Offline iOS Tracking and Remote Wiping

By:
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iOS Offline Tracking and Wiping

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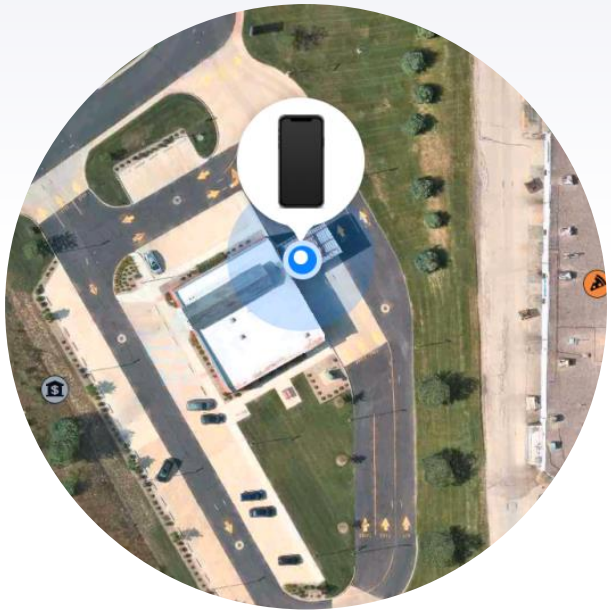
- St. Joseph County (IN) Prosecutor. Executive Director of the Cyber Crimes Unit
- Retired from the South Bend (IN) Police Department
- 33rd year in law enforcement

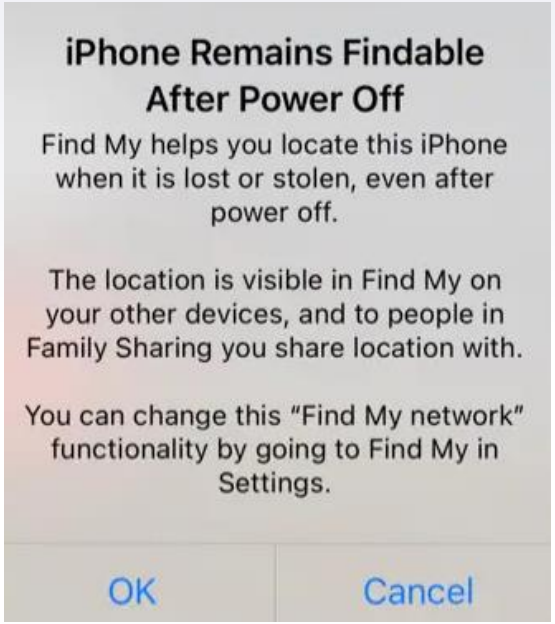
Outline

- Explanation of offline tracking and the U1 chip
- Implications of the chip
- Testing setup, procedure, and results
- Best practices



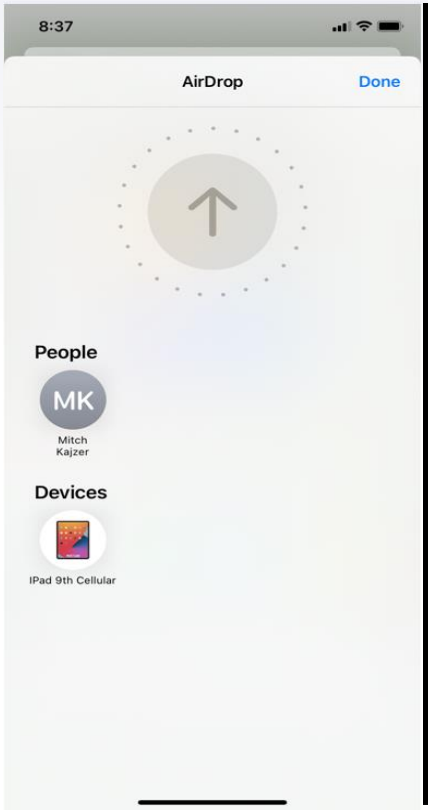
Offline Tracking

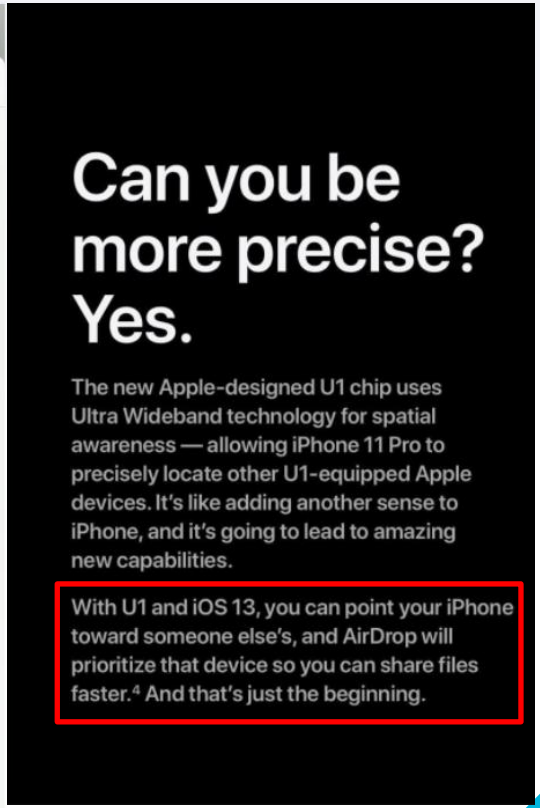
- Certain powered-down iOS devices may still be trackable
- Powered off doesn't really mean powered off
- When powering down a compatible device for the first time, it displays a pop up informing the user that the phone remains findable



U1 Chip

- Apple: "Used for spatial awareness. Allows the iPhone to understand its precise location relative to other nearby U1-equipped Apple devices."





