Live Memory Forensics of Mobile Phones

By

Vrizlynn Thing, Kian-Yong Ng and Ee-Chien Chang

Live Memory Forensics of Mobile Phones

By: Vrizlynn Thing

Digital Forensics Group

Cryptography and Security Department

Institute for Infocomm Research

Email: vriz@i2r.a-star.edu.sg

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

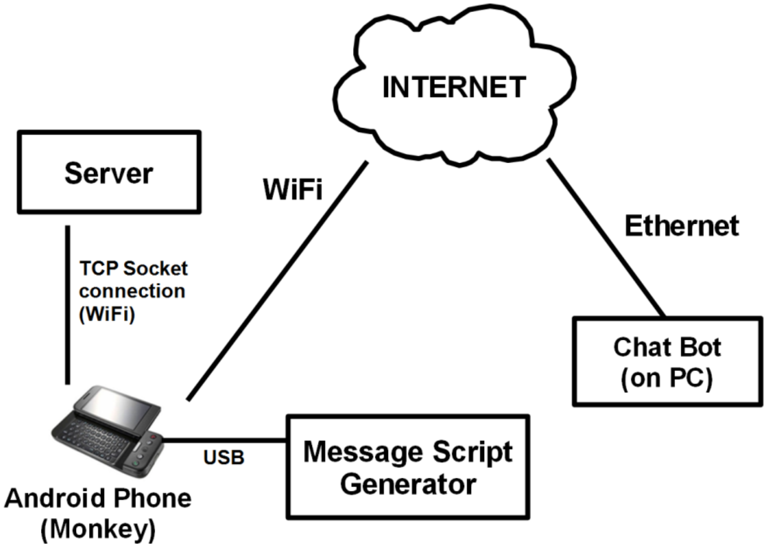
Husian et al. (2010):

