

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF TEXAS
AUSTIN DIVISION

THL Holding Company, LLC,

Plaintiff,

v.

Apple, Inc.

Defendant.

Case No. 1:23-cv-548-OLG

JURY TRIAL DEMANDED

**THL'S DISCLOSURE OF ASSERTED CLAIMS
AND INFRINGEMENT CONTENTIONS**

Plaintiff THL Holding Company, LLC (“THL”) hereby makes the following disclosure of asserted claims and infringement contentions with respect to U.S. Patent No. 11,350,246, U.S. Patent No. 11,265,680, and U.S. Patent No. 8,768,381 (collectively, the “Patents-in-Suit”), to Defendant Apple, Inc. (“Apple”).

THL’s investigation is ongoing. Accordingly, these disclosures are based on information available to THL at this time and THL’s present interpretation of the asserted claims. THL reserves the right to amend or supplement this disclosure after further discovery from Apple, particularly documents and other discovery, including specifications and testimony regarding Apple’s Accused Instrumentalities. THL reserves the right to amend or supplement this disclosure after receiving Apple’s proposed claim constructions and/or the Court’s claim constructions. THL reserves the right to amend or supplement this disclosure after receiving Apple’s non-infringement contentions. THL also reserves the right to accuse different instrumentalities or identify alternative literal and/or equivalent infringing elements in THL’s Accused Instrumentalities.

A. Identification of Asserted Claims

THL asserts that Apple has infringed and continues to infringe at least claims 1-8 and 11-27 of the ’246 Patent.

THL asserts that Apple has infringed and continues to infringe at least claims 1, 3-8, 10, 15 and 17-18 of the ’680 Patent.

THL asserts that Apple has infringed and continues to infringe at least claims 1 and 7-9 of the ’381 Patent.

As explained above, THL believes that discovery from Apple and others will provide additional evidence of the nature and/or scope of Apple’s infringement. Accordingly, THL reserves the right to amend, supplement, or otherwise revise the Asserted Claims.

B. Identification of Accused Instrumentalities

THL asserts that Apple infringes the Asserted Claims of the Patents-In-Suit through specific implementations of Apple’s “Find My” application operating in conjunction with specific hardware on Apple devices including but not limited to all versions and generations of: iPhone, iPad, Watch, AirTags, AirPods, MagSafe Charging Case, and MacPro made, sold or licensed, offered for sale or licensed, and imported in the United States from February 9, 2017 through trial in this matter that perform as described and illustrated in Exhibit A (the “Accused Instrumentalities”).

Exhibit A is a claim chart explaining how the Accused Instrumentalities infringe the Asserted claims of the Patents-In-Suit. THL’s investigation is ongoing. Accordingly, the attached claim chart is based on information available to THL at this time and THL’s present interpretation of the asserted claims. THL reserves the right to amend or supplement this chart after further discovery from Apple, particularly specifications, depositions, and other discovery regarding Apple’s Accused Instrumentalities. THL reserves the right to amend or supplement this chart after receiving Apple’s proposed claim constructions and/or the Court’s claim constructions. THL reserves the right to amend or supplement this chart after receiving Apple’s non-infringement contentions. THL also reserves the right to accuse different instrumentalities or identify alternative literal and/or equivalent infringing elements in THL’s Accused Instrumentalities.

Neither the Accused Instrumentalities nor THL’s infringement contentions are limited to the specifically listed models above but also include all versions and generations of Apple products and applications made, sold or licensed, offered for sale or licensed and imported in the United States from February 9, 2017 through trial in this matter that operate in a manner substantially similar to that described in the attached chart. For example and without limitation,

at the time this chart was prepared, Apple released the iPhone in versions 14 and 14 Pro, the Apple Watch in versions 8, SE and Ultra and the iPad, iPad mini, iPadAir and iPadPro. THL understands that Apple will release new versions and generations of these products while this case is pending. To the extent those new versions of Apple products perform the identified functions in a manner substantially similar to the versions of those products illustrated in this chart, those new versions too are Accused Instrumentalities as of the date they are first made, sold or licensed, offered for sale or license, and/or and imported in the United States by Apple.

DATED: May 30, 2023

Respectfully submitted,

By: /s/ Marc Lorelli

Frank A. Angileri (MI-P45611)

John S. LeRoy (MI-P61964)

Marc Lorelli (MI-P63156)

BROOKS KUSHMAN P.C.

1000 Town Center, 22nd Floor

Southfield, MI 48075

(248) 358-4400/ F: (248) 358-3351

fangileri@brookskushman.com

jleroy@brookskushman.com

mlorelli@brookskushman.com

Charles L. Ainsworth

State Bar No. 00783521

PARKER, BUNT & AINSWORTH, P.C.

100 E. Ferguson, Suite 418

Tyler, Texas 75702

(903) 531-3535

charley@pbatyler.com

Attorneys for Plaintiff, THL Holding

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the foregoing instrument was served or delivered electronically to all counsel of record, on May 30, 2023.

/s/ Nicole Wancour
Nicole Wancour

Exhibit A

THL Holding Company, LLC, v. Apple, Inc.

THL's Infringement Chart

U.S. Patent No. 11,350,246

U.S. Patent No. 11,265,680

U.S. Patent No. 8,768,381

This claim chart provides representative examples of how the Accused Instrumentalities infringe the Asserted claims of the Patents-In-Suit. THL's investigation is ongoing. Accordingly, this claim chart is based on information currently available to THL and THL's present interpretation of the asserted claims.

Neither the Accused Instrumentalities nor THL's infringement contentions are limited to the specifically illustrated models above but also include ***all*** versions and generations of Apple products and applications made, sold or licensed, offered for sale or licensed and imported in the United States from February 9, 2017 through trial in this matter that operate in a manner substantially similar to that described in the attached chart.

For example, and without limitation, at the time this chart was prepared, Apple released the iPhone in versions 14 and 14 Pro, the Apple Watch in versions 8, SE and Ultra and the iPad, iPad mini, iPadAir and iPadPro. THL understands that Apple will release new versions and generations of these products while this case is pending. To the extent those new versions of Apple products perform functions in a manner substantially similar to the versions of the products illustrated in this chart, those new versions too are Accused Instrumentalities as of the date they are first made, sold or licensed, offered for sale or license, and/or imported in the United States by Apple.

THL reserves the right to amend or supplement this chart after further discovery from Apple, particularly specifications, depositions, and other discovery regarding Apple's Accused Instrumentalities. THL reserves the right to amend or supplement this chart after receiving Apple's proposed claim constructions and/or the Court's claim constructions. THL reserves the right to amend or supplement this chart after receiving Apple's non-infringement contentions. THL also reserves the right to accuse different instrumentalities or identify alternative literal and/or equivalent infringing elements in THL's Accused Instrumentalities.

1. A mobile communication device comprising:
 a plurality of wireless transceivers including a **Bluetooth transceiver**, a **long-range transceiver configured to send and receive telephone calls via a telephony network and to communicate Internet data**, and **one or more ultra-wideband transceivers**

iPhone 11

■ **All models**
 Gigabit-class LTE with 2x2 MIMO and LAA⁶
 802.11ax Wi-Fi 6 with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁷
 NFC with reader mode
 Express Cards with power reserve

■ **Model A2111***
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, GSM/EDGE (850, 900, 1800, 1900 MHz)

support.apple.com/kb/
 SP804?locale=en_US

iPhone 12

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
 Gigabit LTE with 4x4 MIMO and LAA⁷
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁸
 NFC with reader mode
 Express Cards with power reserve

Model A2172* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2178* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

iPhone 13

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
 Gigabit LTE with 4x4 MIMO and LAA⁷
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁸
 NFC with reader mode
 Express Cards with power reserve

Model A2481* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2482* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

iPhone 14

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁸
 Gigabit LTE with 4x4 MIMO and LAA⁸
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.3
 Ultra Wideband chip for spatial awareness⁹
 NFC with reader mode
 Express Cards with power reserve

Model A2649* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2632* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

https://www.apple.com/iphone-14/specs/

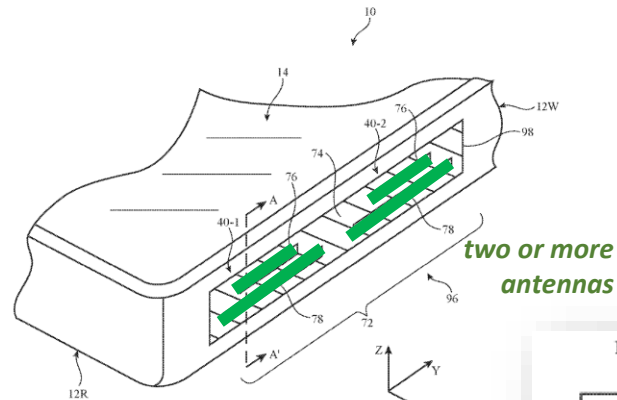
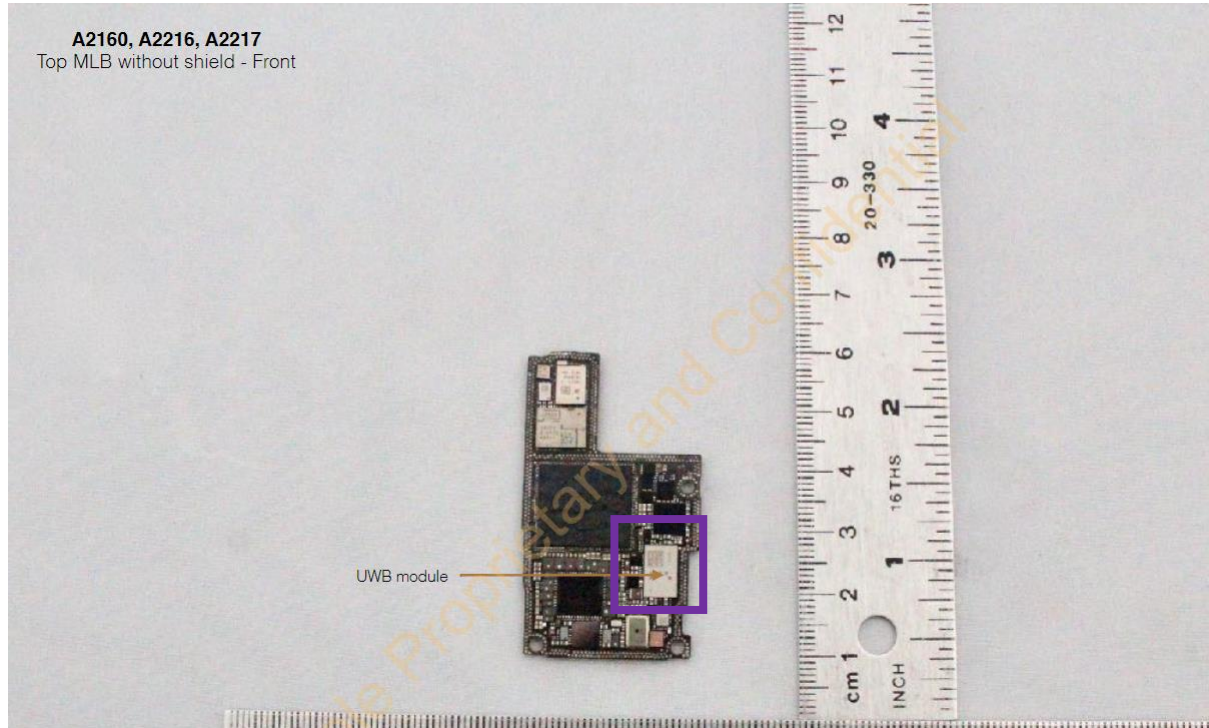


Diagram illustrating a UWB transceiver system (36) connected to two antennas (40-1 and 40-2) via cables (50-1 and 50-2). The antennas are positioned at a distance d_1 from each other. A dashed line indicates a distance d_2 from antenna 40-1 to a point on the surface 56. The distance from antenna 40-2 to the same point on the surface 56 is labeled a . The distance from antenna 40-1 to antenna 40-2 is labeled b . The surface 56 is shown as two intersecting planes. A right-angle symbol is shown at the point on surface 56. A bracket 72 groups the antennas 40-1 and 40-2. A dashed line connects the two antennas, and a dashed line connects antenna 40-1 to a point on surface 56. A right-angle symbol is shown at this point. The label 10 points to the dashed line connecting the antennas.

IPR2024-00397

one or more ultra-wideband transceivers coupled to two or more antennas;

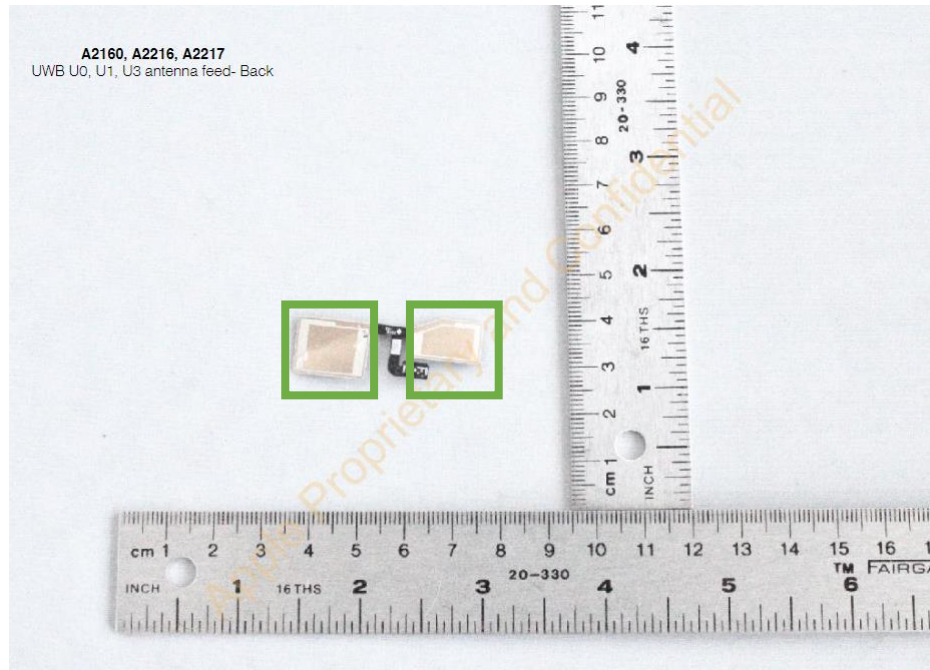
U.S. Patent No. 11,350,246



iPhone 11 UWB module (ultra-wideband transceiver)
(<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

one or more **ultra-wideband** transceivers **coupled to two or more antennas**;

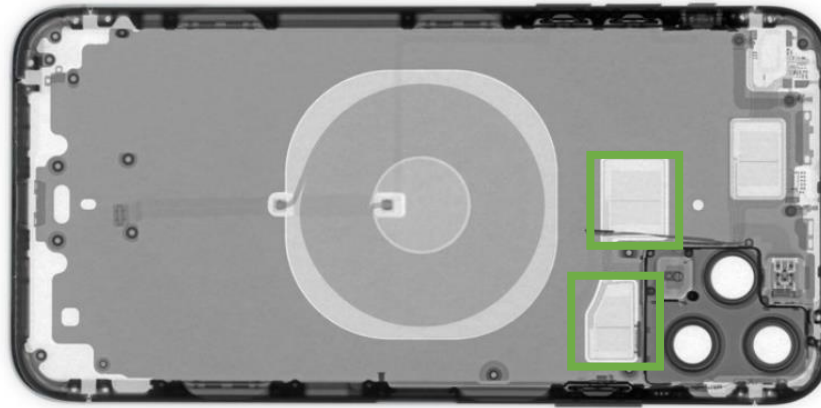
U.S. Patent No. 11,350,246



iPhone 11 UWB (ultra-wideband) antenna feed showing 2 antennas
(<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

one or more **ultra-wideband** transceivers **coupled to two or more antennas**;

U.S. Patent No. 11,350,246



iPhone 11 Pro teardown showing UWB antennas

(<https://www.ifixit.com/Teardown/iPhone+11+Pro+Max+Teardown/126000#s243578>)

“Apple’s **UWB antennas** are the squares within the rectangle metal voids, to the right of the “ring” which charges the iPhone wirelessly.”

(<https://newaer.com/apple-iphone-11-adds-uw-b-proximity-detection/>)

one or more ultra-wideband transceivers coupled to two or more antennas;

U.S. Patent No. 11,350,246

From ChatGPT:

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

Apple's UWB technology page also confirms that the U1 [ultra-wideband IC] chip includes a **UWB radio** and **antenna array with two separate antennas**.

From ChatGPT:

https://www.apple.com/business/docs/site/Apple_U1_Ultra_Wideband.pdf

Apple's white paper on **UWB technology**, which explains the use of **antenna arrays** for AoA [Angle of Arrival]

a **memory** that stores operational instructions;
 a **touch screen**; and
 a **processor** coupled to the plurality of wireless transceivers, the
 memory and the touch screen

iPhone 11

- 64GB
- 128GB
- 256GB

4 GB RAM



support.apple.com/kb/SP804?locale=en_US

iPhone 12

- 64GB
- 128GB
- 256GB

4/6 GB RAM



apple.com/iphone-12/specs

iPhone 13

- 128GB
- 256GB
- 512GB

4/6 GB RAM



apple.com/iphone-13/specs

iPhone 14

- 128GB
- 256GB
- 512GB

6 GB RAM



apple.com/iphone-14/specs

wherein the processor is configured to execute the operational instructions, which upon execution, cause the processor to:

present a **graphical user interface** via the touch screen;

in response to a **pair request** from a user received at the graphical user interface, pair the mobile communication device with **at least one remote device**;

Set up your AirTag

1. Make sure that your device is ready for setup.
2. If your AirTag is new, remove the wrap around the product and pull out the tab to activate the battery. Your AirTag will play a sound.
3. Hold your AirTag near your iPhone, iPad, or iPod touch, then tap Connect.* If you have multiple AirTags and see "More than one AirTag detected", make sure that only one AirTag is near your device at one time. [Need help connecting your AirTag?](#)
4. Select an item name from the list, or select Custom Name to name your AirTag and choose an emoji. Then tap Continue.
5. To register your AirTag with your Apple ID, tap Continue again.
6. Tap Done.

Now you can attach your AirTag to your item and see it in the Find My app.

* You can also set up your AirTag in the Find My app. Tap the Items tab, then tap Add Item.



at least one remote device

Connect your AirPods and AirPods Pro to your iPhone

Learn how to use your iPhone to set up your AirPods.

If you're setting up your AirPods for the first time, make sure that you have an iPhone with the [latest version of iOS](#). Then follow these steps:

1. Go to the Home Screen.
2. With your AirPods in the charging case, open the charging case, and hold it next to your iPhone. A setup animation appears on your iPhone.
3. Tap Connect.
4. If you have AirPods Pro (1st or 2nd generation) or AirPods (3rd generation), read the next three screens.
5. If you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation) and you set up "Hey Siri" on your iPhone already, then "Hey Siri" is ready to use with your AirPods. If you haven't set up "Hey Siri" already and you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation), you'll be guided through the setup.
6. Tap Done.

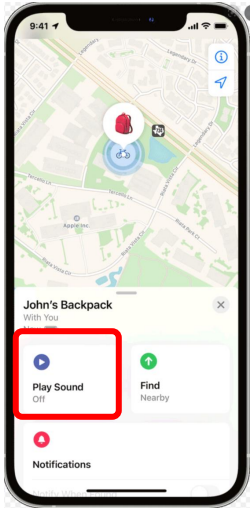


at least one remote device

<https://support.apple.com/en-us/HT207010>

support.apple.com/en-us/HT210973

in response to an **audio alert request** from the user received at the graphical user interface, transmit an **audio alert request signal to the at least one remote device via the Bluetooth transceiver;**



Play a sound

1. Open the Find My app on your iPhone, iPad, or iPod touch, then tap the Items tab.
2. Choose the AirTag you want to play a sound in the Items list.
3. Tap Play Sound . ¹ If your AirTag is within Bluetooth range, it will play a sound.
4. To stop playing this sound before it ends automatically, tap Stop Sound.

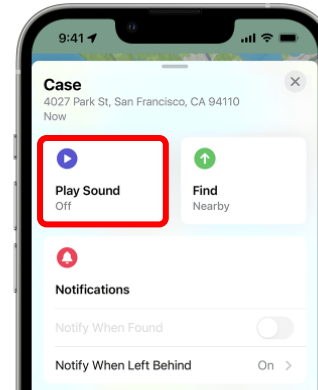
support.apple.com/en-us/HT210967



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, you can play a sound to help you find them. With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>



estimate a **distance** between the **mobile communication device** and the **at least one remote device** based on **ultra-wideband communication between the one or more ultra-wideband transceivers** and the **at least one remote device** and **time of flight calculations**;



US 20200259258A1

(19) **United States**(12) **Patent Application Publication**

Amiri et al.

(10) Pub. No.: **US 2020/0259258 A1**(43) Pub. Date: **Aug. 13, 2020**

(54) **ELECTRONIC DEVICE HAVING
MULTI-FREQUENCY ULTRA-WIDEBAND
ANTENNAS**

(52) **U.S. CL.**
CPC **H01Q 5/25** (2015.01); **H01Q 1/24**
(2013.01); **H01Q 9/16** (2013.01)

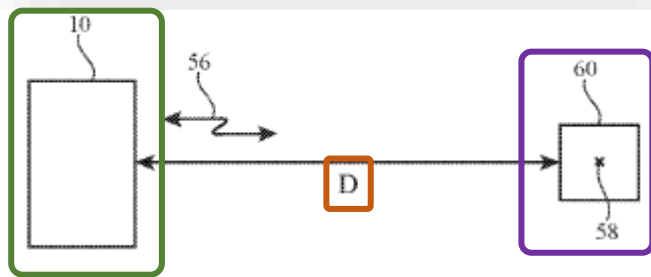


FIG. 4

[0071] In one suitable arrangement, device **10** may determine the **distance** between the **device 10** and **node 60** and the orientation of device **10** relative to node **60** using **two or more ultra-wideband antennas**. The ultra-wide band antennas may receive radio-frequency signals from node **60** (e.g., radio-frequency signals **56** of FIG. 4). Time stamps in the wireless communication signals may be analyzed to determine the time of flight of the wireless communication signals and thereby determine the distance (range) between device **10** and node **60**. Additionally, angle of arrival (AoA)

estimate a **distance** between the **mobile communication device** and the **at least one remote device** based on **ultra-wideband communication between the one or more ultra-wideband transceivers** and the **at least one remote device** and **time of flight calculations**;

From CNET:

Apple's Senior Vice President of Worldwide Marketing, Phil Schiller, mentioned that the **iPhone 11** uses **UWB technology** for "**spatial awareness**".

<https://www.cnet.com/news/apple-iphone-11-uses-ultra-wideband-what-is-it-and-what-can-it-do/>

From ChatGPT:

Apple's official UWB technology page mentions that the U1 chip with UWB technology "measures **distance** by **calculating the time it takes for a radio wave to travel between two devices that support Ultra Wideband**."

