# Wi-Fi® brings immersive XR experiences to life

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# Introduction

Extended Reality (XR) represents the convergence of physical and virtual experiences that create an immersive environment. XR technologies enable immersive applications including augmented reality (AR), virtual reality (VR), and mixed reality (MR), and are used to enhance or simulate real-life experiences, extending the reality we perceive by either merging the virtual and real worlds or by creating fully immersive experiences.

Wi-Fi® supplies the reliable connectivity required to deliver the full potential of XR applications and use cases. Premium XR experiences require high-performance Wi-Fi for four key reasons:

- Low latency for responsive and lag-free experiences
- High reliability with advanced features and optimization for sustained XR-class performance
- Power efficiency to assist rapid and efficient data transfers with advanced power save features
- Multi-gigabit speeds to deliver the instantaneous, massive data exchange XR applications demand

# XR Market Segment Overview

The global XR market is expected to grow significantly in the coming years, and the expected total available market (TAM) for all XR system markets is projected to rise over 250 billion U.S. dollars by 2028[1]. The XR market can be divided into the following market segments of purchasers or key influencers:

- Consumer: for residential use cases including multi-user VR gaming
- Enterprise: for use in offices, healthcare environments, etc.
- Industrial: technologies that support commercial and military use cases

Within each market segment, XR technologies are redefining the way humans interact with each other and their environments, enabling powerful experiences and use cases and opening new, expansive markets. Wi-Fi is the preferred method of connectivity in these markets and is ideally suited to enable wireless XR systems for immersive, untethered experiences for end users across a variety of use cases.

# XR Use Cases

## VR gaming

Virtual Reality (VR) gaming is the new generation of computer games that utilize XR technology to give players a truly immersive, first-person perspective of in-game action. Participants both experience and influence the gaming environment through a variety of VR gaming devices and accessories including Head Mounted Displays (HMDs), sensor-equipped gloves, and hand controllers. VR games can be played standalone, online multiplayer, or massive multiplayer (i.e., online community) using specialized game consoles or advanced PCs serving as companion compute devices.

### Devices and topologies in typical VR gaming setups

A typical high-end VR gaming setup encompasses some or all of the following devices:

- VR HMD, controllers, and sensing accessories
- Access Point (AP)
- PC or game consoles

In the simplest setup, the HMD connects to controllers and other accessories, with all computing local to the HMD. The HMD may also connect to a remote server via the AP to offload some or all of its compute. This offloading case requires high throughput and low latency on the wireless link to deliver an immersive experience. Finally, remote computing and graphics rendering may happen on a local PC (or a laptop, gaming console, etc.) that serves as a

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[1] Statista, July 2022

companion compute device. In this scenario, the compute device services the compute-intensive workloads for VR gaming, including graphics rendering and video compression. The rendered data is then transmitted to the HMD over Wi-Fi. The PC and HMD may connect via an infrastructure network provisioned by an AP, or they may connect directly via a peer-to-peer (P2P) link. In the opposite direction, pose (Inertial Measurement Unit [IMU], button press, etc.) data is sent from the HMD to the PC. In addition, there could also be best-effort traffic being exchanged with a gaming server on the cloud, such as in multiplayer games. This use case may encompass multiple wireless technologies and has stringent throughput and latency requirements.

### Functional requirements for a high-end VR gaming experience

For VR gaming use cases, stringent low latency and high throughput requirements must be met to ensure a smooth user experience. If the requirements are not satisfied, users may experience significant lags and in the worst case, even VR-induced dizziness or nausea.

### Requirements for video frames

Video frames may be rendered by the gaming engine on the PC, encoded by the Graphics Processing Unit (GPU), and transmitted from the PC to the HMD through an AP at fixed intervals of time, governed by the refresh rate of the game (currently up to 120 Hz). Video frames are expected to be displayed at a given future (VSync) time on the HMD. Therefore, these video frames must be transmitted over the Wi-Fi link with high likelihood as a function of the latency distribution, as shown in the table below. *Note that these latency numbers account only for the actual transmission time of the video frame from PC to HMD over an AP, and do not include operations such as rendering and encoding/decoding of the frames.*

### Requirements for other traffic streams

VR gaming may also contain additional traffic streams transmitted from the PC to the HMD and vice versa with requirements captured in the table below. Pose/IMU traffic contains information on controller and HMD movements by the user, which must be precisely tracked at a rate of 500 Hz. Pose/IMU traffic has the most stringent latency requirements of all other streams.