- 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

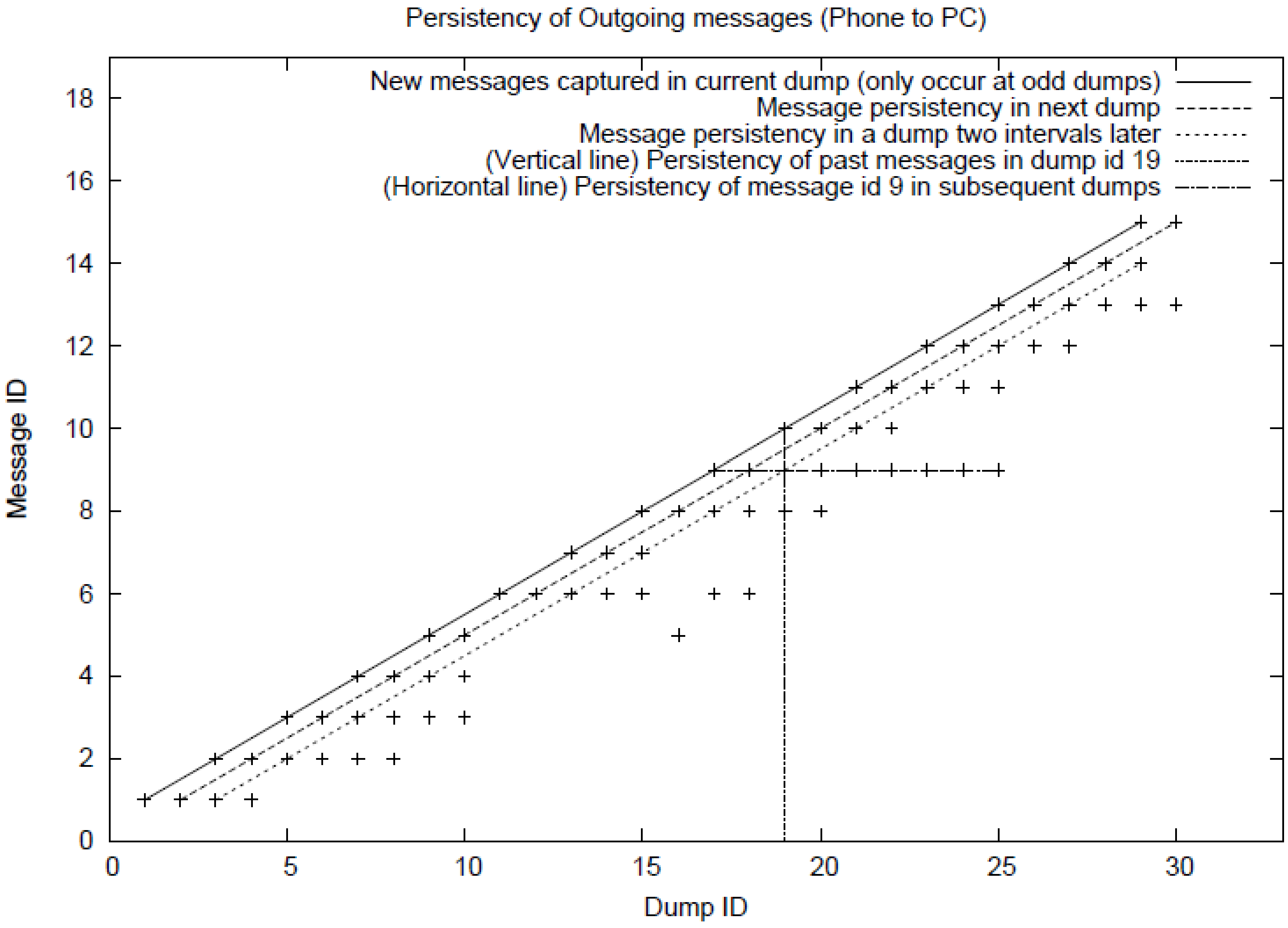
Experiments

- 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

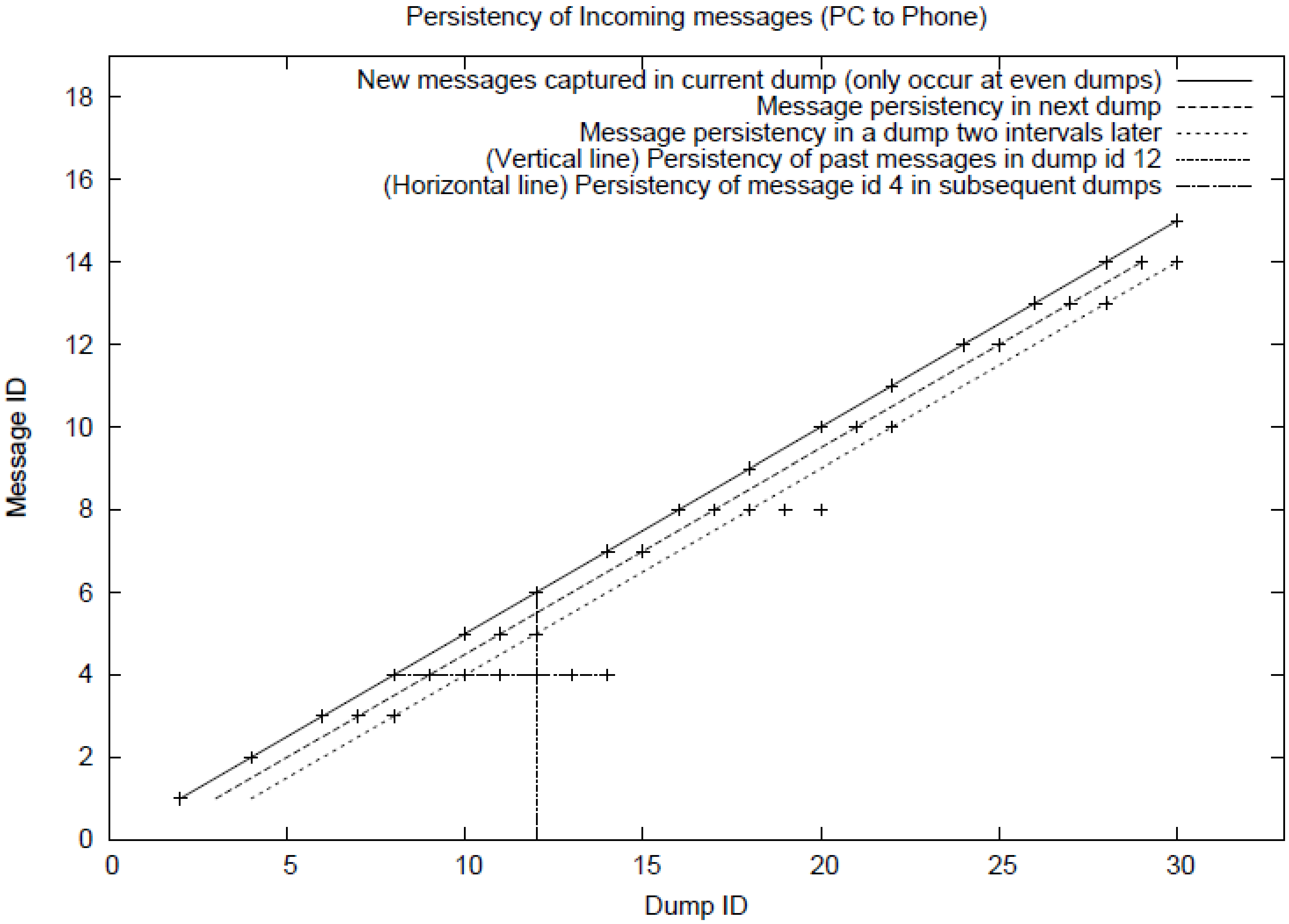
Experiments

- 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



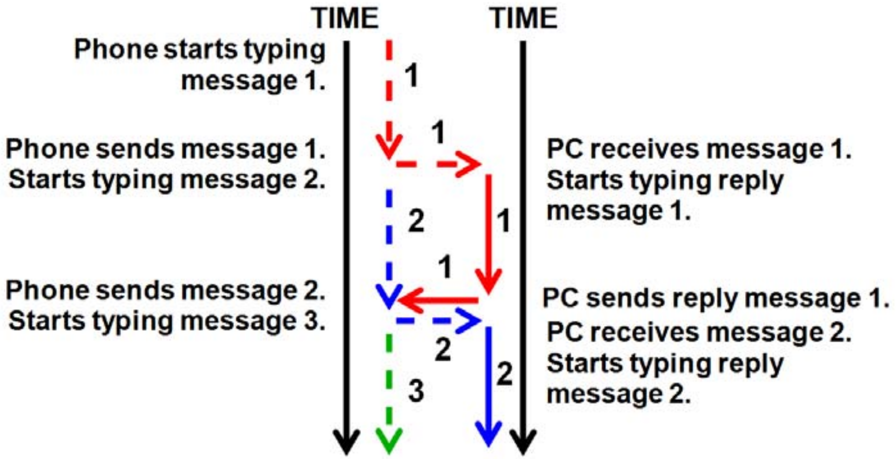
Experiments



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



TIME

TIME

Phone starts typing message 1.