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

determine a **direction** to the **at least one remote device** based on **signal delay of ultra-wideband communications between the two or more antennas and the at least one remote device**; and



US 20200259258A1

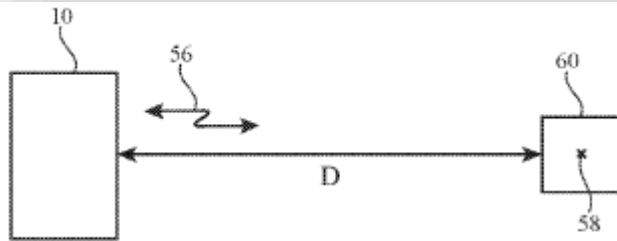
(19) **United States**(12) **Patent Application Publication**
Amiri et al.(10) Pub. No.: US 2020/0259258 A1
(43) Pub. Date: Aug. 13, 2020(54) ELECTRONIC DEVICE HAVING
MULTI-FREQUENCY ULTRA-WIDEBAND
ANTENNAS(52) U.S. CL.
CPC H01Q 5/25 (2015.01); H01Q 1
(2013.01); H01Q 9/16 (2013.01)

FIG. 4

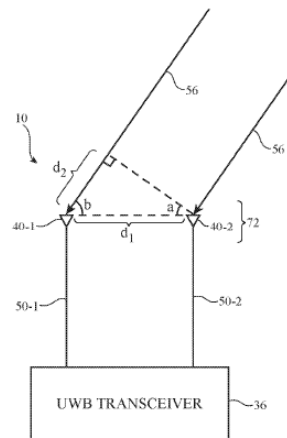


FIG. 6

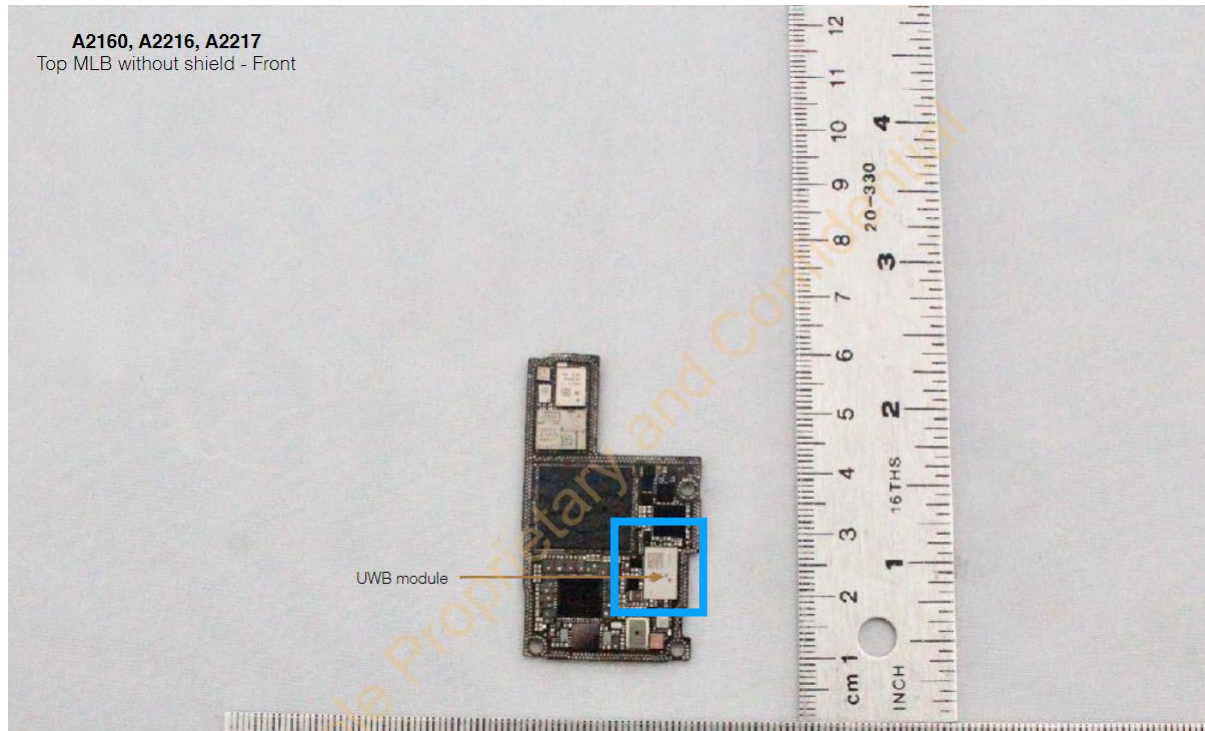
Additionally, angle of arrival (AoA) measurement techniques may be used to determine the orientation of electronic device 10 relative to node 60 (e.g., azimuth angle θ and elevation angle ϕ).

[0072] In angle of arrival measurement, node 60 transmits a radio-frequency signal to device 10 (e.g., radio-frequency signals 56 of FIG. 4). Device 10 may measure a delay in arrival time of the radio-frequency signals between the two or more ultra-wideband antennas. The delay in arrival time (e.g., the difference in received phase at each ultra-wideband antenna) can be used to determine the angle of arrival of the radio-frequency signal (and therefore the angle of node 60 relative to device 10). Once distance D and the angle of arrival have been determined, device 10 may have knowledge of the precise location of node 60 relative to device 10.

[0073] FIG. 6 is a schematic diagram showing how angle of arrival measurement techniques may be used to determine the orientation of device 10 relative to node 60.

determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications** between the two or more antennas and the at least one remote device; and

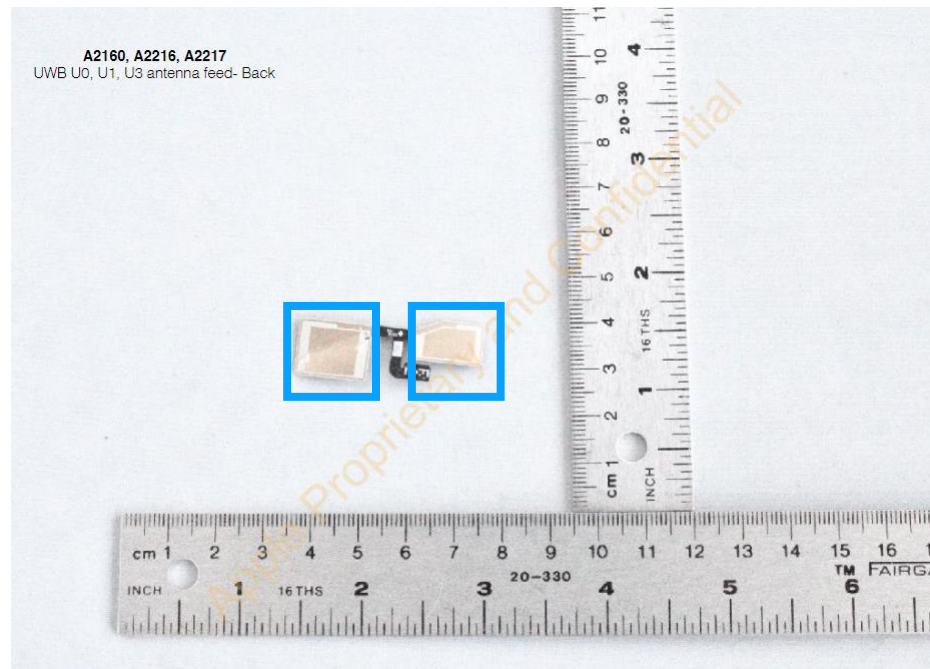
U.S. Patent No. 11,350,246



iPhone 11 UWB module (ultra-wideband transceiver)
(<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

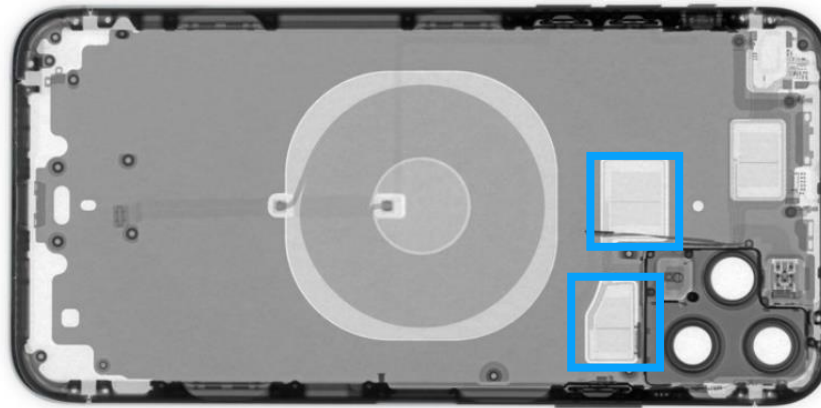
determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications between the two or more antennas** and the at least one remote device; and

U.S. Patent No. 11,350,246



iPhone 11 UWB (ultra-wideband) antenna feed showing 2 antennas
(<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications between the two or more antennas** and the at least one remote device; and



iPhone 11 Pro teardown showing UWB antennas

(<https://www.ifixit.com/Teardown/iPhone+11+Pro+Max+Teardown/126000#s243578>)

“Apple’s **UWB antennas** are the squares within the rectangle metal voids, to the right of the “ring” which charges the iPhone wirelessly.”

(<https://newaer.com/apple-iphone-11-adds-uw-b-proximity-detection/>)

determine a **direction to the at least one remote device based on signal delay** of **ultra-wideband communications between the two or more antennas** and the at least one remote device; and

From ChatGPT:

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

Apple's UWB technology page also confirms that the U1 [ultra-wideband IC] chip includes a **UWB radio** and **antenna array with two separate antennas**.

From ChatGPT:

https://www.apple.com/business/docs/site/Apple_U1_Ultra_Wideband.pdf

Apple's white paper on **UWB technology**, which explains the use of **antenna arrays** for **AoA [Angle of Arrival - direction]**

output to the **graphical user interface** the **estimated distance to the at least one remote device** and **an arrow pointing in the direction of the at least one remote device**.

U.S. Patent No. 11,350,246



arrow pointing in the direction of the at least one remote device

estimated distance to the at least one remote device

Use Precision Finding to pinpoint the location of your item

If you have a [supported iPhone model with Ultra Wideband](#) and your AirTag is nearby,¹ you can tap Find Nearby to help find it, even if it's stuck between couch cushions or hiding under a stack of mail.

<https://support.apple.com/en-us/HT210967>

Overview

Rebuilt from the sound up

AirPods Pro (2nd generation) have been reengineered to deliver up to 2x more Active Noise Cancellation. Adaptive Transparency reduces external noise, while Personalized Spatial Audio immerses you in sound. A single charge delivers up to 6 hours of battery life.² And Touch control lets you easily adjust volume with a swipe. The revamped MagSafe Charging Case is a marvel on its own with Precision Finding³, built-in speaker, and lanyard loop.⁴

apple.com/shop/product/MQD83AM/A/airpods-pro

AirPods User Guide

Search this guide

[Table of Contents](#)

Ultra Wideband information

Ultra Wideband is available on the MagSafe Charging Case for AirPods Pro (2nd generation), and availability varies by region.

Ultra Wideband is only active when the charging case is in close proximity to a paired Ultra Wideband-compatible Apple device and during a user-triggered finding session.

Ultra Wideband must be turned off when onboard aircraft, ships, and other prohibited regions by turning on airplane mode on a paired Ultra Wideband-compatible Apple device. To turn on airplane mode on a paired Ultra Wideband-compatible Apple device, open Control Center, then tap . You can also turn Airplane mode on or off in Settings . When airplane mode is on, appears in the status bar.

Ultra Wideband features require a paired Ultra Wideband-compatible Apple device.

Australia: Ultra Wideband transmitters must not be operated within a nominated distance from specified Australian radio-astronomy sites. For further information about nominated distance, please refer to the Radiocommunications (Low Interference Potential Devices) Class Licence 2015 published by the Australian Communications and Media Authority.

<https://support.apple.com/guide/airpods/ultra-wideband-information-dev4a13375fb/web>

2. The mobile communication device of claim 1, wherein the operational instructions, upon execution, further cause the processor to output to the touch screen an estimated position of the at least one remote device **based on information received at one of the plurality of wireless transceivers via a wireless network.**

AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. **The Find My network can help you track down items on a map.** You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

You can even find devices that are offline.

If your missing device can't connect to the internet, **the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world.** Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

Lost Mode makes finding things even easier.

Just like your other Apple devices, AirTag can be put into Lost Mode. **Then, when it's detected by a device in the network, you'll automatically get a notification.** You can also set it so someone can get your contact info by tapping your AirTag with an NFC-capable smartphone — that's the same technology that lets people pay for things with their phones.

3. The mobile communication device of claim 2, wherein, the operational instructions, upon execution, further cause the processor to output on the touch screen the estimated position of the at least one remote device **based on information received from a second mobile communication device.**

AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. **The Find My network can help you track down items on a map.** You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

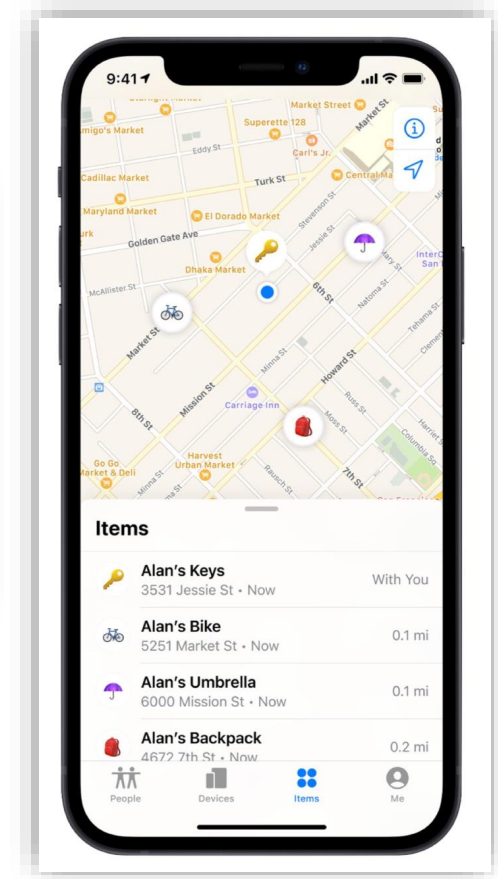
You can even find devices that are offline.

If your missing device can't connect to the internet, **the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world.** Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

apple.com/icloud/find-my/

Lost Mode makes finding things even easier.

Just like your other Apple devices, AirTag can be put into Lost Mode. **Then, when it's detected by a device in the network, you'll automatically get a notification.** You can also set it so someone can get your contact info by tapping your AirTag with an NFC-capable smartphone — that's the same technology that lets people pay for things with their phones.



4. The mobile communication device of claim 3, wherein the second mobile communication device is paired with the at least one remote device.

- At least AirPods can be paired to *both* the mobile communication device and the second mobile communication device.

Find your lost AirPods

Use Find My to locate your AirPods, AirPods Pro, or AirPods Max on a map and play a sound to find them.

About Find My

Find My is the only way that you can track or locate a lost or missing device. There is no other Apple service that can find, track, or otherwise flag your device for you.

To find your AirPods, you need to set up Find My with your iPhone, iPad, or iPod touch that you use with your AirPods. Before you try to find your AirPods, you should update to the latest version of [iOS or iPadOS](#), or [macOS](#).

You can also find your AirPods on the web at [iCloud.com](#). With some AirPods models, the experience on the web might be different and some functionality might not be available.

If you didn't turn on Find My before your AirPods went missing, you can't use Find My to locate them.

[Learn how to set up Find My >](#)

Locate your AirPods on a map

If you've lost or misplaced your AirPods, you might be able to find them if you use the Find My app on your iPhone, iPad, iPod touch, or Mac that you're signed in to with the same Apple ID. With AirPods Pro (2nd generation), you can also locate the charging case on the map if it's separated from your AirPods.

Locate your AirPods in the Find My app

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods. Under each device, you see a location or "No location found."

[If you can't locate your AirPods on the map](#) 😊

support.apple.com/en-us/HT207581

5. The mobile communication device of claim 3, wherein **the second mobile communication device is not paired with the at least one remote device.**

- The Apple Find My network can locate remote devices (AirPods, AirTags, Apple Watch) through iPhones that are not paired to those remote devices:

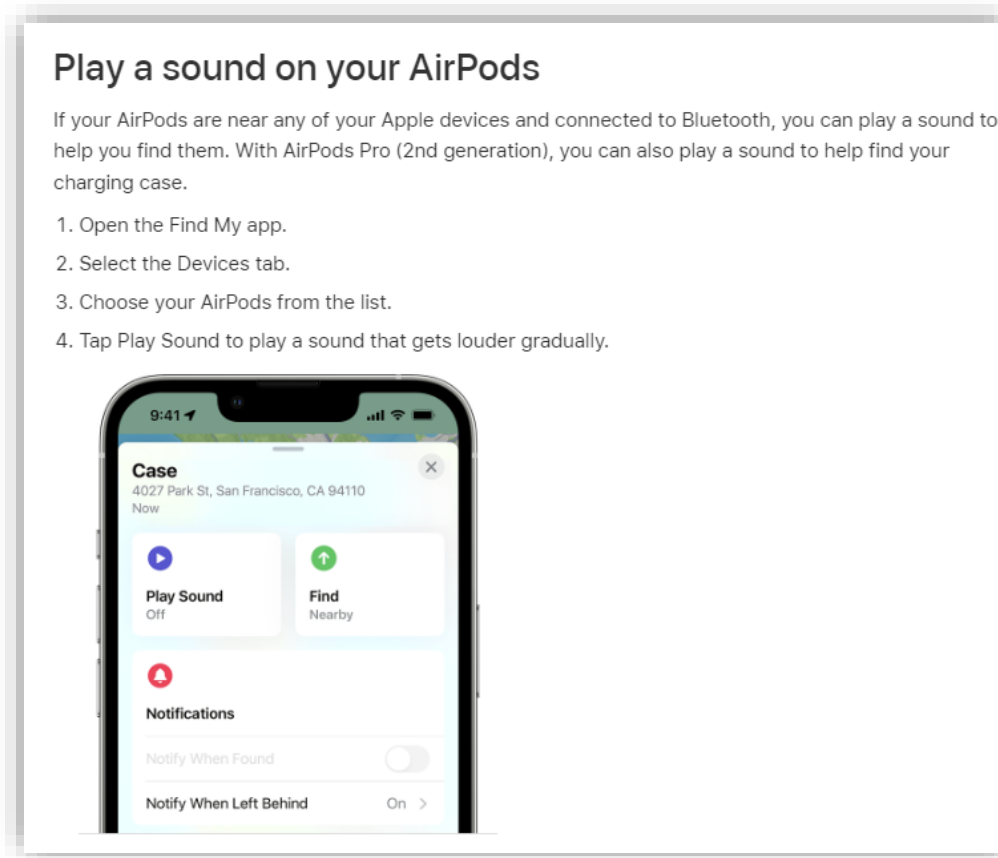
You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. **It's all anonymous and encrypted to protect everyone's privacy.**

apple.com/icloud/find-my/

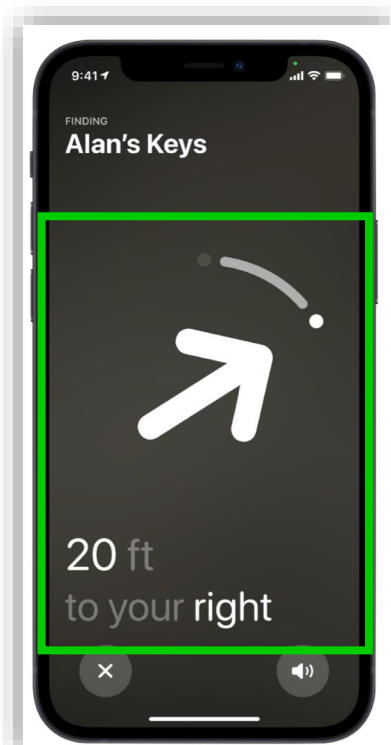
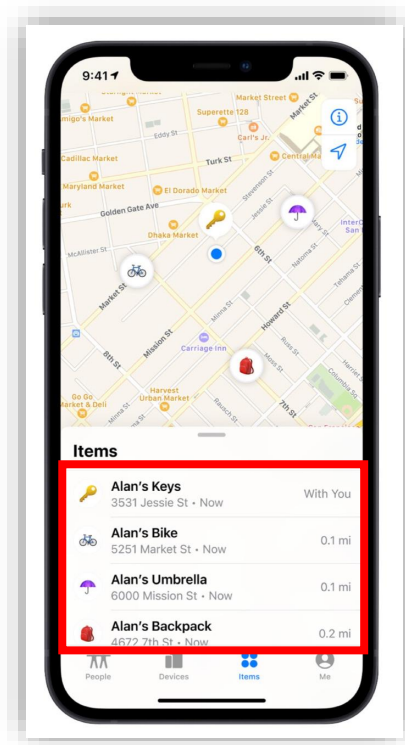
6. The mobile communication device of claim 3, wherein the operational instructions, upon execution, further cause the processor to transmit an audio alert request signal to the at least one remote device via the wireless network.

- At least AirPods can receive an audio alert request signal over a wireless network:

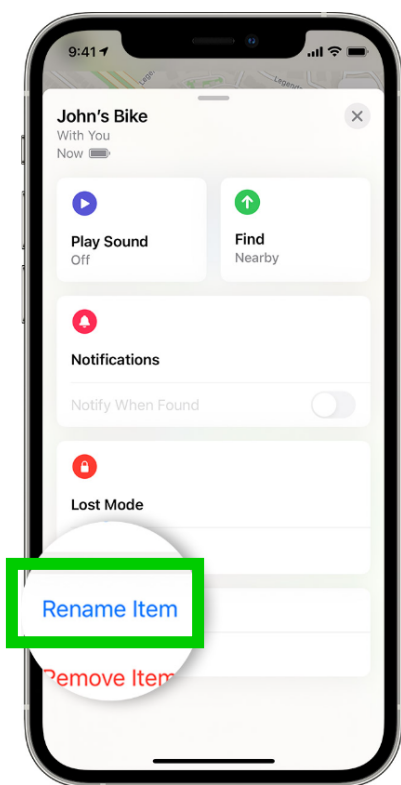


support.apple.com/en-us/HT207581

7. The mobile communication device of claim 6, wherein the at least one remote device includes a plurality of remote devices and wherein the operational instructions further cause the processor to (i) **output to the touch screen a representation of the plurality of remote devices**, (ii) **receive user input from the touch screen selecting one of the plurality of remote devices**, and (iii) **output to the touch screen the estimated distance to the selected one of the plurality of remote devices and the direction to the selected one of the plurality of remote devices**.



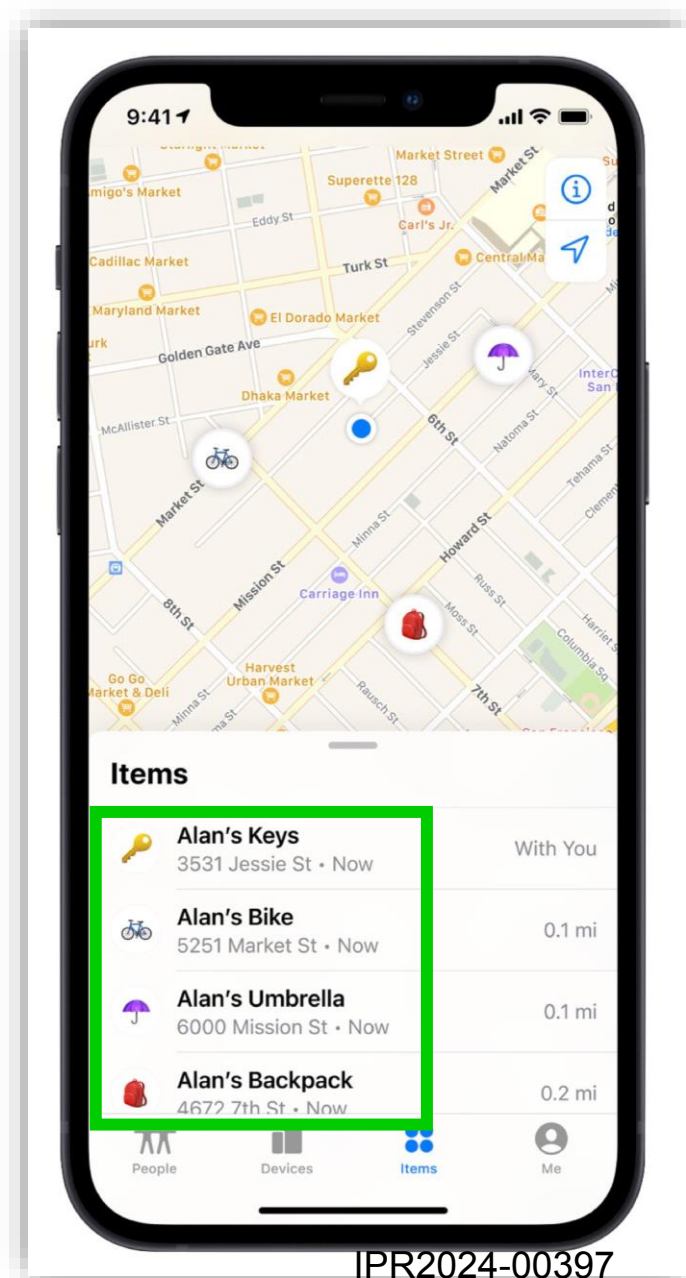
8. The mobile communication device of claim 7, wherein the operational instructions, upon execution, further cause the processor to receive input from the touch screen defining names for one or more of the plurality of remote devices.



