How Evolving Everyday Technology is Impacting Civil and Criminal Litigation

Hennepin County Law Library

September 15, 2023

John J. Carney, Esq.

Carney Forensics
"Synergy is the only word in our language that means behavior of whole systems unpredicted by the separately observed behaviors of any of the system’s separate parts."

Buckminster Fuller
Integrated, Holistic Approach

Mobile
Computer
Cloud
Nav Sat
Cellular
Vehicle
Appliance
Wearable
Speaker

Chapter 20 – “Digital Evidence on Mobile Devices”
“Thinking Outside of the Device”

Criminal Cases
Civil Litigation
Investigations
Forensics of Everything

Cloud

Internet of Things

Mobile

Computer
Forensics of Everything

NavSat

GPS

Internet
of Things

Mobile

Cellular
Telco
Forensics of Everything

Vehicle

Internet of Things

Mobile

Appliance
Forensics of Everything

- Wearable
- Internet of Things
- Mobile
- Smart Speaker
"My day starts and stops with my phone. I am not my phone, but my phone is a reflection of me. It does a pretty good job of taking my life and folding it up into a nice little lightweight, pocket-sized summary. It's almost like I am holding a copy of my brain in my hands."

Derek Smith, Louisville Med-School Student (as reported by CNN)
“We must stop kidding ourselves that handhelds don’t hold unique or discoverable information. Look up from your phones and tablets! They are now the center of our digital lives.”

Craig Ball, Esq.
Dem Phones, Dem Phones, Dem iPhones
Ball in Your Court
“Phones contain more probative evidence per byte of data than computer hard drives do.”

Gary C. Kessler, Ph.D.
The Year Ahead for Mobile Forensics
Cellebrite’s Panel Predictions for 2013
Everyday Technology 2023

- Apple iPhones
- Androids like Google Pixel, Samsung Galaxy
- Burner Phones
- Tablets like Apple iPad, Microsoft Surface, Amazon Fire
- Older GPS Units (Garmin, Magelllan)
Everyday Technology 2023

- Laptops like Dell, Lenovo, Apple MacBook
- Desktops like Dell, Lenovo, Apple iMac
- Small Form Factors like Apple Mac Mini, Intel NUC

- Google Chromebooks (2022 Was the Year)
  - Low cost laptop replacement
  - Dominant @ K-12 and Colleges
Everyday Technology 2023

• Fitness Trackers (Fitbit)

• Digital Watches (Apple, Garmin, Samsung)

• Smart Speakers (Alexa, Siri, Google Asst.)

• Internet of Things (Nest Thermostats)

• Door Bells (Amazon Ring, Nest Door Cam)

• Vehicles (Infotainment, Telematics)
Speed of Technology Innovation

• Underlying Mobile Device Technology
  • Cell Phones
  • Fitness Trackers
  • Digital Watches

• Mobile Device Forensic Artifacts
  • Messaging
  • Activities
  • Device Locations
  • Photograph / Video
  • Browser / Search
  • Pattern of Life

• Artificial Intelligence / Machine Learning
  • Categorization of Messages and Photographs
  • Reverse Image Search
Probative Mobile Artifacts

- Messages and Chat go to communications
- Voice Calls and Mail go to communications
- Activity and Health go to motion, status, and proof of life
- Browsing & Search go to motive & intent
- Photos and Videos go to location and alibi
- Wi-Fi and Bluetooth go to location and alibi
- Device Locations go to alibi & vehicle path
“Pattern of Life” Mobile Artifacts

• Insights into digital behaviors and habits including normal routines in day to day life
  • Power On and Off, Battery Usage
  • Lock Screen and Device Orientation
  • Device Connections using Bluetooth and Wi-Fi to vehicles, watches, fitness trackers, etc.
• Data Consumption from Wi-Fi and Cellular (4G LTE)
• Screen Time and Digital Wellbeing Statistics
Probative A Must

- Most Probative Device Extraction / Image
- Key to Recovery of Deleted Evidence
- Key to Recovery of Fragments / Traces
- Key to Smoking Guns / Great Outcomes
One Tool is Never Enough

- Digital Forensic Tools are Diversified
- Strengths / Weaknesses / Killer Apps
- Cross Validate to Know What to Produce
Plan B for Critical Devices

- Smartphone Wiped, Traded @ Verizon Store
- Smartphone is Damaged, Destroyed
- Hard Drive is Replaced, Repurposed, Crashed, or Destroyed
- Fitness Tracker is Damaged
Apple iPhone Forensic Renaissance

- Examine new, probative, iOS full file system extractions
- Replace decades-old, limited iTunes backups
- Recover abundant, deleted evidence
- Recover new iPhone databases to expose “pattern of life” and other new evidence
Android Smartphone Forensic Innovations