Phone sends message 1. Starts typing message 2.

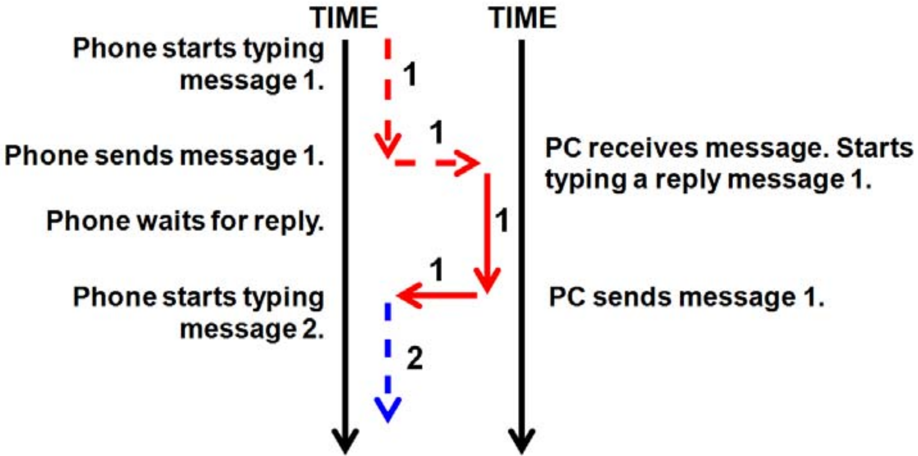
Phone sends message 2. Starts typing message 3.

PC receives message 1. Starts typing reply message 1.

PC sends reply message 1.

PC receives message 2. Starts typing reply message 2.

No-wait Scenario



TIME

TIME

Phone starts typing message 1.

Phone sends message 1.

Phone waits for reply.

Phone starts typing message 2.