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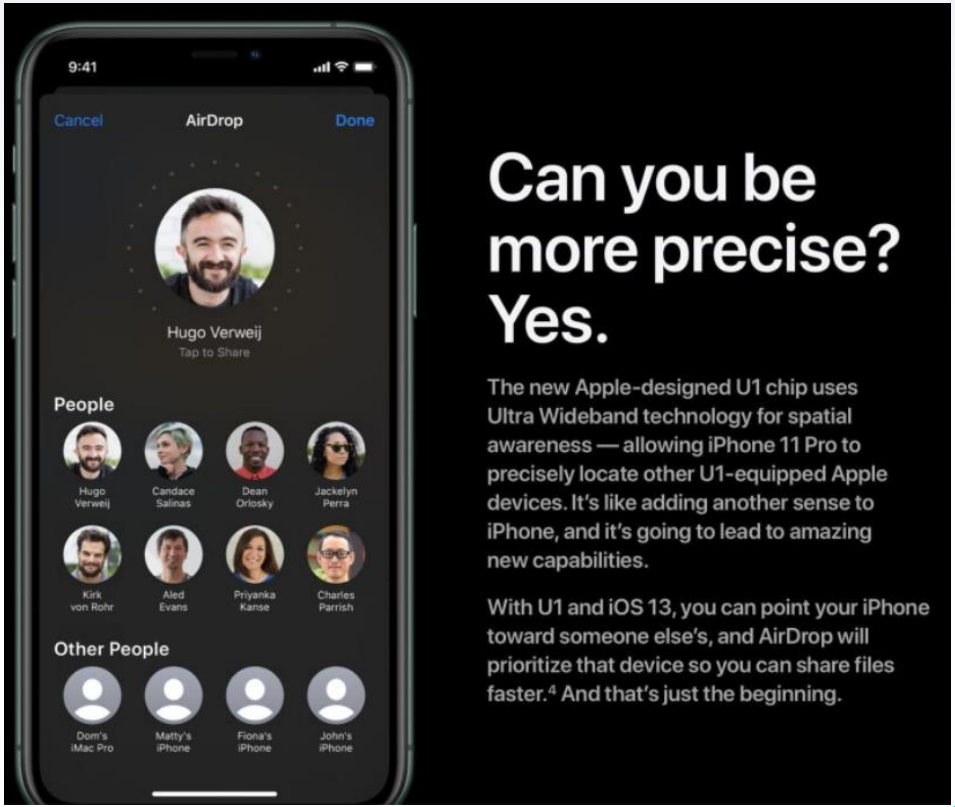
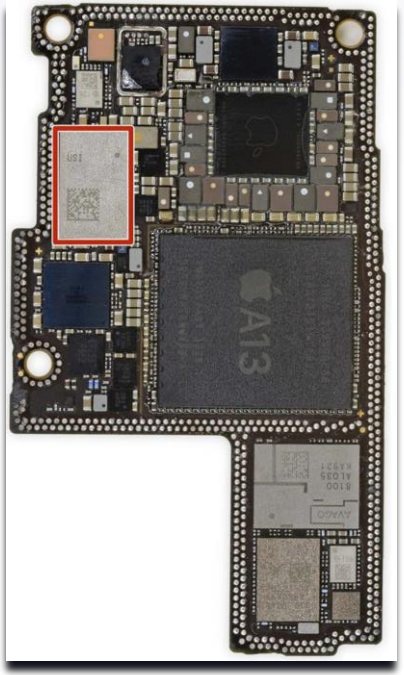


