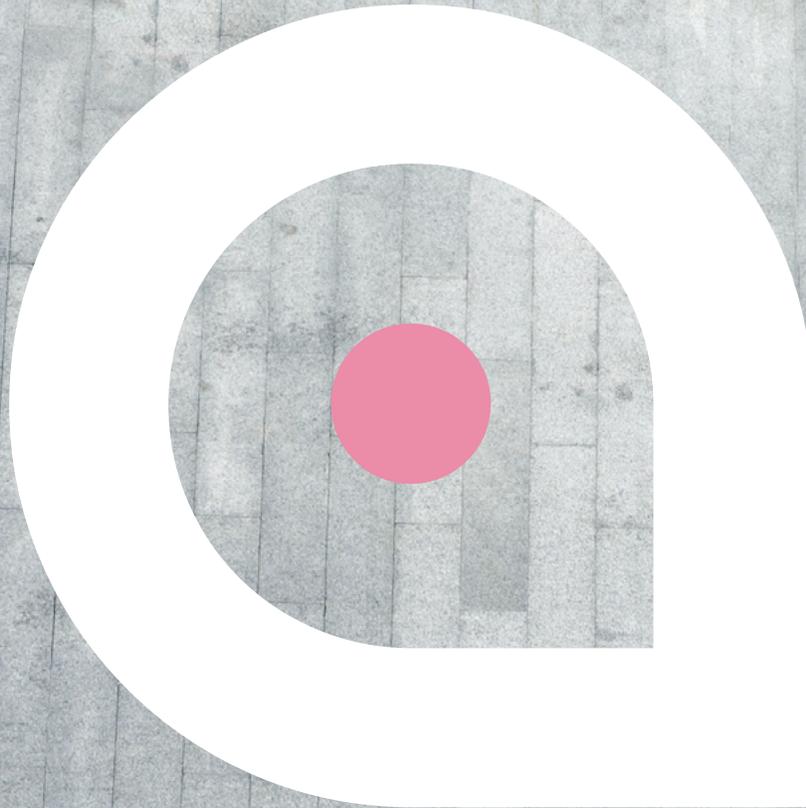




The Power
to Be Precise



Annual Report
2021

Table of Contents

04	<u>Board Chair Message: 2021 - UWB Thrives</u>
07	<u>Our Ambition: Making Fine Ranging a Reality</u>
08	<u>The UWB Market is Dynamic and Growing Rapidly</u>
10	<u>Smart Phones Are Enabled with UWB</u>
11	<u>UWB Comes to Consumer IoT Devices</u>
12	<u>Enterprise and Industrial IoT Rely on UWB-Enabled Location Data</u>
13	<u>Automotive Manufacturers Use UWB for Digital Key Access</u>
13	<u>Development of an Open and Interoperable Ecosystem</u>
17	<u>Industry Leaders Join FiRa</u>
18	<u>Our Members</u>
22	<u>FiRa Hits Major Milestone with the Launch of the FiRa Certification Program</u>
24	<u>The Heart and Soul of FiRa - Our Working Groups</u>
30	<u>FiRa Achieves Major Milestones in 2021</u>
32	<u>Join FiRa Now!</u>

Board Chair Message: 2021 – UWB Thrives



Charlie Zhang, Board Chair

Senior Vice President, Engineering, Samsung Research Americas

Ultra-Wideband (UWB) technology, with its superior positioning and sensing capabilities, is exhibiting clear signs of becoming a prevalent element in the transformation of connectivity experiences across all aspects of life. Overall UWB market dynamics indicate that a broad set of established companies are designing and building products and services utilizing UWB technology. The most visible examples are the inclusion of UWB in handsets by major mobile handset manufacturers such as Apple, Google, Samsung, and Xiaomi and the use of UWB to access automobiles.

In 2019 a handful of organizations came together, sharing a common belief that UWB technology would become ubiquitous alongside established technologies such as Wi-Fi and Bluetooth. These organizations also understood that previous technology adoption curves have demonstrated the pitfalls that can slow or stop widespread use of a new technology. These include:

- Varying interpretations of standards leading to incompatible products.
- Lack of clarity on how the technologies could be used to full effect.

- Dearth of essential building blocks, tools, and technologies to ease adoption.
- No unbiased source to confirm interoperability and give users confidence.

To proactively address this, in August 2019 the FiRa Consortium was launched by seven (7) industry leaders, with a goal for ensuring market success for UWB.

Today, just two short years later, FiRa is comprised of over 100 industry leaders from around the globe. Engaging with FiRa's Working Groups, individuals from these organizations have given freely of their time, knowledge, and passion to evangelize the benefits of UWB while working toward building an open and interoperable ecosystem.

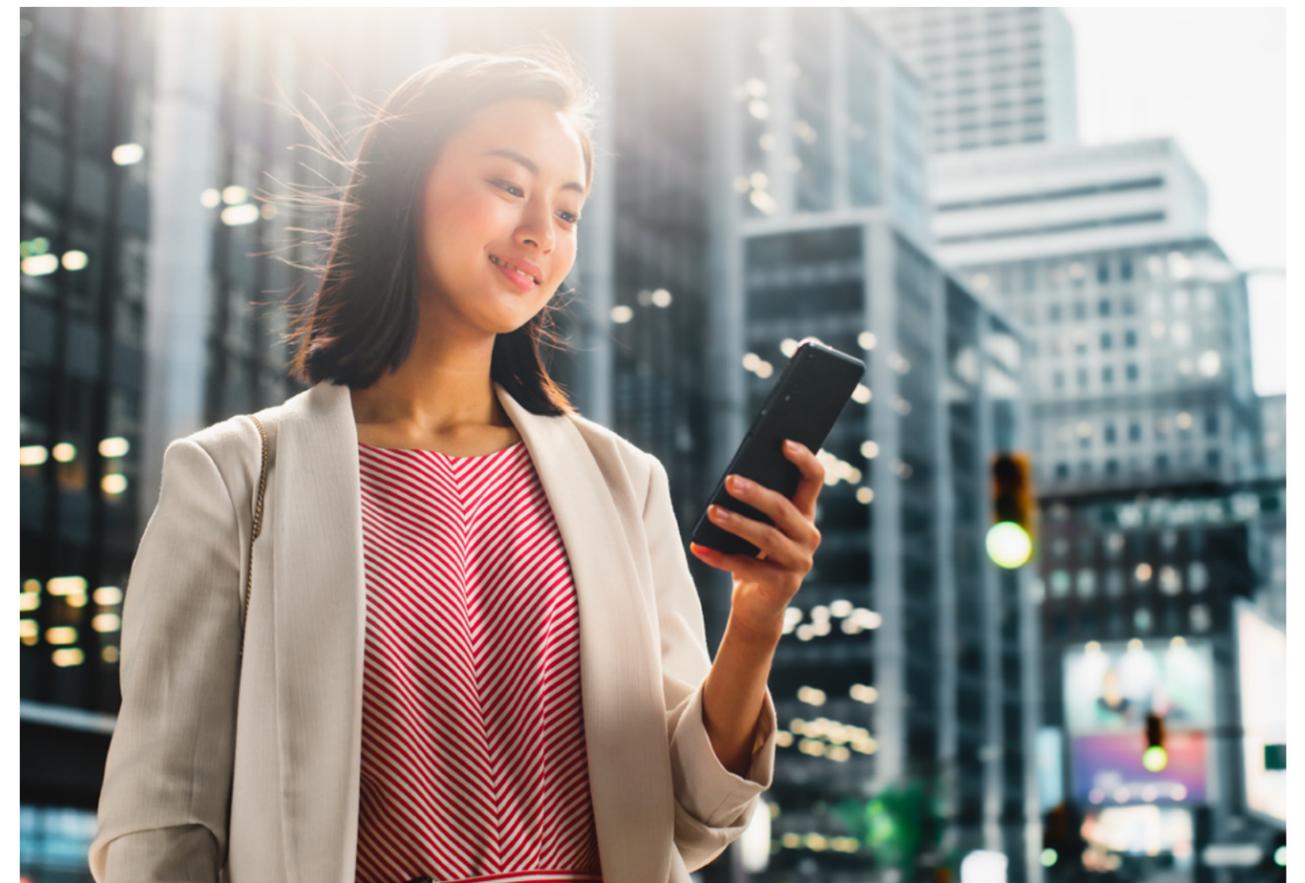
2021 was an impactful year for the FiRa Consortium. In addition to phenomenal membership growth, significant milestones achieved in 2021 include:

- The FiRa Technical Working Group completed the FiRa Consortium UWB MAC and PHY Technical Requirements V1.3 documents.

