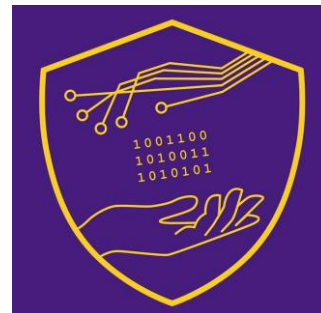


# Every Step You Take, I'll Be Tracking You: Forensic Analysis of the Tile Tracker Application

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# Outline

- Introduction
- Methodology
- Tool Creation
- Anti-Forensics
- Discussion/Conclusion



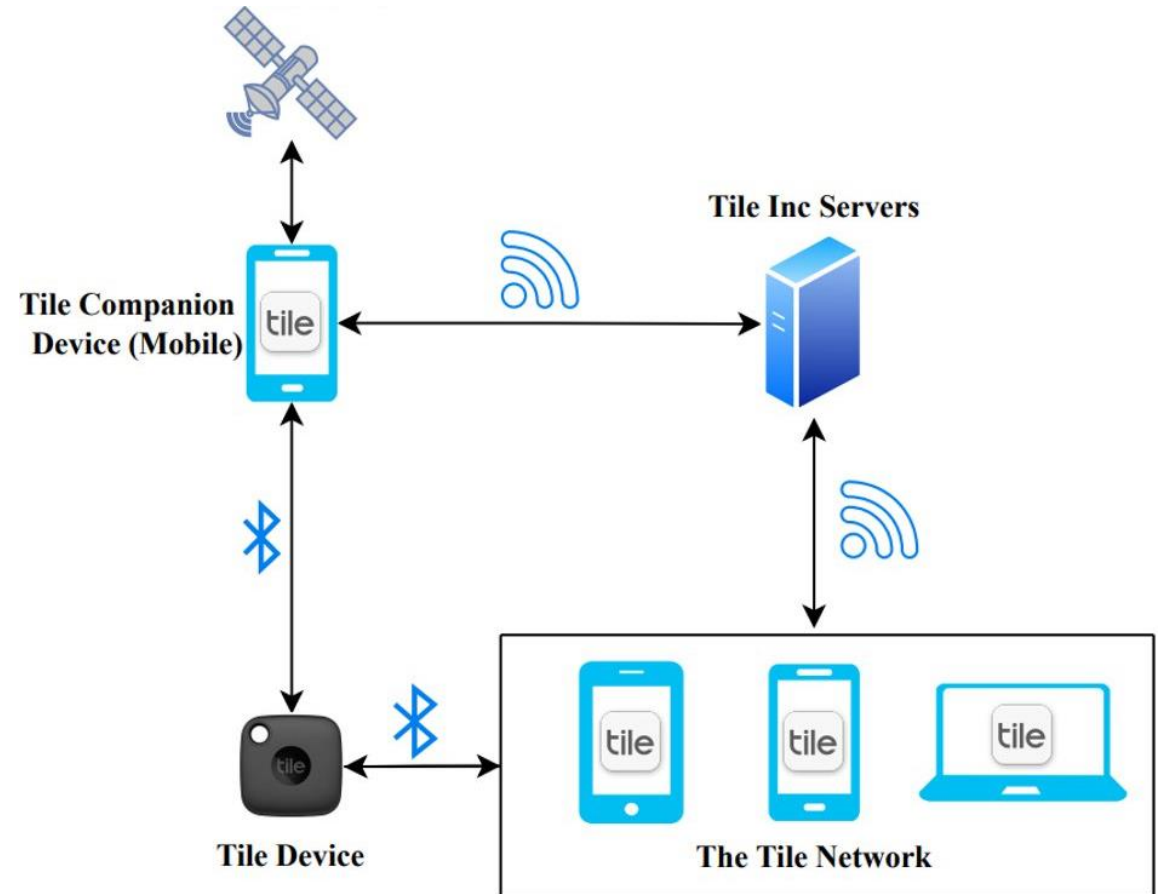
# Introduction

# What is a Tile?



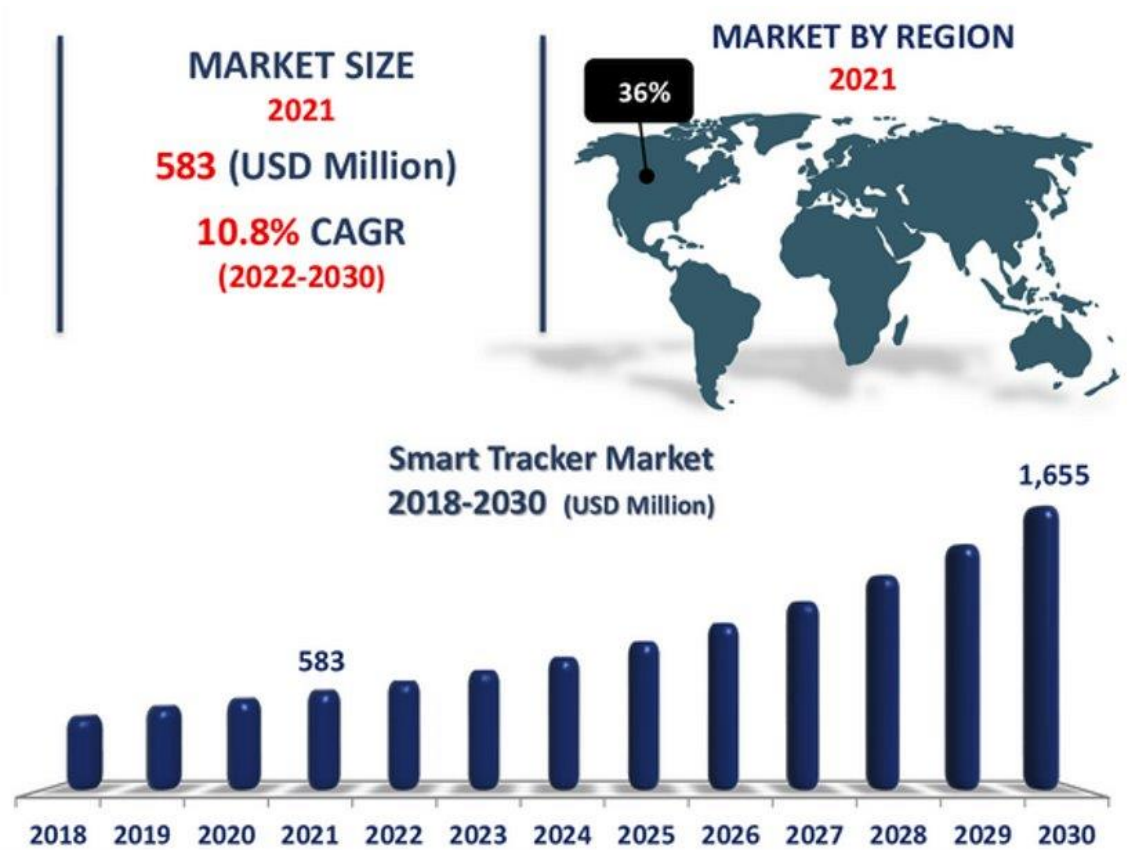
# Tile Network

- Connects through the Bluetooth Low Energy (BLE) protocol and Internet
- Communication over a large network of user devices
- Uses companion devices' location data



# Motivation

- Bluetooth trackers have rapidly grown in popularity [10]
  - Track personal belongings
- Tile is a Bluetooth tracker manufacturer
  - Popular choice for Android users
  - Acquired by Life360 in 2021



Source: <https://www.acumenresearchandconsulting.com/smart-tracker-market>



## Motivation Cont.

- Location artifacts to aid in investigations
- Tiles have been used by criminals to stalk people
- Tile devices are widely used, but little peer-reviewed research has been done

NEWS · CRIME/PUBLIC SAFETY

### Sheriff's Office investigating 'particularly alarming' cyberstalking of teenage girl who found tracker on her car after Hoopfest

July 21, 2022 | Updated Thu., July 21, 2022 at 9:45 p.m.

**BREAKING NEWS**

**PUBLIC SAFETY**

abc13

WATCH LIVE

STALKING