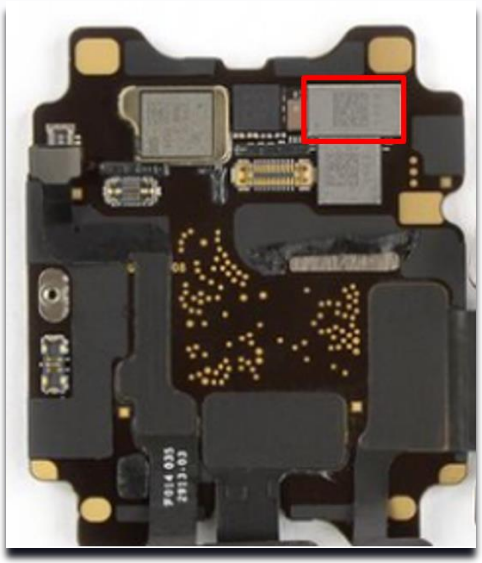
U1 Chip

- Compatible Devices
- iPhone 11



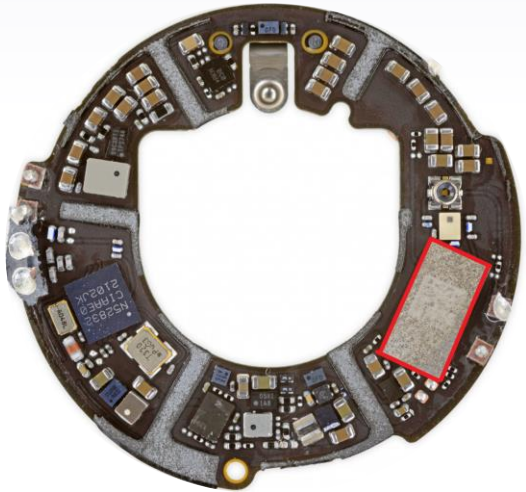
U1 Chip

- Compatible Devices
- Apple Watch 6



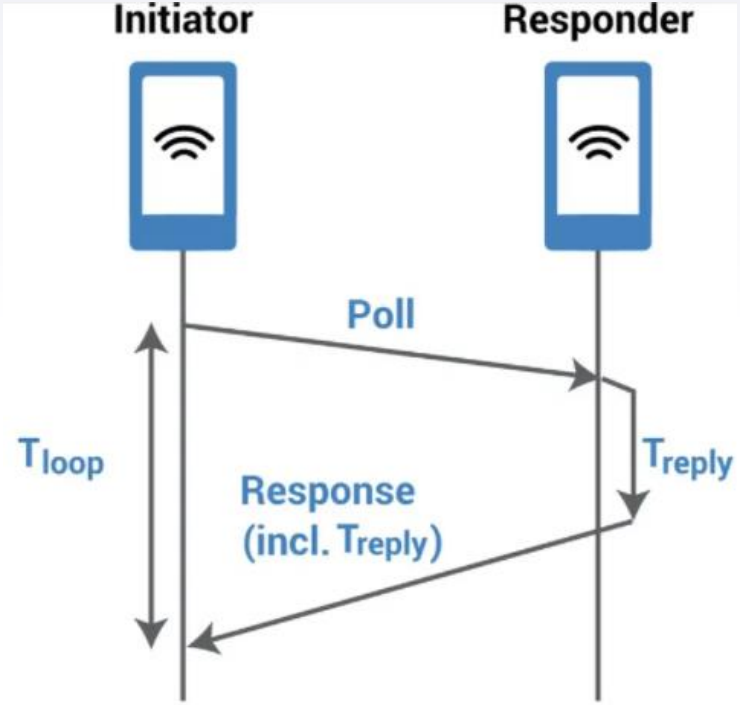
U1 Chip

- Compatible Devices
- AirTag



Ultra-Wideband

- Short-range wireless communications protocol
- Very low energy usage
- “Continuously scanning radar that can precisely lock onto an object, discover it’s location, and communicate with it.”
- Uses high-frequency, low-range pulse radio signals. Much more accurate than GPS or Classic Bluetooth



Capabilities of the Chip

- Very precise spatial and directional data
- It knows what other chips are around it and how far away they are.
- Accuracy of less than four inches
- Line of sight range is over 600feet
- Apple in promotional literature: “Think of it as GPS at the scale of your living room.”

Offline Tracking

- Offline tracking is essentially crowdsourcing using Ultra-Wideband
- To track an offline device, you must either be logged into the iCloud account of the device or using an iOS device configured with the same iCloud account
- Uses asymmetric encryption

Offline Tracking

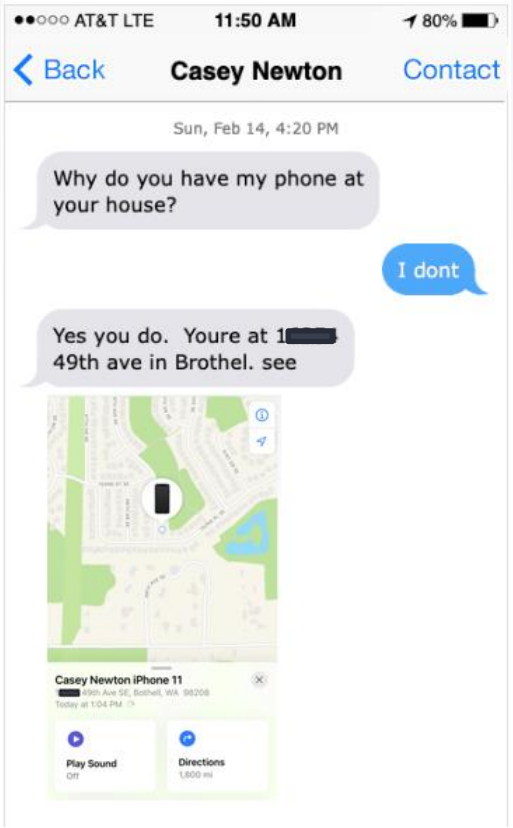
- Offline Device
  - Using Ultra-Wideband, the offline device continuously sends out pulses.
  - These pulses include the Public Key of the offline device.
- Devices in the Area
  - Picks up the Public Key from the offline device.
  - Records the location and encrypts it using the Public Key from the offline device.
  - The encrypted location, along with a hash of the Public Key, is transmitted to Apple.