- The FiRa Certification Program was launched in October 2021.
- As part of the Certification Program, FiRa has validated test tools and has recognized four test labs that meet the requirements of the FiRa Test Lab Authorization Process as Authorized Test Labs (ATLs).
- Confirming compliance with the FiRa-specified MAC and PHY Conformance Test Specifications and the MAC/PHY Interoperability Test Specification, FiRa certified the first devices for base certification.

As we move into 2022, we remain committed to encouraging organizations to join FiRa. As a member-driven organization, we rely on members to help us reach our full potential.

Together we can build upon FiRa's success in 2021 and further expand the UWB ecosystem, growing into new sectors such as indoor localization, industrial IoT, smart home, security applications and others.





Our Ambition: Making Fine Ranging a Reality

The FiRa Consortium is dedicated to transforming the way we interact with our environment by enabling precise location awareness for people and devices.

UWB is the most effective available technology for delivering accurate ranging and positioning in challenging real-world environments, allowing devices to add real-time spatial context, and enabling new user experiences.

Whatever its capabilities, no technology reaches broad market acceptance without effective industry support. The FiRa Consortium provides that support for UWB - developing a robust industry ecosystem to enable broad adoption of the secured fine ranging and positioning capabilities of UWB technology.

Through our Working Groups, we use a three-pronged approach to support the expansion of this remarkable technology:

FiRa's Mission

Support the development of compelling use cases across broad business domains

Define specifications and certify products to ensure interoperability

Foster a robust UWB ecosystem to enable rapid technology deployment

The UWB market is dynamic and growing rapidly, creating an inflection point where a broad set of established companies are designing products and services utilizing UWB technology. As UWB technology makes the transition to mass scale usage, our members know that its success depends on an interoperable, holistic, and interconnected ecosystem.

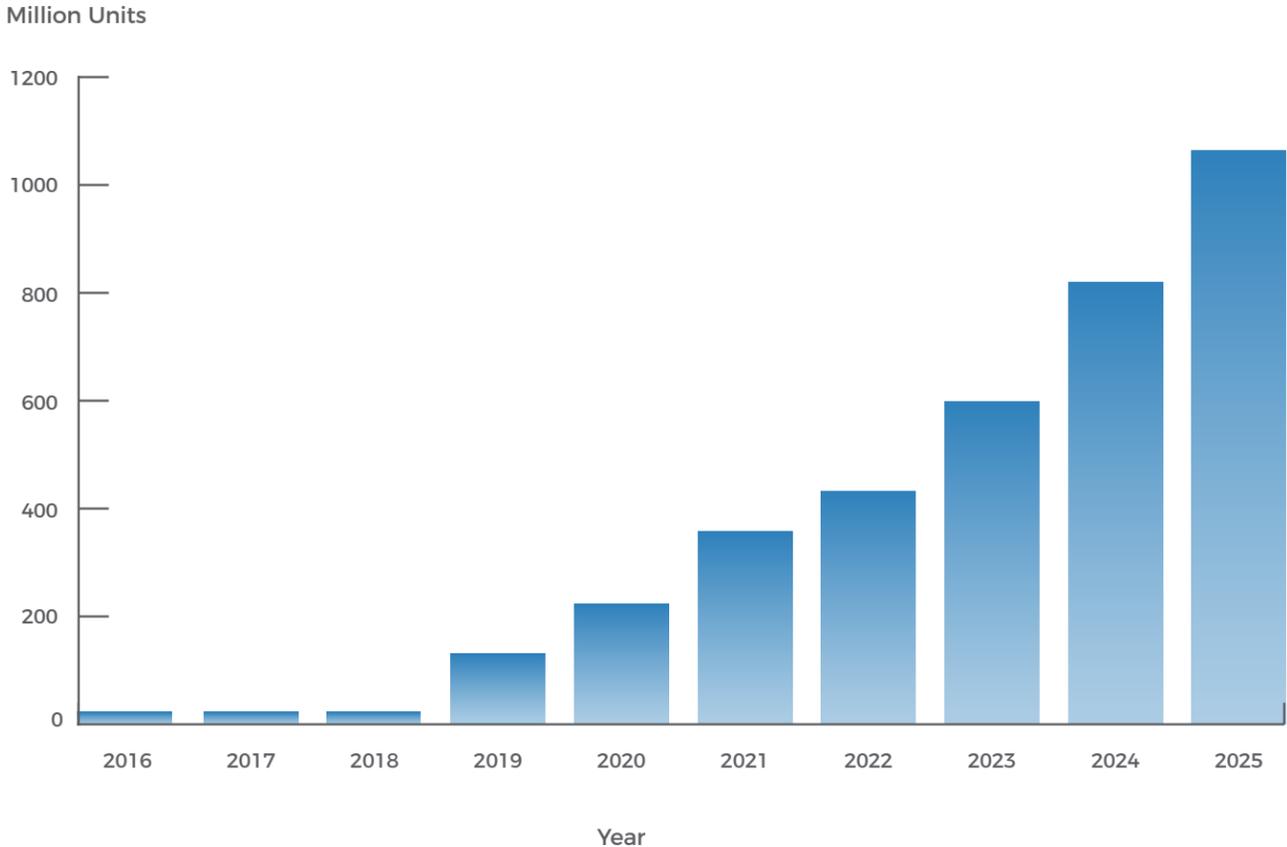
The FiRa Consortium enables a broad base of product and solution companies to quickly solve ecosystem and interoperability challenges for combined future success.

The UWB Market is Dynamic and Growing Rapidly

The marketplace is at an inflection point where a broad set of established companies are designing and building products and services utilizing UWB technology. As validated by industry analysts, FCC product approvals, CE self-declarations and a variety of published case studies, UWB technology is in the early stages of making the transition from niche applications to mass scale usage.

According to ABI research, the total of all UWB-enabled devices shipped globally will grow from 109 million devices in 2019 to over 1 billion devices by 2025. In total, 3.6 billion UWB-enabled devices will be shipped globally by 2025. In fact, the UWB market is projected to grow by double digit percentages for the foreseeable future.

Source: ABI research 2019



“According to information on the FCC website, there were 85 UWB-enabled products granted FCC certification in 2021.”

Jervais Seegars
Regional Business Development Manager for Ultra-Wideband, Qorvo

As highlighted by MarketsandMarkets™, major factors driving growth in the UWB market are:

- Increased growth in deployment of UWB technology in mobile phones
- Increased adoption in the consumer Internet of Things (IoT) and the Industrial Internet of Things (IIoT)
- The rising demand for UWB technology in Real Time Location Systems (RTLS) applications.

