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WHITE PAPER
WI-FI 7 VALIDATION

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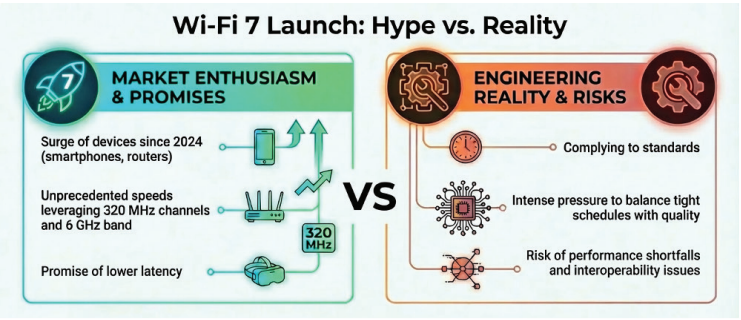
Managing Risks with Comprehensive Testing

The Rapid Emergence of Wi-Fi 7

In recent years, we have seen a surge of Wi-Fi 7 devices entering the market. In 2024, mainstream smartphones like the iPhone 16 debuted with Wi-Fi 7 support, while leading networking brands (eero, TP-Link, Netgear, and others) rolled out their Wi-Fi 7 routers for homes and businesses[1]. Service providers and device manufacturers are promoting Wi-Fi 7's unprecedented speeds and capacity, leveraging features like 320 MHz channels and Multi-Link Operation (MLO) across 2.4 GHz, 5 GHz, and 6 GHz. Early field tests show multi-gigabit throughput and promise dramatically lower latency.[2, 3]

However, with this excitement comes significant risk. Wi-Fi 7 (802.11be) is a major protocol leap and history shows that first-generation implementations of new Wi-Fi standards often carry teething issues. Any performance shortfall or interoperability bug in the field can translate to poor user experiences, costly support incidents, and damage to brand reputation. A router or gadget that fails to deliver on Wi-Fi 7's promises (or worse, breaks connectivity for existing devices) can quickly face returns and negative reviews. In short, thorough validation is not a luxury, but a necessity during this rollout phase. The following sections explore why comprehensive testing is crucial and how Novus Labs can assist.



Why Rigorous Validation Matters

Adopting a new wireless standard isn't just a hardware upgrade; it's a complex system change. Wi-Fi 7 introduces technical enhancements (wider channels, MLO, 4K-QAM modulation, enhanced OFDMA, etc.) that push wireless performance to new heights. But these enhancements also make the system behavior more intricate and less predictable in real-world scenarios. Rigorous validation during this transition phase has technical, experiential, and business importance:

- **Technical relevance:** Lab benchmarks alone aren't enough. Real environments have interference, obstructions, and multi-client setups that can reveal issues not seen in ideal conditions.
- **Experiential relevance:** Ultimately, it's the user experience that defines a successful product. Even technically "compliant" devices can deliver frustrating experiences if edge cases aren't ironed out. Thorough validation can be focused on experiential factors using real world applications so that end users see Wi-Fi 7 as an upgrade, not a headache.
- **Business relevance:** From a business perspective, quality is a key driver of brand credibility. Companies that invest in robust validation will catch issues before products ship while avoiding costly recalls, patch rushes, and public relations fires. In contrast, inadequate testing can lead to customer dissatisfaction, high return rates, and negative reviews. It's far cheaper and faster to fix a bug in the lab than in thousands of customers' homes.

Key Risk Areas of Insufficient Wi-Fi 7 Testing

Even with Wi-Fi 7's technical strengths, inadequate validation can lead to performance issues and failures that only surface in the wild. Here are some of the most critical risk areas:

1. Real-World Performance

On paper, Wi-Fi 7 is extremely fast. It can reach up to 46 Gbps in theoretical throughput. In practice, actual speeds are much lower and can vary widely. Factors like distance, obstruction, orientation, and RF interference all come into play. Validation needs to cover testing in real environments with these variables in mind. Without this testing, companies risk overpromising and underdelivering: customers expecting a "4× faster Wi-Fi" could instead encounter erratic throughput speeds or minimal improvement in everyday use.