• Examine new, probative, physical and full file system extractions, instead of limited backups
• Recover, disable, or bypass Android passcodes
• Overcome encryption with new bootloaders
• Overcome security patch levels
• Analyze abundant, deleted evidence and new Android databases to expose new forms of evidence (pattern of life, digital wellbeing, etc.)
Low-Cost Android Burner Smartphones

- Unmarked, Android burners
- Mobile ID tools for make and model
- Or, call Verizon store, Metro PCS, etc.
- Supported phone lists for recovery capabilities
- Bypass or disable forgotten passcodes
- Obtain physical or full file system extractions
- Analyze live and deleted exculpatory evidence
Wearables

Technology Cycles Have Tended to Last Ten Years

- **Mainframe Computing** (1960s)
- **Mini Computing** (1970s)
- **Personal Computing** (1980s)
- **Desktop Internet Computing** (1990s)
- **Mobile Internet Computing** (2000s)
- **Wearable / Everywhere Computing** (2014+)

Others?

Wearables – Digital Watches

- Limited to no support for some models using mobile device forensic tools
- Access Apple watch evidence synced through to paired iPhone
- Perform “live” extractions of watches
- Use digital watch vendor software tools like Garmin’s Basecamp to recover GPS and date/time stamp evidence
Wearables: Fitbit Forensics

- Activity Tracker over 10 Million Users
- Access Online with Forensic Collection or Examine Mobile App Paired to Tracker
- Personal Activity Metrics
  - Walk, Run, Swim, Sleep
  - Date & Time Stamps, Distance, Duration
  - Steps, Speed, Pace,
- Locations
  - Position
  - Journeys
  - Date & Time Stamps
Wearables: Fitbit Forensics

Fitbit Dashboard: Heart Rate

- 10,146 steps
- 3,253 cal
- 4.92 miles
- 125 active mins
- 10 floors
- Fitbit is more fun with friends!

Recent Exercise

Outdoor Bike
- Sep 18
- 55 minutes
- 530 cal
- 120 avg bpm

Outdoor Bike
- Sep 10
- 26 minutes
- 92 cal
- 76 avg bpm

Outdoor Bike
- Aug 18
- 15 minutes
- 90 cal
- 95 avg bpm

10.0 lbs to go
20,000 steps Best in a day
Wearables: Fitbit Forensics

Fitbit Dashboard:
Steps

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Fitbit is more fun with friends!

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10.0 lbs to go
20,000 steps
Best in a day
Wearables: Fitbit Forensics

Fitbit Sleep Log

### This Week

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Time</th>
<th>Hours</th>
<th>Mins</th>
<th>Avg</th>
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<td>Today</td>
<td>Thu 12 am - Thu 6 am</td>
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<td>Wed</td>
<td>Wed 12 am - Wed 6 am</td>
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<td>5 hrs</td>
<td>31 mins</td>
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<td>Tue</td>
<td>Mon 11 pm - Tue 7 am</td>
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<td>7 hrs</td>
<td>13 mins</td>
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<tr>
<td>Mon</td>
<td>Sun 11 pm - Mon 5 am</td>
<td></td>
<td>6 hrs</td>
<td>8 mins</td>
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### Week of Sep 30th

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<th>Mins</th>
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<td>Sun 3 am - Sun 6 am</td>
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<td>14 mins</td>
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<td>10/06/2019</td>
<td>Sat 10 pm - Sun 1 am</td>
<td>3 hrs</td>
<td>25 mins</td>
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<td>Fri 11 pm - Sat 9 am</td>
<td>9 hrs</td>
<td>27 mins</td>
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### Log Sleep

- **SLEEP START**
  - 11:00 PM
  - 2019-10-09

- **SLEEP END**
  - 07:00 AM
  - 2019-10-10
Wearables: Fitbit Forensics

Your Fitbit Data

Export your Fitbit data in Microsoft Excel or CSV format, which can be opened in any spreadsheet application.

Time Period
You can export up to 31 days of data.
- This Week
- This Month
- Last Week
- Last Month
- Custom

Include Data
- Body
- Foods
- Activities
- Sleep

File Format
Microsoft Excel

Download

Export Your Account Archive

Export your Fitbit data for the lifetime of your account. This data includes your account profile, social posts, wellness programs, body and activity records, nutrition, and sleep. Learn More

You will receive a verification email to confirm export of your account data. After verification, most archives are available for download within 30 minutes. Please note that it could take several days to generate an archive if you have a large amount of data on Fitbit.
The Cloud

- Dropbox
- Box
- Evernote
- iCloud
- OneDrive
- Google Cloud
The Cloud

- Photographs / Videos
- Contacts
- Email / Documents
- Messages
- Activity / Health
- GPS Locations
- Phone Backups
iPhone Personal Navigation Apps