UWB MARKET GROWTH FACTORS: SMART PHONES ARE ENABLED WITH UWB

As a sign of confidence in UWB's ability to enhance smart phone usage, leading handset manufacturers, including Apple, Google, Samsung, and Xiaomi, are implementing UWB in select devices. The inclusion of UWB in smart phones enables new use cases:



Easily find items that have been misplaced



Experience seamless home automation



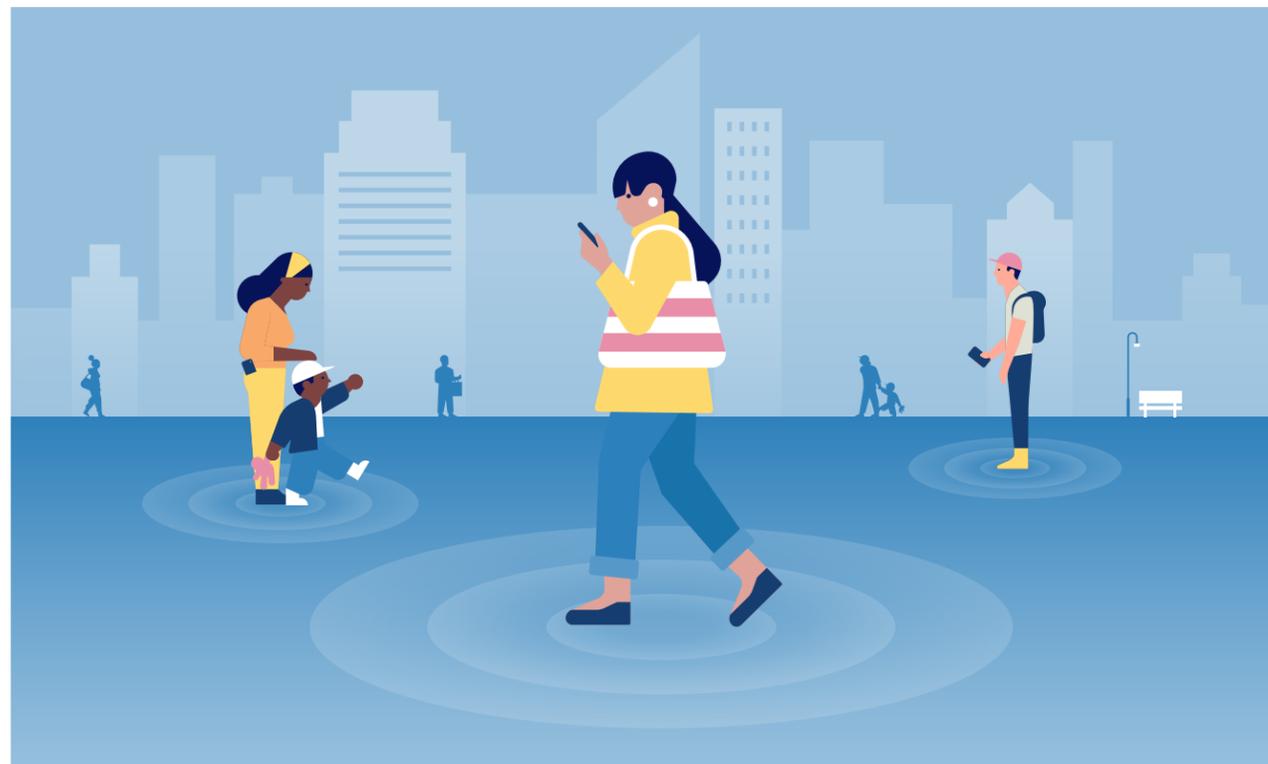
Quickly locate your family or friends in a crowded area



Access your car without a key or key fob (under the Car Connectivity Consortium specifications)



Make more secure purchases

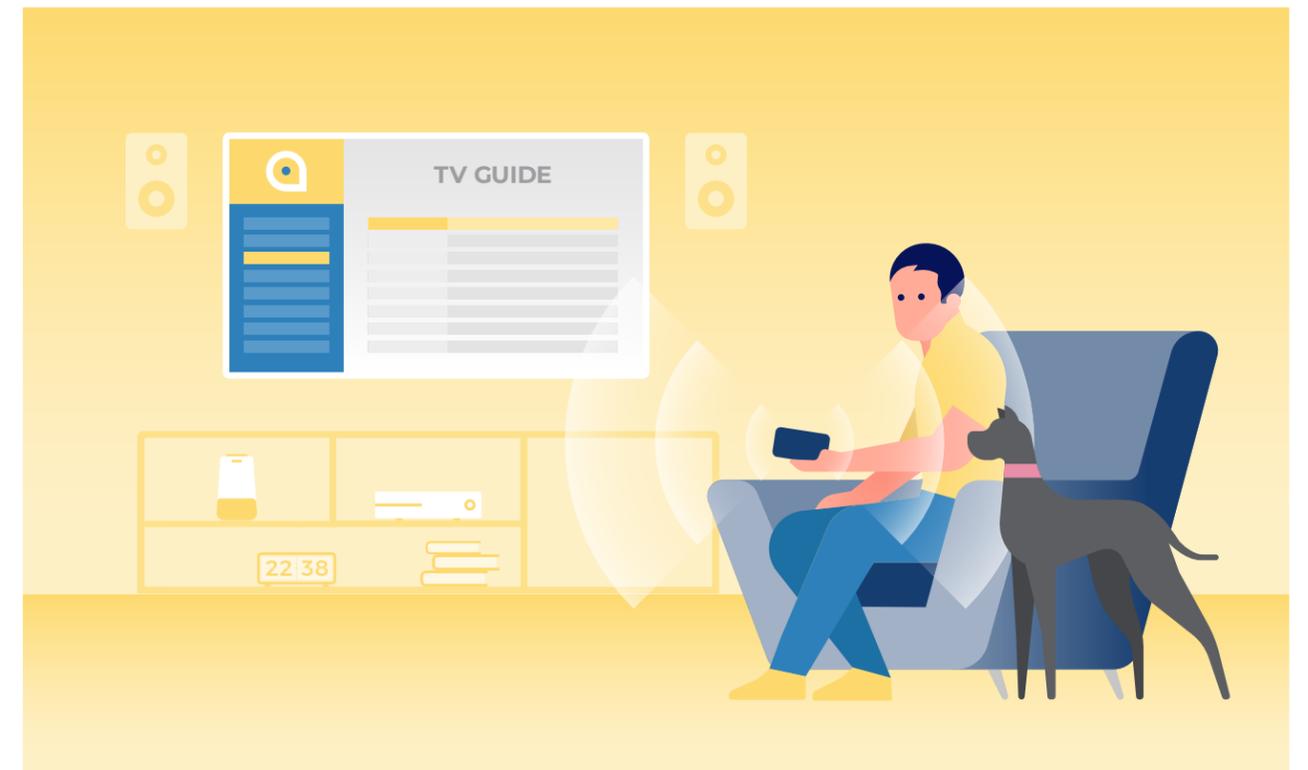


UWB COMES TO CONSUMER IoT DEVICES

MarketsandMarkets notes that the consumer electronics vertical will hold the largest market share of UWB from 2020 to 2025. There is an increasing demand for UWB technology in consumer electronics based on UWB's ability to significantly improve the consumer experience related to home entertainment products such as televisions, laptops, and audio equipment.

UWB will enable IoT devices in the consumer space to be more intuitive. For example, you will be able to have custom audio or video based upon your location in the home. And the overall user experience with Smart Home devices (i.e., speakers, lights, and plugs) will be much better.

With secure fine ranging capability, fast data rate capability, and low power requirements, UWB technology provides a low-cost solution that is well-suited for consumer uses within the home.