### Houston woman says ex used 'Tile' device to stalk her repeatedly



By Jessica Willey via abc13  
Friday, July 6, 2018



## Related Works

- Application Analysis
  - Work done on social media and location tracking applications [2-4]
  - Artifacts often reveal personal information and coordinates [1-4]
- Previous Tile Work
  - Application analysis revealed geolocation data in logs [6, 7]
  - SQLite databases stored device information (names, UUIDs, MAC) [7]
  - Python3 script to plot geolocation data on an interactive map [6]
  - Plugin created for open-source iOS Logs, Events, And Plists Parser (iLEAPP) [9]
  - Plaintext firmware found in application code [8]



## Research Goals

- Explore the entire Tile Ecosystem
  - iOS, Android, Windows
- Create a tool for both mobile and desktop applications
- Can we use Tile data to pinpoint an item to a location at a specific time?

# Methodology

# Methodology

- Scenario Creation
  - Tile application on mobile device at crime scene
  - Tile application on suspect's PC
  - Malicious actor spoofs location
- Data Generation
  - Walked predetermined path with Tiles and companion devices
    - iPhone X
    - Huawei Tablet
  - GPS spoofing applications used for falsifying location data

# Data Acquisition and Analysis

- Cellebrite UFED to obtain Android backup
- iPhone Backup Extractor
- VMWare for Windows Memory Samples
  