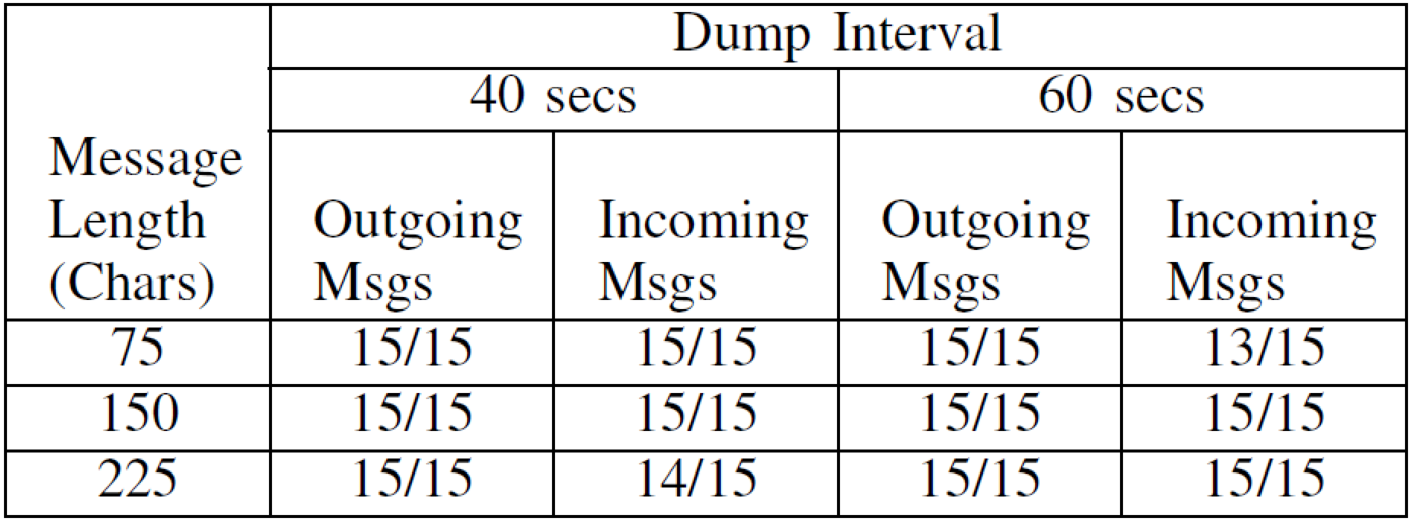
PC receives message. Starts typing a reply message 1.

PC sends message 1.

Waiting Scenario

A*STAR I²R

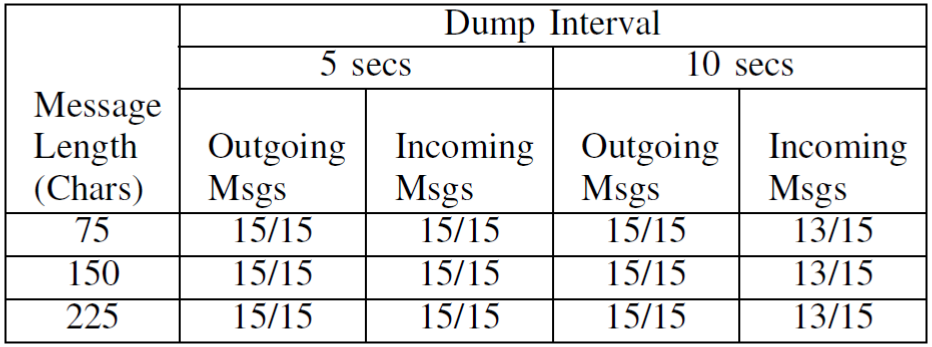
Experiments



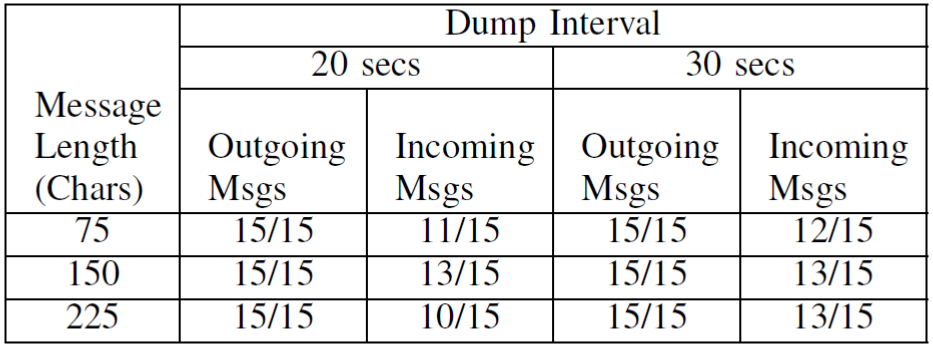
Message Length (Chars)	Dump Interval			
	40 secs		60 secs	
	Outgoing Msgs	Incoming Msgs	Outgoing Msgs	Incoming Msgs
75	15/15	15/15	15/15	13/15
150	15/15	15/15	15/15	15/15
225	15/15	14/15	15/15	15/15

- 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



Message Length (Chars)	Dump Interval			
	5 secs		10 secs	
	Outgoing Msgs	Incoming Msgs	Outgoing Msgs	Incoming Msgs
75	15/15	15/15	15/15	13/15
150	15/15	15/15	15/15	13/15
225	15/15	15/15	15/15	13/15



Message Length (Chars)	Dump Interval			
	20 secs		30 secs	
	Outgoing Msgs	Incoming Msgs	Outgoing Msgs	Incoming Msgs
75	15/15	11/15	15/15	12/15
150	15/15	13/15	15/15	13/15
225	15/15	10/15	15/15	13/15

- 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!

Vrizlynn Thing
vriz@i2r.a-star.edu.sg