ENTERPRISE AND INDUSTRIAL IoT RELY ON UWB-ENABLED LOCATION DATA

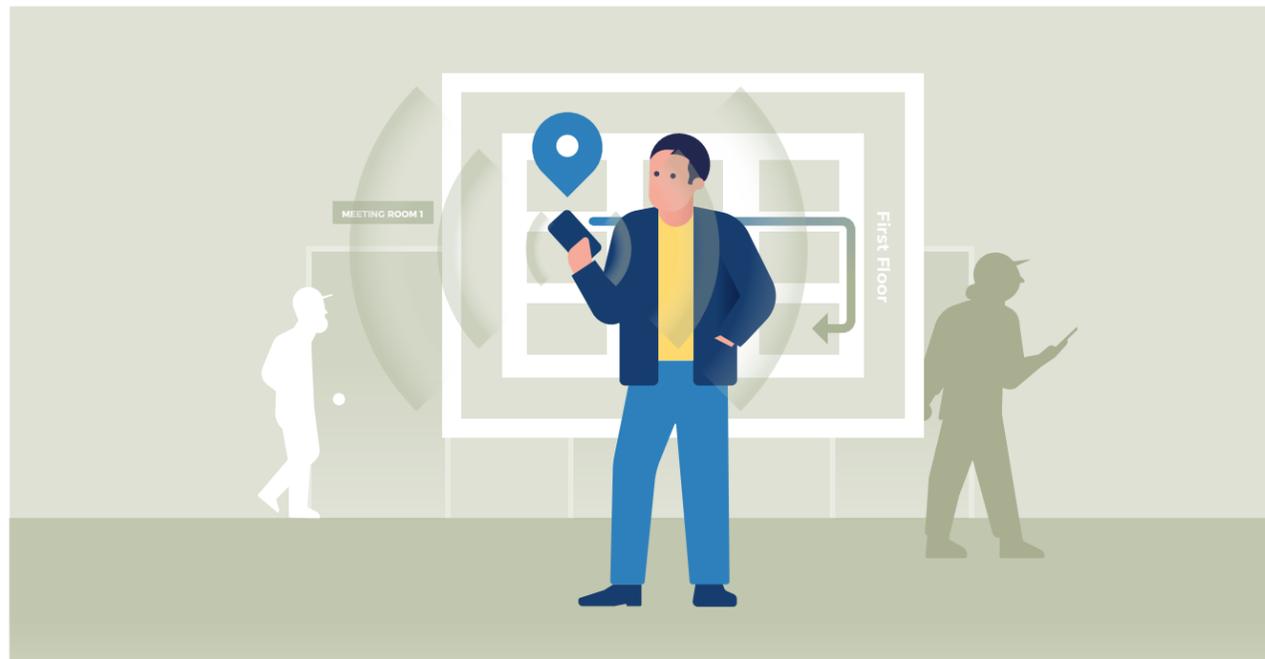
UWB has been used for more than 10 years in the enterprise and industrial space delivering location data with unrivaled accuracy that drives process efficiencies in factories, warehouses and retail as well as improving the safety of workers in hazardous environments.

For example, the use of UWB technology can improve safety in mining operations by helping to locate miners in emergency situations or in warehouses by helping workers to avoid collisions with forklifts.

Working with Humatics, the New York Metropolitan Transportation Authority (MTA) has identified UWB as a transformational technology for signal modernization and has been evaluating its capabilities.

In a press release, the MTA noted that “UWB wireless technology brings the promise of fewer and shorter delays, and faster and cheaper installation of modern CBTC signaling by eliminating much of the equipment traditionally fitted under trains and on tracks. This is a game-changer for our customers”.

Next up will be the broad adoption of UWB in city and building infrastructure via the integration of UWB in wireless access points, access control, lighting infrastructure, and transportation.



AUTOMOTIVE MANUFACTURERS USE UWB FOR DIGITAL KEY ACCESS

As evidenced by early adoption of UWB by BMW, Volkswagen, Mercedes, Jaguar and Land Rover, the automotive segment will be a mass adopter of UWB technology. Digital car key is currently supported by Apple, Google, and Samsung smart phones providing seamless and secure access to cars from smart phones. (Note that vehicle digital key is being standardized by the Car Connectivity Consortium.)



DEVELOPMENT OF AN OPEN AND INTEROPERABLE ECOSYSTEM

The FiRa Consortium is comprised of industry leaders from all market sectors, helping to propel UWB market growth. In the FiRa Consortium 2020 Annual Report, we wrote about the “network effect” in which the proliferation of UWB in one sector accelerates innovation in other sectors. We are clearly seeing this today.

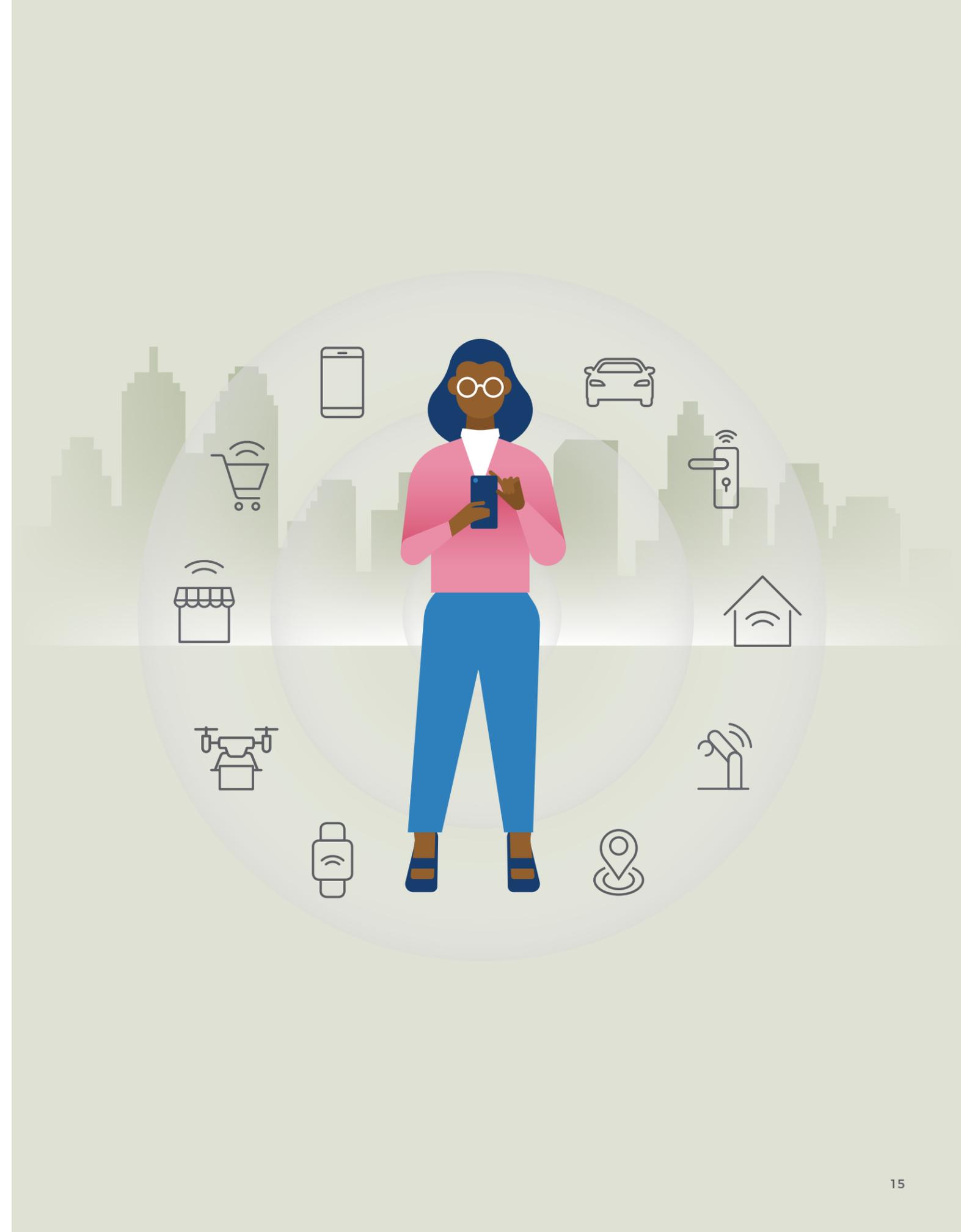
As more UWB-enabled mobile devices are coming to market, end-users are beginning to have the opportunity to experience the power that UWB places in their hands.