| Traffic Stream | KPI Description | Specification |
|---|---|---|
| Video frames (PC to HMD) | Bit Rate (Throughput) | 100 Mbps to 200 Mbps (4k/8k @ 72-120 Hz) |
| | Latency | P75 < 5 ms, P95 <10 ms, P99.9 < 50 ms |
| Pose/IMU/Controller button presses (HMD to PC) | Throughput | 2 Mbps |
| | Latency | P90 < 2 ms; P99.9 < 10 ms |
| MIC Audio (HMD to PC) | Throughput | < 1 Mbps |
| | Latency | P90 < 10 ms; P99.9 < 15 ms |
| Haptics (PC to HMD) | Latency | P90 < 10 ms; P99.9 < 15 ms |
| Audio (PC to MHD) | Throughput | 2 Mbps |
| | Latency | P90 < 10 ms; P99.9 < 15 ms |

## Enterprise collaboration and enhancing workplace productivity

Enterprise immersion is a form of hybrid work enabled by existing and next-generation XR applications that give a truly immersive work experience to employees, customers, and IT end users. Whether it is groups of students learning with the help of VR, product designers creating collaboratively in a mix of real and virtual space (MR), or enhancing hybrid workers' productivity in their virtualized workspaces, XR systems must deliver sensory experiences indistinguishable from real life. Each of these experiences can be individual (interacting with the system) or multi-user (interacting with others) with both real and synthetic (e.g., AI) participants.

These immersive experiences require not only Enterprise-grade XR devices such as comfortable low-weight HMDs, but also high-speed and deterministic network connectivity to access compute resources. Wi-Fi, and in particular, Wi-Fi CERTIFIED® programs such as Wi-Fi 6E and Wi-Fi CERTIFIED 7™ are ideally suited for delivering the full potential of the immersive XR workspace by providing both high-speed and low latency to meet stringent XR performance requirements.

## Devices and topologies in the immersive workspace

A typical Enterprise XR system encompasses all or a subset of the following devices:

- XR HMD plus controllers and sensing accessories
- Enterprise-grade wireless LAN (WLAN)
- Enterprise-cloud/edge-hosted XR applications
- Wired or wireless paired companion devices

In the simplest deployment, the standalone HMD (XR Device) connects to its controllers, all rendering local to the HMD. In this case, the Wi-Fi link between the AP and the HMD is not considered time-critical. For more complex Enterprise-grade experiences, the HMD can use split rendering and offload some or all its rendering to an edge/cloud service via the WLAN making the Wi-Fi link between the AP and HMD time-critical. In other deployments, a user's personal compute device or companion device is paired to the HMD for rendering offload making the peer-to-peer (P2P) link between the AP and the HMD time-critical. In all cases, the HMD can simultaneously leverage a non-time-critical Wi-Fi link for non-real-time portions of app functionality (e.g., software updates).

In these offload modes over time-critical XR links, video and audio frames are typically rendered and delivered to the HMD in the downlink (DL) direction over the Wi-Fi or P2P links with corresponding HMD data (pose, IMU, controller state, mic. audio/camera, video, etc.) delivered in the uplink (UL) direction. This mutual dependency is often referred to as a motion-to-photon (M-to-P) requirement which needs bounded (worst-case) latency compliance.

## Functional requirements for an immersive enterprise XR experience

For all XR use cases described above, both the HMD and the companion device must be securely onboarded to the WLAN before it can be served by the infrastructure. Enterprise-grade authentication (WPA3™ Enterprise) and technologies such as Wi-Fi QoS Management™ may be needed to ensure appropriate Enterprise network QoS enablement.

For the rendering offload cases, stringent low latency and high throughput requirements must be met to ensure a smooth user experience. Failing to satisfy these requirements may lead to user dissatisfaction and thus lower collaboration engagement and productivity. If the M-to-P requirement (bounded latency) is not met, for example, users may experience XR-induced fatigue and dizziness. Signaling of these specific flow requirements is envisioned via Wi-Fi QoS Management and Wi-Fi 7 SCS QoS Characteristics.