Change the name of your AirTag

1. Open the Find My app, then tap the Items tab.
2. Tap the AirTag whose name or emoji you want to change.
3. Scroll down and tap Rename Item.
4. Select a name from the list or select Custom Name.
5. Type a custom name for your AirTag and select an emoji.
6. Tap Done.

support.apple.com/en-us/HT210973



IPR2024-00397

Apple EX1039 Page 32

11. A mobile communication device comprising:
 a **plurality of wireless transceivers including a Bluetooth transceiver**, **a long-range transceiver configured to send and receive telephone calls via a telephony network and to communicate Internet data**, and **one or more ultra-wideband transceivers coupled to two or more antennas**;

iPhone 11

■ **All models**
 Gigabit-class LTE with 2x2 MIMO and LAA⁶
 802.11ax Wi-Fi 6 with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁷
 NFC with reader mode
 Express Cards with power reserve

iPhone 12

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
 Gigabit LTE with 4x4 MIMO and LAA⁶
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁸
 NFC with reader mode
 Express Cards with power reserve

iPhone 13

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
 Gigabit LTE with 4x4 MIMO and LAA⁶
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.0 wireless technology
 Ultra Wideband chip for spatial awareness⁸
 NFC with reader mode
 Express Cards with power reserve

iPhone 14

All models 5G (sub-6 GHz and mmWave) with 4x4 MIMO⁸
 Gigabit LTE with 4x4 MIMO and LAA⁶
 Wi-Fi 6 (802.11ax) with 2x2 MIMO
 Bluetooth 5.3
 Ultra Wideband chip for spatial awareness⁹
 NFC with reader mode
 Express Cards with power reserve

■ **Model A2111***
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17,
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100,
 GSM/EDGE (850, 900, 1800, 1900 MHz)

[support.apple.com/kb/
 SP804?locale=en_US](https://support.apple.com/kb/SP804?locale=en_US)

Model A2172* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2176* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

Model A2481* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2482* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
 CDMA EV-DO Rev. A (800, 1900 MHz)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

Model A2649* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)
 Model A2632* 5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
 5G NR mmWave (Bands n258, n260, n261)
 FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
 TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
 UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
 GSM/EDGE (850, 900, 1800, 1900 MHz)

<https://www.apple.com/iphone-14/specs/>

 US 20200259258A1	
(19) United States	
(12) Patent Application Publication	(10) Pub. No.: US 2020/0259258 A1
Amiri et al.	(43) Pub. Date: Aug. 13, 2020
(54) ELECTRONIC DEVICE HAVING MULTI-FREQUENCY ULTRA-WIDEBAND ANTENNAS	(52) U.S. CL. CPC H01Q 5/25 (2015.01); H01Q 1/24 (2013.01); H01Q 9/16 (2013.01)
(71) Applicant: Apple Inc. , Cupertino, CA (US)	(57) ABSTRACT
(72) Inventors: Mikal Askarian Amiri , Tempe, AZ (US); Carlo di Nallo , Belmont, CA (US); David Garrido Lopez , Campbell, CA (US); Harish Rajagopalan , San Jose, CA (US); Nikolaj P. Kammergaard , København (DK); Rodney A. Gomez Angulo , Santa Clara, CA (US); Umar Azad , Santa Clara, CA (US)	An electronic device may be provided with control circuitry and doublets of first and second antennas that are used to determine the position and orientation of the device relative to external wireless equipment. The control circuitry may determine the relative position and orientation of the external equipment by measuring the angle of arrival of radio-frequency signals from the external equipment. Each doublet may include first and second cavity-backed slot antennas. The first and second antennas may each include a first slot element that is directly fed and a second slot element that is parasitically fed by the first slot element. The first slot element may radiate in an ultra-wideband communications band at 8.0 GHz and the second slot element may radiate in an ultra-wideband communications band at 6.5 GHz. The doublet may be aligned with a dielectric window in a conductive sidewall for the device.
(21) Appl. No.: 16/271,617	
(22) Filed: Feb. 8, 2019	
Publication Classification	
(51) Int. Cl. H01Q 5/25 (2006.01)	
H01Q 9/16 (2006.01)	
H01Q 1/24 (2006.01)	

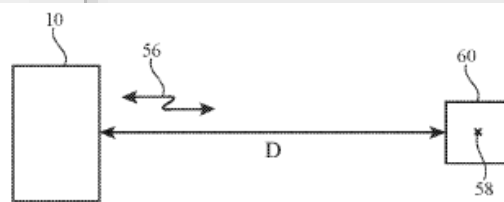
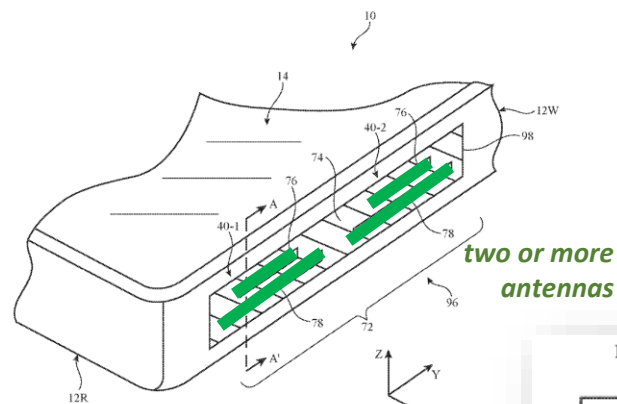


FIG. 4

[0073] FIG. 6 is a schematic diagram showing how angle of arrival measurement techniques may be used to determine the orientation of device 10 relative to node 60. As shown in FIG. 6, device 10 may include multiple antennas (e.g., a first antenna 40-1 and a second antenna 40-2) coupled to UWB transceiver circuitry 36 over respective transmission lines (e.g., a first transmission line 50-1 and a second transmission line 50-2).

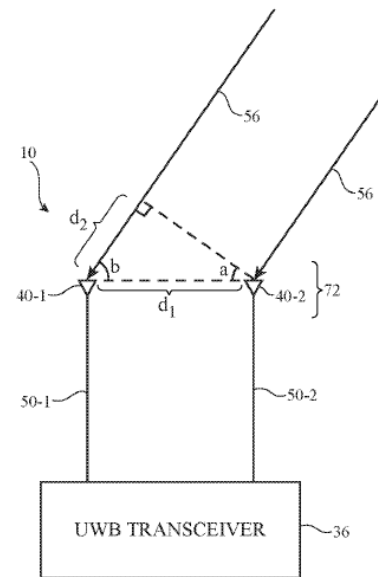
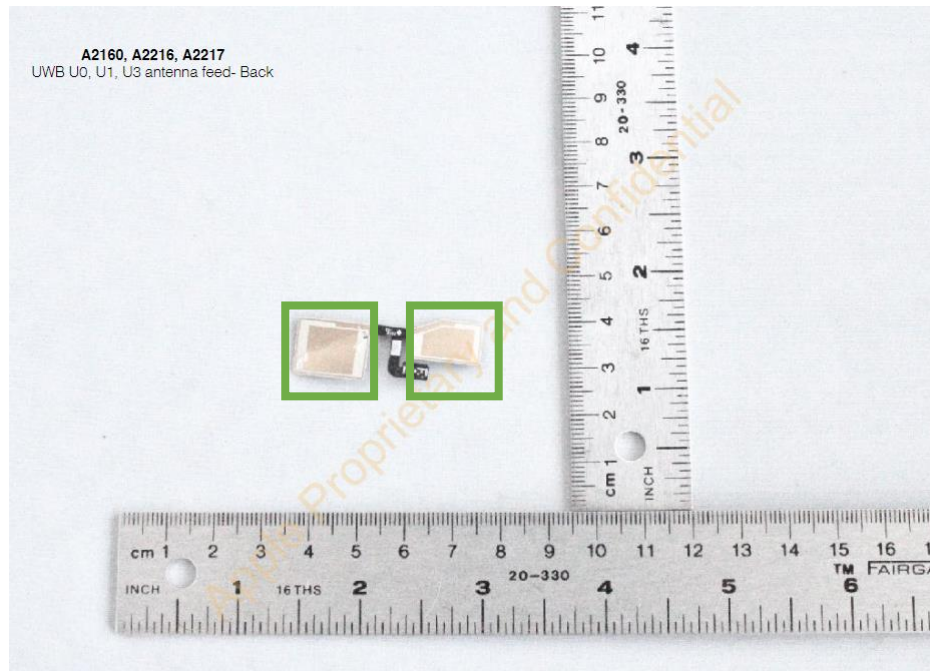


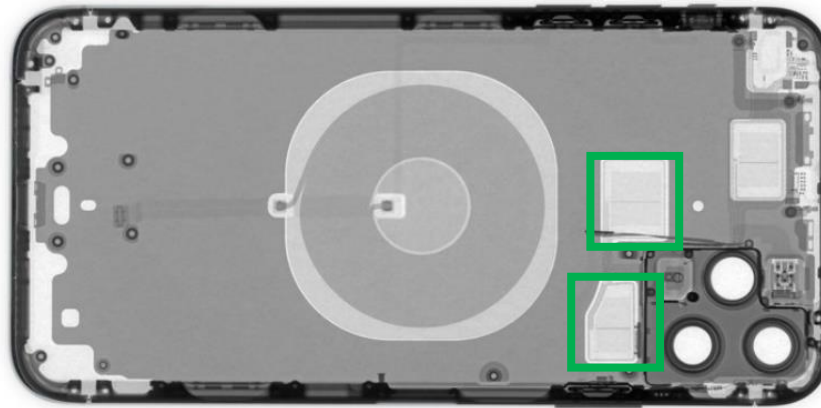
FIG. 6

coupled to **two or more antennas**;



iPhone 11 UWB (ultra-wideband) antenna feed showing 2 antennas
(<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

coupled to **two or more antennas**;



iPhone 11 Pro teardown showing UWB antennas

(<https://www.ifixit.com/Teardown/iPhone+11+Pro+Max+Teardown/126000#s243578>)

“Apple’s **UWB antennas** are the squares within the rectangle metal voids, to the right of the “ring” which charges the iPhone wirelessly.”

(<https://newaer.com/apple-iphone-11-adds-uw-b-proximity-detection/>)

coupled to **two or more antennas**;

From ChatGPT:

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

Apple's UWB technology page also confirms that the U1 [ultra-wideband IC] chip includes a UWB radio and **antenna array with two separate antennas**.

From ChatGPT:

https://www.apple.com/business/docs/site/Apple_U1_Ultra_Wideband.pdf

Apple's white paper on UWB technology, which explains the use of **antenna arrays** for AoA [Angle of Arrival - direction]

a **memory** that stores operational instructions;
 a **touch screen**;
 an **orientation sensor** to detect rotation of the mobile communication device; and
 a **processor** coupled to the plurality of wireless transceivers, the memory, the touch screen and the orientation sensor, wherein the processor is configured to execute the operational instructions, which upon execution, cause the processor to:

iPhone 11

■ 64GB
 ■ 128GB
 ■ 256GB
 4 GB RAM

Three-axis gyro



support.apple.com/kb/SP804?locale=en_US

iPhone 12

64GB
 128GB
 256GB
 4/6 GB RAM

Three-axis gyro



apple.com/iphone-12/specs

iPhone 13

128GB
 256GB
 512GB
 4/6 GB RAM

Three-axis gyro



apple.com/iphone-13/specs

iPhone 14

128GB
 256GB
 512GB
 6 GB RAM

Dynamic High Range Gyro



apple.com/iphone-14/specs

present a **graphical user interface** via the touch screen;

in response to a **pair request from a user** received at the graphical user interface, **pair the mobile communication device with at least one remote device**;

Set up your AirTag

1. Make sure that your device is ready for setup.
2. If your AirTag is new, remove the wrap around the product and pull out the tab to activate the battery. Your AirTag will play a sound.
3. Hold your AirTag near your iPhone, iPad, or iPod touch, then tap Connect.* If you have multiple AirTags and see "More than one AirTag detected", make sure that only one AirTag is near your device at one time. [Need help connecting your AirTag?](#)
4. Select an item name from the list, or select Custom Name to name your AirTag and choose an emoji. Then tap Continue.
5. To register your AirTag with your Apple ID, tap Continue again.
6. Tap Done.

Now you can attach your AirTag to your item and see it in [the Find My app](#).

* You can also set up your AirTag in the Find My app. Tap the Items tab, then tap Add Item.



support.apple.com/en-us/HT210973

Connect your AirPods and AirPods Pro to your iPhone

Learn how to use your iPhone to set up your AirPods.

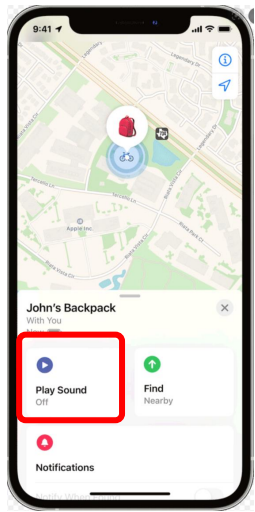
If you're setting up your AirPods for the first time, make sure that you have an iPhone with the [latest version of iOS](#). Then follow these steps:

1. Go to the Home Screen.
2. With your AirPods in the charging case, open the charging case, and hold it next to your iPhone. A setup animation appears on your iPhone.
3. Tap Connect.
4. If you have AirPods Pro (1st or 2nd generation) or AirPods (3rd generation), read the next three screens.
5. If you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation) and you set up "Hey Siri" on your iPhone already, then "Hey Siri" is ready to use with your AirPods. If you haven't set up "Hey Siri" already and you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation), you'll be guided through the setup.
6. Tap Done.



<https://support.apple.com/en-us/HT207010>

in response to an audio alert request from the user received at the graphical user interface, transmit an audio alert request signal to the at least one remote device via the Bluetooth transceiver;



Play a sound

1. Open the Find My app on your iPhone, iPad, or iPod touch, then tap the Items tab.
2. Choose the AirTag you want to play a sound in the Items list.
3. Tap Play Sound . ¹ If your AirTag is within Bluetooth range, it will play a sound.
4. To stop playing this sound before it ends automatically, tap Stop Sound.

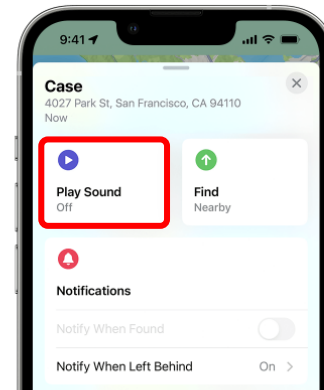
support.apple.com/en-us/HT210967



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, you can play a sound to help you find them. With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

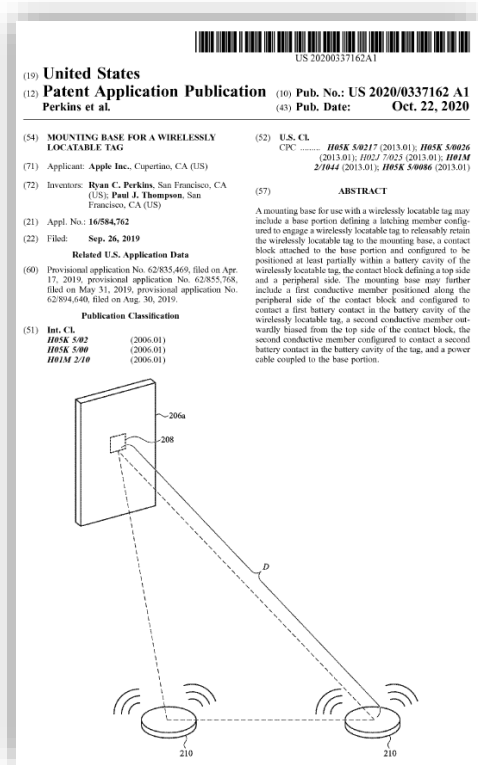
1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>

estimate a distance between the mobile communication device and the at least one remote device based on ultra-wideband communication between the one or more ultra-wideband transceivers and the at least one remote device and time of flight calculations;



[0216] The receiving device 206a (or a device operably coupled to a receiving device) may analyze a UWB signal pulse detected by an antenna 208 of the receiving device 206a to determine the distance D between the receiving device 206a and a transmitting device 210 that transmitted the UWB signal pulse. In particular, the receiving device 206a may determine a time of flight (TOF) of the UWB signal pulse and multiply the TOF by the propagation speed of the signal pulse (e.g., the speed of light) to determine or estimate the distance D between the transmitting device 210 and the receiving device 206a. As used herein, a UWB signal pulse may be a beacon signal or a portion of a beacon signal.

estimate a distance between the mobile communication device and the at least one remote device based on ultra-wideband communication between the one or more ultra-wideband transceivers and the at least one remote device and time of flight calculations;



US 20200259258A1

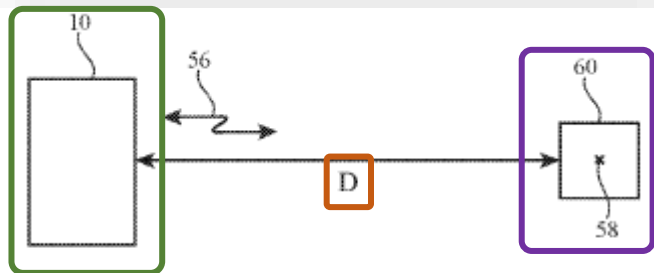
(19) **United States**(12) **Patent Application Publication**
Amiri et al.(10) **Pub. No.:** US 2020/0259258 A1(43) **Pub. Date:** Aug. 13, 2020(54) **ELECTRONIC DEVICE HAVING
MULTI-FREQUENCY ULTRA-WIDEBAND
ANTENNAS**(52) **U.S. CL.**
CPC *H01Q 5/25* (2015.01); *H01Q 1/24*
(2013.01); *H01Q 9/16* (2013.01)

FIG. 4

[0071] In one suitable arrangement, device **10** may determine the distance between the device **10** and node **60** and the orientation of device **10** relative to node **60** using two or more ultra-wideband antennas. The ultra-wide band antennas may receive radio-frequency signals from node **60** (e.g., radio-frequency signals **56** of FIG. 4). Time stamps in the wireless communication signals may be analyzed to determine the time of flight of the wireless communication signals and thereby determine the distance (range) between device **10** and node **60**. Additionally, angle of arrival (AoA)

estimate a **distance** between the **mobile communication device** and the **at least one remote device** based on **ultra-wideband communication between the one or more ultra-wideband transceivers** and the **at least one remote device** and **time of flight calculations**;

From CNET:

Apple's Senior Vice President of Worldwide Marketing, Phil Schiller, mentioned that the **iPhone 11** uses **UWB technology** for "**spatial awareness**".

<https://www.cnet.com/news/apple-iphone-11-uses-ultra-wideband-what-is-it-and-what-can-it-do/>

From ChatGPT:

Apple's official UWB technology page mentions that the U1 chip with UWB technology "measures **distance** by **calculating the time it takes for a radio wave to travel between two devices that support Ultra Wideband**."

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

determine a direction to the at least one remote device based on signal delay of ultra-wideband communications between the two or more antennas and the at least one remote device and on rotation of the mobile communication device detected by the orientation sensor; and



US 20200259258A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2020/0259258 A1
 Amiri et al. (43) Pub. Date: Aug. 13, 2020

(54) ELECTRONIC DEVICE HAVING
 MULTI-FREQUENCY ULTRA-WIDEBAND
 ANTENNAS

(52) U.S. CL.
 CPC H01Q 5/25 (2015.01); H01Q 1/24
 (2013.01); H01Q 9/16 (2013.01)

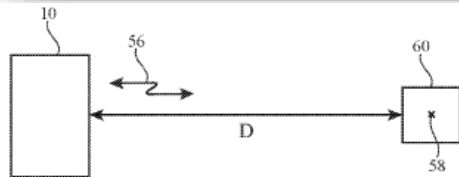


FIG. 4

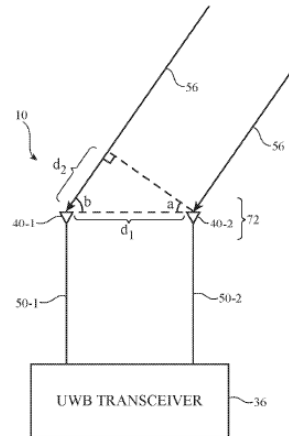


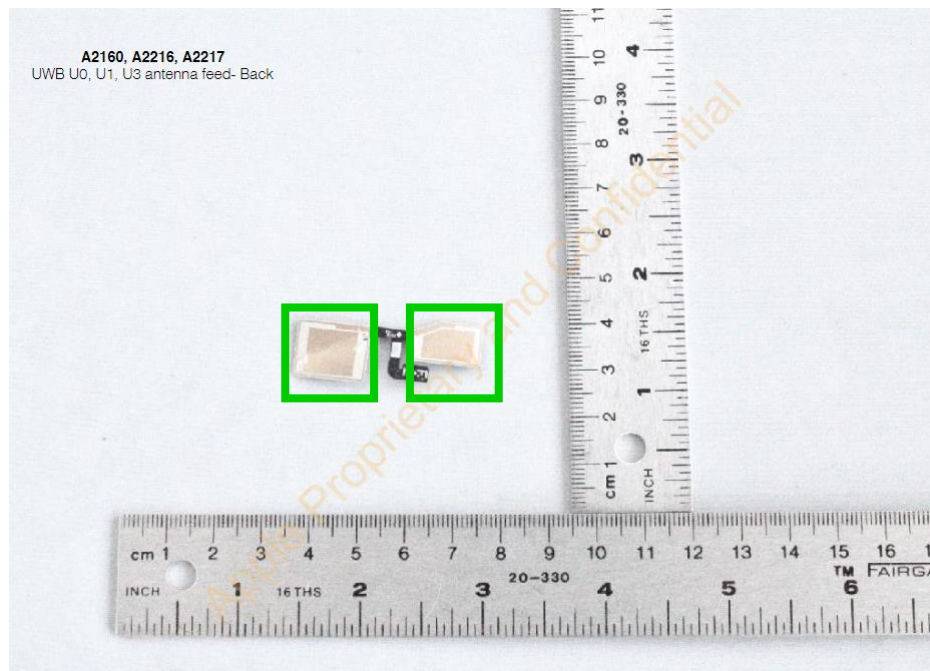
FIG. 6

Additionally, angle of arrival (AoA) measurement techniques may be used to determine the orientation of electronic device 10 relative to node 60 (e.g., azimuth angle θ and elevation angle φ).

[0072] In angle of arrival measurement, node 60 transmits a radio-frequency signal to device 10 (e.g., radio-frequency signals 56 of FIG. 4). Device 10 may measure a delay in arrival time of the radio-frequency signals between the two or more ultra-wideband antennas. The delay in arrival time (e.g., the difference in received phase at each ultra-wideband antenna) can be used to determine the angle of arrival of the radio-frequency signal (and therefore the angle of node 60 relative to device 10). Once distance D and the angle of arrival have been determined, device 10 may have knowledge of the precise location of node 60 relative to device 10.

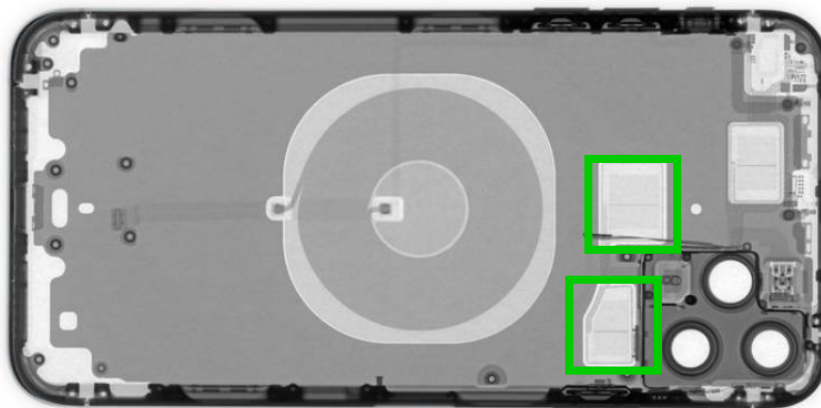
[0073] FIG. 6 is a schematic diagram showing how angle of arrival measurement techniques may be used to determine the orientation of device 10 relative to node 60.

determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications between the two or more antennas** and the at least one remote device and on rotation of the mobile communication device detected by the orientation sensor; and



iPhone 11 UWB (ultra-wideband) antenna feed showing 2 antennas
<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>

determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications** between the two or more antennas and the at least one remote device and on rotation of the mobile communication device detected by the orientation sensor; and



iPhone 11 Pro teardown showing UWB antennas

(<https://www.ifixit.com/Teardown/iPhone+11+Pro+Max+Teardown/126000#s243578>)

“Apple’s **UWB antennas** are the squares within the rectangle metal voids, to the right of the “ring” which charges the iPhone wirelessly.”