The brand power and reach of the mobile OEMs, many of whom are FiRa members, will play a large role in educating consumers and thus will drive demand for UWB-enabled mobile devices. This, in turn, will trigger demand for increased interactions between mobile and IoT devices, particularly in the home over the near-term. Consumers will demand that the ecosystem continues to develop as they see that UWB can make their home life more convenient and secure.

As people become familiar with the technology and build trust in its use, new habits will be formed that rely on the use of UWB. This will drive expectations for a higher penetration of UWB technology in all types of commercial devices. In turn, the smart city infrastructure will have to adapt to new device capabilities to deliver a more seamless response to user’s needs.

It is expected that mobile, automotive, and IoT OEMs will benefit from a broader penetration in other sectors and will together contribute to building one UWB ecosystem that provides numerous use case options to end-users.

With FiRa being comprised of industry leaders sharing a common vision for the development of an open and interoperable ecosystem, the Consortium is in the right place at the right time to propel the industry forward.





Industry Leaders Join FiRa

The FiRa Consortium now has more than 100 members, including market leaders across consumer technology, semiconductors, networking, and secure access.

In 2021 many industry leaders joined FiRa, actively providing their expertise and market prowess to foster the growth of an open and interoperable UWB ecosystem.

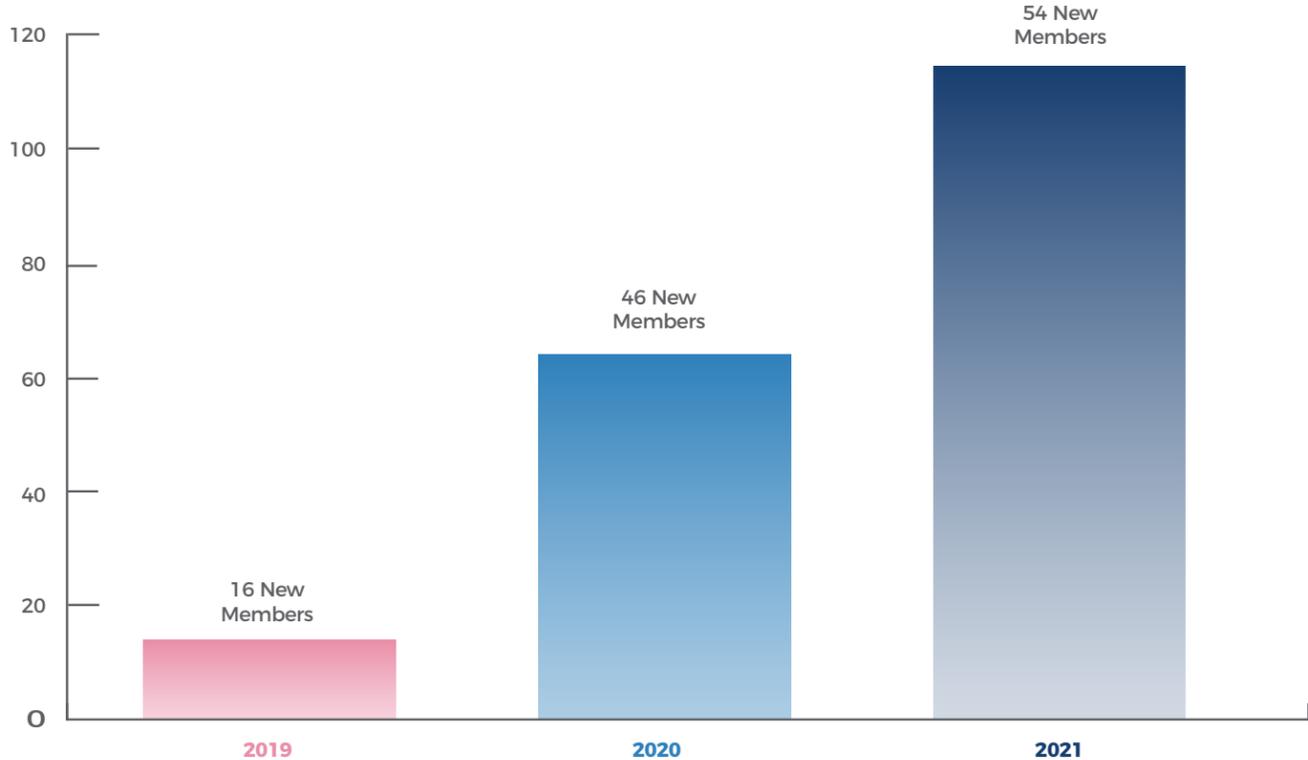
New members include:

- **Sponsor Members:** Apple, Cisco, and Google
- **Contributor Members:** 3db Access, Infineon, Kastle Systems, and Microsoft

Helping to drive membership forward, these market leaders were joined by an additional 47 organizations who share a common belief in the power of UWB.

This level of membership growth is a remarkable achievement for an organization that was formed just over 2 years ago!

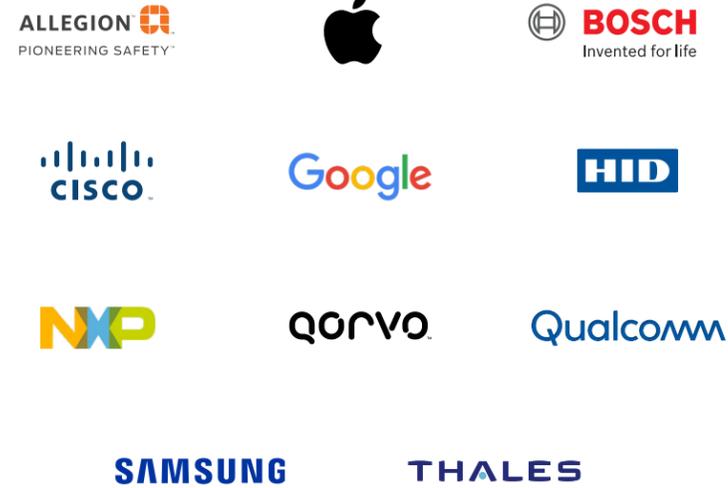
FiRa Consortium Member Growth through 2021



Our Members

Sponsor Members

Aside from being long-time leaders in technology and innovation, our Sponsor members understand the vital importance of interoperability when it comes to establishing a new approach, and recognize the need for a strong, sustainable ecosystem to support emerging applications.