- Location data was found on all three devices
  - Data on each device varied

# Android Findings

- Minimally populated SQLite database
- Logs detailing app events
  - Battery level
  - Timestamps
  - UUID

```
{"schema":"1.1.0","name":"app_started","version":"1.0.0","sub_type":"AndroidTileApp",  
"type":"AccessPointSystem","context":{"app_id":"android-tile-production","app_build":"3285",  
"app_version":"2.75.0","client_model":"SHT-W09","application_state":"background",  
"locale":"en-US","os_release":"8.0.0","permissions":  
{"run_after_swipe_close":true,"bluetooth_auto_restart":true,  
"push_notifications":true,"power_saver_mode":false},  
"tzoffset":-18000000,"location_level":"authorized_always",  
"client_uuid":"b5016f2c-1ba8-3caf-83e2-9352c000ad90",  
"user_uuid":"051ea06d-008a-4320-a05e-c6a82c36f746"},"tags":{"battery_level":62},  
"payload":{"timestamp":1665515403298,"sessions":{"app":1665515402719}}}
```

## iOS Findings

- Large SQLite database
- One table contained most pertinent data
- Same logs as Android, but with coordinates
- AWS S3 Bucket link to firmware binary

ZLATITUDE	ZLONGITUDE	ZTIMESTAMP
Filter	Filter	Filter
30.4074592590332	-91.1724624633789	685227368.465915
30.4075031280518	-91.1722869873047	685227368.519483

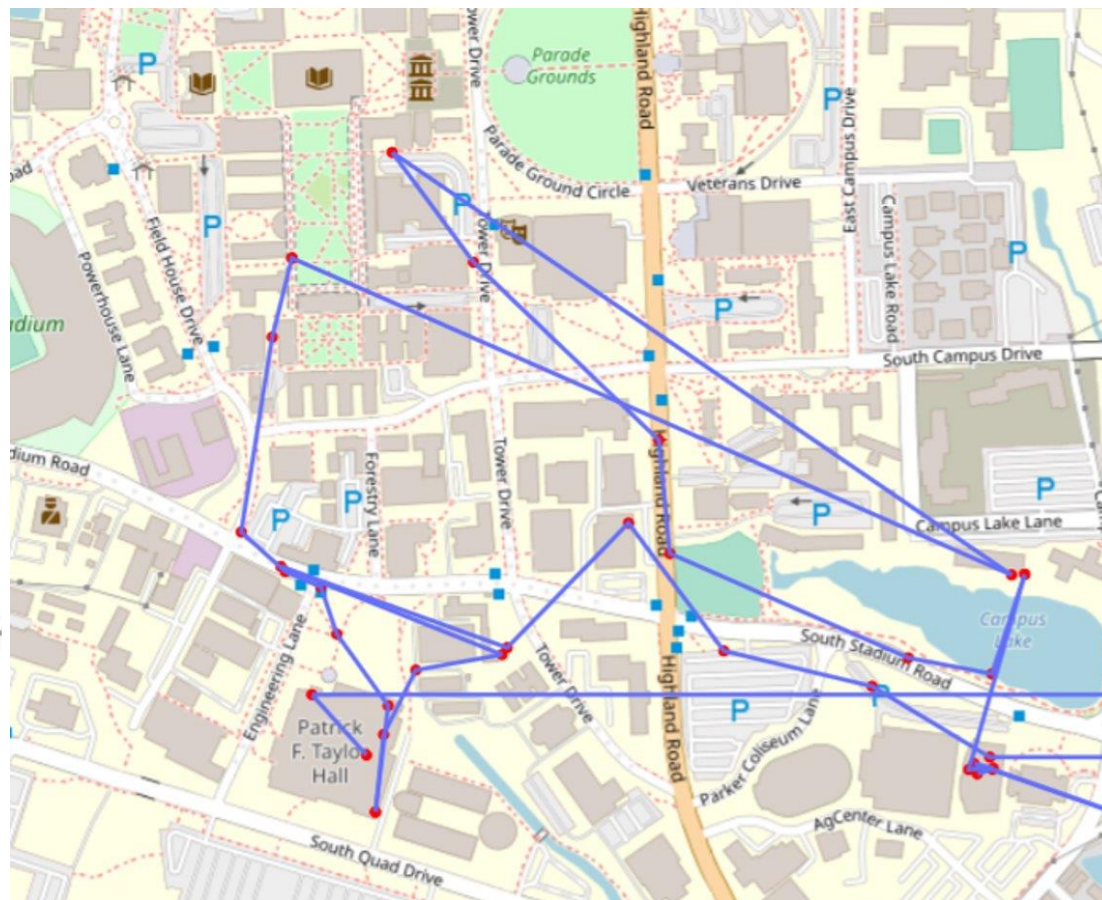
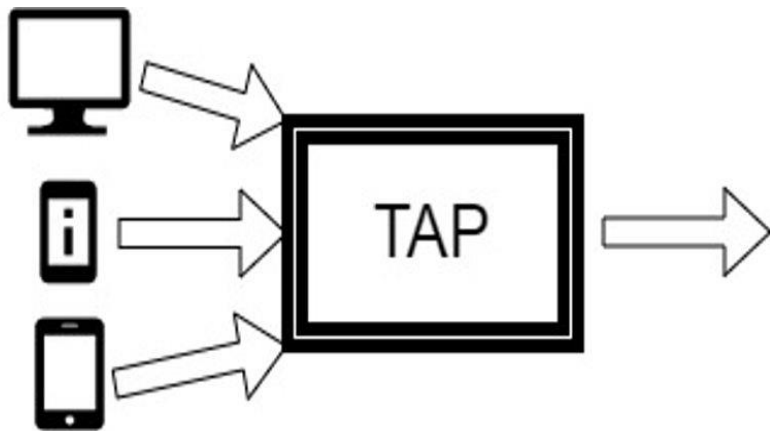