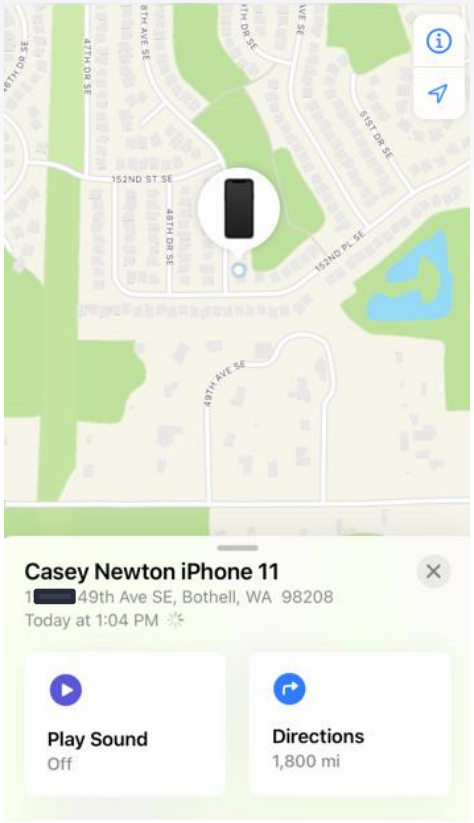
Offline Tracking

- Tracking Device or iCloud
  - When you click on FindMy, the hash of the Public Key is sent to Apple. They search their database for any matches.
  - When a match is found, it sends the encrypted location data that it received from the snitch device to the tracking device.
  - FindMy on the tracking device decrypts it using the Private Key.
- What can Apple see and what records do they keep?
  - Nothing. Since they do not know the Private Key, they cannot decrypt any location data. There is no historical data kept.

Implications and Questions

- Evidence Handling





Implications and Questions

- Remote Wiping
  - The wipe command uses crypto-shredding and erases all encryption keys.
  - Data is left encrypted and inaccessible.
  - Can a device be wiped remotely using Ultra-Wideband?

Testing Materials and Setup

Target Device

Apple iPhone 11

iOS 15.0.2

Chip: A13 Bionic and U1

Cellular and WiFi

Name: iPhone 11 Cellular

C[redacted]s.org

Friendly Device

Apple iPad 9th Generatoin

iOS 15.1

Chip: A12 Bionic 64 bit

Cellular and WiFi

Name: iPad 9th Cellular

C[redacted]s.org

Unknown (snitch) Devices

iPhone XR

iPhone 8

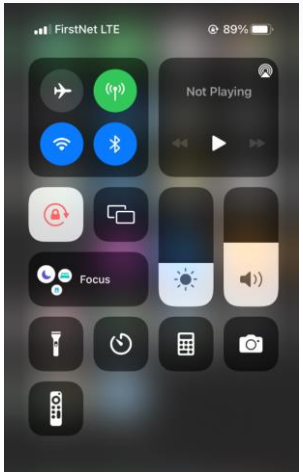
iPhone 13 Pro

iPad 6th Generation

Radio Terminology

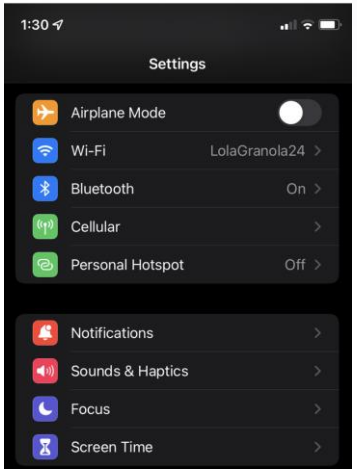
Disabled

- Via the Control Center.
- Typically for 24 hours. Then automatically reenabled.



Turned Off

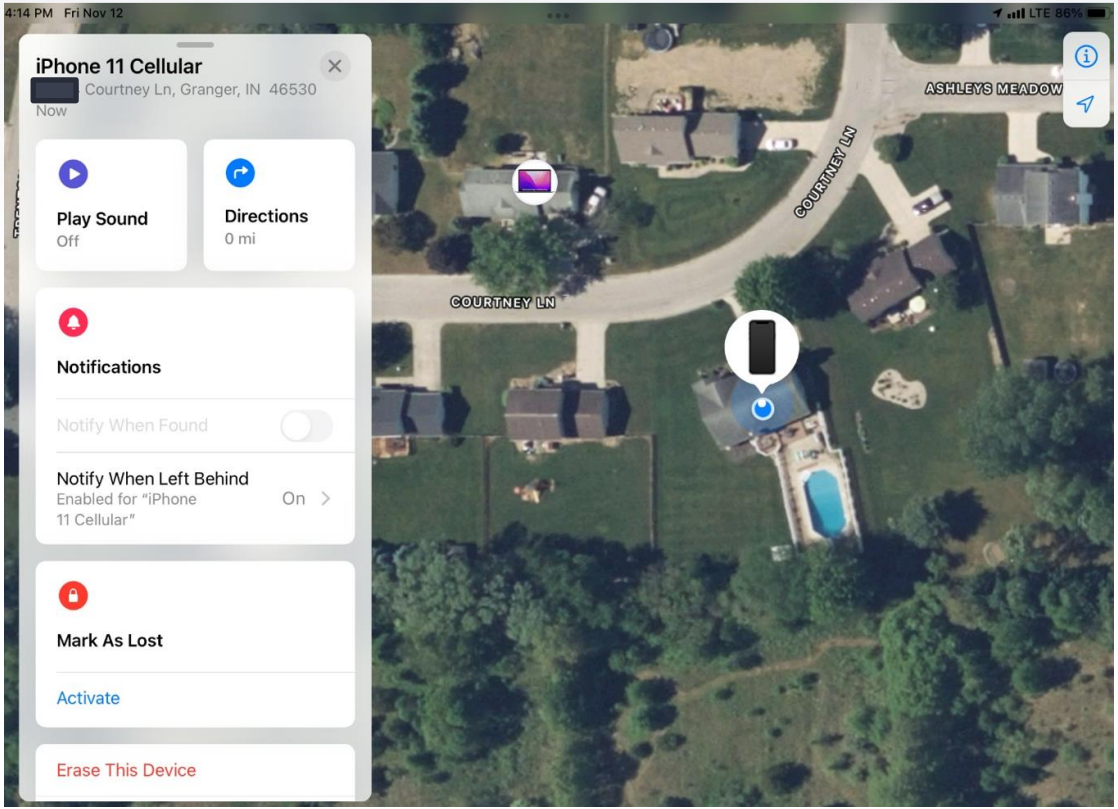
- Via Settings.
- Remains off until turned on again by the user.