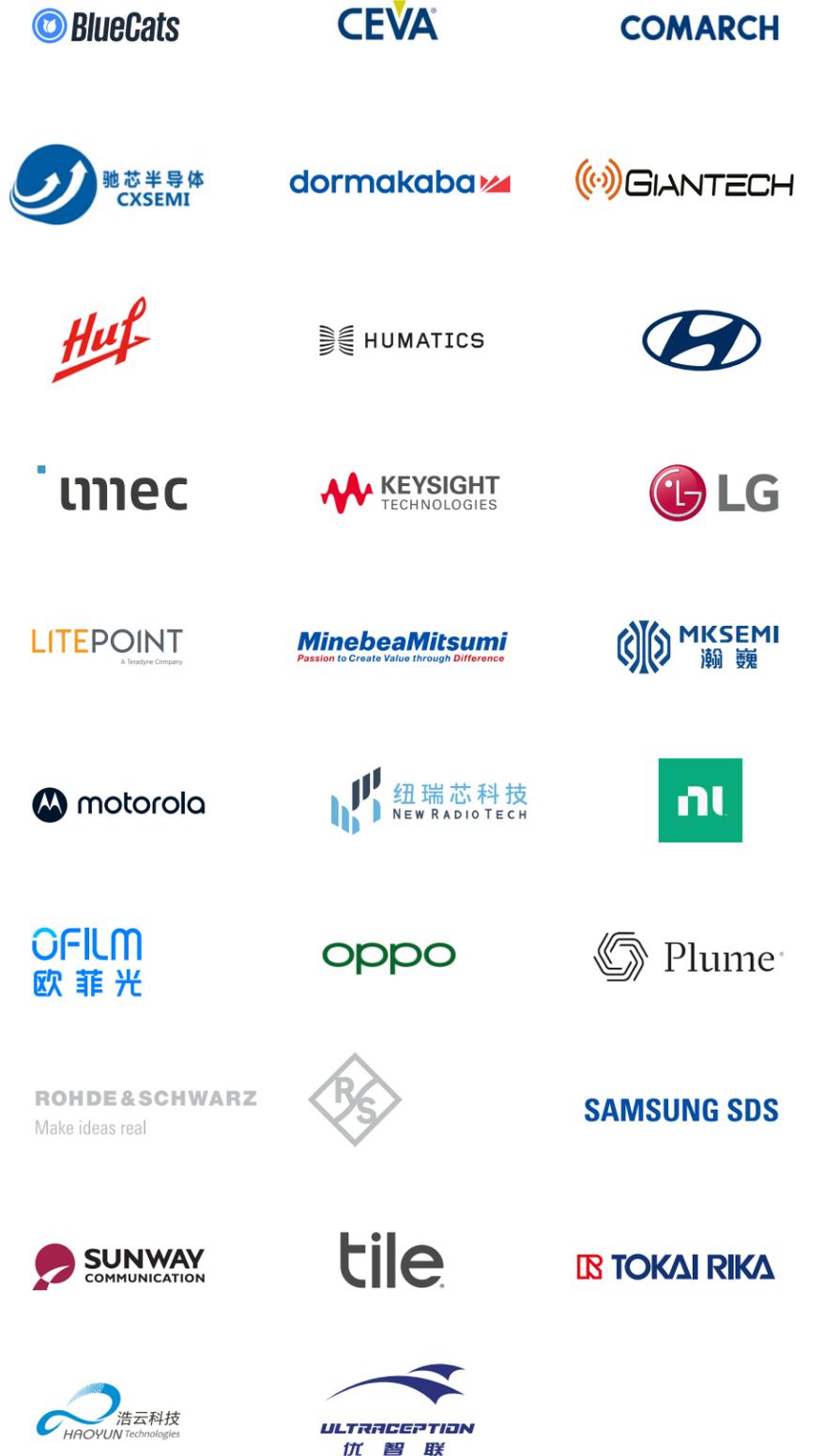
Contributor Members

Contributor members bring significant technical and market knowledge to the creation of technical specifications that result in an interoperable UWB ecosystem.



Associate Members

Associate members share their expertise and have the opportunity to grow the ecosystem by enabling products with UWB technology.



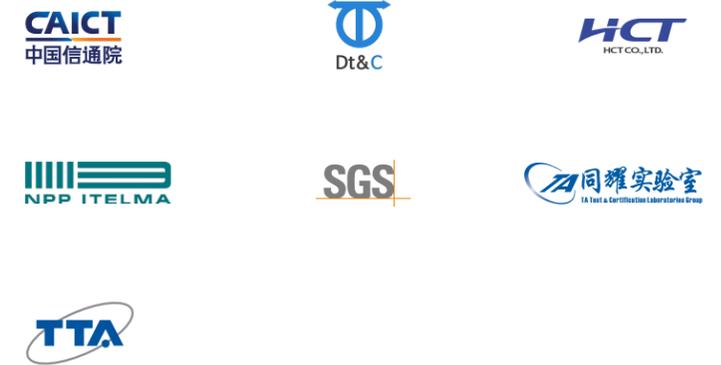
Adopter Members

Adopter members help to expand the UWB ecosystem by integrating UWB technology meeting agreed-to specifications into products.



Test Lab Members

Test lab members ensure that UWB-enabled products and solutions meet the standards set by the FiRa Consortium.



Academic and Educational Members

Academic and educational members are able to bring their academic knowledge and expertise to the FiRa Consortium, helping to ensure that we are leveraging some of the world's best resources in the development of UWB technology.



FiRa Hits Major Milestone with the Launch of the FiRa Certification Program



In October 2021 FiRa Consortium launched the initial phase of its Certification Program aimed at driving interoperability between UWB devices. The FiRa Certification Program is a crucial foundational element for interoperability of devices utilizing UWB's pinpoint location capabilities.

FiRa Consortium's Certification Program is the first to provide baseline testing and certification focused on UWB's pinpoint location and spacing capabilities, one of the key steps needed to facilitate interoperability of devices. This is an essential component of FiRa's vision for the future of fine-ranging UWB where certified smart phones can find location tags, securely unlock doors, and interact seamlessly with consumer electronics built using FiRa-certified UWB technology from any vendor.

All FiRa Certified™ devices are tested by independent Authorized Test Laboratories (ATLs) using the FiRa Device Certification Process. Devices must meet FiRa specifications for MAC/PHY conformance –

demonstrating that the device conforms to the relevant FiRa specifications.

Manufacturers can now start moving towards certifying their devices for MAC/PHY conformance. Once a device is certified, the manufacturer gains promotional and marketing benefits of the certification process including the ability to:

- Promote certification by using the FiRa Certified logo according to the FiRa Brand Guidelines (and with an executed FiRa Certification Mark License Agreement in place)
- Have the certified device(s) listed on the FiRa Certified Products webpage
- Leverage FiRa's marketing as FiRa looks to highlight UWB ecosystem expansion

The first products in the program have been certified, with many more expected to be certified in 2022. FiRa Consortium will continue to develop UWB certification for layers above MAC/PHY, with the next iteration slated for mid-2022.

Learn more about the FiRa Certification Program at: <https://www.firaconsortium.org/certifications/certification-program>