# Tool Creation

# Tool Creation

- Tile Artifact Parser (TAP)
- Cross-platform data parsing
- Plotting to interactive map for visible results
  - plotly
  - geopy



# TAP Algorithm

- Takes datapoints from recovered database or memory image
- Connects datapoints by time
- Works for VMEM files and SQL databases found in mobile application data



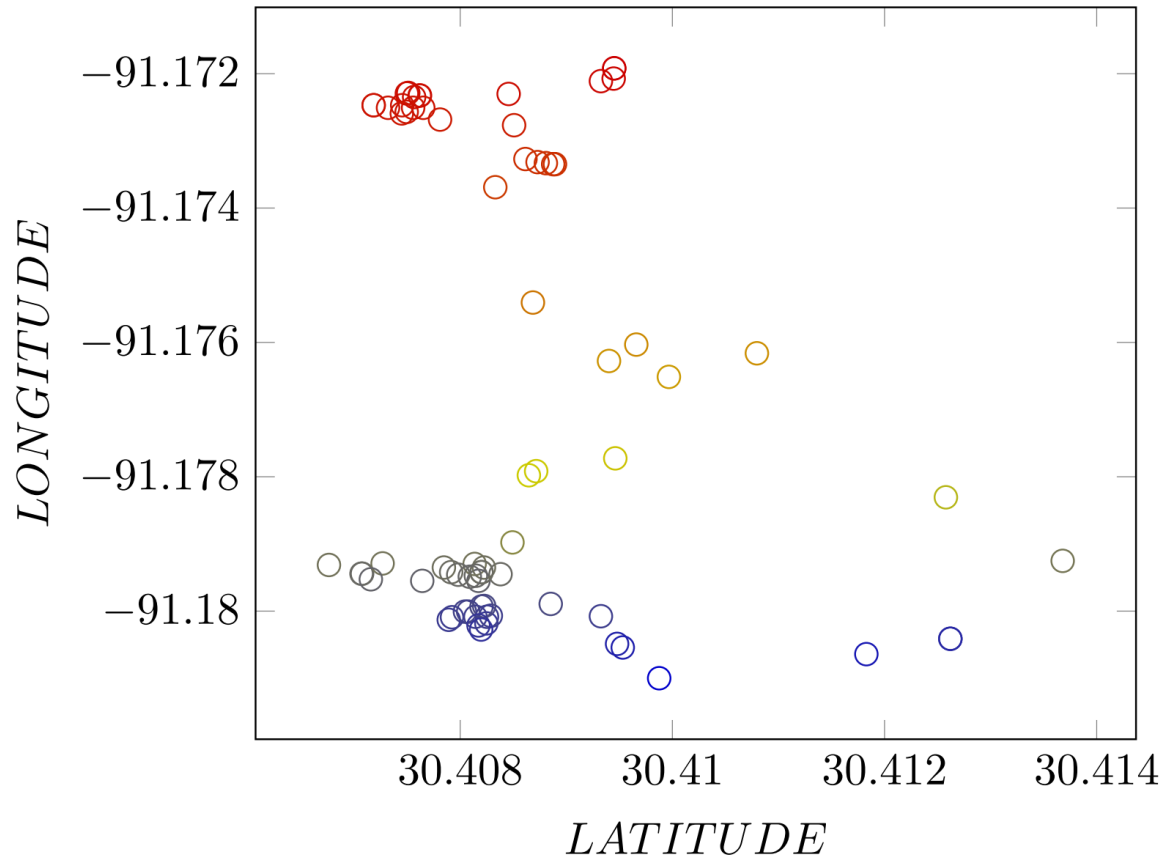
# Evaluation

- Generated test data of various sizes
- Tested two data formats
  - SQLite
  - VMEM
- Compared the generated points with TAP's output