- Apple Maps
- Google Maps
- Waze – Social GPS
- Garmin USA
- Magellan RoadMate
- Navigon North America
- TomTom
- CoPilot Live
- MotionX GPS Drive
- MapQuest
- Scout by TeleNav
- Bing Maps
Android Personal Navigation Apps

- Google Maps
- Waze – Social GPS Maps
- Wisepilot
- Navigon North America
- CoPilot Live
- MapQuest
- Scout by TeleNav
- GPS Navigation by Sygic
- iGO My Way
- BackCountry Navigator
- MapFactor
- OsmAnd+ Maps & Navigation

Waze

- 48MM Users, +2x Y/Y
- 1B+ Miles Driven per Month w/ Waze Open
Examine Cloud for GPS Locations

- Apple iCloud Photos and Photo Stream
  - GPS locations in photo EXIF data
- Google Timeline Tracked from Mobile Device (aka Google Location History)
  - Passive GPS locations tracked every few minutes for years
  - More GPS locations are sampled when moving
  - GPS location time stamps are precise to second
  - Google shows compelling GPS location maps
Google Timeline: Tampa Bay 2015
Google Location History: Ireland 2015
Beyond the Black Box

- Electronic Data Recorder (EDR)
  - Installed in Vehicle
  - Records Vehicle Crash Evidence
    - Before Crash
    - During Crash
    - After Crash
  - Generally part of a vehicle's
    - Airbag control module
    - Powertrain control module
    - Rollover sensor
Beyond the Black Box

• Infotainment System
  • Advanced technology in vehicle for user interaction
  • Seamlessly & safely integrates access to digital life
  • Facilitates voice & data communications while we travel

• Telematics System
  • Embedded in vehicle
  • Integration of telecommunications and information
  • Connects infotainment system to
    • Vehicle’s infrastructure (v2i)
    • Sensors that detect other vehicles on the road (v2v)
Recoverable Device Evidence

- Mobile Devices Connected to Vehicle
  - Smart Phones
  - Media Players
  - USB Drives
  - SD Cards
  - Wireless Access Points

- Bluetooth Connections – when and where
- Wi-Fi Connections –
- USB Connections –
- SD Card Connections –
Vehicle System Forensics

- Recoverable User Evidence
  - Contact Lists (Phone Books)
  - Text Messages
  - Call Logs
  - E-mails
  - Photographs
  - Movies / Videos
  - Music / Audio
  - Games
  - Social Media Feeds
  - Installed Apps
Recoverable Navigation Evidence

- Track Logs or Navigation History
- Track Points or GPS Locations
- Recent Destinations
- Favorite Locations or Waypoints
- Favorite Routes
“Your Car is Spying on You”

“…we pulled the system out, and we recovered 70 phones that had been connected to it. All of their call logs, their contacts and their SMS.”

Berla iVe Founder and CEO, The Forensic Lunch podcast, 2015

The kit can discover “when and where a vehicle’s lights are turned on, and which doors are opened and closed at specific locations.”

Sam Biddle, The Intercept, May 3, 2021
Vehicle System Forensics

• Recoverable Vehicle Evidence
  • Serial Number
  • Original VIN Number

• Recoverable Vehicle Event Evidence
  • Headlights On and Off
  • Doors Identified for Open and Close
  • Gear Changes for Park and Drive
  • Odometer Readings
  • Velocity Logs
  • GPS Time Synchs
  • System Reboots
Automotive Vehicle Support

- Over 5,200 Models Back to 2008
- Non-destructive Acquisition
- Acquire Evidence via Logical and Physical Extractions
- Recover Deleted Data Using Three VSF Tools
- Map Geo-coded Data
- Search and Filter Data
- Revealing Reports for Digital Forensic Investigations
Smart Speakers

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  - 1980s

- **Desktop Internet Computing**
  - 1990s

- **Mobile Internet Computing**
  - 2000s

- **Wearable / Everywhere Computing**
  - 2014+

Smart Speaker Apps

Amazon Alexa
Cortana
Google Assistant
Google Home
Smart Speaker: Amazon Alexa

- Tens of Millions of Echo Devices Sold
- Alexa Works w/ 20,000 Smart Home Devices
- Over 50,000 “Skills” Available for Integration
  - Thermostat, Fitbit, Pandora, TED Talks
  - Sleep Sounds, NY Times, Famous Quotes, UPS
- Alexa Data Stored in Primarily in Cloud
  - Echo Dot has only Wi-Fi Connections
  - Mobile Apps have Limited Data
  - What Evidence is Recoverable?
Smart Speaker: Amazon Alexa
Smart Speaker: Amazon Alexa
**Smart Speaker: Amazon Alexa**