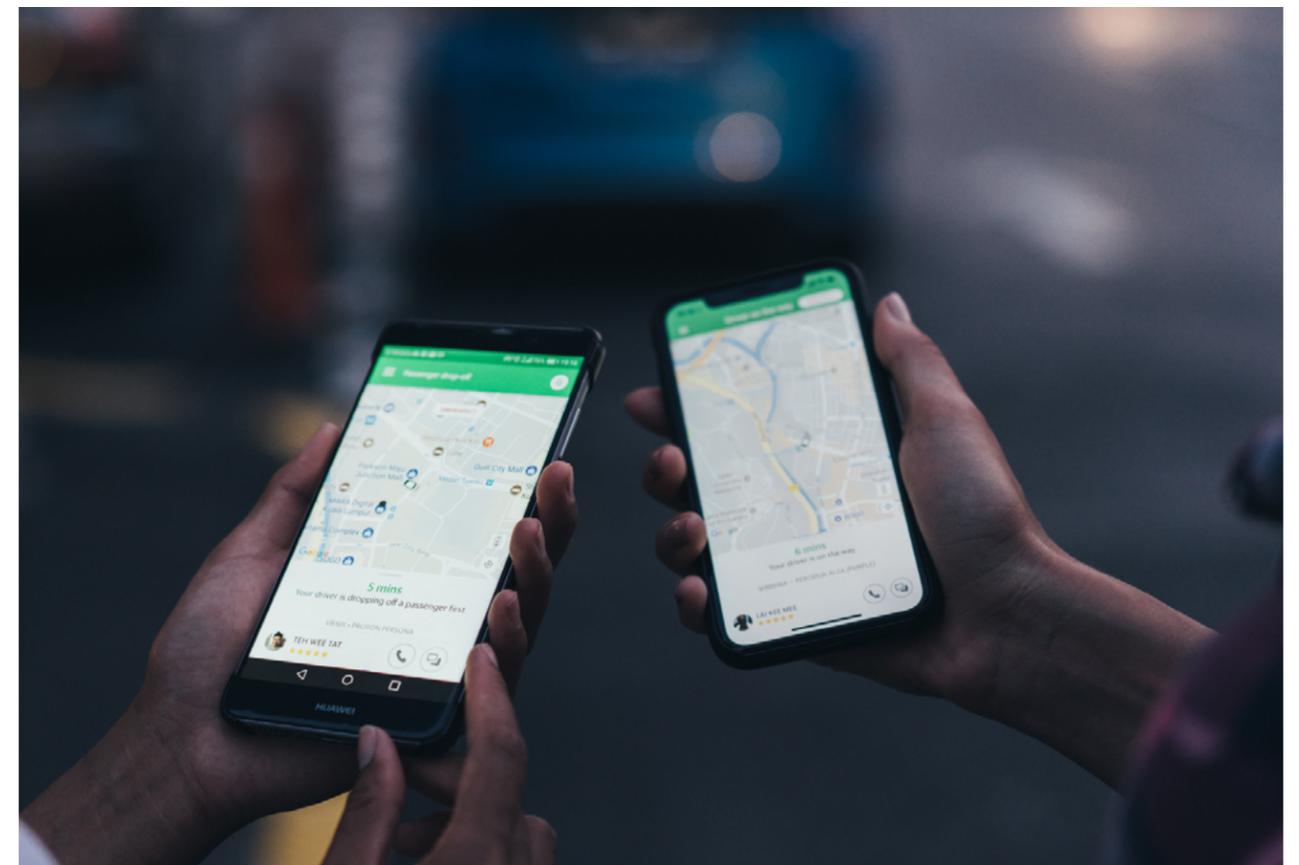
"UWB is fast becoming a pillar of wireless local connectivity technology alongside Wi-Fi and Bluetooth. When combined with the membership momentum we are seeing, our certification program signifies that the market is prepared and ready for broad implementation of UWB across market sectors."

Charlie Zhang
Board Chair



"Interoperability across vendors is foundational to the growth of any open technology ecosystem. Our base certification program is an important first step, ensuring an essential layer of conformance as we build a platform for continued growth in UWB usage."

Reinhard Meindl
Co-Chair of the Compliance & Certification Working Group

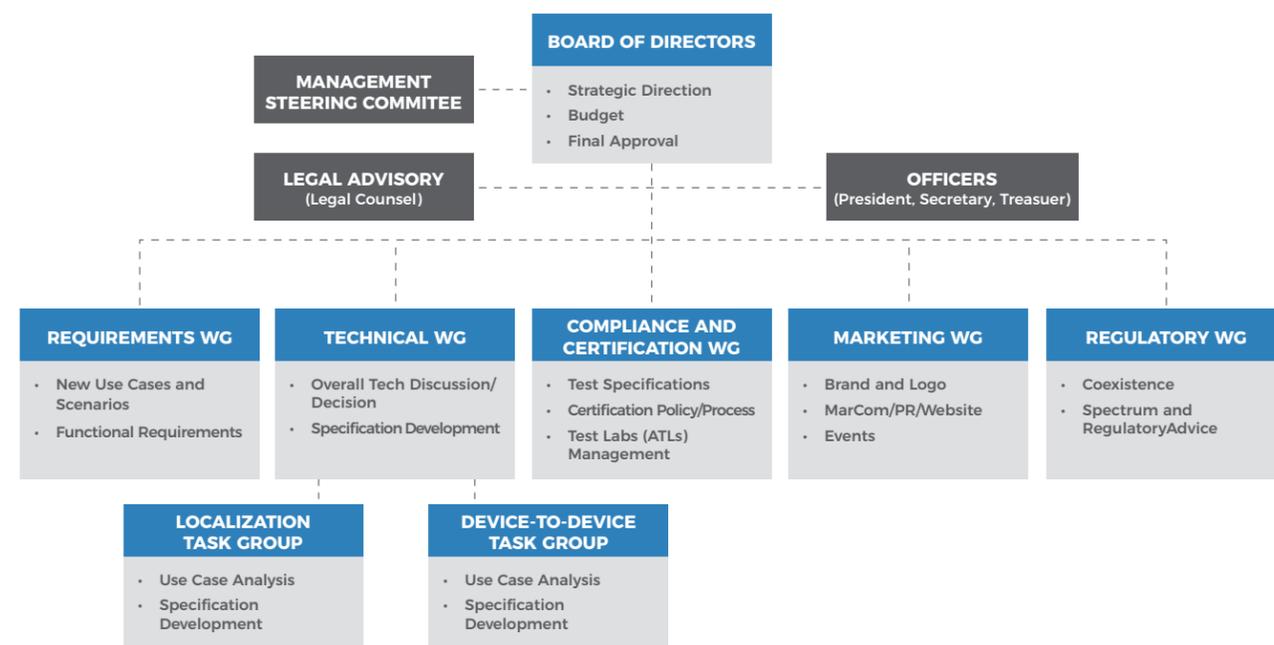


The Heart and Soul of FiRa – Our Working Groups

Technologies only endure when they are backed by strong, quality-driven infrastructure that enables rapid expansion. FiRa Consortium and our Working Groups foster this ecosystem and help:

- Evangelize UWB technology to industry players to encourage the development of building blocks, tools, and technologies to support the ecosystem.
- Liaise and collaborate with standards bodies and related consortia working on complementary technologies to enable UWB use cases.
- Advocate for UWB with Government and Regulatory bodies to drive fair spectrum rulings for UWB deployments.
- Promote UWB use cases to end-users to demonstrate unmatched capabilities now enabled in their world.

FiRa Working Groups are comprised of individuals who work tirelessly, and openly share their expertise.



The achievements of each Working Group are significant; we would like to highlight a few.

REQUIREMENTS WORKING GROUP (RWG)

2021 Achievements	2022 Priorities
Reviewed and introduced new and interesting UWB use cases and applications to enhance the FiRa ecosystem	Exploring new use cases related to UWB growth markets (i.e., mobile, IoT and RTLS)
Developed requirements documentation to support existing FiRa-specified use cases	Continuing work on the development of requirements documentation for UWB-enabled use cases
Collaborated with the FiRa Technical Working Group (TWG) and Marketing Working Group (MWG) on key UWB use case development and communications	



“Building a new seamless ecosystem starts with defining the potential use cases which drive the requirements of the technical specification. The RWG has continued to work on exciting and impactful new use cases that will create new UWB applications and markets with the potential to benefit millions of consumers.”

Ardavan Tehrani (Meta Platforms, Inc.)

Rias Al-Kadi (NXP Semiconductors)

Co-chairs

TECHNICAL WORKING GROUP (TWG)

2021 Achievements	2022 Priorities
<p>Developed specifications including:</p> <ul style="list-style-type: none"> • UWB MAC Technical Requirements, Version 1.3 • UWB PHY Technical Requirements, Version 1.3 • UCI Technical Specification, Version 1.0 	<p>Publication of the FiRa Framework specifications</p> <ul style="list-style-type: none"> • Common Service Management Layer (CSML) • Bluetooth Low Energy Out-of-Band (BLE OOB) • Secure UWB Service API (SUSAPI)
<p>Created two new task groups to update and enhance FiRa specifications to support the use of UWB technology in new sectors including smart home, find my device, transportation payment, and location-based services</p>	<p>Enhancing the FiRa Base specifications (PHY, MAC, UWB Controller Interface (UCI)) to support additional use cases</p>



“As interest and excitement around UWB technology continues to grow, new individuals have joined the TWG, providing new perspectives and expertise in the development of specifications. We look forward to developing new features to enhance the technical specifications to support new use cases that will expand the FiRa-certified ecosystem.”

