the broader dataset clearly indicates that Android smartphones powered by Qualcomm modems are more capable and better optimized for the performance demands of today's standalone 5G networks.

1. Superior Aggregation Capability

Both the Android A and B support 4CC downlink carrier aggregation and TDD+FDD uplink carrier aggregation (ULCA) presently supported by the network—a critical differentiator. In contrast, the iPhone 16e objectively appears constrained on the downlink and lacks observable ULCA support, a limitation that currently manifests itself in lower uplink throughput across mid- and near-cell conditions.

- In mid-cell scenarios, Android devices maintained higher uplink throughput, clearly benefiting from ULCA while the iPhone 16e struggled to exceed 100 Mbps.
- In far-cell tests, the gap widened further, with Android devices demonstrating much higher sensitivity even in conditions where a single FDD uplink carrier was used, while the iPhone dropped as low as 5 Mbps.
- The gap in UL performance in poor signal conditions significantly impacts user experience such as indoor coverage, audio/video call quality, etc

2. Higher Spectral Efficiency and Utilization

Android smartphones powered by Qualcomm modems exhibited more efficient spectrum utilization, particularly across wider TDD channels (100 + 50 MHz n41) where MIMO Rank 3/4 usage was dominant.

Conversely, the iPhone 16e powered by Apple C1 modem displayed:

- Lower FDD utilization in the presence of strong TDD coverage,
- Inability to fully capitalize on available channel bandwidth.

3. Forward Compatibility and Platform Maturity

After examining UE Capability signaling messages from the Android A device, we've confirmed the support for sub-6 GHz 5CC downlink carrier aggregation as well as (F+F ULCA)—features that position the device well for upcoming 5G network enhancements. Further, according to Qualcomm's official product documentation, the Snapdragon X80 5G Modem-RF System is designed with AI-enhanced optimizations targeting improvements in power efficiency, coverage, latency, and quality of service (QoS). The platform also supports 5G-Advanced 3GPP Release 18 features, 6xRx, sub-6 GHz 6CC CA, and 10CC mmWave aggregation, underscoring its status as a highly capable, future-proof modem architecture. The Android B, while one generation behind, still outperformed the iPhone 16e across the board. These advantages will become increasingly important as operators deploy F+F ULCA, and advanced spectrum reuse features that demand high aggregation complexity and modem-side intelligence.

Final Thoughts

The Android A and B smartphones powered by Qualcomm modems deliver measurably superior performance in real-world 5G standalone environments. While the iPhone 16e powered by Apple C1 performs adequately under optimal RF and network load conditions, it lags significantly in edge cases—the very scenarios where next-generation modems are expected to excel. For users operating in dense urban, indoor, or uplink-intensive environments, the benefits of better 5G performance in the Android smartphones is not just theoretical—it is quantifiable, repeatable, and operationally significant.