(<https://newaer.com/apple-iphone-11-adds-uw-b-proximity-detection/>)

determine a direction to the at least one remote device based on signal delay of **ultra-wideband communications between the two or more antennas** and the at least one remote device and on rotation of the mobile communication device detected by the orientation sensor; and

From ChatGPT:

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

Apple's UWB technology page also confirms that the U1 [ultra-wideband IC] chip includes a **UWB radio** and **antenna array with two separate antennas**.

From ChatGPT:

https://www.apple.com/business/docs/site/Apple_U1_Ultra_Wideband.pdf

Apple's white paper on **UWB technology**, which explains the use of **antenna arrays** for AoA [Angle of Arrival - direction]

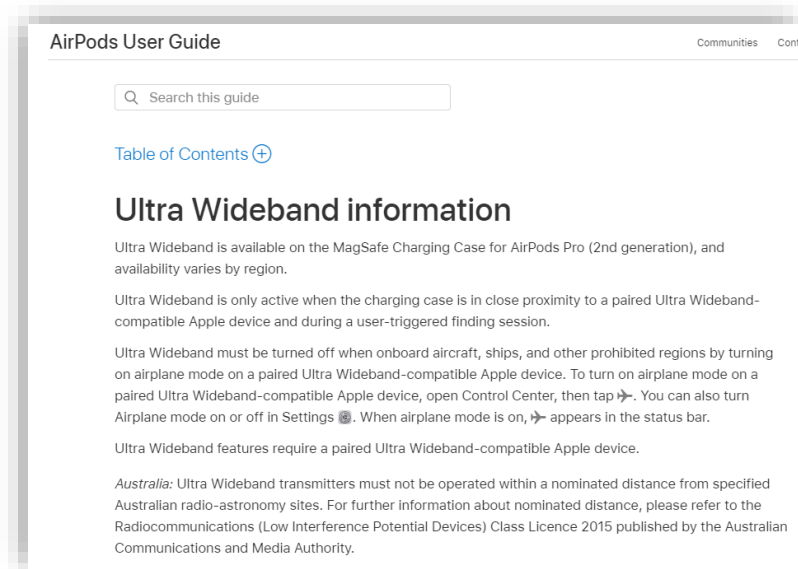
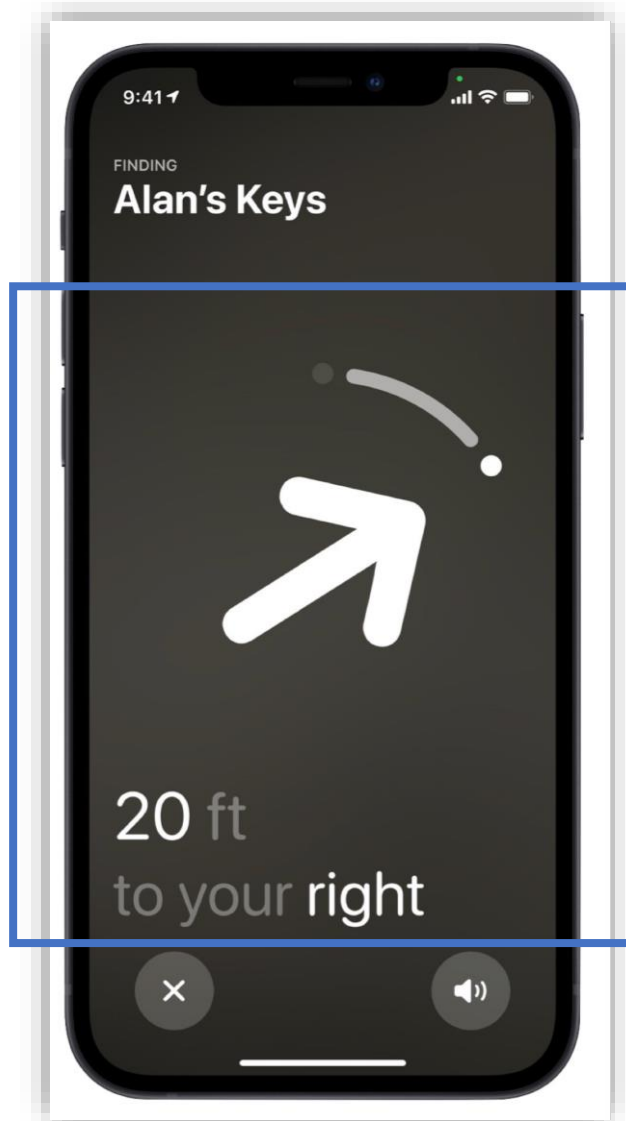
determine a direction to the at least one remote device based on signal delay of ultra-wideband communications between the two or more antennas and the at least one remote device **and on rotation of the mobile communication device detected by the orientation sensor**; and

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0337162 A1**
Perkins et al. (43) **Pub. Date: Oct. 22, 2020**

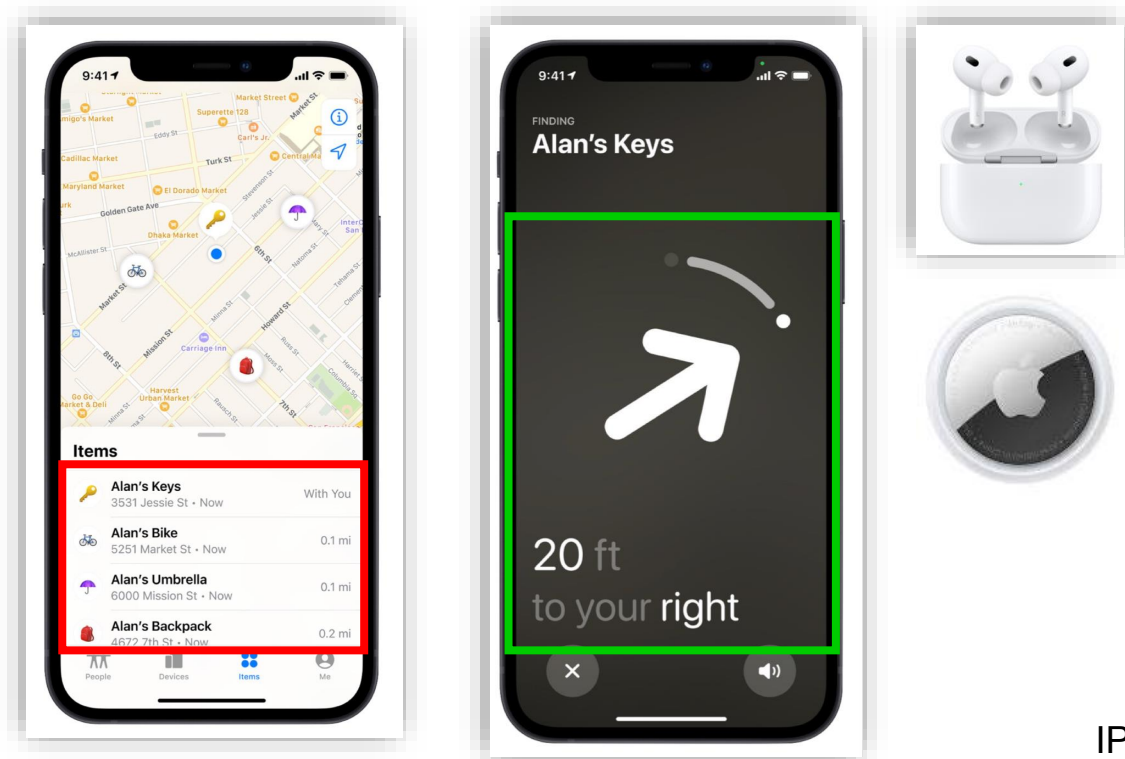
[0869] The device **14000** may determine the position of each object by communicating with each tag. For example, the tags may send signals using Bluetooth and/or UWB communication protocols, and the device **14000** may use techniques such as time of flight (ToF), angle of arrival (AoA), time difference of arrival (TDOA), received signal strength indication (RSSI), triangulation, synthetic aperture, and/or any other suitable technique, to determine positions of the tags relative to the device **14000**. Using the detected position of the tags (and optionally spatial parameters of the device **14000** from onboard sensors such as accelerometers, magnetometers, gyroscopes, GPS systems, or the like), the device **14000** may display a directional indicator that points towards the tags. As shown in FIG. 140, the device **14000** displays, on a display such as a touchscreen display, a first directional indicator **14008** (e.g., an arrow) that points towards the AED **14002**, and a second directional indicator **14010** (e.g., an arrow) that points towards the fire extinguisher. The device **14000** also displays a name (or other information) of each device, which may have been provided to the device **14000** from the tags themselves, as described above.

output to the graphical user interface **the estimated distance to the at least one remote device and an arrow pointing in the direction of the at least one remote device.**



<https://support.apple.com/guide/airpods/ultra-wideband-information-dev4a13375fb/web>

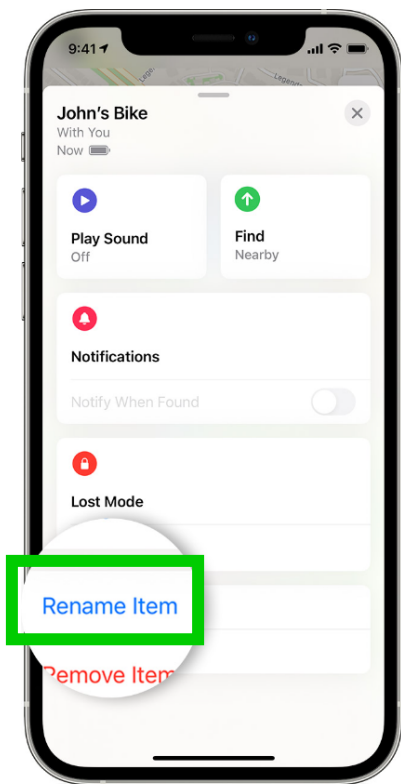
12. The mobile communication device of claim 11, wherein the at least one remote device includes **a plurality of remote devices** and wherein the operational instructions further cause the processor to (i) **output to the touch screen a representation of the plurality of remote devices**, (ii) **receive user input from the touch screen selecting one of the plurality of remote devices**, and (iii) **output to the touch screen the estimated distance to the selected one of the plurality of remote devices and the direction to the selected one of the plurality of remote devices**.



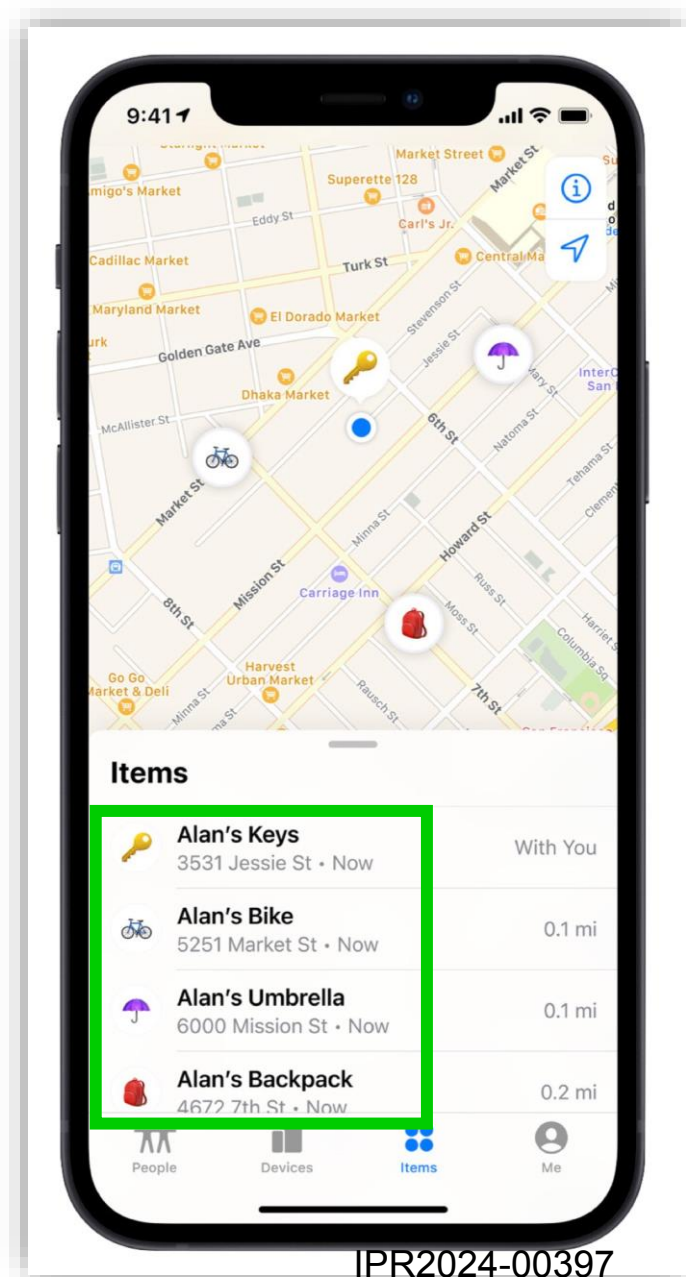
13. The mobile communication device of claim 12, wherein the operational instructions, upon execution, **further cause the processor to receive input from the touch screen defining names for one or more of the plurality of remote devices.**

Change the name of your AirTag

1. Open the Find My app, then tap the Items tab.
2. Tap the AirTag whose name or emoji you want to change.
3. Scroll down and tap Rename Item.
4. Select a name from the list or select Custom Name.
5. Type a custom name for your AirTag and select an emoji.
6. Tap Done.



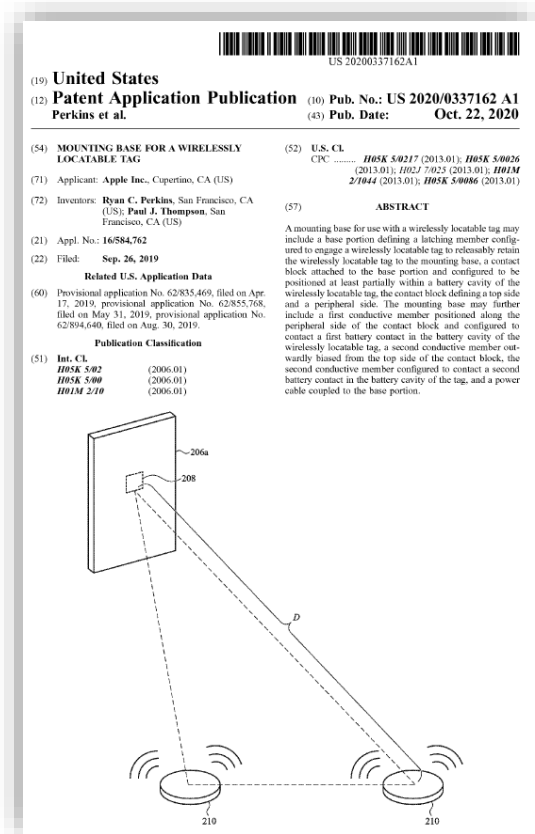
support.apple.com/en-us/HT210973



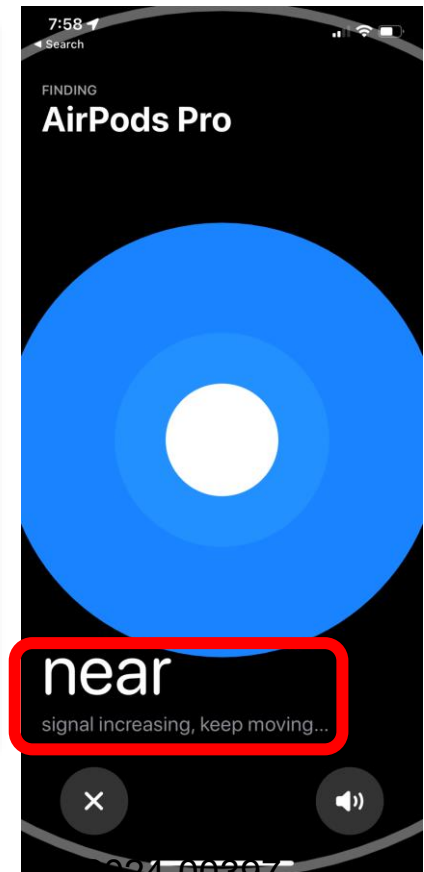
IPR2024-00397

Apple EX1039 Page 51

14. The mobile communication device of claim 13, wherein the operational instructions, upon execution, further cause the processor to determine the direction to one or more of the plurality of remote devices based on a **strength of a signal received** from the one or more of the plurality of remote devices at one or more of the plurality of wireless transceivers.



[0822] An array of wirelessly locatable tags (also referred to herein as “wireless tags” or simply “tags”) may be positioned or fixed with respect to various regions along a user’s body in order to track and monitor a user’s posture. As shown in FIG. 136A, a posture-monitoring system 13601 may include an array of wireless tags 13600a-13600f that are positioned along various locations of a user’s back. As previously discussed, a location of a wireless tag may be determined relative to another device using wireless location-tracking techniques including, for example, time of flight (ToF), angle of arrival (AoA), time difference of arrival (TDOA) received signal strength indication (RSSI), triangulation, synthetic aperture, and/or any other similar techniques. The wireless tag may be used to determine a relative location or distance with respect to another external device or wireless tag. The wireless tag, in some implementations, may be used to determine an absolute location or position by using a global positioning system (GPS) or other locating system that is either integrated with the wireless tag or integrated with a separate device.



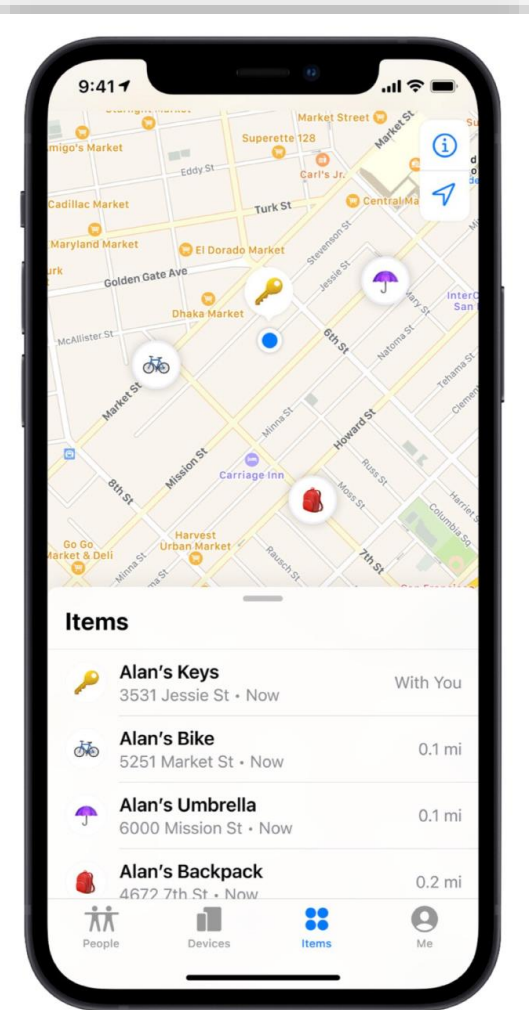
15. The mobile communication device of claim 14, wherein the operational instructions, upon execution, further cause the processor to output to the touch screen an estimated position of the one or more of the plurality of remote devices based on information received at one of the plurality of wireless transceivers from a wireless network.

AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. The Find My network can help you track down items on a map. You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.



Just like your other Apple devices, AirTag can be put into Lost Mode. Then, when it's detected by a device in the network, you'll automatically get a notification. You can

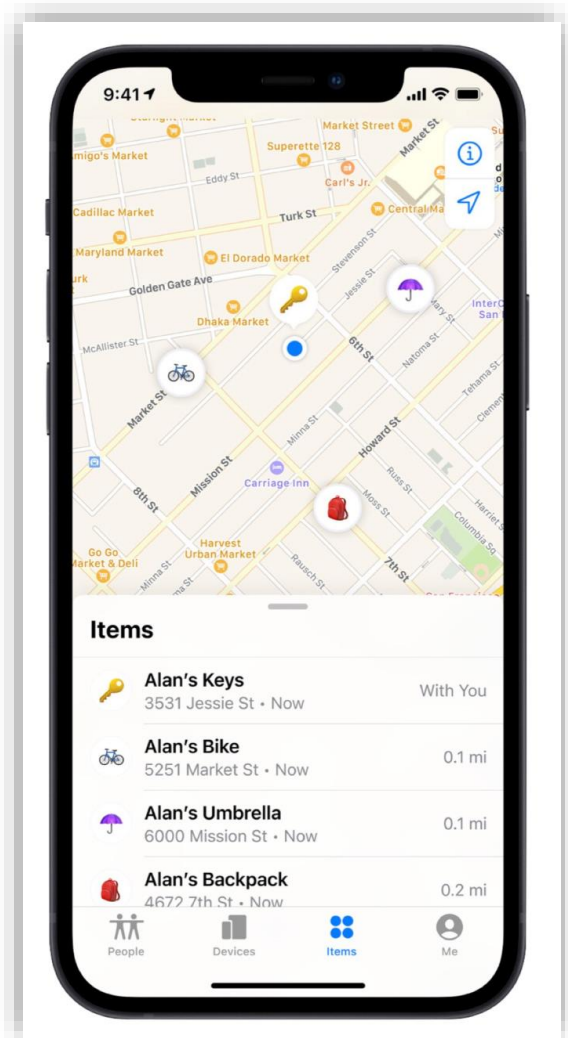
16. The mobile communication device of claim 15, wherein the operational instructions, upon execution, further cause the processor to output on the touch screen an estimated position of the one or more of the plurality of remote devices based on information received from a second mobile communication device.

AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. **The Find My network can help you track down items on a map.** You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

You can even find devices that are offline.

If your missing device can't connect to the internet, **the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world.** Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.



Just like your other Apple devices, AirTag can be put into Lost Mode. **Then, when it's detected by a device in the network, you'll automatically get a notification.** You can

17. The mobile communication device of claim 16, wherein the second mobile communication device is paired with the at least one remote device.

- At least AirPods can be paired to *both* the mobile communication device and the second mobile communication device.

Find your lost AirPods

Use Find My to locate your AirPods, AirPods Pro, or AirPods Max on a map and play a sound to find them.

About Find My

Find My is the only way that you can track or locate a lost or missing device. There is no other Apple service that can find, track, or otherwise flag your device for you.

To find your AirPods, you need to set up Find My with your iPhone, iPad, or iPod touch that you use with your AirPods. Before you try to find your AirPods, you should update to the latest version of [iOS or iPadOS](#), or [macOS](#).

You can also find your AirPods on the web at [iCloud.com](#). With some AirPods models, the experience on the web might be different and some functionality might not be available.

If you didn't turn on Find My before your AirPods went missing, you can't use Find My to locate them.

[Learn how to set up Find My >](#)

Locate your AirPods on a map

If you've lost or misplaced your AirPods, you might be able to find them if you use the Find My app on your iPhone, iPad, iPod touch, or Mac that you're signed in to with the same Apple ID. With AirPods Pro (2nd generation), you can also locate the charging case on the map if it's separated from your AirPods.

Locate your AirPods in the Find My app

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods. Under each device, you see a location or "No location found."

[If you can't locate your AirPods on the map](#) 😊

support.apple.com/en-us/HT207581

18. The mobile communication device of claim 16, wherein the second mobile communication device is not paired with the at least one remote device.

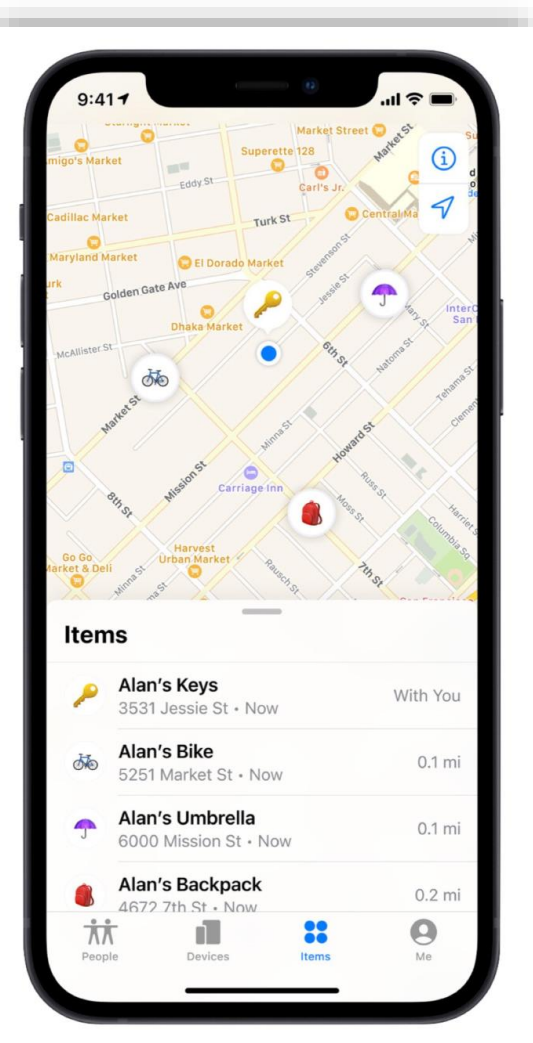
AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. **The Find My network can help you track down items on a map.** You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

You can even find devices that are offline.

