Live Memory Forensics of Mobile Phones

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Outline of Presentation

- Post-mortem forensics
- Live forensics
- Mobile phone forensics
- Related work
- Our proposed method
- Experiments and results
- Conclusions
Post-Mortem Digital Forensics

- Pull the plug
- Acquire data from static media
- Analyse data
- Correlate data to retrieve relevant evidence
- Forensically sound
- Limitations?
Live Forensic Approach

• Evidence stored (or transferred) off-site
• Static storage media increases in size, so does acquired potential evidence
• Use of encryption and password protection
• More efficient and effective through forensic investigation of system/device’s current state
Mobile Phone Forensics

- Volatile information (e.g. application data, conversation histories) often not stored in static storage media
- Current approaches restricted to analysis of static data on SIM, memory cards and internal flash
- Need for live mobile phone forensics (prevent loss of potentially incriminating evidence)
Related Work

Kiley et al. (2008):
• Examined artifacts recovery
• Web-based IM services
• Windows XP system’s unallocated hard disk space
• Tools: AccessData Forensic Toolkit and Runtime DiskExplorer
• Results: Very limited chat logs recoverable
• Limitations: short list of unique phrases, experiment parameters not well defined, static memory analysis
Related Work

Husian et al. (2010):

- Investigate possibility of IM related evidence recovery on iPhone
- Logical acquisition through iTunes Backup
- Results: evidence found for client-based IM, no trace found for web-based IM
- Limitation: Only saved logs on static memory could be retrieved
Live Memory Forensics of Mobile Phones

• Main functionality – support communications
• Importance of capability to perform forensic analysis of its interactive based applications
• Our work – An automated system to analyse the dynamic properties of the phone’s volatile memory and applications
• Investigate persistency of volatile data and real-time acquisition and analysis
Live Memory Forensics of Mobile Phones

- Message Script Generator (MSG)
- UI/Application Exerciser Monkey
- Chat Bot
- Memory Acquisition Tool
- Memory Dump Analyser (MDA)
Experiments

- Process memory region investigation
- Identify region where conversations reside
- 15 rounds of outgoing messages and 15 rounds of incoming messages
- Results: 1) messages consistently found in shared memory regions; 2) database initialization information and chat session credentials found in heap and stack
Experiments

• Cached data examination
  - Examine browser cached data to investigate information retrieval possibility
  - 15 rounds of outgoing messages and 15 rounds of incoming messages
  - Results: cached data stored in SQLite databases; contains bookmarks, searches, images, javascripts, formdata, cookies, etc. but no trace of conversation found
Experiments

• Volatile data persistency investigation
  - Determine realistic set of parameters
  - Interval between keypresses: 500ms
  - Character set: standardise one key press = one character in memory
  - Message length: 75, 150, 225 characters
  - 15 rounds of outgoing messages and 15 rounds of incoming messages
Experiments

Persistency of Outgoing messages (Phone to PC)

- New messages captured in current dump (only occur at odd dumps)
- Message persistency in next dump
- Message persistency in a dump two intervals later
  (Vertical line) Persistency of past messages in dump id 10
  (Horizontal line) Persistency of message id 9 in subsequent dumps
Experiments

Persistency of Incoming messages (PC to Phone)

- New messages captured in current dump (only occur at even dumps)
- Message persistency in next dump
- Message persistency in a dump two intervals later
  (Vertical line) Persistency of past messages in dump id 12
  (Horizontal line) Persistency of message id 4 in subsequent dumps
Experiments

- Memory dump interval investigation
  - No-wait scenario (worst case)
  - Waiting scenario
  - Intervals of 5, 10, 20, 30 seconds for no-wait
  - Intervals of 40, 60 seconds for waiting
  - 15 rounds of outgoing messages and 15 rounds of incoming messages
Experiments

No-wait Scenario

TIME

Phone starts typing message 1.

Phone sends message 1. Starts typing message 2.

Phone sends message 2. Starts typing message 3.

PC receives message 1. Starts typing reply message 1.

PC sends reply message 1. PC receives message 2.

Waiting Scenario

TIME

Phone starts typing message 1.

Phone sends message 1. Starts typing reply message 1.

Phone waits for reply.

Phone starts typing message 2.

PC receives message. Starts typing a reply message 1.

PC sends message 1.
Experiments

<table>
<thead>
<tr>
<th>Message Length (Chars)</th>
<th>Dump Interval</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40 secs</td>
<td>60 secs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Outgoing Msgs</td>
<td>Incoming Msgs</td>
<td>Outgoing Msgs</td>
</tr>
<tr>
<td>75</td>
<td>15/15</td>
<td>15/15</td>
<td>15/15</td>
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</tr>
<tr>
<td>225</td>
<td>15/15</td>
<td>14/15</td>
<td>15/15</td>
</tr>
</tbody>
</table>

- Waiting scenario
- 100% of outgoing messages acquired and detected successfully
- Avg. acquisition rate: 97.8% for 40-sec interval and 95.6% for 60-sec interval
Experiments

- No-wait scenario
- 100% of outgoing messages acquired and detected successfully
- Avg. acquisition rate: 100%, 86.7%, 75.6% and 84.4% for 5, 10, 20 and 30-sec interval, respectively
Conclusions

• Identified the need for live memory forensic analysis for mobile phones
• Proposed a method and system to analyse dynamic properties of mobile phones’ volatile memory and perform real-time evidence acquisition, automatically and systematically in different communication scenarios
• Current system capable of optimizing acquisition parameters to improve efficiency
Thank you!

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