Tracking Scenario 1

- All radios left on
- Phone powered down at Notre Dame.
- Drove to Granger, IN
- Friendly Device and Snitch Devices in the car

Tracking Scenario 1

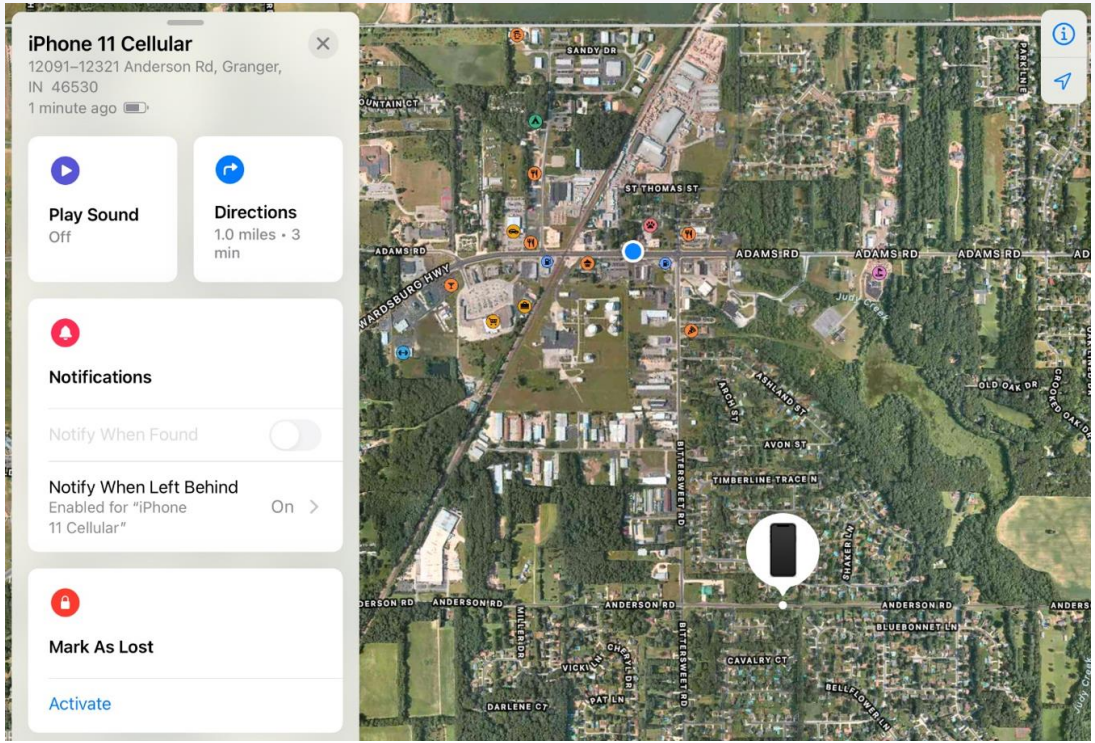


Tracking Scenario 2

- All radios left on
- Phone powered down at home in Granger
- Taken for a drive
- One Friendly Device and three Snitch Devices in the car