If your missing device can't connect to the internet, **the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world.** Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

apple.com/icloud/find-my/



Just like your other Apple devices, AirTag can be put into Lost Mode. **Then, when it's detected by a device in the network, you'll automatically get a notification.** You can

IPR2024-00397

Apple EX1039 Page 56

19. The mobile communication device of claim 16, wherein the operational instructions, upon execution, **further cause the processor to transmit an audio alert request signal to the at least one remote device via the wireless network.**

Play a sound on a device with Find Devices on iCloud.com

If you lose your device and you think it's nearby, you can use Find Devices on iCloud.com to play a sound on it to help you find it. The sound plays even if the device is in silent mode or the volume is muted.

If you have Family Sharing set up, you can also play a sound on a family member's device. For more information on setting up a family group, see the Apple Support article [What is Family Sharing?](#)

To sign in to Find Devices, go to icloud.com/find.

support.apple.com/guide/icloud/play-a-sound-on-a-device-mmfc0f19b5/icloud

20. A mobile communication device comprising: a **plurality of wireless transceivers including a Bluetooth transceiver**, **a long-range transceiver configured to send and receive telephone calls via a telephony network and to communicate Internet data** and **one or more ultra-wideband transceivers**

iPhone 11

■ **All models**
Gigabit-class LTE with 2x2 MIMO and LAA⁶
802.11ax Wi-Fi 6 with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness*
NFC with reader mode
Express Cards with power reserve

iPhone 12

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
Gigabit LTE with 4x4 MIMO and LAA⁶
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness*
NFC with reader mode
Express Cards with power reserve

iPhone 13

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
Gigabit LTE with 4x4 MIMO and LAA⁶
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness*
NFC with reader mode
Express Cards with power reserve

iPhone 14

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO⁸
Gigabit LTE with 4x4 MIMO and LAA⁶
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.3
Ultra Wideband chip for spatial awareness
NFC with reader mode
Express Cards with power reserve

■ **Model A2111***
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, GSM/EDGE (850, 900, 1800, 1900 MHz)

support.apple.com/kb/SP804?locale=en_US

Model A2172*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2176*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

Model A2481*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2482*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

Model A2649*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2632*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

<https://www.apple.com/iphone-14/specs/>

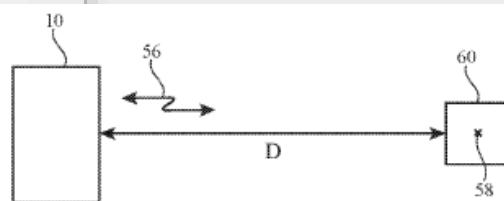
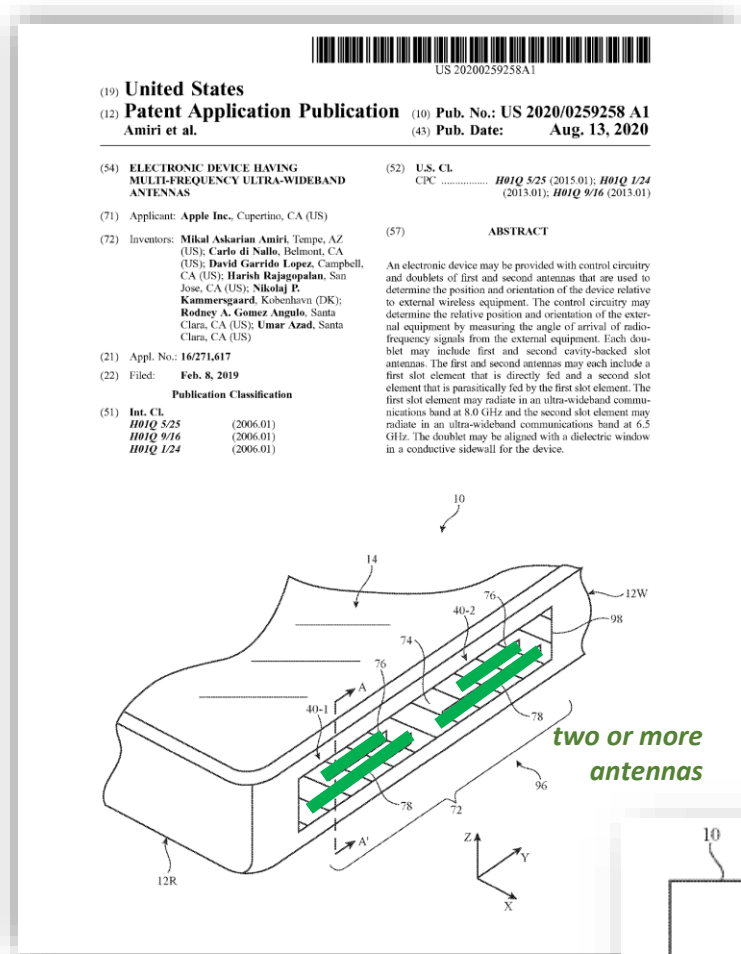


FIG. 4

[0073] FIG. 6 is a schematic diagram showing how angle of arrival measurement techniques may be used to determine the orientation of device 10 relative to node 60. As shown in FIG. 6, device 10 may include multiple antennas (e.g., a first antenna 40-1 and a second antenna 40-2) coupled to UWB transceiver circuitry 36 over respective transmission lines (e.g., a first transmission line 50-1 and a second transmission line 50-2).

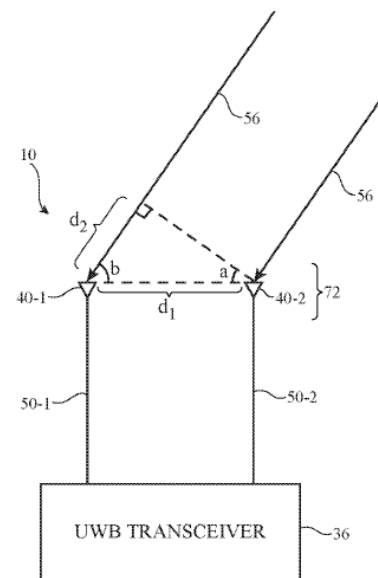
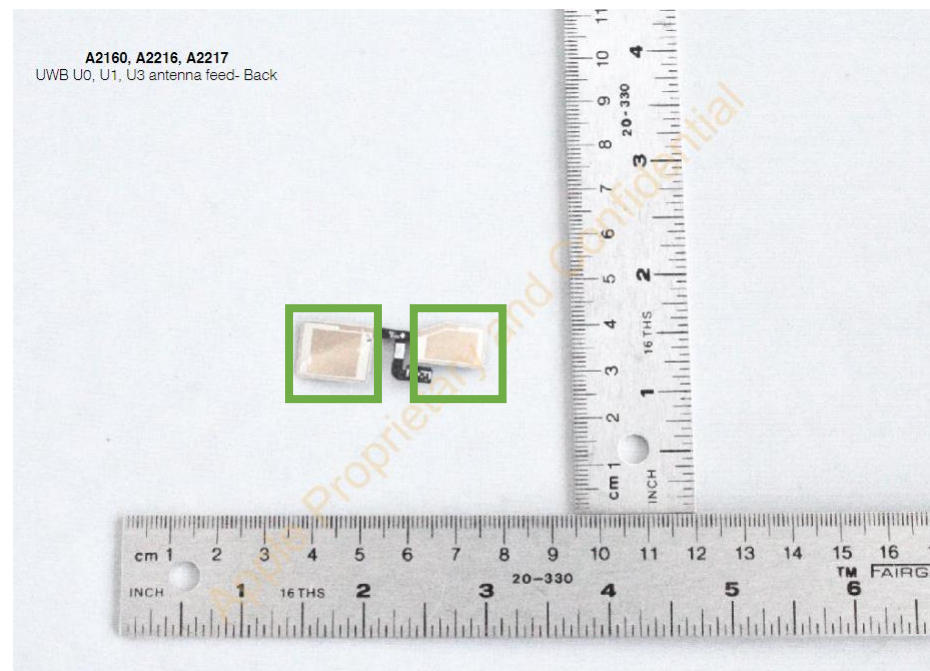


FIG. 6

coupled to **two or more antennas**;

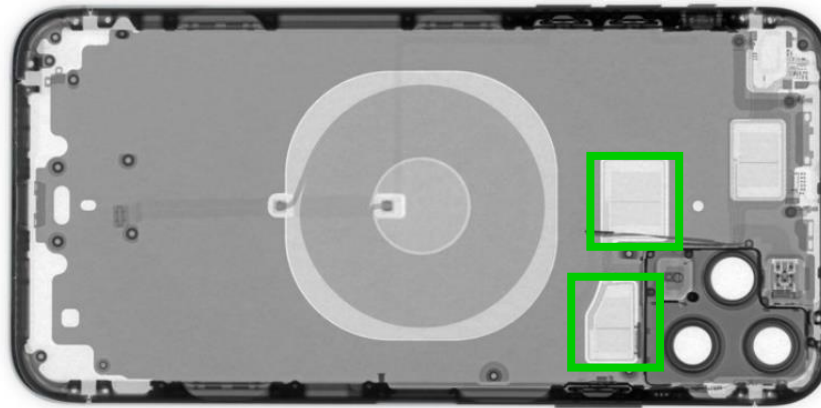
[0073] FIG. 6 is a schematic diagram showing how angle of arrival measurement techniques may be used to determine the orientation of device 10 relative to node 60. As shown in FIG. 6, device 10 may include multiple antennas (e.g., a first antenna 40-1 and a second antenna 40-2) coupled to UWB transceiver circuitry 36 over respective transmission lines (e.g., a first transmission line 50-1 and a second transmission line 50-2).



iPhone 11 UWB antenna feed showing 2 antennas (<https://fccid.io/BCG-E3305A/Internal-Photos/Internal-Photos-4423150>)

IPR2024-00397

coupled to **two or more antennas**;



iPhone 11 Pro teardown showing UWB antennas

(<https://www.ifixit.com/Teardown/iPhone+11+Pro+Max+Teardown/126000#s243578>)

“Apple’s **UWB antennas** are the squares within the rectangle metal voids, to the right of the “ring” which charges the iPhone wirelessly.”

(<https://newaer.com/apple-iphone-11-adds-uw-b-proximity-detection/>)

coupled to **two or more antennas**;

From ChatGPT:

<https://www.apple.com/ios/feature-availability/#ultra-wideband>

Apple's UWB technology page also confirms that the U1 [ultra-wideband IC] chip includes a UWB radio and **antenna array with two separate antennas**.

From ChatGPT:

https://www.apple.com/business/docs/site/Apple_U1_Ultra_Wideband.pdf

Apple's white paper on UWB technology, which explains the use of **antenna arrays** for AoA [Angle of Arrival - direction]

a **memory** that stores operational instructions;
 a **touch screen**; and
 a **processor** coupled to the memory and to the touch screen, wherein the processor is configured to execute the operational instructions, which upon execution, cause the processor to:

iPhone 11

- 64GB
- 128GB
- 256GB

4 GB RAM



support.apple.com/kb/SP804?locale=en_US

iPhone 12

- 64GB
- 128GB
- 256GB

4/6 GB RAM



apple.com/iphone-12/specs

iPhone 13

- 128GB
- 256GB
- 512GB

4/6 GB RAM



apple.com/iphone-13/specs

iPhone 14

- 128GB
- 256GB
- 512GB

6 GB RAM



apple.com/iphone-14/specs

present a **graphical user interface** via the touch screen;

generate pairing signals in response to indications from a user via the graphical user interface to pair the mobile communication device to each of a plurality of remote devices, wherein the **Bluetooth transceiver responds to the pairing signals by communicating RF signals to pair the mobile communication device** to each of the plurality of remote devices,

Set up your AirTag

1. Make sure that your device is ready for setup.
2. If your AirTag is new, remove the wrap around the product and pull out the tab to activate the battery. Your AirTag will play a sound.
3. Hold your AirTag near your iPhone, iPad, or iPod touch, then tap Connect.* If you have multiple AirTags and see "More than one AirTag detected", make sure that only one AirTag is near your device at one time. [Need help connecting your AirTag?](#)
4. Select an item name from the list, or select Custom Name to name your AirTag and choose an emoji. Then tap Continue.
5. To register your AirTag with your Apple ID, tap Continue again.
6. Tap Done.

Now you can attach your AirTag to your item and see it in [the Find My app](#).

* You can also set up your AirTag in the Find My app. Tap the Items tab, then tap Add Item.



support.apple.com/en-us/HT210973

Connect your AirPods and AirPods Pro to your iPhone

Learn how to use your iPhone to set up your AirPods.

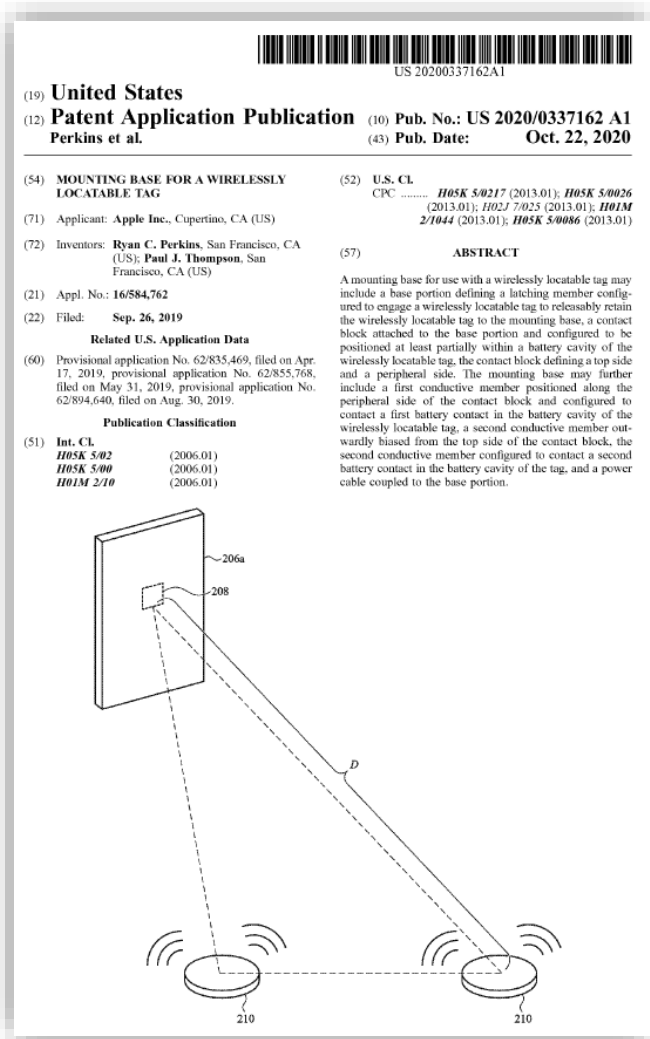
If you're setting up your AirPods for the first time, make sure that you have an iPhone with the [latest version of iOS](#). Then follow these steps:

1. Go to the Home Screen.
2. With your AirPods in the charging case, open the charging case, and hold it next to your iPhone. A setup animation appears on your iPhone.
3. Tap Connect.
4. If you have AirPods Pro (1st or 2nd generation) or AirPods (3rd generation), read the next three screens.
5. If you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation) and you set up "Hey Siri" on your iPhone already, then "Hey Siri" is ready to use with your AirPods. If you haven't set up "Hey Siri" already and you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation), you'll be guided through the setup.
6. Tap Done.



<https://support.apple.com/en-us/HT207010>

wherein a unique identifier associated with each of the plurality of remote devices is shared with the mobile communication device during pairing;



[0185] The tag may communicate with nearby devices by sending a periodic wireless beacon signal. The wireless beacon signal, which may be transmitted using a Bluetooth communication protocol, ultra-wideband communication protocol, or any other suitable protocol, may be detectable by any device that is monitoring that protocol (e.g., receiving communications via that protocol). The wireless beacon signal, also referred to herein simply as a “beacon signal” or “beacon,” may be transmitted at any suitable frequency, and the particular frequency may depend at least in part on a mode of the tag. For example, when the tag is in an initialization mode or pairing mode, the beacon may be transmitted at a first frequency; when the tag is in a lost

[0186] The beacon may include the public key of the tag and optionally other information such as a tag identifier, a last reported location, a time since a last direct connection to another device, or the like. In some cases, the beacon and the optional additional information are sent to other devices using separate communications channels, protocols, or the like. For example, a tag may send a beacon signal using an ultra-wideband radio and send other information, such as the public key, via Bluetooth. Of course, other assignments of information types to different communications channels or protocols are also possible.

wherein **a unique identifier associated with each of the plurality of remote devices** is **shared with the mobile communication device** during pairing;

*From **Bluetooth Core Specification**, Version: v5.4:*

1.2 BLUETOOTH DEVICE ADDRESSING

Each Bluetooth device shall be allocated **a unique 48-bit Bluetooth Device Address (BD_ADDR)**.

The Bluetooth Device Address, BD_ADDR, is used to identify a Bluetooth device.

From https://bluetoothle.wiki/mac_address#:

Every Bluetooth device has a unique 48 bit MAC [Media Access Control] address.

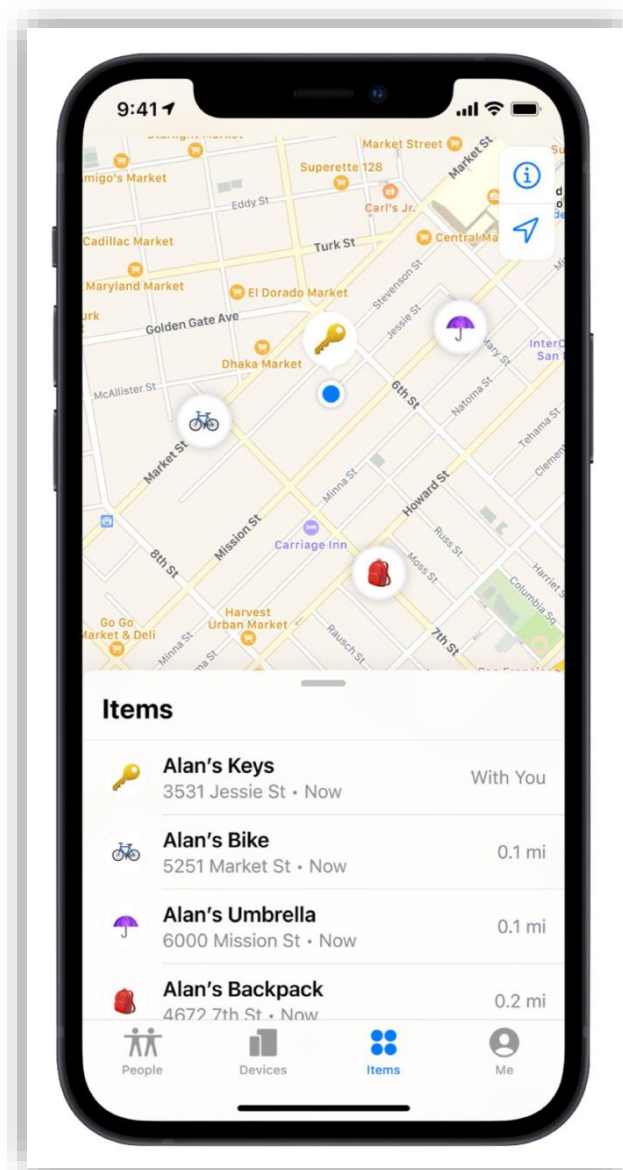
From Bluetooth SIG [Special Interest Group]:

<https://www.bluetooth.com/blog/bluetooth-technology-protecting-your-privacy/>

Bluetooth Smart peripherals, such as activity trackers, **announce their presence to other devices through a process known as advertising**. Bluetooth Smart advertising packets also contain a **MAC address to identify the device**.

display, via the graphical user interface, a *name associated with each of the plurality of remote devices*;

*name
associated
with each of
the plurality
of remote
devices*

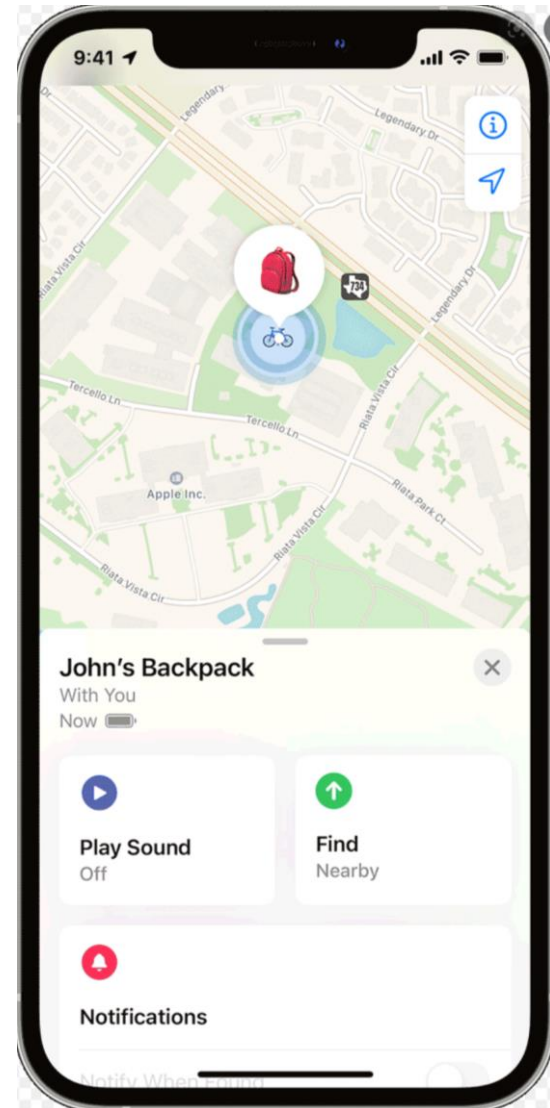


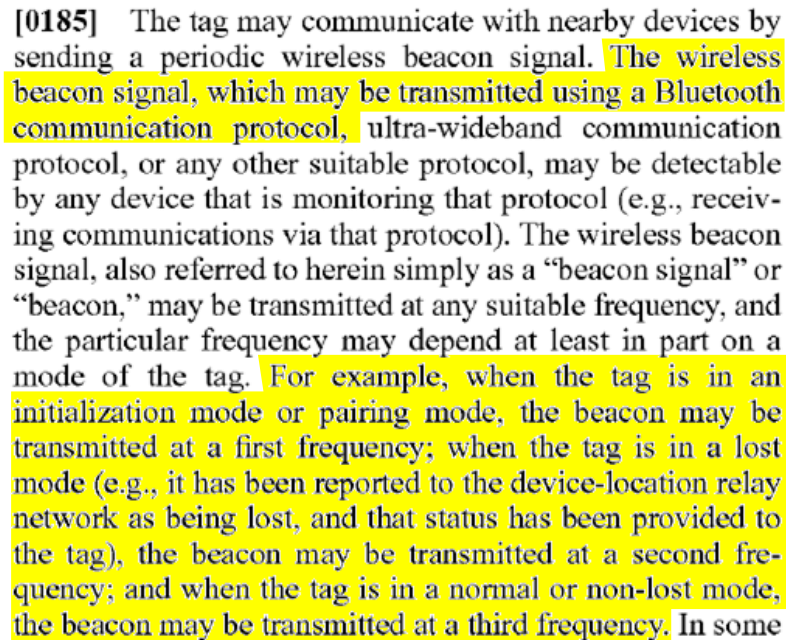
IPR2024-00397

Apple EX1039 Page 67

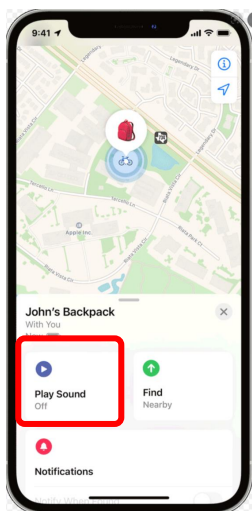
receive a selection of a selected remote device of the plurality of remote devices in response to selection, via the graphical user interface, of the name associated with the selected remote device, *wherein the graphical user interface visually indicates the selection of the selected remote device*;

the graphical user interface visually indicates the selection of the selected remote device





generate an audio alert signal in response to a second indication from the user via the graphical user interface, wherein the Bluetooth transceiver transmits a first RF signal to the selected remote device in response to the audio alert signal, wherein the first RF signal indicates a request to the selected remote device to emit an audio alert to audibly assist the user in determining a location of the selected remote device;



Play a sound

1. Open the Find My app on your iPhone, iPad, or iPod touch, then tap the Items tab.
2. Choose the AirTag you want to play a sound in the Items list.
3. Tap Play Sound . ¹ If your AirTag is within Bluetooth range, it will play a sound.
4. To stop playing this sound before it ends automatically, tap Stop Sound.



support.apple.com/en-us/HT210967

Play a sound on your iPhone, iPad, iPod touch, Mac, or Apple Watch

1. Open the Find Devices app  on your Apple Watch, then tap a device.
2. Tap Play Sound.

- *If the device is online:* A sound starts after a short delay and gradually increases in volume, then plays for about two minutes. The device vibrates (if applicable). A Find My [device] alert appears on the device's screen.