It is important to note that in an Enterprise environment, both time-critical Wi-Fi links (AP to HMD, Companion to HMD) must be managed in a way that neither can disrupt the latency/throughput targets of the other. This is especially important when the AP is serving other time-critical flows in the presence of several individual time-critical Wi-Fi Direct/P2P links. For these cases, it is expected a form of coordination between the AP-managed Wi-Fi and Wi-Fi Direct/P2P links is provided that, for example, supports contention/interference-free channels and/or time slots to the latter given knowledge of the time-critical flow requirements by the former. Specifically, Wi-Fi 7 methods such as SCS QoS Characteristics and TXOP Sharing are appropriate.

### Requirements for traffic streams (time-sensitive links)

Remotely rendered video frames (by edge or companion device) are generated at a target period (inter-arrival time) appropriate for the application (codec) and synced (VSync) to the future HMD's video display output and refresh rate (e.g., 72 Hz). These frames are transmitted to the HMD via Wi-Fi/Wi-Fi Direct/P2P links with the expectation of a specific latency distribution, as shown in the table below. *Note that these latency targets account only for the actual transmission time of the video frame over the link, and do not include operations such as rendering and encoding/decoding of the frames.*

While the nominal or target video inter-arrival time (period) is established by the codec and VSync requirements, the actual period (as measured) varies due to compression (e.g., motion) and other factors. This means any QoS, or scheduling capability must account for the non-arrival of a video frame at the nominal period.

| Traffic Stream | KPI Description | Specification |
|---|---|---|
| Video frames (to HMD) | Bit Rate (Throughput) | Min. 30 Mbps (1080p @ 72 Hz) |
| | Period | Nominal:13.8ms; P99 < 20 ms |
| | Latency* | P75 < 10 ms, P95 <15 ms, P99 < 20 ms |
| Pose/IMU/Controller button presses (HMD to PC) | Throughput | 2 Mbps** |
| | Latency | P90 < 2 ms; P99.9 < 10 ms** |
| MIC Audio (HMD to PC) | Throughput | < 1 Mbps** |
| | Latency | P90 < 10 ms; P99.9 < 15 ms** |
| Haptics (PC to HMD) | Latency | P90 < 10 ms; P99.9 < 15 ms** |
| Audio (PC to MHD) | Throughput | 2 Mbps** |
| | Latency | P90 < 10 ms; P99.9 < 15 ms** |

*Latency is suggested-only and based on empirical observations (i.e., no experience impact was measured) **as per VR gaming requirements

## Social VR

Social VR encompasses social media and connections among users in Virtual Reality (VR) through shared, immersive experiences. Users who are geographically distributed can meet, interact, and participate in shared activities like watching movies, playing games, and exploring virtual worlds with their family, friends, and extended virtual communities. Social VR experiences are evolving and will be a key part of the Metaverse experiences for end users[2], allowing users from across the world to come together and have shared experiences, overcoming distance barriers.

Wi-Fi is well positioned to deliver immersive Social VR use cases to mobile users connecting wirelessly to access various VR services and applications. Wi-Fi CERTIFIED programs such as Wi-Fi CERTIFIED 7. Wi-Fi CERTIFIED 6® and Wi-Fi 6E offer low latency, high throughput, and power efficiency to meet performance requirements for high-end Social VR use cases.

### Devices and key use cases for Social VR

Most Social VR experiences are best delivered through Social VR applications and platforms on a VR headset (HMD). The HMD may be connected to accessories such as controllers and audio peripherals. In some applications, users with other non-VR devices like smartphones, tablets or PCs may be able to join some of the experiences in a collective virtual world, providing higher inclusivity.

[2] https://about.meta.com/metaverse/

Social VR applications represent a rapidly expanding market as VR device adoption increases and serve several use cases for immersive connectivity:

- Virtual travel: exploring virtual worlds, visiting places, or experiencing nature
- World building: building and creating virtual worlds together
- Live Events:  attending live events such as concerts and sports games
- Content Consumption: viewing pre-recorded content like movies and TV shows with multiple users
- Gaming: playing video games, board games, or multi-player games

### Functional requirements for delivering immersive Social VR experiences

For immersive experiences, Social VR requires supporting real-time, interactive, conversational, and/or streaming media transport based on specific use cases. It involves the integration of multiple VR and MR functionalities such as 6DoF streaming with VR conversational services along with capturing facial expressions, eye movement, and body gestures, and mapping to users' digital representations in real-time. VR objects such as virtual spaces, user avatars, conversational media, sound sources, streaming content, social feeds, etc. originating from different sources are combined into a single social VR experience. Rendering of Social VR content could be done locally on the HMD or remotely on a server (e.g., running as a cloud service).