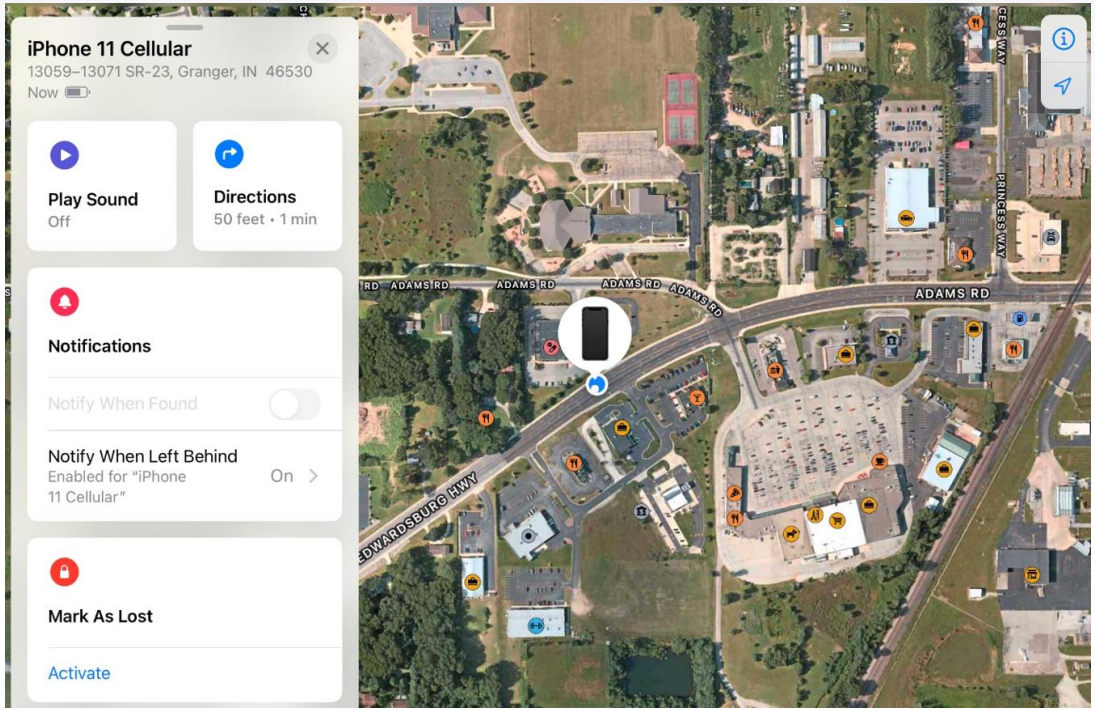
Tracking Scenario 2

- Initial tracking delay of about one-minute

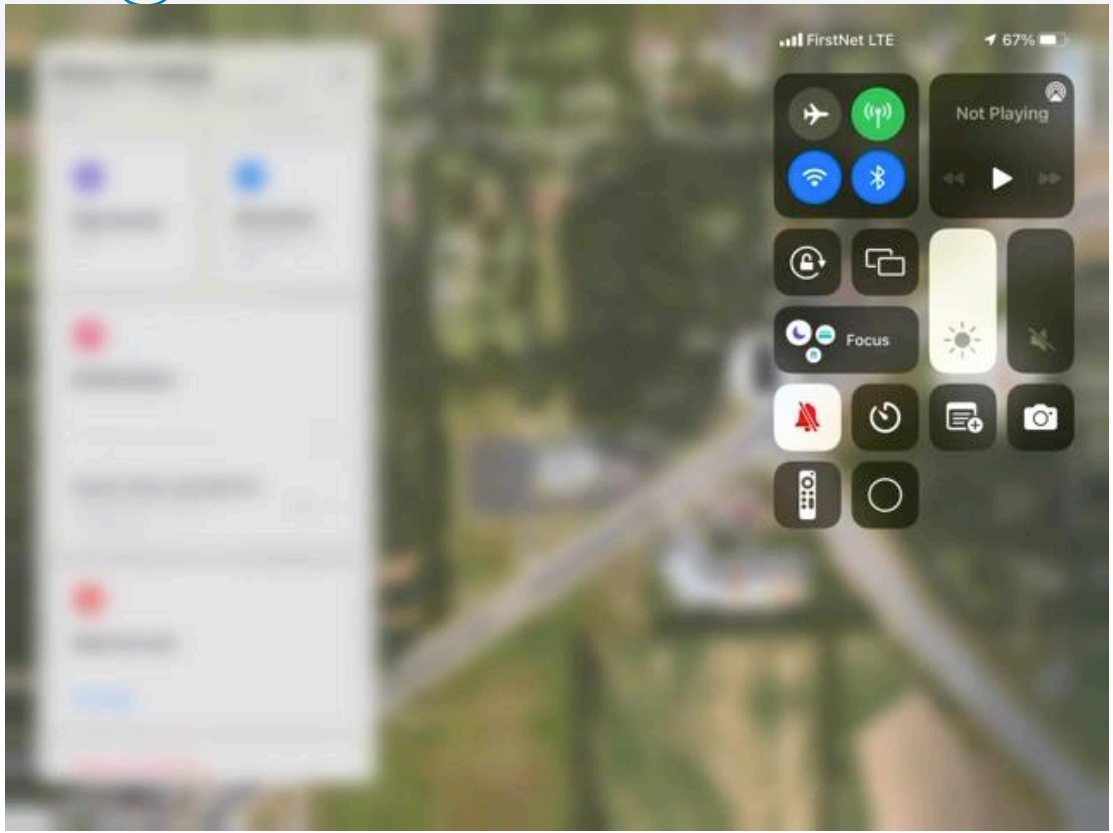


Tracking Scenario 2

- After about one minute, Ultra-Wideband locked on to the offline device



Tracking Scenario 2

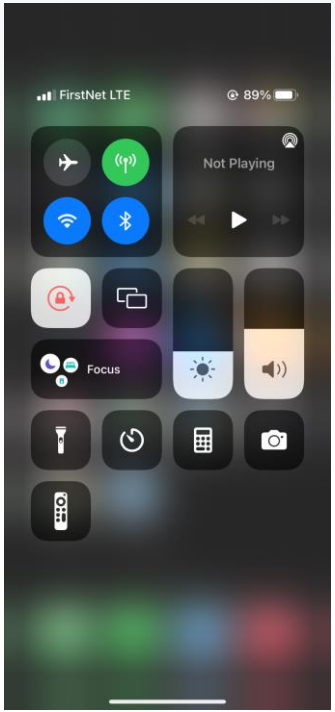


Powered Off Tracking

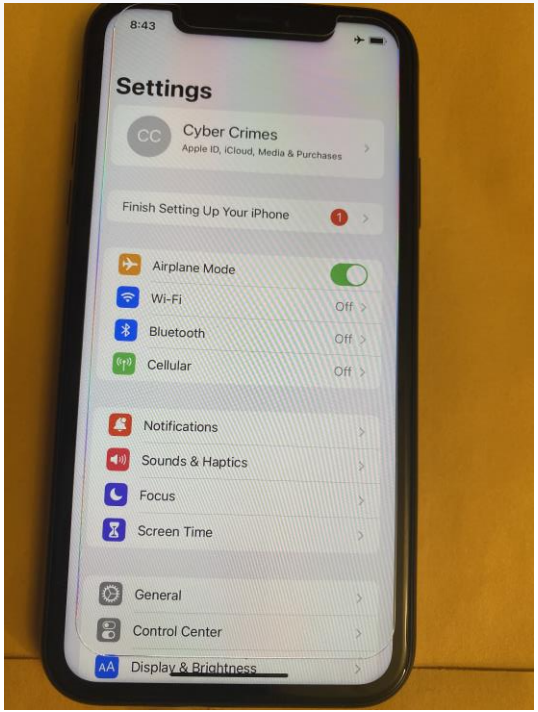
Powered-off State	Tracked?
All radios left on	**Yes**
Airplane Mode	**Yes**
Bluetooth disabled (Control Center)	**Yes**
Bluetooth turned off (Settings)	**No**
All radios turned off	**No**