A confirmation email is also sent to your Apple ID email address.

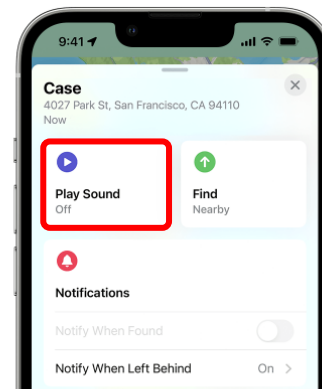
- *If the device is offline:* You see Sound Pending. The sound plays the next time the device connects to a Wi-Fi or cellular network.



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, **you can play a sound to help you find them.** With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>

determine an estimated distance to the selected remote device, based on the reception, via the Bluetooth transceiver, of the beacon from the selected remote device; and



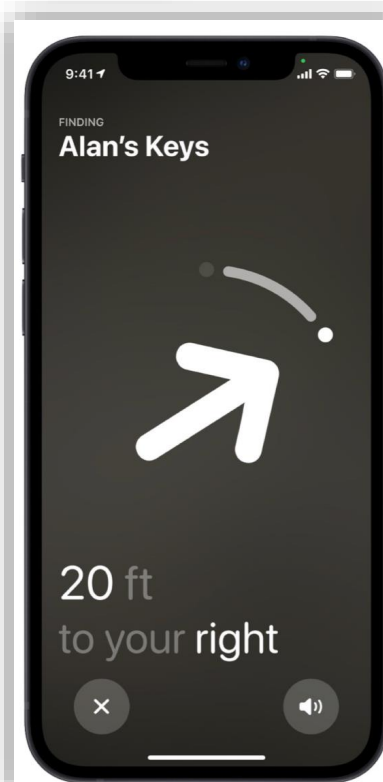
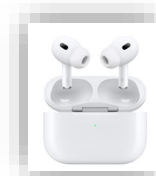
US 20200337162A1

(19) **United States**(12) **Patent Application Publication** (10) Pub. No.: **US 2020/0337162 A1**

Perkins et al.

(43) Pub. Date: **Oct. 22, 2020**

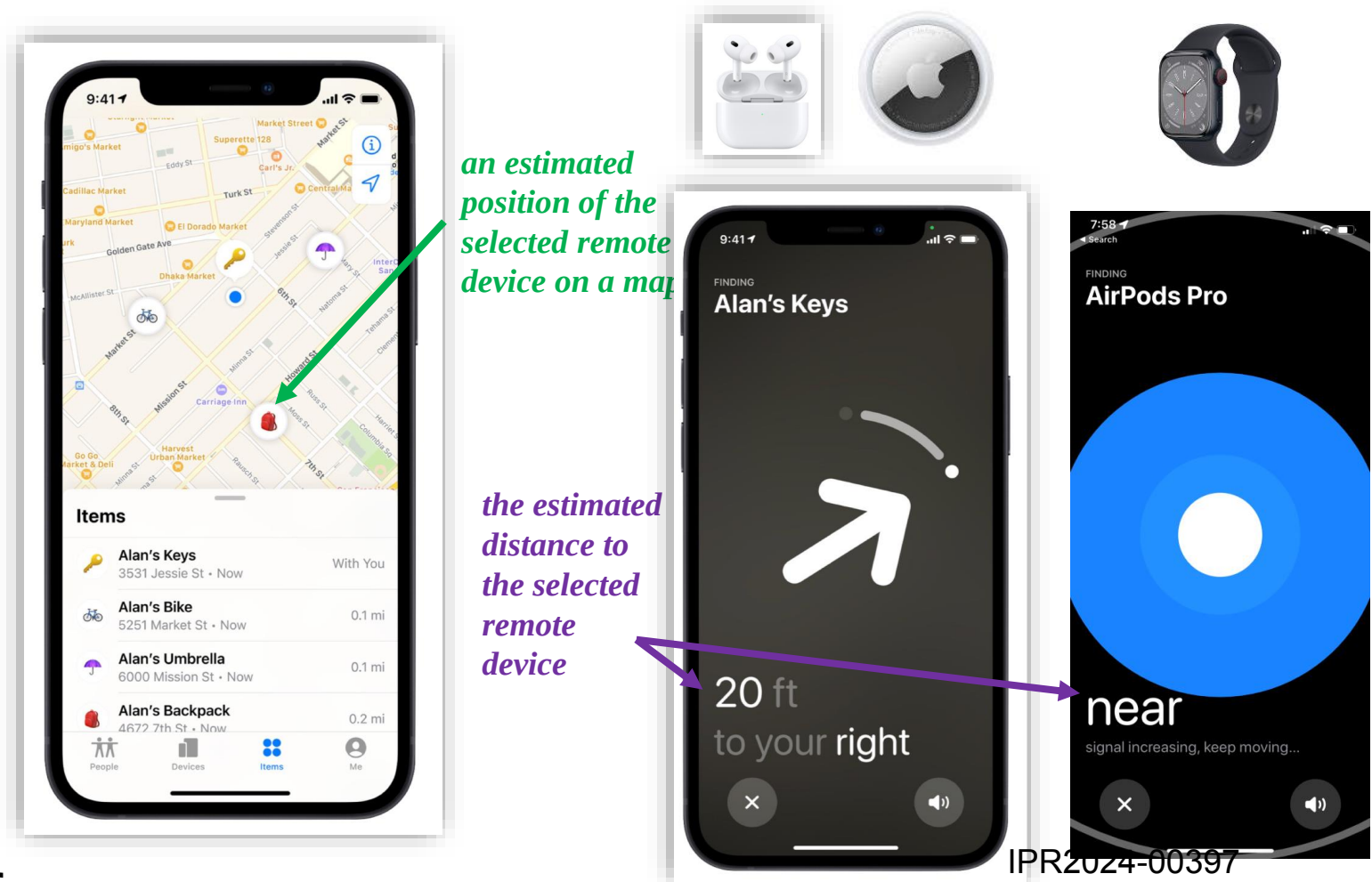
[0822] An array of wirelessly locatable tags (also referred to herein as “wireless tags” or simply “tags”) may be positioned or fixed with respect to various regions along a user’s body in order to track and monitor a user’s posture. As shown in FIG. 136A, a posture-monitoring system 13601 may include an array of wireless tags 13600a-13600f that are positioned along various locations of a user’s back. As previously discussed, a location of a wireless tag may be determined relative to another device using wireless location-tracking techniques including, for example, time of flight (ToF), angle of arrival (AoA), time difference of arrival (TDOA) received signal strength indication (RSSI), triangulation, synthetic aperture, and/or any other similar techniques. The wireless tag may be used to determine a relative location or distance with respect to another external device or wireless tag. The wireless tag, in some implementations, may be used to determine an absolute location or position by using a global positioning system (GPS) or other locating system that is either integrated with the wireless tag or integrated with a separate device.



IPR2024-00397

present **at least one display, via the graphical user interface**, wherein the at least one display includes **an estimated position of the selected remote device on a map**, and wherein the at least one display indicates **the estimated distance to the selected remote device**.

at least one display, via the graphical user interface



IPR2024-00397

Apple EX1039 Page 72

21. The mobile communication device of claim 20, wherein the estimated position of the selected remote device is determined based on information received at one of the plurality of wireless transceivers via a wireless network.

AirTag can help you find just about anything.

Misplaced your keys? Forgot your purse? If they have AirTag attached, they won't be lost for long. The Find My network can help you track down items on a map. You can play a sound on your AirTag to find something hiding nearby — you can even get the distance and direction to your AirTag with Precision Finding.²

You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

Lost Mode makes finding things even easier.

Just like your other Apple devices, AirTag can be put into Lost Mode. Then, when it's detected by a device in the network, you'll automatically get a notification. You can also set it so someone can get your contact info by tapping your AirTag with an NFC-capable smartphone — that's the same technology that lets people pay for things with their phones.

22. The mobile communication device of claim 21, wherein the information is received from a second mobile communication device.

You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

apple.com/icloud/find-my/

Lost Mode makes finding things even easier.

Just like your other Apple devices, AirTag can be put into Lost Mode. Then, when it's detected by a device in the network, you'll automatically get a notification. You can also set it so someone can get your contact info by tapping your AirTag with an NFC-capable smartphone — that's the same technology that lets people pay for things with their phones.

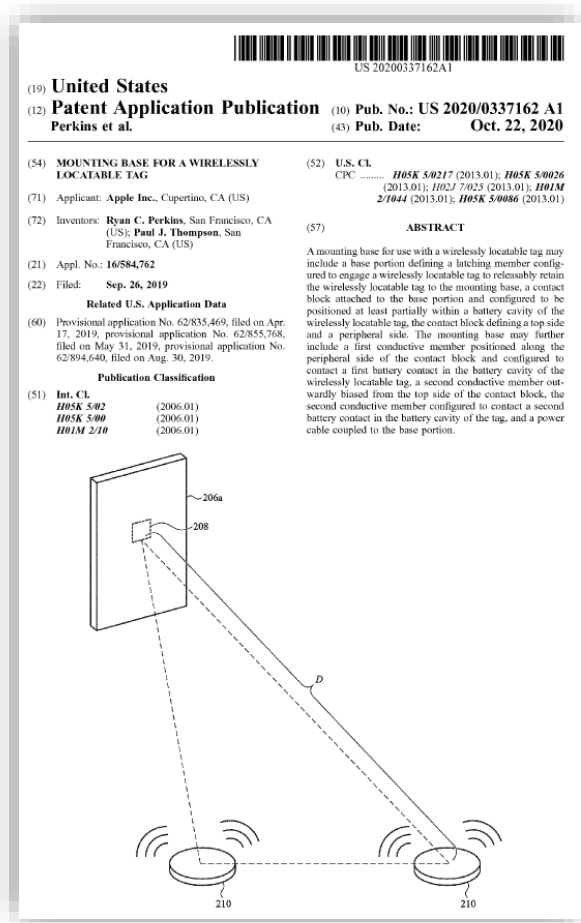
23. The mobile communication device of claim 22, wherein the information indicates one or more of: position information, signal strength information, proximity information, or coordinate information.

You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

apple.com/icloud/find-my/

24. The mobile communication device of claim 23, wherein the information is based on GPS coordinates.



[0167] The embodiments herein are generally directed to a device, such as a small, battery-powered tag, puck, or other object of convenient size and shape, that can be physically and/or geographically located using wireless communications systems and techniques. For example, a tag may include an antenna that emits a wireless signal or beacon that is detectable by another electronic device such as a smartphone. Using the detected wireless signal (and using localization techniques such as time of flight, received signal strength indication, triangulation, etc.), the smartphone may be able to determine the position of the tag relative to the smartphone, and, using an absolute location of the smartphone from a GPS, the absolute location of the tag as well. The embodiments herein also relate to the overall network environment that includes (or is defined by) the tags, smartphones, computers, and other devices, and that facilitates the locating of tags as well as numerous other features and functions.

25. The mobile communication device of claim 22 wherein the second mobile communication device is paired with the selected remote device.

- At least AirPods can be paired to *both* the mobile communication device and the second mobile communication device.

Find your lost AirPods

Use Find My to locate your AirPods, AirPods Pro, or AirPods Max on a map and play a sound to find them.

About Find My

Find My is the only way that you can track or locate a lost or missing device. There is no other Apple service that can find, track, or otherwise flag your device for you.

To find your AirPods, you need to set up Find My with your iPhone, iPad, or iPod touch that you use with your AirPods. Before you try to find your AirPods, you should update to the latest version of [iOS or iPadOS](#), or [macOS](#).

You can also find your AirPods on the web at [iCloud.com](#). With some AirPods models, the experience on the web might be different and some functionality might not be available.

If you didn't turn on Find My before your AirPods went missing, you can't use Find My to locate them.

[Learn how to set up Find My >](#)

Locate your AirPods on a map

If you've lost or misplaced your AirPods, you might be able to find them if you use the Find My app on your iPhone, iPad, iPod touch, or Mac that you're signed in to with the same Apple ID. With AirPods Pro (2nd generation), you can also locate the charging case on the map if it's separated from your AirPods.

Locate your AirPods in the Find My app

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods. Under each device, you see a location or "No location found."

[If you can't locate your AirPods on the map](#) 😊

support.apple.com/en-us/HT207581

26. The mobile communication device of claim 22 wherein the *second mobile communication device is not paired with the selected remote device*.

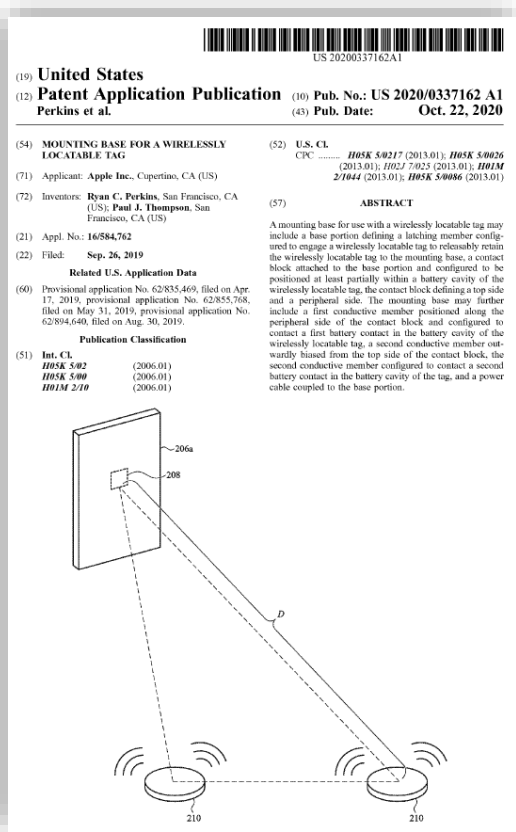
You can even find devices that are offline.

If your missing device can't connect to the internet, the Find My app can still help you track it down using the Find My network — hundreds of millions of iPhone, iPad, and Mac devices around the world. Nearby devices securely send the location of your missing device to iCloud, then you can see where it is in the Find My app. It's all anonymous and encrypted to protect everyone's privacy.

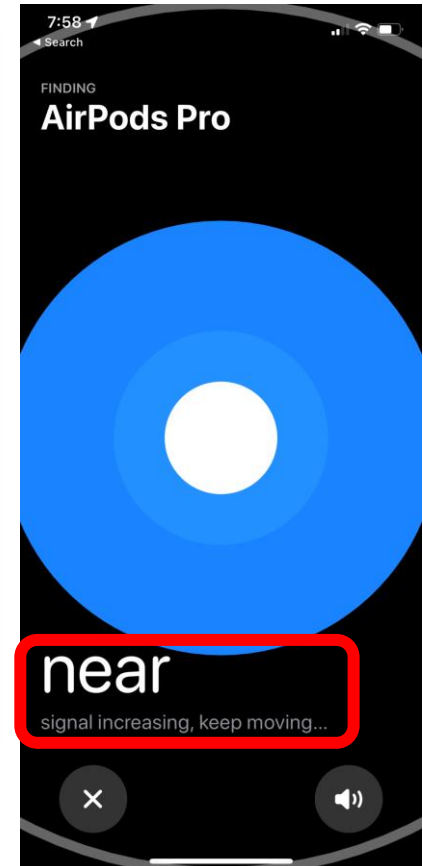
second mobile communication device is not paired with the selected remote device

<https://www.apple.com/icloud/find-my/>

27. The mobile communication device of claim 20, wherein the estimated distance to the selected remote device is determined ***based on a strength of the beacon from the selected remote device.***



[0822] An array of wirelessly locatable tags (also referred to herein as “wireless tags” or simply “tags”) may be positioned or fixed with respect to various regions along a user’s body in order to track and monitor a user’s posture. As shown in FIG. 136A, a posture-monitoring system 13601 may include an array of wireless tags 13600a-13600f that are positioned along various locations of a user’s back. As previously discussed, a location of a wireless tag may be determined relative to another device using wireless location-tracking techniques including, for example, time of flight (ToF), angle of arrival (AoA), time difference of arrival (TDOA) received signal strength indication (RSSI), triangulation, synthetic aperture, and/or any other similar techniques. The wireless tag may be used to determine a relative location or distance with respect to another external device or wireless tag. The wireless tag, in some implementations, may be used to determine an absolute location or position by using a global positioning system (GPS) or other locating system that is either integrated with the wireless tag or integrated with a separate device.



Preliminary Infringement Charts for U.S. Patent No. 11,265,680



US011265680B2

(12) **United States Patent**
Howard et al.

(10) **Patent No.:** **US 11,265,680 B2**
(45) **Date of Patent:** ***Mar. 1, 2022**

(54) **WIRELESS DEVICE AND METHODS FOR USE IN A PAGING NETWORK**
G08B 21/0272 (2013.01); G08B 21/0277 (2013.01); G08B 25/016 (2013.01); H04L 41/0618 (2013.01); H04W 4/02 (2013.01); (Continued)

(71) Applicant: **THL Holding Company, LLC**, Austin, TX (US)

(72) Inventors: **John W. Howard**, Cedar Park, TX (US); **Richard Cutler**, Round Rock, TX (US); **Robert M. Kennard**, Dallas, TX (US)

(73) Assignee: **THL Holding Company, LLC**, Austin, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/036,535**

(22) Filed: **Sep. 29, 2020**

(65) **Prior Publication Data**
US 2021/0029506 A1 Jan. 28, 2021

Related U.S. Application Data

(63) Continuation of application No. 16/837,481, filed on Apr. 1, 2020, now Pat. No. 10,834,539, which is a (Continued)

(51) **Int. Cl.**
H04W 4/029 (2018.01)
H04W 4/80 (2018.01)
(Continued)

(52) **U.S. Cl.**
CPC **H04W 4/029** (2018.02); **G08B 13/1427** (2013.01); **G08B 21/0244** (2013.01); **G08B 21/0247** (2013.01); **G08B 21/0269** (2013.01);

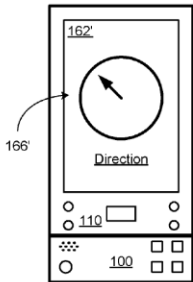
(58) **Field of Classification Search**
CPC H04W 4/029; H04W 4/024; H04W 4/80; H04W 64/00; H04W 4/02
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS
4,476,469 A 10/1984 Lander
5,146,231 A 9/1992 Ghem et al.
(Continued)

OTHER PUBLICATIONS
International Preliminary Report on Patentability; PCT Application No. PCT/US11/24923, dated Feb. 10, 2012, 11 pages.
(Continued)

ABSTRACT
(57) A wireless device includes a user interface that generates a pairing signal in response to an indication from a user to pair the wireless device to at least one remote device and generates a first location request signal in response to a second indication from a user to locate the at least one remote device. A short-range wireless transceiver communicates RF signals to pair the wireless device to the at least one remote device and that transmits a first RF paging signal to the at least one remote device in response to the location request signal.

20 Claims, 22 Drawing Sheets



Asserted Against:

- iPhone 11 (all U.S. models)
- iPhone 12 (all U.S. models)
- iPhone 13 (all U.S. models)
- iPhone 14 (all U.S. models)



1. A mobile communication device comprising: a plurality of wireless transceivers;

iPhone 11

■ All models

Gigabit-class LTE with 2x2 MIMO and LAA⁶
802.11ax Wi-Fi 6 with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁷
NFC with reader mode
Express Cards with power reserve

■ Model A2111*

FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17,
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100,
GSM/EDGE (850, 900, 1800, 1900 MHz)

[support.apple.com/kb/
SP804?locale=en_US](https://support.apple.com/kb/SP804?locale=en_US)

iPhone 12

All models

5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
Gigabit LTE with 4x4 MIMO and LAA⁷
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁸
NFC with reader mode
Express Cards with power reserve

Model A2172*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41,
n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28,
29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2176*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41,
n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28,
29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

iPhone 13

All models

5G (sub-6 GHz and mmWave) with 4x4 MIMO⁷
Gigabit LTE with 4x4 MIMO and LAA⁷
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁸
NFC with reader mode
Express Cards with power reserve

Model A2481*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38,
n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26,
28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2482*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38,
n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26,
28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

iPhone 14

All models

5G (sub-6 GHz and mmWave) with 4x4 MIMO⁸
Gigabit LTE with 4x4 MIMO and LAA⁸
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.3
Ultra Wideband chip for spatial awareness⁹
NFC with reader mode
Express Cards with power reserve

Model A2649*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29,
n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28,
29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2632*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29,
n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28,
29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

[https://www.apple.com/iphone-14/specs/](https://www.apple.com/iphone-14/specs)

a **memory** that stores operational instructions;
 a **touch screen**; and
 a **processor** coupled to the **memory** and to the **touch screen**,

iPhone 11

- 64GB
- 128GB
- 256GB

4 GB RAM



support.apple.com/kb/SP804?locale=en_US

iPhone 12

- 64GB
- 128GB
- 256GB

4/6 GB RAM



apple.com/iphone-12/specs

iPhone 13

- 128GB
- 256GB
- 512GB

4/6 GB RAM



apple.com/iphone-13/specs

iPhone 14

- 128GB
- 256GB
- 512GB

6 GB RAM



apple.com/iphone-14/specs

wherein the processor executes the operational instructions that cause the processor to present a graphical user interface via the touch screen and wherein the processor operates in association with the graphical user interface to:

generate a **pairing signal** in response to a **first indication from a user to pair** the **mobile communication device to at least one remote device**,

pairing

Set up your AirTag

1. Make sure that your device is ready for setup.
2. If your AirTag is new, remove the wrap around the product and pull out the tab to activate the battery. Your AirTag will play a sound.
3. Hold your AirTag near your iPhone, iPad, or iPod touch, then tap Connect.* If you have multiple AirTags and see "More than one AirTag detected", make sure that only one AirTag is near your device at one time. [Need help connecting your AirTag?](#)
4. Select an item name from the list, or select Custom Name to name your AirTag and choose an emoji. Then tap Continue.
5. To register your AirTag with your Apple ID, tap Continue again.
6. Tap Done.

Now you can attach your AirTag to your item and see it in the [Find My app](#).

* You can also set up your AirTag in the Find My app. Tap the Items tab, then tap Add Item.



first indication from a user

support.apple.com/en-us/HT210973

Connect your AirPods and AirPods Pro to your iPhone

Learn how to use your iPhone to set up your AirPods.

If you're setting up your AirPods for the first time, make sure that you have an iPhone with the [latest version of iOS](#). Then follow these steps:

1. Go to the Home Screen.
2. With your AirPods in the charging case, open the charging case, and hold it next to your iPhone. A setup animation appears on your iPhone.
3. Tap Connect.
4. If you have AirPods Pro (1st or 2nd generation) or AirPods (3rd generation), read the next three screens.
5. If you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation) and you set up "Hey Siri" on your iPhone already, then "Hey Siri" is ready to use with your AirPods. If you haven't set up "Hey Siri" already and you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation), you'll be guided through the setup.
6. Tap Done.