In increasing Social VR use cases, end users are often located in different geographic regions and are able to join together in a virtual space. Such use cases typically require only a small number of VR devices (e.g., <10 HMDs) connected over a Wi-Fi network, which is distinct from other enterprise VR collaboration use cases requiring a large number of wirelessly connected VR devices over a narrow range of coverage. Social VR applications have strict latency requirements with low jitter to deliver premium and immersive VR experiences, and as such the Wi-Fi network should support high throughput and low latency. Power efficiency is another key requirement as VR devices are battery operated and low power consumption while communicating is critical to ensure long battery life. Throughput and latency requirements for the Wi-Fi network for a typical Social VR use case are described in the table below:

| Traffic Stream | KPI Description | Specification |
|---|---|---|
| Downlink (AP to HMD)<br>Video traffic for streaming, calling, etc., virtual space data, other application data | Bit Rate (Throughput) | 20-30 Mbps (video streams typically have 60Hz-120 Hz frame rates) |
| | Latency | P75 < 10 ms, P95 <15 ms, P99 < 50 ms |
| Uplink (HMD to AP)<br>Sensor data, audio | Throughput | Up to 5 Mbps |
| | Latency | P90 < 10 ms; P99 < 20 ms |

# Wi-Fi Certified Technologies to Deliver the Ultimate XR Experience

## Wi-Fi 7

Wi-Fi CERTIFIED 7, based on IEEE 802.11be technology, enhances Wi-Fi performance in the 2.4 GHz, 5 GHz, and 6 GHz bands, bringing cutting-edge capabilities to enable innovations that require high throughput, lower latency, and greater reliability across home, enterprise, and industrial environments. Wi-Fi CERTIFIED 7 supports key AR/VR/XR applications that provide immersive, interactive experiences including social gaming, immersive 3D training, and the collaboration tools that have become essential in today's workplace.

Wi-Fi CERTIFIED 7 delivers extremely high throughputs, low latency, and jitter based on new features that support wideband, high-speed communication with more nimble and robust use of spectrum in the presence of interference.

The key features benefits of Wi-Fi 7 include:

- 320 MHz channels: Superwide channels enable multigigabit Wi-Fi device speeds

- Multi-link operation (MLO): Enables devices to combine different channels across frequency bands together, allowing concurrent transmission and reception of data over multiple links
- 4K quadrature amplitude modulation (QAM): Increased transmission rates and efficiency enable next-generation use cases
- 512 compressed Block Ack: Allows the transmitter to aggregate up to 512 MAC protocol data units (MPDUs) in a single frame and allows the receiver to acknowledge up to 512 MPDUs in a single Block Ack (BA) frame
- Multiple resource units (M-RU) to a single STA: Allows multiple RUs to be assigned to a single user and can combine RUs for increased transmission efficiency
- Triggered uplink access: Satisfies uplink streams' quality of service (QoS) requirements and significantly improves uplink efficiency

Wi-Fi 7 features such as Multi-link operation, 320 MHz channels, and 4K QAM significantly increase per-device and network-wide throughput to enable XR use cases with the highest throughput demands with extremely low latency and jitter. Wi-Fi 7 features such as Triggered uplink access enable prioritized delivery of latency-sensitive traffic with predictable latency.

## QoS Management

Wi-Fi QoS Management provides robust service delivery and higher-quality experiences with latency-sensitive applications in Wi-Fi networks.

The program builds on the widely adopted Wi-Fi Multimedia (WMM) technology and helps deliver consistent, end-to-end QoS treatment. It enables Wi-Fi devices, applications, and network managers to prioritize traffic flows. The program benefits residential, enterprise, and public networks. It works with all Wi-Fi generations and includes certain features that are optimized for the latest Wi-Fi 6 and Wi-Fi 7 devices.

Wi-Fi QoS Management features focus on uplink assignment and scheduler behavior. The assignment of the User Priority (UP) used by the stream in the Traffic Identifier (TID) subfield, is critical to QoS management since it determines the WMM Access Category used for a flow's transmission and can help reduce head-of-line queuing delays for latency-sensitive traffic. Scheduler behavior is becoming increasingly important. In the downlink, the AP's scheduler must manage multiple downlink flows and users with different traffic characteristics and KPIs. In the uplink, the AP can schedule resources for STAs depending on the traffic characteristics and KPIs of uplink flows, using Wi-Fi 6 and Wi-Fi 7 trigger frames.