Powered Off Tracking

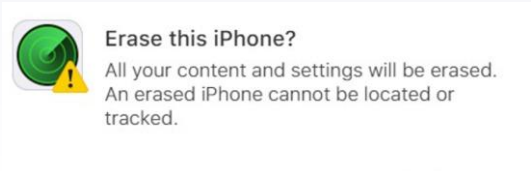
Tracked

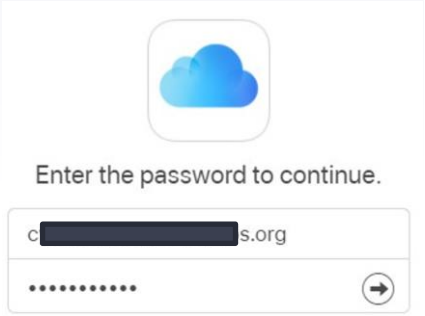


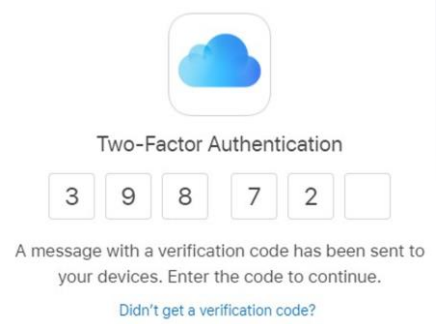
Not Tracked

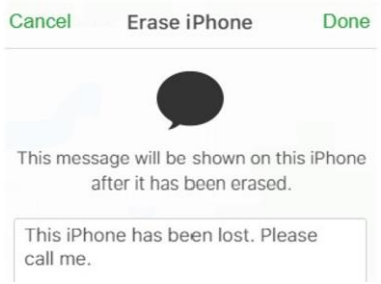


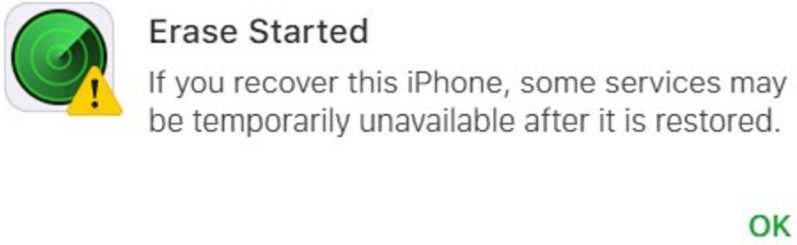
Let's Wipe Some Phones





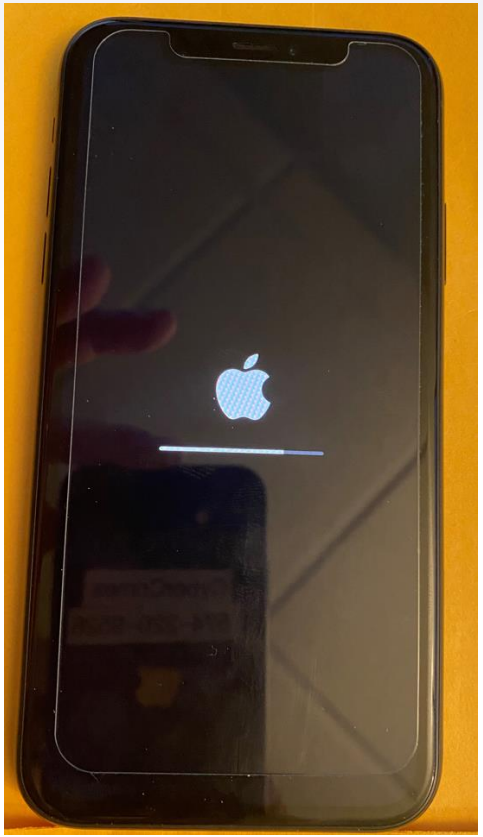






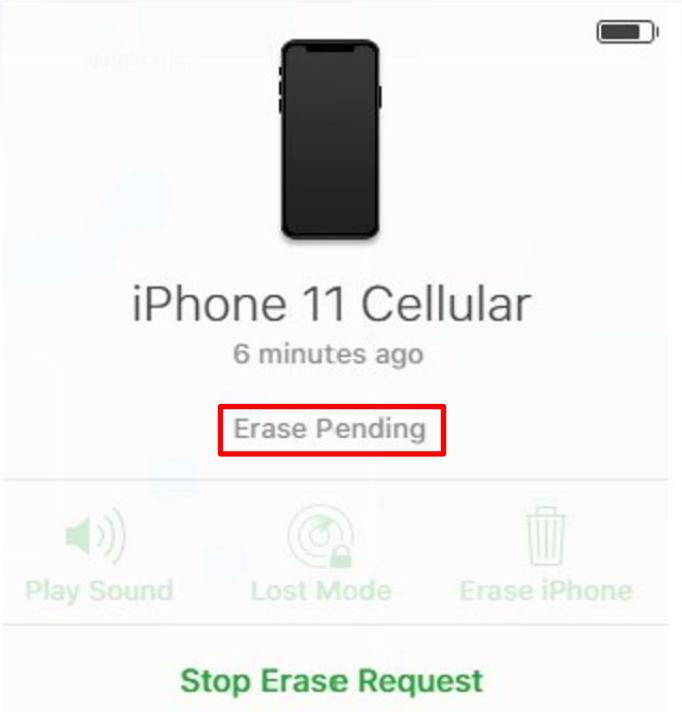
Wiping Scenario

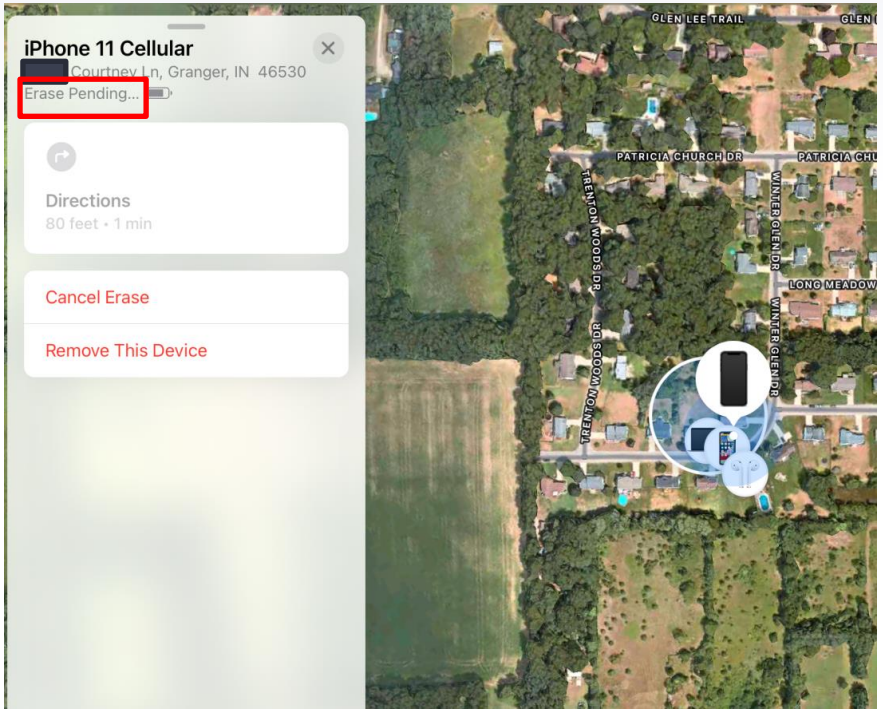
- Phone powered on with all radios enabled



Wiping Scenario

- Phone powered off with all radios turned off





Wiping Scenario

- With the wipe command pending, the phone was then powered on.
- (Reminder. When the phone was powered off, all radios were off).
- The phone was not wiped when it powered on

Powered Off Wiping

Powered-off State	Wiped when Powered on?
All radios left on	**Yes**
Airplane Mode	**No**
Bluetooth disabled (Control Center)	**No**
Bluetooth turned off (Settings)	**No**
All radios turned off	**No**

Summary: Tracking and Wiping

Powered-on and Powered-off Devices	Tracked?	Wiped?
All radios active	**Yes**	**Yes**
Airplane Mode	**Yes**	**No**
Bluetooth disabled (Control Center)	**Yes**	**No**
Bluetooth turned off (Settings)	**No**	**No**
All radios turned off	**No**	**No**
Faraday bag	**No**	**No**

Summary

- The device remains trackable unless Bluetooth is turned off from settings. Disabling it from the Control Center only disables Classic Bluetooth, not Ultra-Wideband.
- If a wipe command is sent to the device, it will not wipe unless it successfully connects to a cellular or Wi-Fi network.
- The wipe command is not executed on the device via Ultra-Wideband.
- Is the wipe command delivered via Ultra-Wideband?

Best Practices

- If you have the passcode, enter Settings and turn off all radios. This is the ideal situation as the phone will not be trackable and cannot be sent the wipe command.
- If you do not have the passcode, place the phone into Airplane Mode. The phone will still be trackable, but it will not accept the wipe command.
- If you cannot get the phone into Airplane Mode, place into a Faraday Bag/Box.
- When GrayKey accesses the phone, it turns off all radios.

Best Practices

- Currently, devices will not execute the wipe command through Ultra-Wideband.
- What if that changes?

Best Practices

- Place GrayKey into a Faraday Box

Best Practices

- Place GrayKey into a Faraday Box

THANK YOU!

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