2. Interoperability

Wi-Fi has always claimed backward compatibility, and Wi-Fi 7 routers are expected to work with older Wi-Fi 6/5/4 devices. But in practice, compatibility isn't always seamless – especially if new protocol features aren't carefully vetted for legacy interactions. For instance, TP-Link noted that some Wi-Fi 7 routers with advanced features enabled (6 GHz, WPA3, MLO, etc.) caused certain smart home devices to fail to connect or even detect the network 4, 5. So while the standard is backward compatible on paper, edge-case incompatibilities can emerge, leading to devices that refuse to join the network, disconnect frequently, and perform poorly. True interoperability assurance comes only from broad testing across many device types and brands.

3. RF Coexistence

Today's smart homes are a dense mesh of wireless tech. It's not just legacy Wi-Fi devices that new Wi-Fi 7 routers must coexist with. It's Zigbee sensors, Bluetooth locks, Thread/Matter devices, microwaves, baby monitors, all in addition to neighbor Wi-Fi noise. The use of the 5 and 6 GHz is great, but Wi-Fi 7 still operates on 2.4 GHz where many other technologies share the same frequency band. An inadequately tested device may cause major disruptions to other technologies and vice versa.

4. MLO (Multi-Link-Operation)

One of Wi-Fi 7's hallmark features, MLO (a feature that allows a client device to be connected to multiple bands simultaneously), adds a new dimension to throughput speeds and how client devices roam from one AP to the other.

1. Multiple bands can be combined for greater throughput

2. A device could seamlessly roam from one AP to another as the user moves around without dropping the connection

However, this requires extensive testing:

- Does the throughput really increase?
- Which band combinations can be linked? (i.e. 2.4 + 5 GHz, 2.4 + 6 GHz, 5 + 6 GHz, etc.)
- Is the roaming transition truly seamless, or are there hiccups?
- How will legacy clients perform?
- What if the gateway is Wi-Fi 7 but the extender is Wi-Fi 6?

Only by testing these scenarios can engineers ensure that Wi-Fi 7 devices deliver on the promise of MLO.

Validation Strategies

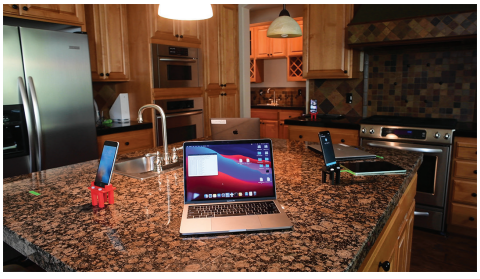
Having identified the risk areas, how can teams uncover and resolve these issues before products reach customers? A comprehensive validation program should include a mix of lab-based performance testing, real-world scenarios, and interoperability testing.

- **RF Chamber Testing as a Baseline:** Before going into a real home, baseline results need to be collected in a controlled environment. Using tools like attenuators and iPerf / IxChariot, throughput speeds can be collected at varying signal conditions in a noise free environment.
- **Real-World Throughput and Signal Coverage:** Once baseline results are collected from the chamber, it is time to collect real-world data. The same approach as the chamber testing can be used in the home except distance and obstructions are the major varying factor instead of attenuation. It is important to note that every home is different, whether that is the construction materials, amount of obstruction, or RF interference. Results may differ from home to home, but the goal here is to collect data from a real house and compare against baseline results from the chamber to analyze for any correlation.
- **RF Congestion and Multi-Client Testing:** So far, measurements may have been conducted against a single client device on the network. It is equally important to measure performance in real-world scenarios where RF noise is significant, and dozens of client devices are also on the same network. Monitor how the system handles this congestion and/or multi-client traffic and pay close attention to measurements like throughput and latency.
- **MLO:** Using an MLMR (multi-link multi radio) device, ensure multiple bands are effectively combined for greater throughput. Verification can also be done through spectrum analysis. Also verify roaming is seamless by moving from AP1 to AP2 while continuous traffic (or an active video call) is ongoing.
- **Interoperability:** Create a test matrix of various client devices: different Wi-Fi chipsets (Qualcomm, Broadcom, Intel, MediaTek, etc.), different operating systems, and different Wi-Fi generations (Wi-Fi 4/5/6). Attempt to connect these devices to see if any issues are observed. The broader the net, the more likely you'll catch odd incompatibilities which you can then address via firmware updates or at least document as known issues.