Wi-Fi QoS Management supports both client-centric and network-centric QoS management. The client-centric features are the most useful when client devices (or apps running on those devices) have the best knowledge of the QoS requirements for given data flows. The network-centric features are most useful in cases where the network/venue needs to manage QoS at the system level, such as when mission-critical enterprise services are deployed. Client-centric and network-centric features can be used simultaneously.

### Client-centric features

The client-centric features defined in the program are MSCS (Mirrored Stream Classification Service) and SCS (Stream Classification Service).

In the MSCS feature, the STA sends a request to the AP to activate QoS mirroring. Once activated, the AP derives downlink UP assignment rules by monitoring and mirroring the UP of uplink IP packets in each bidirectional IP flow. Each derived MSCS rule is associated with an IP tuple-based classifier.

In the SCS feature, the STA sends a request to the AP to apply a downlink UP assignment rule for a given flow, associated with an IP tuple (or IPsec header) based classifier explicitly included in the request. The SCS request can also contain explicit traffic characteristics (such as burst size and burst cadence) and key performance indicators (KPIs), such as maximum latency, for each flow that the AP's scheduler is expected to meet.

 

In addition, an STA can also send an SCS request to an AP containing traffic characteristics and KPIs for an uplink flow. In this case, the AP is expected to facilitate the scheduling of the STA's uplink transmissions using trigger frames defined in Wi-Fi 6 and Wi-Fi 7 to meet the KPIs.

### Network-centric features

The network-centric features defined in the program are QoS Map and DSCP Policy.

In the QoS Map feature, the AP configures each associated STA with a (custom) DSCP-to-UP mapping table used for the STA's uplink transmissions, either during or post-association. This is useful when the network needs to reassign the QoS priority of uplink flows that the STA marks with a given DSCP value.

In the DSCP Policy feature, the AP sends a request to the STA to apply a policy for DSCP marking of a given uplink traffic flow, associated with an IP tuple or domain name-based classifier explicitly included in the request. DSCP Policy, especially when combined with QoS Map, provides finer granularity when the network needs to reassign the QoS priority of individual uplink flows.

In addition, the QoS Management program defines the use (by both APs and STAs) of the DSCP-to-UP mapping table in IETF 8325 by default. This mapping is used to determine the UP of flows for which other features (such as MSCS, SCS, and QoS Map) do not apply.

### Summary

QoS Management features currently primarily target QoS-sensitive flows traversing infrastructure networks, for example where XR devices are connected to rendering and/or compute engines located on the local network, edge, or public Internet. Each XR flow – such as those corresponding to video, audio, haptic, and motion tracking – can have its QoS treatment managed based on its individual traffic characteristics and KPI requirements.

## Wi-Fi 6

Wi-Fi CERTIFIED 6, the industry certification program based on the IEEE 802.11ax standard, provides the capacity, efficiency, coverage, and performance required by users today in highly demanding Wi-Fi environments. Emphasizing quality connectivity in locations with hundreds or thousands of connected devices such as stadiums and other public venues, as well as corporate networks utilizing time-sensitive, high bandwidth applications, Wi-Fi CERTIFIED 6 networks ensure each connected device performs at an optimum level. Wi-Fi CERTIFIED 6 devices meet high standards for security and interoperability, and enable lower battery consumption, making it a solid choice for any environment, including XR use cases.

Wi-Fi operation in the 6 GHz frequency band enables Wi-Fi to continue delivering positive experiences for the most bandwidth-intensive applications. Wi-Fi 6E certification as part of Wi-Fi CERTIFIED 6 offers the features and capabilities of Wi-Fi 6 extended to the 6 GHz band. Nations around the globe are making the 6 GHz band available for unlicensed use, and Wi-Fi CERTIFIED 6 provides worldwide interoperability certification for devices in these markets.

Wi-Fi 6E can utilize up to 14 additional 80 MHz channels or seven additional superwide 160 MHz channels in 6 GHz for applications such as high definition video streaming and XR use cases. Wi-Fi 6E devices leverage these wider channels and additional capacity to deliver greater network performance and support more Wi-Fi users at once, even in very dense and congested environments. Wi-Fi 6E will bring greater technology advancements to Wi-Fi that will introduce new use cases, such as unified communications, cloud computing, XR use cases, and telepresence, and accelerate the next generation of connectivity with 5G networks.

Wi-Fi CERTIFIED 6 delivers improvements and new features that enable Wi-Fi devices to operate efficiently in the most dense and dynamic connectivity settings.