Karthik Srinivasa Gopalan (Samsung R&D Institute India - Bangalore)

Brian Redding (Qualcomm Technologies, Inc.)

Co-chairs

COMPLIANCE & CERTIFICATION WORKING GROUP (CCWG)

2021 Achievements	2022 Priorities
<p>Validated the MAC Conformance Test Tool (MCTT), PHY Conformance Test Tool (PCTT) and Interoperability Test Tool (ITT)</p>	<p>Evolving the MAC/PHY certification criteria to support new use cases</p>
<p>Published the MAC Conformance Test Specification, PHY Conformance Test Specification and MAC/PHY Interoperability Test Specification</p>	<p>Authorizing additional test labs to provide testing services in other geographic areas of the world</p>
<p>Authorized four test labs to conduct official certification testing</p>	<p>Beginning certification of the framework middleware that sits on top of the MAC and PHY</p>
<p>Launched the FiRa Certification Program</p>	<p>Actively work with FiRa members to certify additional member devices</p>
<p>Announced the FiRa certification of three devices</p>	



“In 2021 the Compliance & Certification Working Group was focused on doing the foundational work that was necessary to support the launch of the FiRa Certification Program. As UWB gains momentum in the market, the Certification Program is an essential element to building an open technology ecosystem.”

Clint Chaplin (Samsung Research America)

Reinhard Meindl (NXP Semiconductors)

Co-chairs

MARKETING WORKING GROUP (MWG)

2021 Achievements	2022 Priorities
Evangelizing the capability of UWB technology through FiRa Presents video sessions, website content, webinars, podcasts, social media, and the production of other digital assets	Evangelizing the benefits of UWB and FiRa certification with industry analysts, the press, industry, etc.
Managing FiRa's international portfolio of trademarks to maximize FiRa's global name recognition	Supporting new initiatives to establish FiRa as the primary UWB industry consortium
Engaging with FiRa members via newsletters, internal surveys, and supporting member events with a UWB focus	
Collaborating with other FiRa Working Groups on events such as the FiRa Certification Program launch or the development of materials used in a variety of engagements with regulatory agencies, other consortia or potential FiRa members	



"As FiRa matures as an organization, the Marketing Working Group strives to support new initiatives and programs to establish FiRa as the primary industry consortium enabling the development and expansion of an interoperable UWB ecosystem."

Ardavan Tehrani (Meta Platforms, Inc.)

Debra Spitler (HID Global)

Co-chairs



REGULATORY WORKING GROUP (ReWG)

2021 Achievements	2022 Priorities
Engagement with an external law firm to develop a detailed petition to modify the FCC regulations for UWB in the United States	Filing a petition for rulemaking with the FCC (working in conjunction with other industry stakeholder consortia)
Active engagement in the regulatory process to modify regulations for UWB in Europe	Finalizing the UWB rules update in Europe
Collaboration with the UWB Alliance and other UWB proponents to coordinate global strategy for more favorable UWB regulations	



"The FiRa Regulatory Working Group's goal is to engage with regulators around the world to lower regulatory barriers for broad adoption of FiRa Certified UWB technology."

Dries Neiryck (Qorvo, Inc.)

Jim Lansford (Qualcomm Technologies, Inc.)

Co-chairs

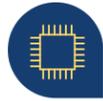


FiRa Achieves Major Milestones in 2021

TECHNICAL MILESTONES



Two FiRa member devices were tested against the MAC Conformance Test Tool (MCTT) for the first time.



Three FiRa member devices were tested against the MAC and PHY test tools.



Created two new task groups to update and enhance FiRa specifications to support the use of UWB technology in new sectors, including smart home, find my device, transportation payment, and location-based services.

FiRa validates the LitePoint PHY Conformance Test Tool (PCTT) as an official test platform to be used for PHY certification testing.

FiRa validates the Comarch MAC Conformance Test Tool (MCTT) as an official test platform to be used for MAC certification testing.



FiRa validates the Comarch Interoperability Test Tool (ITT) as an official test platform to be used for MAC and PHY interoperability testing.



Two FiRa member devices were tested against the MAC/PHY Interoperability Test Tool (ITT) for the first time.



Three specifications were released in support of the launch of the FiRa base Certification Program.

- UWB MAC Technical Requirements Version 1.3
- UWB PHY Technical Requirements Version 1.3
- UCI Generic Specification Version 1.1

Six FiRa member devices were tested in a large-scale interoperability test bed.



FEB

MAY

JUN

JUL

AUG

SEP

OCT

DEC



FiRa Consortium launches the FiRa Presents video series to promote UWB technology and use cases.



FiRa Consortium joins ETSI as a member, providing FiRa with the opportunity to be involved in drafting the Harmonized Standards that FiRa members need to use to certify their devices. Membership also provides FiRa with the right to participate in other regulatory bodies in Europe, helping to ensure that European UWB regulations align with how UWB technology will be used.

FiRa reaches milestone of having 100 members!



Four test labs passed their on-site assessment to become the first Authorized Test Labs (ATLs), enabling them to conduct official FiRa certification testing.



The FiRa Certification Program was launched!



Three devices were FiRa Certified!

ECOSYSTEM BUILDING MILESTONES

Join FiRa Now!

The FiRa Consortium enables its members to maximize the benefits of UWB technology for their brand:

- Demonstrate leadership in wireless innovation
- Explore new market opportunities
- Get innovative products to market faster
- Sell products and solutions more easily because they are part of an open and interoperable ecosystem

Joining is easy!

1. Choose the membership level that is right for your organization
2. Review the FiRa Governing Documents
3. Complete and submit the Membership Application
4. Get involved!

More details: <https://www.firaconsortium.org/membership/information>



“The FiRa Consortium has created an incomparable platform that removes the barrier to UWB-based interaction between mobile phones and smart devices and makes innumerable UWB-driven applications possible. FiRa members are expecting more participants to join forces to build a more powerful ecosystem, explore the infinity in this industry, and embrace a promising future.”

Darren Liu

Product Director
Tsingol



“Meta Platforms, Inc. is committed to supporting FiRa through active engagement including acting in leadership roles in multiple working groups, by developing new impactful use cases, driving regulatory initiatives and contributing to UWB specification development. We look forward to collaborating with other members in building another successful year for FiRa Consortium.”

Chunyu Hu, PhD

Director, Wireless Standards
Reality Labs, Meta Platforms, Inc.



“As a platform provider, we want to be actively involved in the normalization work led by FiRa, and help shape the future of UWB technology with ecosystem-wide scale and interoperability.”

Amol Tuli

FiRa Board Member
Head of Standards, Android Connectivity, Google

About FiRa Consortium

Headquartered in Beaverton, OR, the FiRa Consortium is a member-driven organization dedicated to the development and widespread adoption of seamless user experiences using the secured fine ranging and positioning capabilities of Ultra-Wideband (UWB) technologies. To learn more about the FiRa Consortium, visit www.firaconsortium.org.

January 2022

© 2022 FiRa Consortium. All rights reserved. FiRa, FiRa Consortium, the FiRa logo, the FiRa Certified logo, and FiRa tagline are trademarks or registered trademarks of FiRa Consortium or its licensor(s)/supplier(s) in the US and other countries and may not be used without permission. All other trademarks, service marks, and product or service names are trademarks or registered trademarks of their respective owners.