**Extraction finished!**
Data is successfully extracted from the Cloud

Extraction ID: 0F6F7FB310FA4FEEBE816332A383DCF0
Account owner: John Carney

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<tr>
<th>Cloud services</th>
<th>Extraction summary</th>
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<td><img src="image" alt="Activity - 749" /></td>
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<tr>
<td><img src="image" alt="Amazon Alexa" /></td>
<td><img src="image" alt="Contacts - 472" /></td>
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<td><img src="image" alt="Voice records - 748" /></td>
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<tr>
<td></td>
<td><img src="image" alt="Player history - 0" /></td>
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<tr>
<td></td>
<td><img src="image" alt="Reminders and alarms - 0" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Skills - 13" /></td>
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<tr>
<td></td>
<td><img src="image" alt="Lists - 2" /></td>
</tr>
<tr>
<td></td>
<td><img src="image" alt="Other - 74" /></td>
</tr>
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</table>
Exhibit – Facebook Messenger

<table>
<thead>
<tr>
<th>ID</th>
<th>Remote Party</th>
<th>Sender</th>
<th>Text</th>
<th>Source</th>
<th>Time stamp (UTC)</th>
<th>Coordinates</th>
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</thead>
<tbody>
<tr>
<td>12</td>
<td>Madonna Stevens</td>
<td>Patrick Page</td>
<td>What about going to the cinema?</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>55.7503175;37.64529469</td>
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<tr>
<td>13</td>
<td>Madonna Stevens</td>
<td>Patrick Page</td>
<td>Hello friend!</td>
<td>mobile</td>
<td>06.12.2011 13:40:07</td>
<td>N/A</td>
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<tr>
<td>14</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>A nice evening out there</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>N/A</td>
</tr>
<tr>
<td>15</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>You are kidding!</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>N/A</td>
</tr>
<tr>
<td>16</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>Where is your phone?</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>N/A</td>
</tr>
<tr>
<td>17</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>Where is your phone?</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>N/A</td>
</tr>
<tr>
<td>18</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>How's your business?</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
<td>N/A</td>
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<tr>
<td>19</td>
<td>Patrick Page</td>
<td>Patrick Page</td>
<td>Meet as usual</td>
<td>mobile</td>
<td>06.12.2011 13:00:47</td>
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</tr>
<tr>
<td>20</td>
<td>Tel Budios</td>
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<td>mobile</td>
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<td>21</td>
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<td>Hey, how are you?</td>
<td>mobile</td>
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<td>N/A</td>
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<td>N/A</td>
<td>N/A</td>
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</table>
Exhibit – Foursquare App
# Verizon Wireless Text Message Log

<table>
<thead>
<tr>
<th>Network Element Name</th>
<th>Switch MDN</th>
<th>Msg Send Date</th>
<th>Msg Deliver Date</th>
<th>Message</th>
<th>Originating Addr</th>
<th>Destination Address</th>
<th>Message Direction</th>
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<td>M 612</td>
<td>8/30/2014 11:54:49 AM</td>
<td>8/30/2014 11:54:49 AM</td>
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<td>8/30/2014 11:57:54 AM</td>
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<td>8/30/2014 11:54:19 AM</td>
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<td>4</td>
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<td>8/30/2014 12:00:21 PM</td>
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<td>16</td>
<td>612</td>
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</table>
Garmin GPS unit contained 318 journeys with 49,130 device locations.
Correlated Message & GPS Evidence

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<thead>
<tr>
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<th>Name</th>
<th>Time</th>
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<th>Longitude</th>
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<td>-96.42018</td>
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<td></td>
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<td>-96.42018</td>
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- Text message sent @ 11:57:11AM
- Text message sent @ 11:57:39AM
- Text message received @ 11:57:58AM
Visualizing Message & GPS Evidence

First text sent @ 11:57:11AM

Second text sent @ 11:57:39AM

Third text received @ 11:57:58AM

Accident Location at 11:59AM
Visualizing Message & GPS Evidence

Accident Location

8/30/2014 11:59:13 AM (UTC-5)
8/30/2014 11:59:12 AM (UTC-5)
8/30/2014 11:59:17 AM (UTC-5)
8/30/2014 11:58:59 AM (UTC-5)

Before Sarah's Stop

8/30/2014 11:58:51 AM (UTC-5)
8/30/2014 11:58:50 AM (UTC-5)
8/30/2014 11:58:49 AM (UTC-5)

Sarah's U-Turn

8/30/2014 11:58:32 AM (UTC-5)
8/30/2014 11:58:29 AM (UTC-5)
8/30/2014 11:58:17 AM (UTC-5)
8/30/2014 11:58:20 AM (UTC-5)
8/30/2014 11:58:19 AM (UTC-5)
Visualizing Message & GPS Evidence

First text sent @ 11:57:11AM

Second text sent @ 11:57:39AM

Third text received @ 11:57:58AM

Accident Location at 11:59AM
Questions & Answers

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