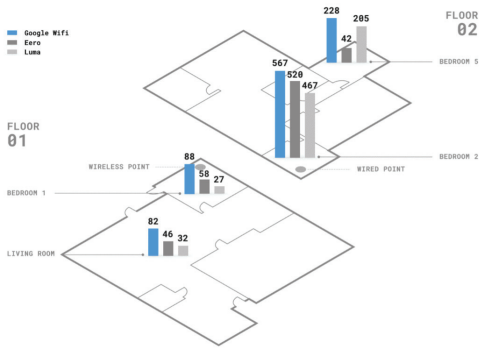
How Novus Labs Can Support

Many organizations recognize the challenges of Wi-Fi 7 testing but lack the full range of resources. Whether it is creating an effective test plan, access to an inventory of diverse devices, specialized facilities, or simply the time and staff, this is where Novus Labs can become an invaluable partner. Novus Labs specializes in rigorous product testing and has built an ecosystem of capabilities specifically suited to wireless and smart home technologies.

- **RF Chambers: Novus labs is equipped with 27 RF isolation chambers.** These allow for precise, repeatable wireless measurements. Not only can this be used to baseline Wi-Fi performance, it can also be used to recreate and isolate issues observed in the field for proper root cause analysis.
- **Real-World Test House:** Novus Labs maintains multiple fully furnished test homes in Beaverton, Oregon, as part of the test infrastructure. These aren't just empty spaces; they are outfitted like normal homes with furniture and appliances. The home environment is used to test real-world scenarios. For a Wi-Fi device, this means validating the throughput performance in different rooms, verifying signal coverage, testing how it handles RF interference, and coexistence with other common household devices. The combination of controlled chambers and real homes gives a holistic view.



- **World's Largest Device Library:** Novus labs carries more than 5,000 devices including smartphones, tablets, laptops, routers, etc. This means a comprehensive test can be performed for a Wi-Fi 7 product against a huge array of other devices and standards.
- **Competitive Analysis and Benchmarking:** In addition to validation, Novus Labs also offers benchmarking services so that you can see how your device stacks up against the competition. The data can be used for marketing purposes, and Novus can assist with the claims as well.
- **Flexible, Client-Centric Engagement:** Novus labs understand that every team and project has unique needs and can tailor the involvement to best support you.
    - Full end-to-end validation – program everything from test plan creation to execution and reporting
    - If you have an in-house QA team but need to augment it in specific areas, Novus will serve as an extension to your team, on-site or remotely.
    - Novus engineers can engage at various project stages, whether it's early in development, during the pre-certification phase, or in the final validation before launch



Throughout, the goal is to reduce the pressure on your team by providing experienced help where you need it most. In essence, Novus labs provides the people, environment, and expertise to find problems before your customers do – delivering a product that meets both its technical promises and customer expectations, all while respecting the real-world constraints of timelines and resources that teams face.

Conclusion

Wi-Fi 7 represents a leap forward in wireless capabilities: higher speeds, lower latency, and new possibilities for smart homes and businesses alike. But as with any leap, there is a risk of stumbling without proper preparation. A key take-away of this white paper is that insufficient validation is a risk not worth taking. Performance inconsistencies, if left un-checked, will erode user trust. Compatibility and coexistence problems will frustrate customers and generate support costs. Conversely, investing in comprehensive testing and leveraging expert resources can turn the Wi-Fi 7 transition into a success story. For engineering leaders, QA managers, and executives, the message is one of both caution and optimism. Yes, there are many challenges to address, but the tools, methodologies, and partners exist to address them. Whether it's more time, more devices to test with, or external expertise to lighten the load, these investments will pay dividends when your product launches smoothly. At Novus Labs, we share your passion for quality and under-stand the pressure of major product releases. Our mission is to help teams like yours.

Ready to fortify your Wi-Fi 7 product against real-world challenges? Let's collaborate to make your launch a resound-ing success. Visit http://www.novuslabs.comto learn more about our services or to get in touch with our team.

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