<https://support.apple.com/en-us/HT207010>

wherein the **at least one of the plurality of wireless transceivers**, responds to the pairing signal generated by the graphical user interface by communicating **RF signals** to pair the **mobile communication device** to the **at least one remote device**;



generate a **first location request signal in response to a second indication from the user to locate the at least one remote device**, wherein **at least one of the plurality of wireless transceivers** transmits a **first RF signal** to the **at least one remote device** in response to the **first location request signal**; and

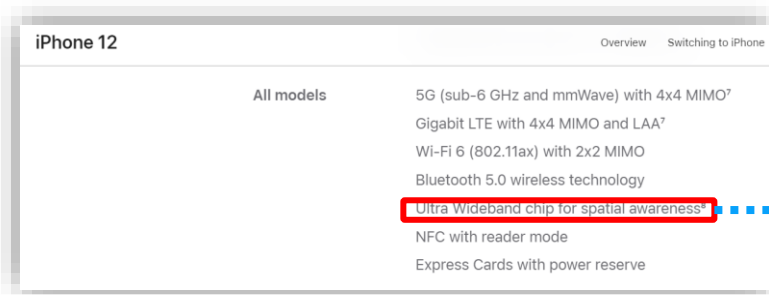
first location request signal in response to a second indication from the user to locate the at least one remote device



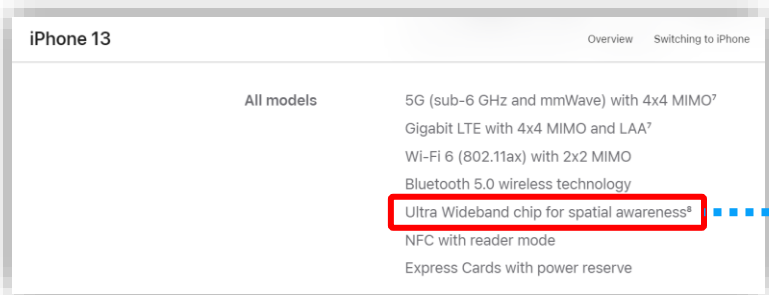
See it on a map

1. Open the Find My app.
2. Choose the Devices or Items tab.
3. Select the device or item to see its location on the map. If you belong to a Family Sharing group, you can see the devices in your group.
4. Choose Directions to open its location in Maps.

support.apple.com/en-us/HT210515



apple.com/iphone-12/specs



apple.com/iphone-13/specs

first RF signal



at least one remote device

wherein **at least one of the plurality of wireless transceivers** receives a **second RF signal** from the **at least one remote device** that facilitates determining the location of the at least one remote device

Use Precision Finding to pinpoint the location of your item

If you have a [supported iPhone model with Ultra Wideband](#) and your AirTag is nearby,¹ you can tap Find Nearby to help find it, even if it's stuck between couch cushions or hiding under a stack of mail.

<https://support.apple.com/en-us/HT210967>

iPhone 12	
Overview	Switching to iPhone
All models	5G (sub-6 GHz and mmWave) with 4x4 MIMO ⁷ Gigabit LTE with 4x4 MIMO and LAA ⁷ Wi-Fi 6 (802.11ax) with 2x2 MIMO Bluetooth 5.0 wireless technology Ultra Wideband chip for spatial awareness⁸ NFC with reader mode Express Cards with power reserve

apple.com/iphone-12/specs

iPhone 13	
Overview	Switching to iPhone
All models	5G (sub-6 GHz and mmWave) with 4x4 MIMO ⁷ Gigabit LTE with 4x4 MIMO and LAA ⁷ Wi-Fi 6 (802.11ax) with 2x2 MIMO Bluetooth 5.0 wireless technology Ultra Wideband chip for spatial awareness⁸ NFC with reader mode Express Cards with power reserve

apple.com/iphone-13/specs

second RF signal



at least one remote device

Ultra Wideband information

Ultra Wideband is available on the MagSafe Charging Case for AirPods Pro (2nd generation), and availability varies by region.

Ultra Wideband is only active when the charging case is in close proximity to a paired Ultra Wideband-compatible Apple device and during a user-triggered finding session.

Ultra Wideband must be turned off when onboard aircraft, ships, and other prohibited regions by turning on airplane mode on a paired Ultra Wideband-compatible Apple device. To turn on airplane mode on a paired Ultra Wideband-compatible Apple device, open Control Center, then tap . You can also turn Airplane mode on or off in Settings . When airplane mode is on, appears in the status bar.

Ultra Wideband features require a paired Ultra Wideband-compatible Apple device.

Australia: Ultra Wideband transmitters must not be operated within a nominated distance from specified Australian radio-astronomy sites. For further information about nominated distance, please refer to the Radiocommunications (Low Interference Potential Devices) Class Licence 2015 published by the Australian Communications and Media Authority.

<https://support.apple.com/guide/airpods/ultra-wideband-information-dev4a13375fb/web>

present a **display that visually assists the user to determine a location of the at least one remote device**, . . . wherein the display visually assists the user to determine the location of the at least one remote device via **an arrow pointing in a direction to the at least one remote device**.

display that visually assists the user to determine a location of the at least one remote device



arrow pointing in a direction to the at least one remote device

3. The mobile communication device of claim 1 wherein the display visually assists the user further by displaying an **indication [of] distance to** the **at least one remote device**.

at least one remote device



at least one remote device

indication [of] distance

4. The mobile communication device of claim 1 wherein the mobile communication device is a **handheld wireless communication device**.

5. The mobile communication device of claim 4 wherein the plurality of wireless transceivers includes a **long range transceiver for sending and receiving telephone calls via a telephony network and further for communicating Internet data**.

handheld wireless communication device:

iPhone 11



iPhone 12



iPhone 13



iPhone 14



long range transceiver for sending and receiving telephone calls via a telephony network and further for communicating Internet data:

■ **Model A2111***

FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, GSM/EDGE (850, 900, 1800, 1900 MHz)

support.apple.com/kb/
SP804?locale=en_US

Model A2172*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2176*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2481*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2482*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2649*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2632*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

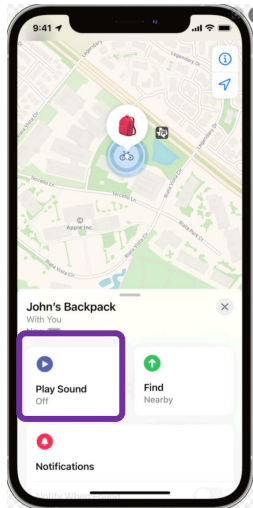
apple.com/iphone-13/specs

<https://www.apple.com/iphone-14/specs/>

IPR2024-00397

Apple EX1039 Page 89

6. The mobile communication device of claim 1, wherein **the at least one remote device emits a detectable alert signal** in response to the first RF signal to further assist the user in determining the location of the at least one remote device.



Play a sound

1. Open the Find My app on your iPhone, iPad, or iPod touch, then tap the Items tab.
2. Choose the AirTag you want to play a sound in the Items list.
3. Tap Play Sound . ¹ If your AirTag is within Bluetooth range, it will play a sound.
4. To stop playing this sound before it ends automatically, tap Stop Sound.

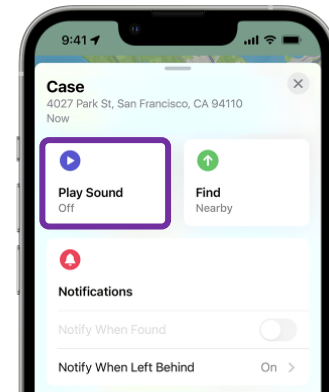
support.apple.com/en-us/HT210967



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, **you can play a sound to help you find them.** With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>



IPR2024-00397
Apple EX1039 Page 90

7. The mobile communication device of claim 1 wherein the at least one remote device includes **a plurality of remote devices** and wherein the graphical user interface allows selection of a particular one of the plurality of remote devices to be located.

8. The mobile communication device of claim 7 wherein the **display visually indicates the selection of the particular one of the plurality of remote devices to be located.**

*plurality of
remote
devices*



*display visually
indicates the
selection of the
particular one of
the plurality of
remote devices to
be located*

10. A mobile communication device comprising: a plurality of wireless transceivers;

iPhone 11

■ **All models**
Gigabit-class LTE with 2x2 MIMO and LAA⁶
802.11ax Wi-Fi 6 with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁷
NFC with reader mode
Express Cards with power reserve

■ **Model A2111***
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17,
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100,
GSM/EDGE (850, 900, 1800, 1900 MHz)

[support.apple.com/kb/
SP804?locale=en_US](https://support.apple.com/kb/SP804?locale=en_US)

iPhone 12

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO²
Gigabit LTE with 4x4 MIMO and LAA⁷
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁸
NFC with reader mode
Express Cards with power reserve

Model A2172*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2176*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

iPhone 13

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO²
Gigabit LTE with 4x4 MIMO and LAA⁷
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.0 wireless technology
Ultra Wideband chip for spatial awareness⁸
NFC with reader mode
Express Cards with power reserve

Model A2481*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2482*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

iPhone 14

All models
5G (sub-6 GHz and mmWave) with 4x4 MIMO²
Gigabit LTE with 4x4 MIMO and LAA⁸
Wi-Fi 6 (802.11ax) with 2x2 MIMO
Bluetooth 5.3
Ultra Wideband chip for spatial awareness⁹
NFC with reader mode
Express Cards with power reserve

Model A2649*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2632*
5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n261)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

<https://www.apple.com/iphone-14/specs/>

iPad Pro 12.9-in. (6th generation) ▾

iPad Air (5th generation) ▾

iPad (10th generation) ▾

All models

Wi-Fi 6E; speeds up to 2.4 Gbps⁷
MIMO
Bluetooth 5.3

Wi-Fi + Cellular

—
UMTS/HSPA/HSPA+/DC-HSDPA
5G (sub-6 GHz and mmWave)²
Gigabit LTE (up to 32 bands)²
GPS/GNSS
Data only⁸
Wi-Fi calling²

All models

Wi-Fi 6; speeds up to 1.2 Gbps
MIMO
Bluetooth 5.0

Wi-Fi + Cellular

—
UMTS/HSPA/HSPA+/DC-HSDPA
5G (sub-6 GHz)²
Gigabit LTE (up to 32 bands)²
GPS/GNSS
Data only⁸
Wi-Fi calling²

All models

Wi-Fi 6; speeds up to 1.2 Gbps
MIMO
Bluetooth 5.2

Wi-Fi + Cellular

—
UMTS/HSPA/HSPA+/DC-HSDPA
5G (sub-6 GHz)²
Gigabit LTE (up to 32 bands)²
GPS/GNSS
Data only⁸
Wi-Fi calling²

IPR2024-00397

Apple EX1039 Page 92

a **touchscreen**;
a **memory** that stores operational instructions; and
a **processor** configured to execute operational instructions,

iPhone 11



- 64GB
- 128GB
- 256GB

4 GB RAM



support.apple.com/kb/SP804?locale=en_US

iPhone 12



- 64GB
- 128GB
- 256GB

4/6 GB RAM



apple.com/iphone-12/specs

iPhone 13



- 128GB
- 256GB
- 512GB

4/6 GB RAM



apple.com/iphone-13/specs

iPhone 14



- 128GB
- 256GB
- 512GB

6 GB RAM



apple.com/iphone-14/specs

a **touchscreen**;
a **memory** that stores operational instructions; and
a **processor** configured to execute operational instructions,

iPad Pro 12.9-in. (6th genera ▾

iPad Air (5th generation) ▾

iPad (10th generation) ▾



touchscreen

processor

memory



M2 chip

Storage up to
2TB

Apple M2 chip

8-core CPU with 4 performance cores
and 4 efficiency cores
10-core GPU
16-core Neural Engine
100GB/s memory bandwidth
8GB or 16GB RAM



M1 chip

Storage up to
256GB

Apple M1 chip

8-core CPU with 4 performance cores
and 4 efficiency cores
8-core GPU
16-core Neural Engine
8GB RAM



A14 Bionic chip

Storage up to
256GB

A14 Bionic chip

6-core CPU with 2 performance cores
and 4 efficiency cores
4-core GPU
16-core Neural Engine

a **touchscreen**;

a **memory** that stores operational instructions; and

a **processor** configured to execute operational instructions,

Use AirPods with iPad

1. On iPad, go to Settings > Bluetooth, then turn on Bluetooth.
2. Go to the Home Screen on your iPad.
3. Do one of the following: AirPods (1st, 2nd, and 3rd generation) and AirPods Pro: Open the case with your AirPods inside, then hold it next to your iPad. ...
4. Follow the onscreen instructions, then tap Done.

[https://support.apple.com > guide > ipad > ipados](https://support.apple.com/guide/ipad/ipados) ⋮

Use AirPods with iPad - Apple Support

On iPhone or iPad, **open the Find My app, tap Devices, then tap the name of your AirPods Pro.** You can see the location of your AirPods Pro and the charging case on the map. Choose one of your AirPods Pro, or the charging case, then tap Play Sound.

[https://support.apple.com > guide > airpods > web](https://support.apple.com/guide/airpods/web) ⋮

Locate AirPods in Find My - Apple Support

wherein the operational instructions cause the processor to present a graphical user interface via the touch screen and wherein the processor operates in association with the graphical user interface to:

respond to a first user interaction with the touchscreen by **pairing**, via at least one of the plurality of wireless transceivers, the **mobile communication device** with **at least one remote device**,

pairing

Set up your AirTag

1. Make sure that your device is ready for setup.
2. If your AirTag is new, remove the wrap around the product and pull out the tab to activate the battery. Your AirTag will play a sound.
3. Hold your AirTag near your iPhone, iPad, or iPod touch, then tap Connect.* If you have multiple AirTags and see "More than one AirTag detected", make sure that only one AirTag is near your device at one time. [Need help connecting your AirTag?](#)
4. Select an item name from the list, or select Custom Name to name your AirTag and choose an emoji. Then tap Continue.
5. To register your AirTag with your Apple ID, tap Continue again.
6. Tap Done.

Now you can attach your AirTag to your item and see it in [the Find My app](#).

* You can also set up your AirTag in the Find My app. Tap the Items tab, then tap Add Item.



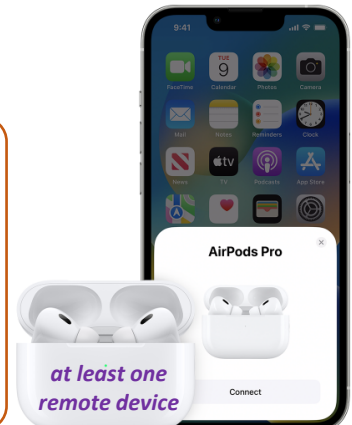
at least one remote device

Connect your AirPods and AirPods Pro to your iPhone

Learn how to use your iPhone to set up your AirPods.

If you're setting up your AirPods for the first time, make sure that you have an iPhone with the [latest version of iOS](#). Then follow these steps:

1. Go to the Home Screen.
2. With your AirPods in the charging case, open the charging case, and hold it next to your iPhone. A setup animation appears on your iPhone.
3. Tap Connect.
4. If you have AirPods Pro (1st or 2nd generation) or AirPods (3rd generation), read the next three screens.
5. If you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation) and you set up "Hey Siri" on your iPhone already, then "Hey Siri" is ready to use with your AirPods. If you haven't set up "Hey Siri" already and you have AirPods Pro (1st or 2nd generation) or AirPods (2nd or 3rd generation), you'll be guided through the setup.
6. Tap Done.



at least one remote device

support.apple.com/en-us/HT210973

wherein the operational instructions cause the processor to present a graphical user interface via the touch screen and wherein the processor operates in association with the graphical user interface to:

respond to a first user interaction with the touchscreen by pairing, via at least one of the plurality of wireless transceivers, the **mobile communication device** with **at least one remote device**,

Turn on, pair, and set up your Apple Watch

1. Put your Apple Watch on your wrist. Adjust the band or choose a band size so your Apple Watch fits closely but comfortably on your wrist.

For information about changing the band on your Apple Watch, see [Remove, change, and fasten Apple Watch bands](#).

2. To turn on your Apple Watch, press and hold the side button until you see the Apple logo.

3. Bring your iPhone near your Apple Watch, wait for the Apple Watch pairing screen to appear on your iPhone, then tap Continue.

Or open the Apple Watch app on your iPhone, then tap Pair New Watch.

**respond to a
first user
interaction
with the
touchscreen
by pairing**



4. Tap Set Up for Myself.
5. When prompted, position your iPhone so that your Apple Watch appears in the viewfinder in the Apple Watch app. This pairs the two devices.
6. Tap Set Up Apple Watch, then follow the instructions on your iPhone and Apple Watch to finish setup.



**at least one
remote device**

support.apple.com/guide/watch/set-up-and-pair-your-apple-watch-with-iphone-apdde4d6f98e/watchos

the **at least one remote device** including a **sound emitter** configured to generate an audio alert;

AirTag Tech Specs

Size and Weight

at least one remote device



Size

Diameter: 1.26 inches (31.9 mm)
Height: 0.31 inch (8.0 mm)

Weight

0.39 ounce (11 grams)

Splash, Water, and Dust Resistance

Rated IP67 (maximum depth of 1 meter up to 30 minutes) under IEC standard 60529

Connectivity

Bluetooth for proximity finding
Apple-designed U1 chip for Ultra Wideband and Precision Finding
NFC tap for Lost Mode

Speaker

Built-in speaker

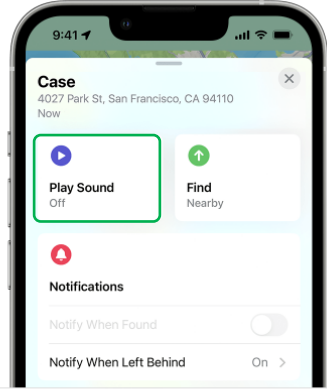
apple.com/airtag



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, you can play a sound to help you find them. With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



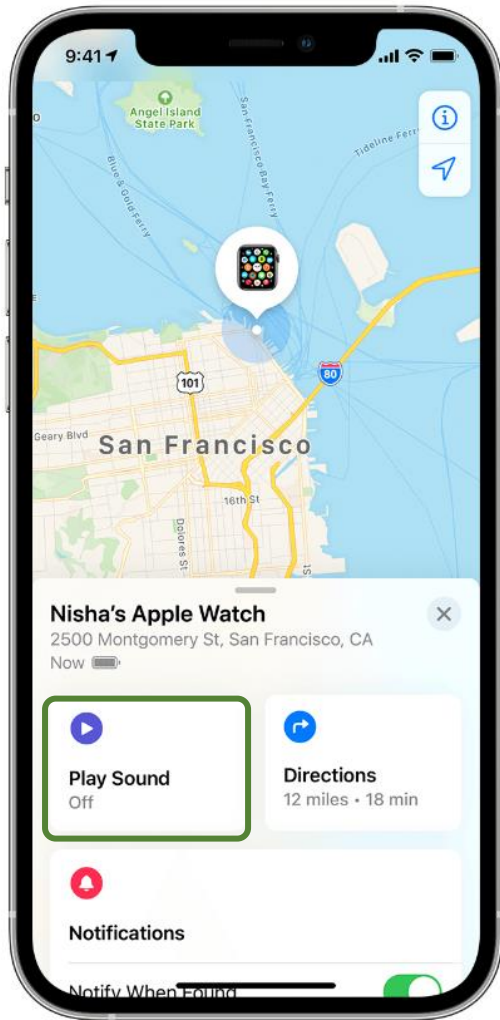
Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>



the **at least one remote device** including a **sound emitter** configured to generate an audio alert;

U.S. Patent No. 11,265,680



**at least one
remote
device
including a
sound
emitter**

Play a sound on your iPhone, iPad, iPod touch, Mac, or Apple Watch

1. Open the Find Devices app  on your Apple Watch, then tap a device.
2. Tap Play Sound.

- *If the device is online:* A sound starts after a short delay and gradually increases in volume, then plays for about two minutes. The device vibrates (if applicable). A Find My [device] alert appears on the device's screen.

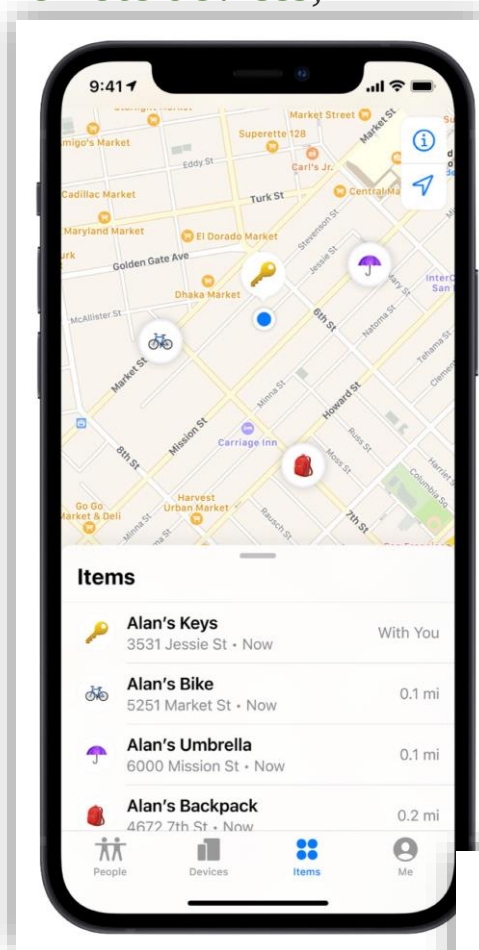
A confirmation email is also sent to your Apple ID email address.

- *If the device is offline:* You see Sound Pending. The sound plays the next time the device connects to a Wi-Fi or cellular network.

support.apple.com/en-us/HT207024

facilitates, via a second interaction with the touchscreen, **selection of the at least one remote device from a plurality of remote devices;**

selection of the at least one remote device from a plurality of remote devices

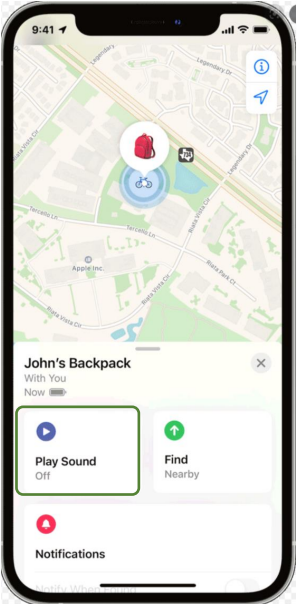


Locate your AirPods in the Find My app

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods. Under each device, you see a location or "No location found."

<https://support.apple.com/en-us/HT207581>

responds to a **third interaction with the touchscreen** by transmitting, via at least one of the plurality of wireless transceivers, a first paging signal to the at least one remote device, wherein **the first paging signal causes the at least one remote device to generate the audio alert**; and



Play a sound

1. Open the Find My app on your iPhone, iPad, or iPod touch, then tap the Items tab.
2. Choose the AirTag you want to play a sound in the Items list.
3. Tap Play Sound . ¹ If your AirTag is within Bluetooth range, it will play a sound.
4. To stop playing this sound before it ends automatically, tap Stop Sound.

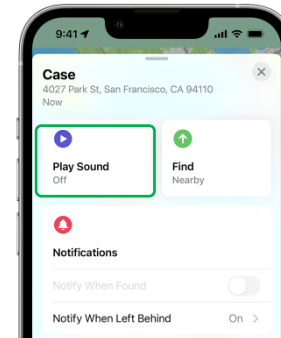
support.apple.com/en-us/HT210967



Play a sound on your AirPods

If your AirPods are near any of your Apple devices and connected to Bluetooth, you can play a sound to help you find them. With AirPods Pro (2nd generation), you can also play a sound to help find your charging case.

1. Open the Find My app.
2. Select the Devices tab.
3. Choose your AirPods from the list.
4. Tap Play Sound to play a sound that gets louder gradually.