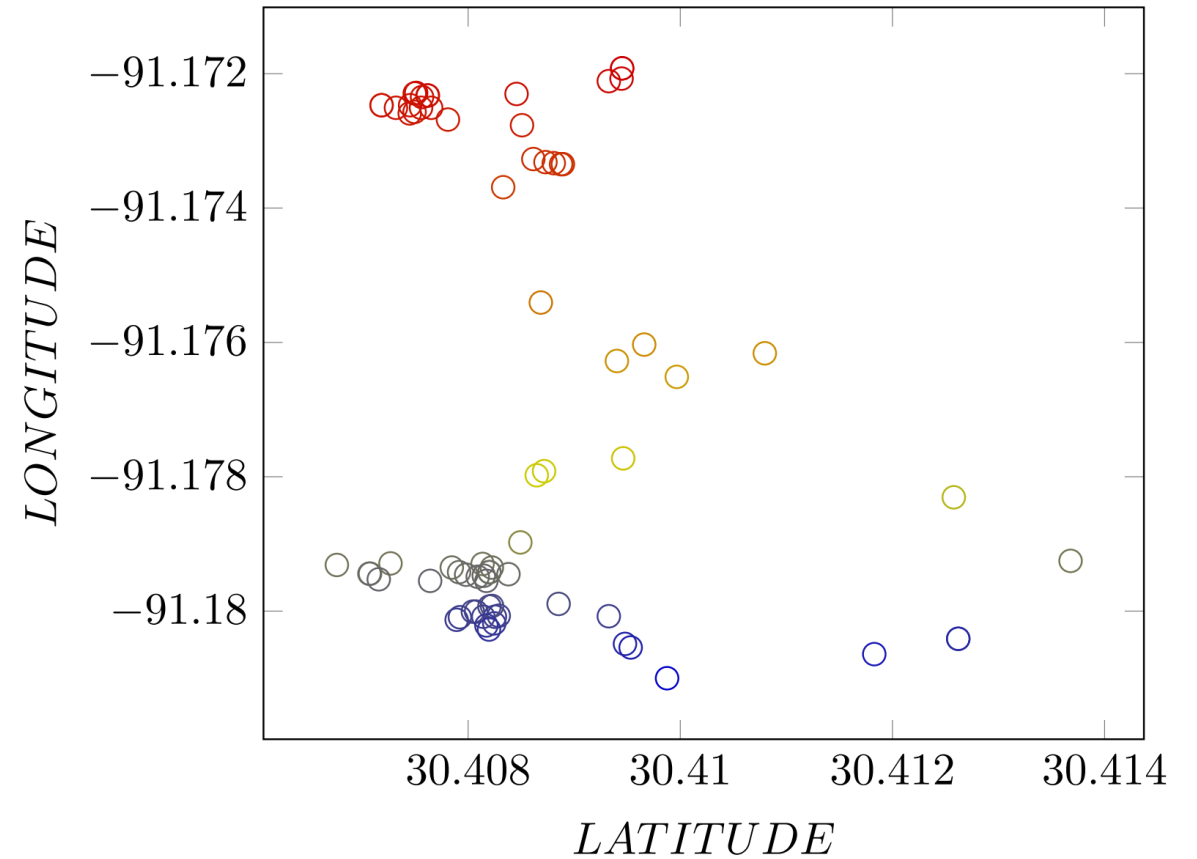


# Comparing SQLite database vs. TAP output

SQLite Geolocation Data

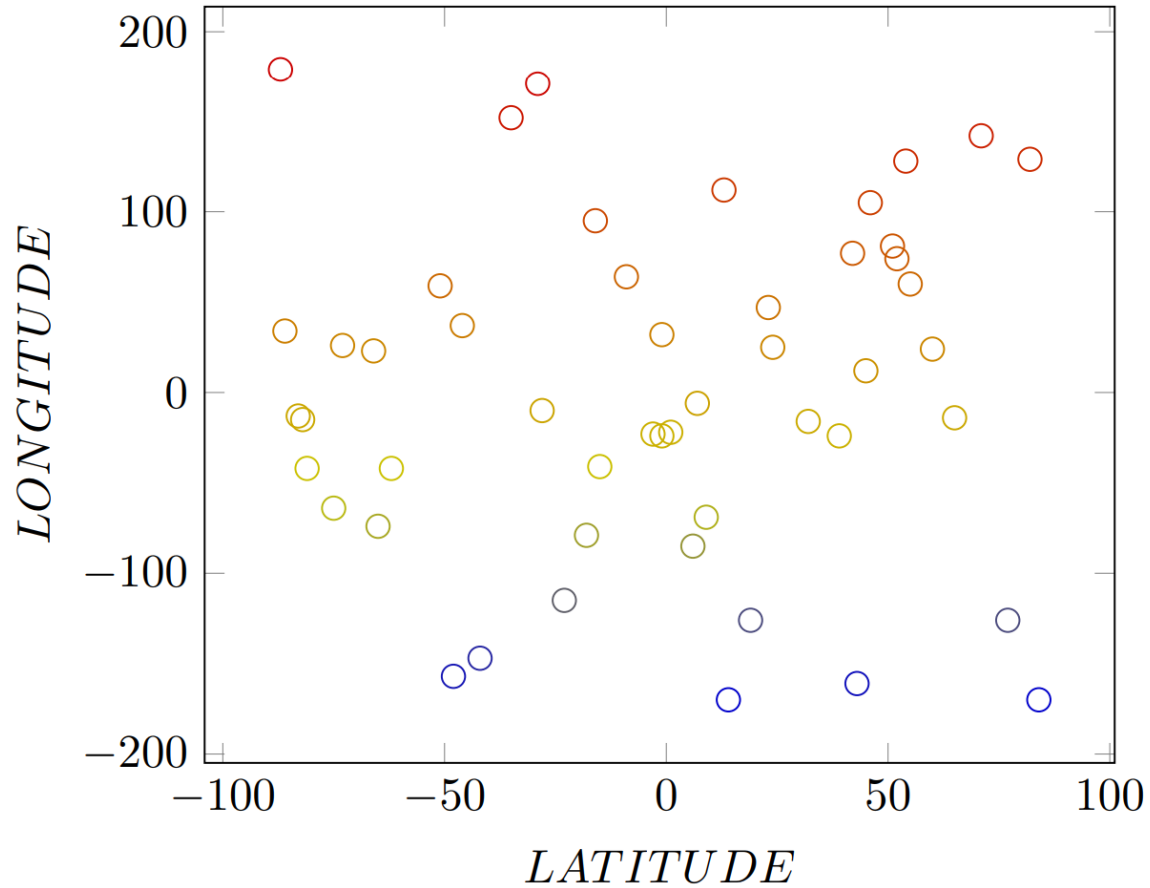


TAP-Parsed SQLite Geolocation Data

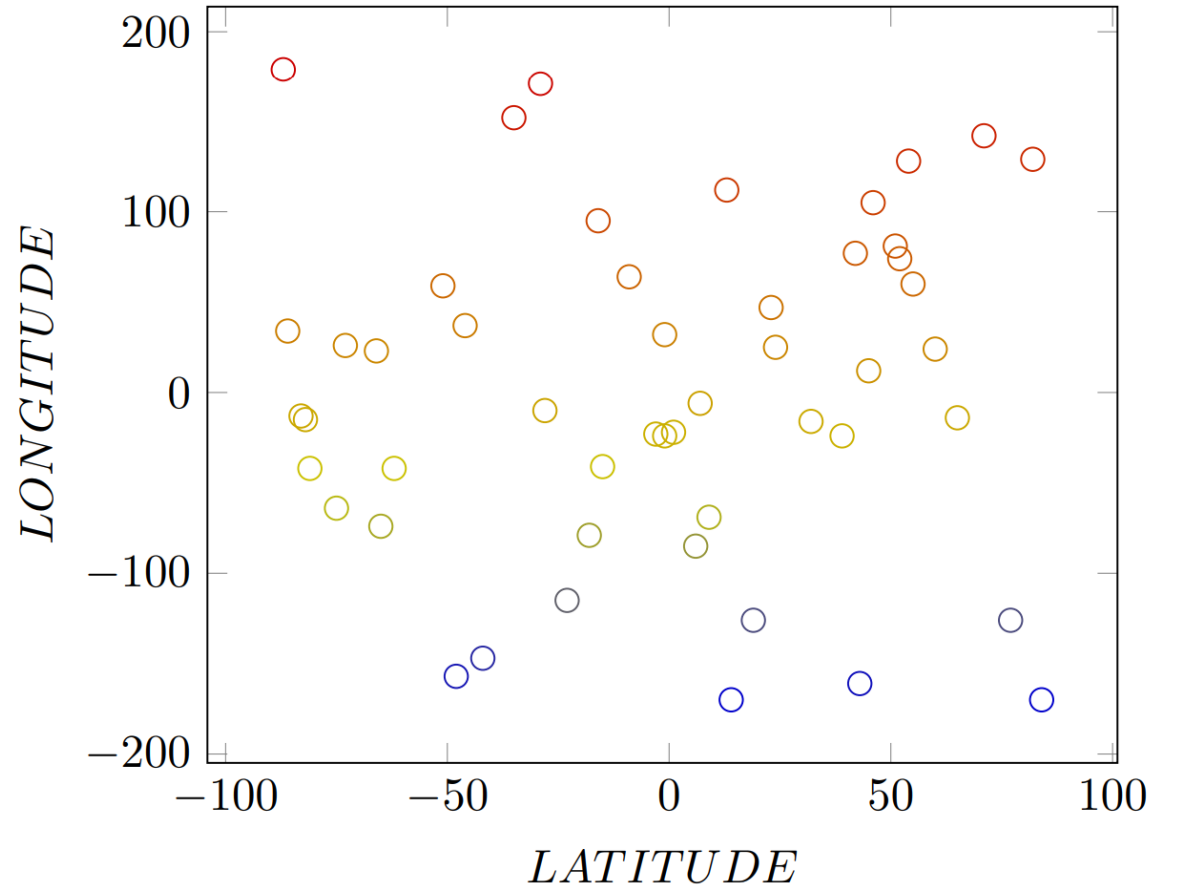


# Comparing VMEM Data vs. TAP output

VMEM Geolocation Data



TAP-Parsed VMEM Geolocation Data

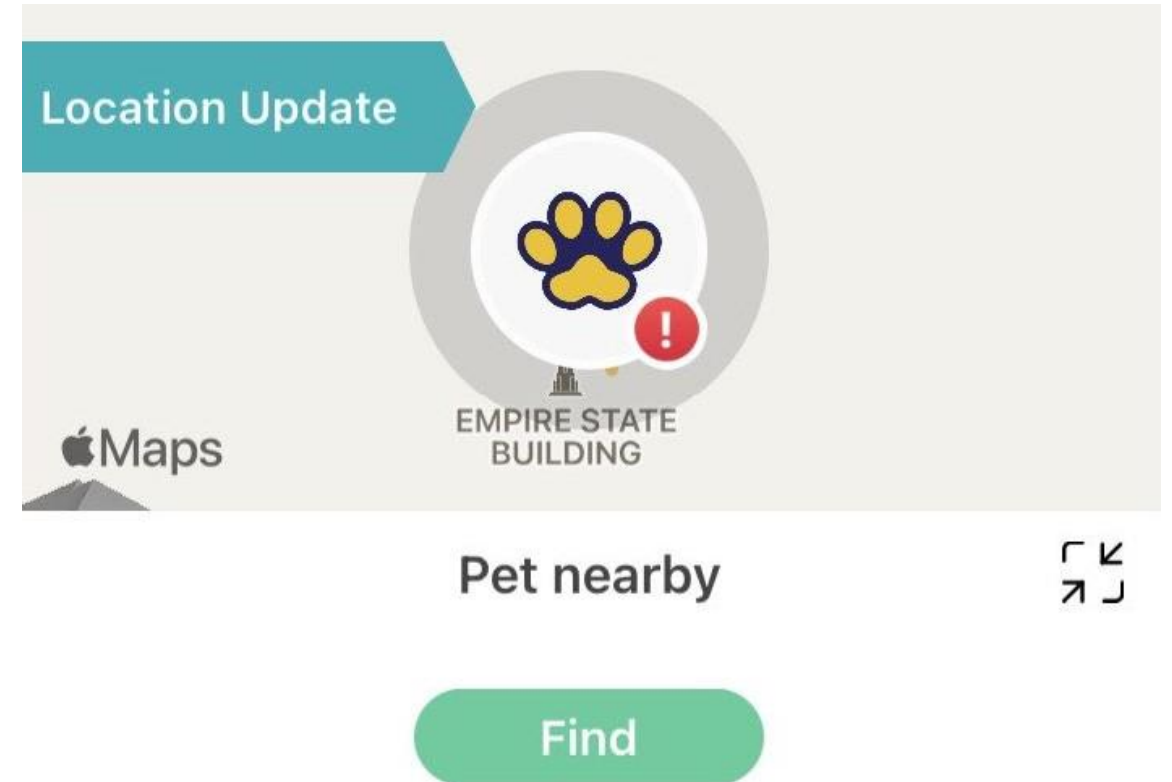




# Anti-Forensics

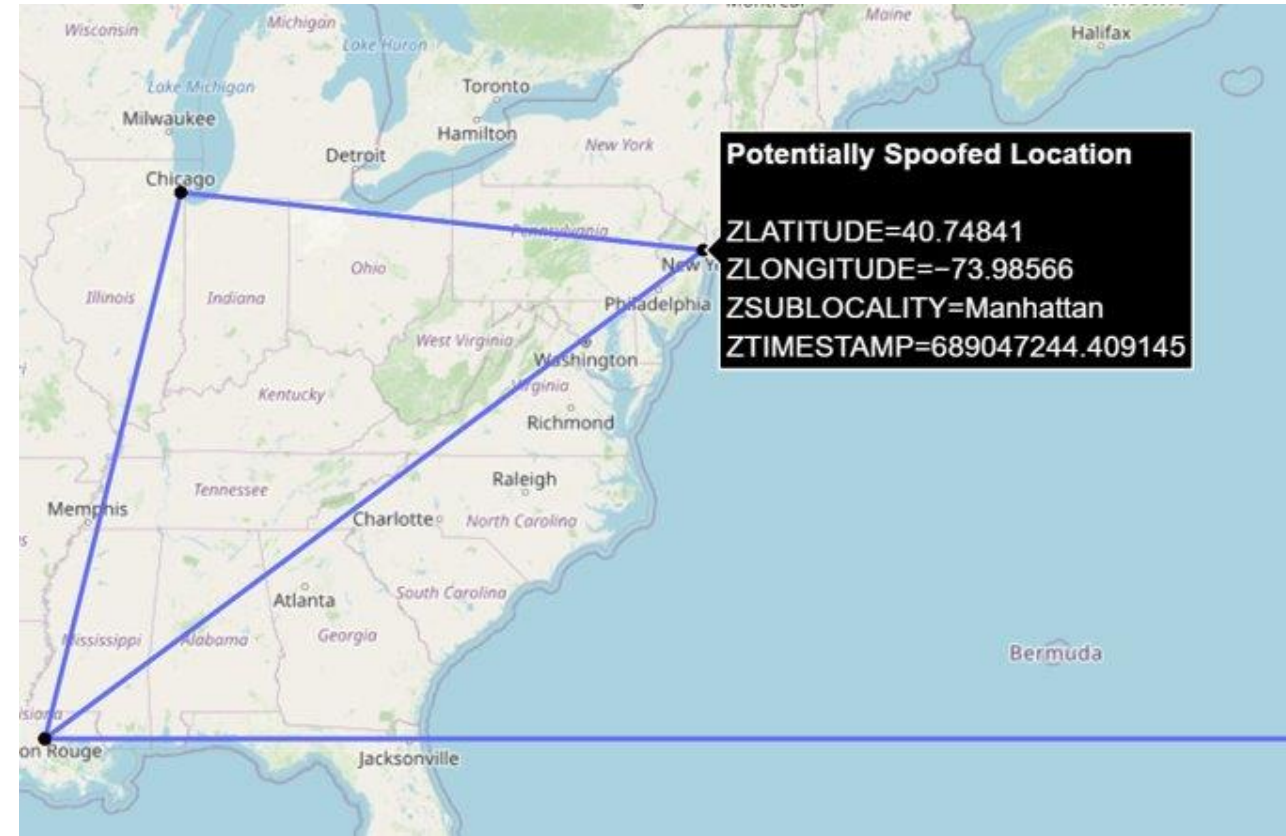
## Anti-Forensics

- Set up an iPhone and Samsung with two Tile accounts
- Paired a Tile to the iPhone and marked it as lost
- Spoofed location on Samsung
- "Found" the iPhone's lost Tile



# TAP Spoofing Detection

- Mark unnatural changes in locations as potentially spoofed
- This was a very limited solution
- Can only detect extreme spoofing



# Discussion/Conclusion

## Discussion

- Volatile memory dataset had more frequent data points than the iPhone SQLite database