Key capabilities and benefits Wi-Fi CERTIFIED 6 devices operate in the 2.4 and 5 GHz bands and deliver greater capacity than the prior generation of Wi-Fi. Wi-Fi CERTIFIED 6 devices bring reliable performance indoors, outdoors, and in dense environments. Devices also demonstrate longer battery life.

Key features enabling the benefits of Wi-Fi CERTIFIED 6 include:

- Wi-Fi 6E operation in 6 GHz spectrum: 160 MHz channels provide additional capacity for greater network performance
- Orthogonal frequency division multiple access (OFDMA): More effectively shares channels to increase network efficiency and lower latency for both uplink and downlink traffic in high-demand environments
- Multi-user multiple input, multiple output (MU-MIMO): Allows more uplink and downlink data to be transferred at once and enables an access point to handle a larger number of concurrent clients
- 160 MHz channel utilization capability: Increases bandwidth to deliver greater performance with low latency
- Target wake time (TWT): Enables scheduled sleep and wake times for better network efficiency and longer device battery life
- 1024 quadrature amplitude modulation mode (1024-QAM): Enables throughput increases by encoding more data in the same amount of spectrum
- Transmit beamforming: Improves signal power resulting in significantly higher rates at a given range

### P2P Technologies

Driven by the desire of users to easily connect their devices together, Wi-Fi CERTIFIED Wi-Fi Direct® and Wi-Fi CERTIFIED Wi-Fi Aware™ provide peer-to-peer (P2P) technologies for devices to connect to each other using their Wi-Fi interfaces without the need for traditional infrastructure services.

Wi-Fi Direct uses the existing IEEE 802.11 standard and AP/STA topologies to set up a P2P group or P2P link. The existing Wi-Fi Direct certification is based on Wi-Fi 4, but there is an ongoing effort as part of the Wi-Fi Direct R2 program to update the Wi-Fi Direct certification to support the latest Wi-Fi technologies, including Wi-Fi 7 and WPA3. This updated certification aims to leverage these technologies to offer optimal peer-to-peer operation for applications including XR. This updated Wi-Fi Direct certification is expected to launch by December 2024.

Wi-Fi Alliance® has also developed Wi-Fi Aware technology for low-power proximity-based discovery and data exchange in a mobile environment where devices may join or leave a synchronized cluster of devices. Wi-Fi Aware devices continuously discover other devices within a user's Wi-Fi range before association, making it easy to find nearby information and services that match preferences set by the user. In Wi-Fi Aware, the focus is to establish a continuously synchronized cluster of several devices that can perform low-power service discovery, secure data exchange (including the use of 160 MHz Wi-Fi 6 channels), and ranging measurement.

P2P technologies are well suited to various XR use cases where there is a need for pairing and direct high bandwidth data exchange between HMDs, controllers, sensors, and local rendering devices such as game consoles, PCs, and phones. These technologies can help improve the XR user experience since QoS KPIs such as latency can be enhanced by the use of a direct link, as opposed to connecting the devices over two (or more) hops via infrastructure APs.

## Conclusion

XR use cases enable powerful new experiences that are redefining the way humans interact with each other and their environments. Wi-Fi will continue to serve as the foundation of connectivity for new and emerging XR applications, with the 6 GHz spectrum of Wi-Fi 7 and Wi-Fi 6E positioned to fuel endless possibilities for XR innovation. Wi-Fi Alliance certification programs enable the technologies that meet XR's stringent requirements for high data rates, high reliability, low latency, and low power consumption. The Wi-Fi CERTIFIED™ logo signifies that devices delivering XR experiences meet the high standards for QoS performance, interoperability, and security.

## About Wi-Fi Alliance®

www.wi-fi.org
Wi-Fi Alliance® is the worldwide network of companies that brings you Wi-Fi®. Members of our collaboration forum come together from across the Wi-Fi ecosystem with the shared vision to connect everyone and everything, everywhere, while providing the best possible user experience. Since 2000, Wi-Fi Alliance has completed more than

80,000 Wi-Fi certifications. The Wi-Fi CERTIFIED™ seal of approval designates products with proven interoperability, backward compatibility, and the highest industry-standard security protections in place. Today, Wi-Fi carries more than half of the Internet's traffic in an ever-expanding variety of applications. Wi-Fi Alliance continues to drive the adoption and evolution of Wi-Fi, which billions of people rely on every day.

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