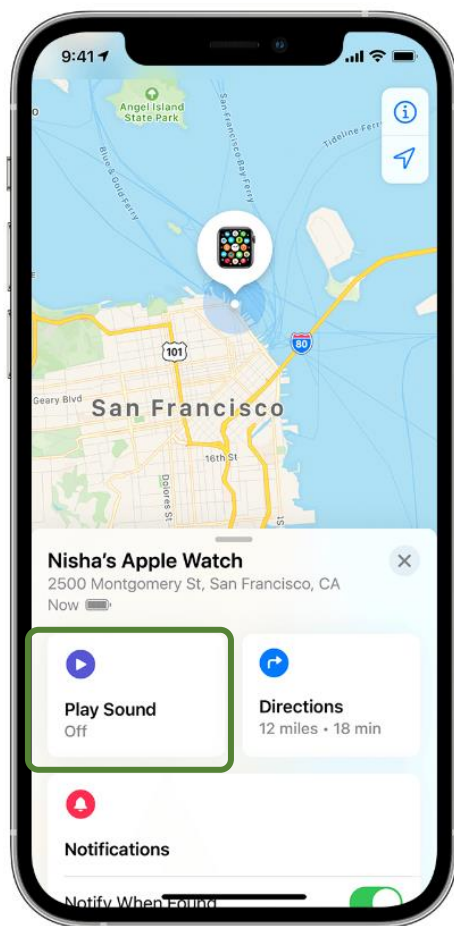
Make sure that your AirPods are not in or on your ears before you play a sound.

<https://support.apple.com/en-us/HT207581>



responds to a **third interaction with the touchscreen** by transmitting, via at least one of the plurality of wireless transceivers, a **first paging signal** to the at least one remote device, wherein the **first paging signal causes the at least one remote device to generate the audio alert**; and

U.S. Patent No. 11,265,680



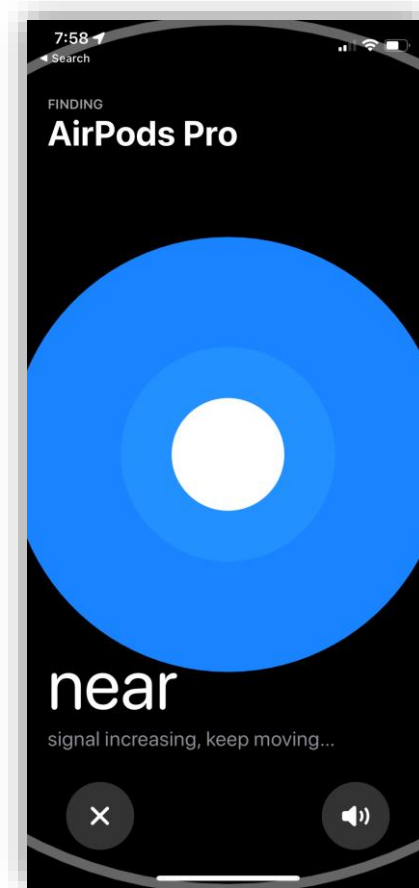
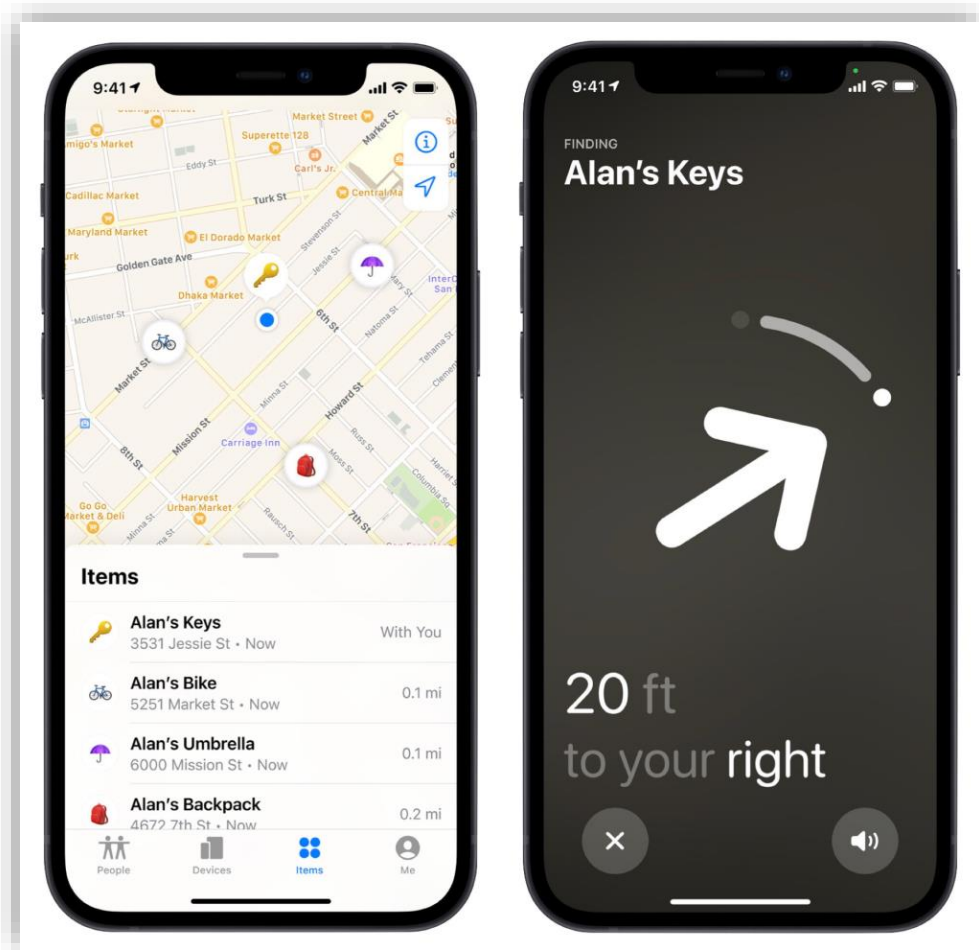
first paging signal



*at least one
remote
device
generates an
audio alert*

support.apple.com/en-us/HT207024

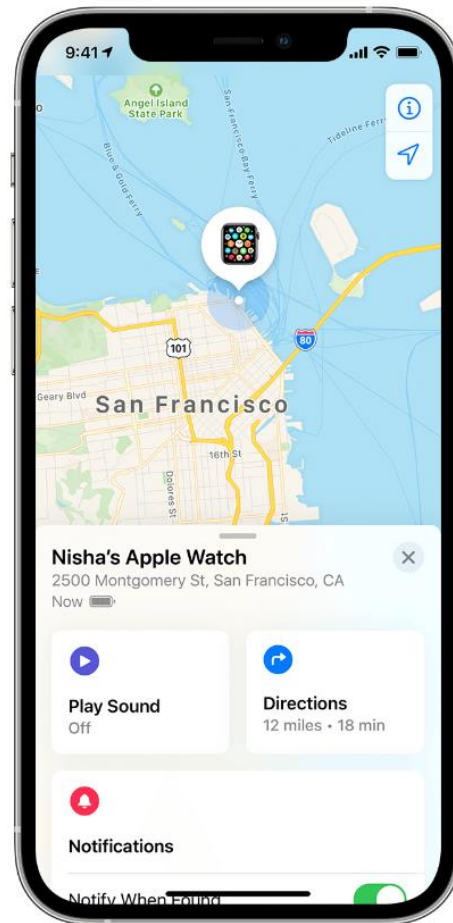
present a display on the touchscreen, based on a signal received via at least one of the plurality of wireless transceivers from the at least one remote device, wherein the **display visually assists a user to determine a location of the at least one remote device.**



display visually assists a user to determine a location of the at least one remote device

present a display on the touchscreen, based on a signal received via at least one of the plurality of wireless transceivers from the at least one remote device, wherein the **display visually assists a user to determine a location of the at least one remote device.**

*display visually
assists a user to
determine a
location of the
at least one
remote device*



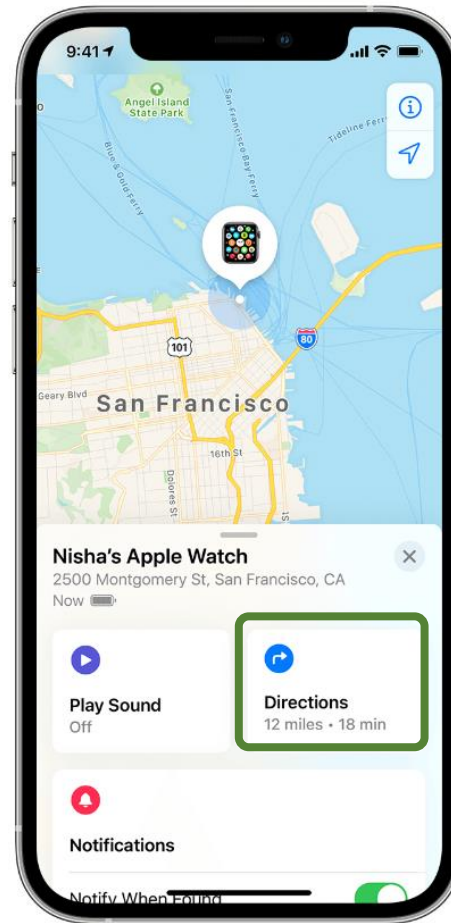
support.apple.com/en-us/HT207024

15. The mobile communication device of claim 10 wherein the display visually assists the user in **determining a distance to the at least one remote device.**



determining a distance to the at least one remote device

15. The mobile communication device of claim 10 wherein the display visually assists the user in **determining a distance to the at least one remote device.**



*determining a
distance to the
at least one
remote device*

support.apple.com/en-us/HT207024

17. The mobile communication device of claim 10 wherein the mobile communication device is a **handheld wireless communication device**.

18. The mobile communication device of claim 17 wherein the plurality of wireless transceivers includes **a long range transceiver for sending and receiving telephone calls via a telephony network and further for communicating Internet data**.

handheld wireless communication device:

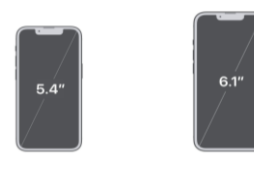
iPhone 11



iPhone 12



iPhone 13



iPhone 14



long range transceiver for sending and receiving telephone calls via a telephony network and further for communicating Internet data:

■ **Model A2111***

FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, GSM/EDGE (850, 900, 1800, 1900 MHz)

support.apple.com/kb/
SP804?locale=en_US

Model A2172*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n30, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2178*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n30, n38, n40, n41, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-12/specs

Model A2481*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2482*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n20, n25, n28, n29, n30, n38, n40, n41, n48, n66, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 11, 12, 13, 14, 17, 18, 19, 20, 21, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48)
CDMA EV-DO Rev. A (800, 1900 MHz)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

apple.com/iphone-13/specs

Model A2649*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

Model A2632*

5G NR (Bands n1, n2, n3, n5, n7, n8, n12, n14, n20, n25, n26, n28, n29, n30, n38, n40, n41, n48, n53, n66, n70, n71, n77, n78, n79)
5G NR mmWave (Bands n258, n260)
FDD-LTE (Bands 1, 2, 3, 4, 5, 7, 8, 12, 13, 14, 17, 18, 19, 20, 25, 26, 28, 29, 30, 32, 66, 71)
TD-LTE (Bands 34, 38, 39, 40, 41, 42, 46, 48, 53)
UMTS/HSPA+/DC-HSDPA (850, 900, 1700/2100, 1900, 2100 MHz)
GSM/EDGE (850, 900, 1800, 1900 MHz)

https://www.apple.com/iphone-14/specs/

IPR2024-00397

Apple EX1039 Page 107

17. The mobile communication device of claim 10 wherein the mobile communication device is a **handheld wireless communication device**.

18. The mobile communication device of claim 17 wherein the plurality of wireless transceivers includes **a long range transceiver for sending and receiving telephone calls via a telephony network and further for communicating Internet data**.

handheld wireless communication device:

iPad Pro 12.9-in. (6th genera

▼

iPad Air (5th generation)

▼

iPad (10th generation)

▼







All models

Wi-Fi 6E; speeds up to 2.4 Gbps⁷

MIMO

Bluetooth 5.3

Wi-Fi + Cellular

All models

Wi-Fi 6; speeds up to 1.2 Gbps

MIMO

Bluetooth 5.0

Wi-Fi + Cellular

All models

Wi-Fi 6; speeds up to 1.2 Gbps

MIMO

Bluetooth 5.2

Wi-Fi + Cellular

Preliminary Infringement Charts for U.S. Patent No. 8,768,381



US008768381B2

(12) **United States Patent**
Howard et al.

(10) **Patent No.:** **US 8,768,381 B2**
(45) **Date of Patent:** ***Jul. 1, 2014**

(54) **WIRELESS DEVICE AND METHODS FOR USE IN A PAGING NETWORK**

(71) Applicant: **THL Holding Company, LLC**, Round Rock, TX (US)

(72) Inventors: **John W. Howard**, Cedar Park, TX (US); **Richard Cutler**, Leander, TX (US); **Robert M. Kennard**, Dallas, TX (US)

(73) Assignee: **THL Holding Company, LLC**, Round Rock, TX (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/044,202**

(22) Filed: **Oct. 2, 2013**

(65) **Prior Publication Data**
US 2014/0031017 A1 Jan. 30, 2014

Related U.S. Application Data

(63) Continuation of application No. 12/713,346, filed on Feb. 26, 2010, now Pat. No. 8,588,806.

(51) **Int. CL.**
H04W 24/00 (2009.01)

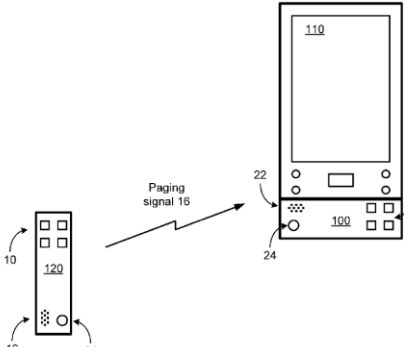
(52) **U.S. CL.**
USPC: **455/456.1**

(58) **Field of Classification Search**
USPC: 455/404.2, 41.2, 575.6, 404.1, 418, 455/419, 3.06, 3.03, 426.1, 414.1, 550.1, 455/556.2, 661, 466; 340/539.32, 925.69; 710/315; 725/114; 348/734
See application file for complete search history.

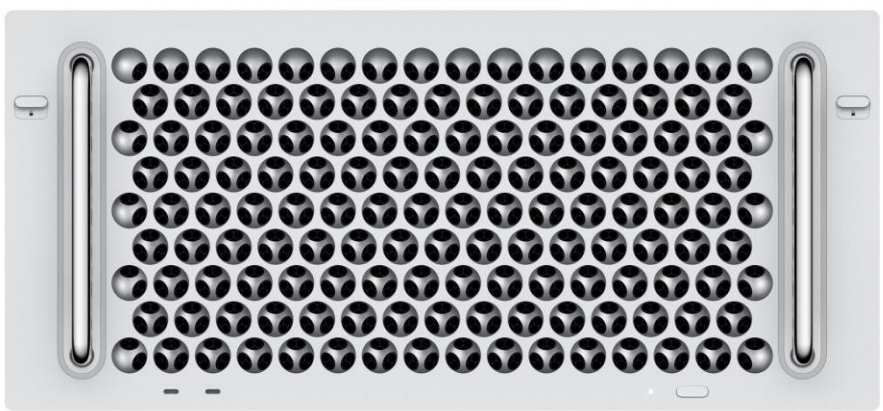
(56) **References Cited**
U.S. PATENT DOCUMENTS
8,588,806 B2 * 11/2013 Howard et al. 455/456.1
* cited by examiner
Primary Examiner — Melody Mehrpour
(74) *Attorney, Agent, or Firm* — Garlick & Markison; Bruce E. Stuckman

(57) **ABSTRACT**
A wireless device includes a user interface that generates a pairing signal in response to an indication from a user to pair the wireless device to at least one remote device and generates a first location request signal in response to a second indication from a user to locate the at least one remote device. A short-range wireless transceiver communicates RF signals to pair the wireless device to the at least one remote device and that transmits a first RF paging signal to the at least one remote device in response to the location request signal.

20 Claims, 22 Drawing Sheets

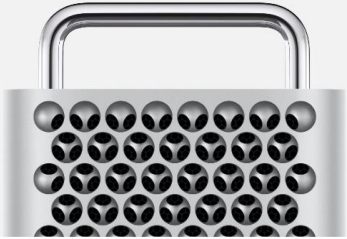


Mac Pro



1. A **wireless device** for locating at least one remote object, the wireless device comprising:

Mac Pro



Technical Specifications

Wireless

Wi-Fi

802.11ac Wi-Fi wireless networking

IEEE 802.11a/b/g/n compatible

Bluetooth

Bluetooth 5.0 wireless technology

www.apple.com/mac-pro/specs/

Set up Find My on Mac

Before you can share your location with your friends and find your Apple devices and items, you need to turn on [Location Services](#) and Find My Mac. You can do this when you open Find My for the first time or later in System Settings.

support.apple.com/guide/findmy-mac/set-up-fmm53101237/mac

a graphical user interface that generates a pairing signal in response to a first indication from a user to pair the wireless device to at least one remote device

Use AirPods with your Mac

When your AirPods are nearby and ready to use with your Mac, you can use them to listen to music, use Siri, or handle phone calls. To learn more about AirPods, see the AirPods User Guide.

Pair your AirPods with your Mac

If your AirPods are not connected with your iPhone, you can connect them directly with your Mac.

1. With your AirPods in their case, open the lid.
2. Press and hold either the setup button on the back of the case or the noise control button (on AirPods Max only) until the status light flashes white.
3. On your Mac, choose Apple menu  > System Preferences, then click Bluetooth .
4. Select AirPods in the Devices list.
5. If your AirPods support it, click Enable to be able to say “Hey Siri” to start using Siri with your AirPods.

Use AirPods with your Mac – Apple Support

and generates a first location request signal in response to a second indication from a user to locate the at least one remote device; and

Play a sound on your AirPods or Beats product

You can play a sound on your AirPods or Beats headphones if they're out of their case. If you turn on the Find My network for AirPods (3rd generation), AirPods Pro, or AirPods Max, you can also play a sound when they're in their case.

1. In the Find My app  on your Mac, click Devices.
2. In the Devices list, select your AirPods or Beats product, then click the Info button  on the map.
3. Click Play Sound. If your AirPods or Beats product are separated, you can click Left or Right to find them one at a time.

Locate a device in Find My on Mac – Apple Support

a short-range wireless transceiver, coupled to the graphical user interface, that responds to the pairing signal generated by the graphical user interface by communicating RF signals to pair the wireless device to the at least one remote device

The Mac Pro's Bluetooth wireless transceiver communicates RF signals to pair the Mac Pro to the AirPods, in response to the pairing signal generated in response to user interaction with the Find My app as discussed above. The Mac Pro's Bluetooth wireless transceiver transmits a first RF paging signal to the AirPods in response to the location request signal to "Play Sound." That first RF paging signal is sent to the AirPods to command the AirPods to play a sound from each AirPod.

Play a sound on your AirPods or Beats product

You can play a sound on your AirPods or Beats headphones if they're out of their case. If you turn on the Find My network for AirPods (3rd generation), AirPods Pro, or AirPods Max, you can also play a sound when they're in their case.

1. In the Find My app  on your Mac, click Devices.
2. In the Devices list, select your AirPods or Beats product, then click the Info button ⓘ on the map.
3. Click Play Sound. If your AirPods or Beats product are separated, you can click Left or Right to find them one at a time.

[Locate a device in Find My on Mac – Apple Support](#)

and that transmits a first RF paging signal to the at least one remote device in response to the first location request signal and that receives a location signal from the at least one remote device;

A location signal is received by the Mac Pro's Bluetooth short-range wireless transceiver from the AirPods. As noted above, the Mac Pro can connect directly to the AirPods. In response, the Find My app updates the location of the AirPods on a map display.

Locate AirPods in Find My

If your AirPods are paired with your iPhone, iPad, iPod touch, Apple Watch, or Mac, you can use the Find My app to help you locate them if they're lost.

support.apple.com/guide/airpods/locate-your-airpods-dev8e8b93d71/web

Get the location of your AirPods

- *On Mac:* Open the Find My app, click Devices, then select your AirPods.

<https://support.apple.com/guide/airpods/locate-your-airpods-dev8e8b93d71/web>

wherein the graphical user interface presents a display that visually assists the user to locate the at least one remote device.

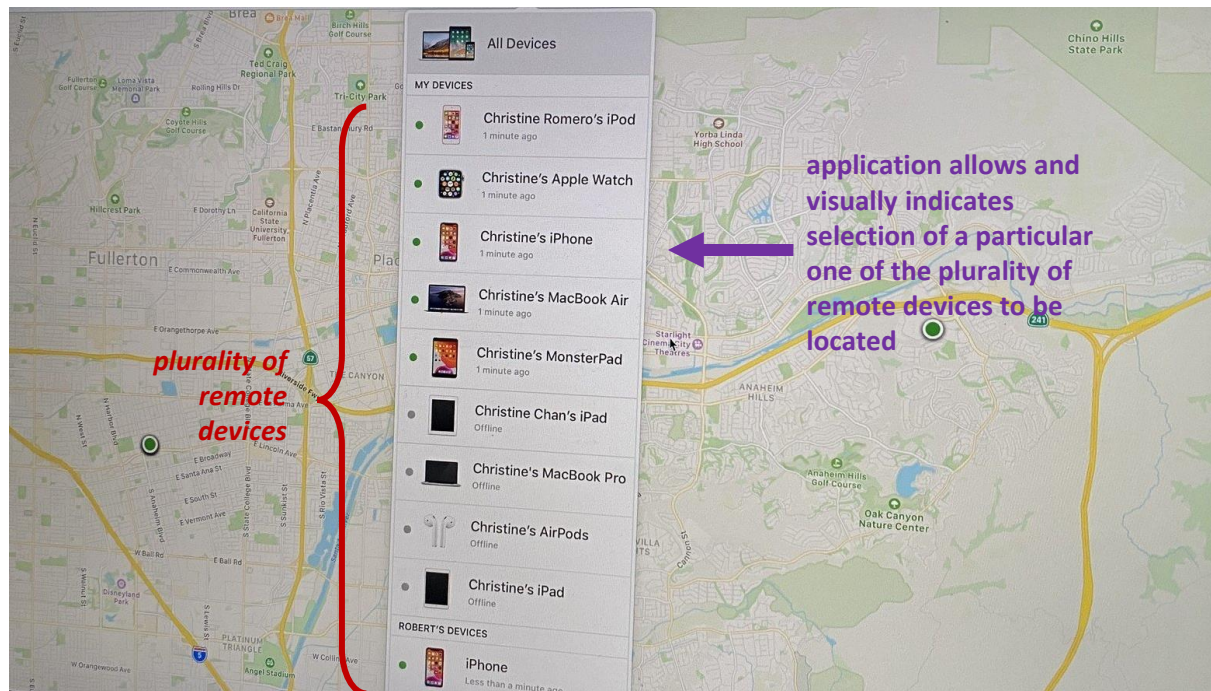
See the location of a device

1. In the Find My app  on your Mac, click Devices.
2. In the Devices list, select the device you want to locate.
 - *If the device can be located:* It appears on the map so you can see where it is. The updated location and timestamp appear under the device's name. If there's a blue circle around the device, the location is approximate.

[Locate a device in Find My on Mac – Apple Support](#)

7. The wireless device of claim 1 wherein the at least one remote device includes a **plurality of remote devices** and wherein the application allows selection of a particular one of the plurality of remote devices to be located.

8. The wireless device of claim 7 wherein the display visually indicates the selection of the particular one of the plurality of remote devices to be located.



9. The wireless device of claim 7 wherein the plurality of remote devices comprise a first paging network wherein each of the plurality of **remote devices emits corresponding detectable alert signals in response to the first RF paging signal to assist the user in locating at least one of the plurality of remote devices.**

Play a sound on your AirPods

You can play a sound on your AirPods to help you locate them if they're out of their case.

If your AirPods are separated from each other, you can mute one by tapping Left or Right to find them one at a time.

- *On iPhone, iPad, or iPod touch:* Open the Find My app, tap Devices, tap the name of your AirPods, then tap Play Sound.
- *On Apple Watch:* With a Wi-Fi or cellular connection, open the Find Devices app, choose your AirPods, then tap Play Sound (watchOS 8.0 or later).
- *On Mac:* Open the Find My app, click Devices, select your AirPods, click ⓘ, then click Play Sound.
- *On iCloud.com:* Go to iCloud.com/find, sign in with your Apple ID, select All Devices, select your AirPods, then click Play Sound.

If your AirPods are connected to your device, they play a sound for a few minutes to help you locate them, or until you stop the sound.

If the AirPods are not connected, the sound plays the next time they connect to a Wi-Fi or cellular network.

If the [Find My network](#) is on, you can play a sound on your AirPods (3rd generation), AirPods Pro, or AirPods Max, even if they are not connected to your device. See [Turn on the Find My network](#).

support.apple.com/guide/airpods/locate-your-airpods-dev8e8b93d71/web