- Tile's free version only saves last known location, while last 30 days are recoverable

# Conclusion

- Cross-platform analysis of the Tile application
  - Revealed forensic artifacts from iOS, Android, and Windows devices
  - Data could be valuable evidence in a criminal investigation
- Quick parsing of geolocation coordinates (TAP)
  - Valuable data could contribute to forensic investigations
- Tile has no location spoofing mitigation

# References

- [1] Salamh, F. E., Mirza, M. M., Hutchinson, S., Yoon, Y. H. and Karabiyik, U. (2021), 'What's on the horizon? an in-depth forensic analysis of android and ios applications', IEEE Access 9, 99421– 99454.
- [2] Bays, J. and Karabiyik, U. (2019), Forensic analysis of third party location applications in android and ios, in 'IEEE INFOCOM 2019 - IEEE Conference on Computer Communications Workshops (INFOCOM WKSHPS)', pp. 1–6
- [3] Hassenfeldt, C., Baig, S., Baggili, I. and Zhang, X. (2019), Map my murder: A digital forensic study of mobile health and fitness applications, Association for Computing Machinery, New York, NY, USA.
- [4] Backstrom, L., Sun, E. and Marlow, C. (2010), Find me if you can: Improving geographical prediction with social and spatial proximity, in 'Proceedings of the 19th International Conference on World Wide Web', WWW '10, Association for Computing Machinery, New York, NY, USA, p. 61–70.
- [5] Singh, B. and Patil, S. (2020), Single wire debug interface, in '2020 IEEE 63rd International Midwest Symposium on Circuits and Systems (MWSCAS)', pp. 814–8
- [6] Gazeau, V., & Liu, Q. (2020). Catch Me if You Can: Analyzing Geolocation Artifacts Left by the Tile Application on iPhones. Acta Scientific COMPUTER SCIENCES, 2(10), 38–43.
- [7] Vance, C. (2019, August 30). Android - locating location data: The tile app. Android - Locating Location Data: The Tile App. Retrieved September 28, 2022, from <https://blog.d204n6.com/2019/08/android-locating-location-data-tile-app.html>
- [8] Mira Weller, Jiska Classen, Fabian Ullrich, Denis Waßmann, and Erik Tews. 2020. Lost and found: stopping bluetooth finders from leaking private information. In Proceedings of the 13th ACM Conference on Security and Privacy in Wireless and Mobile Networks (WiSec '20). Association for Computing Machinery, New York, NY, USA, 184–194. <https://doi.org/10.1145/3395351.3399422>
- [9] Vance, C. (2020, September 3). IOS - Tile App Part 2: Custom artifact boogaloo. iOS - Tile App Part 2: Custom Artifact Boogaloo. Retrieved September 28, 2022, from <https://blog.d204n6.com/2020/09/ios-tile-app-part-2-custom-artifact.html>
- [10] Acumen (2022), 'Smart tracker market analysis - global industry size, share, trends and forecast 2022 - 2030', <https://www.acumenresearchandconsulting.com/smart-tracker-market>.



## Questions?

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