International Journal of Cyber-Security and Digital Forensics (IJCSDF) 6(3): 101-108
The Society of Digital Information and Wireless Communications (SDIWC), 2017 ISSN: 2305-0012

Manual Analysis Phase for (PIFPM): Platform Independent Forensics Process Model for Smartphones

F. Chevonne Thomas Dancer
Jackson State University
1400 JR Lynch Street
frances.c.dancer@jsums.edu

ABSTRACT

In this paper, the Apple iPhone, HTC Aria, and HTC TouchPro 6850 was used in an effort to generate the average change in file content by device while applying XRYv6.1 and DiffMerge in Experiment 2. XRY writes the data in the form of files at the root of the folder to determine the manual analysis phase for smartphones. RIM (Blackberry 7105, Blackberry 8530, and Blackberry 8703e) and Symbian Nokia 5230 Nuron were used to analyze data that averages the percent of change by category in Experiment 1, along with Apple iPhone, HTC Aria, and HTC TouchPro 6850. The manual analysis of smartphones can be obtained by comparing Experiment 1 with Experiment 2 to show what was altered and what did not change. Apple iPhone 3G A1242 has the greatest change of all the smartphones. Both the HTC TouchPro 6850 and HTC Aria have the same order in Experiment 1 as in the final order and the RIM OS' order is the same as well. The Nokia Nuron 5320 is not supported by XRYv.6.1 for MMS and Picture categories, but the final order was the same as Experiment 2; SMS, Contact, Picture, MMS.

KEYWORDS

Digital forensics, XRY, Apple, Android, WMD, RIM, Symbian

1 INTRODUCTION

Digital Forensics, primarily Small Scale Digital Forensics, enables examiners to determine whether it did happen or it did not happen on a smartphone based on data from XRY. Because many mobile OS devices contain proprietary software, the full operation of each has not been realized by forensic examiners. In most cases, without the needed equipment and software for each, the kernel is unreachable. In others, the kernel may still be inaccessible [1] and [8]. In order to help combat this issue, experiments were designed that can reveal how the kernel deals with file stores, edits, and deletes after certain operations. Knowing this information may help an examiner at certain points in the examination. It may even help to negate or support the testimony of a potential witness, victim, or offender [2] and [4].

The following categories are studied: browser operations, call operations, voicemail operations (only applicable to the Apple iPhone), messaging operations, contact operations, and camera operations. There are three smartphones used in this experiment with varying levels of operation. The Apple iPhone 3G A1241 is functional and currently under contract with AT&T®. The HTC Touch Pro 6850 had to be hard reset in order to function correctly and was previously under contract with Sprint® [5]. The OS is WM OS v6.1. The HTC Aria was previously under contract with AT&T® with an Android OS v2.1.

Experiment 1 compares the files with their smartphone category with respect to the size, carrier, and platform. The former of the three tests are taken into consideration when coming up with a manual analysis. RIM Blackberry 8703e, Blackberry 7103, Blackberry 8530, Apple iPhone, HTC Aria, Symbian Nokia Nuron and HTC TouchPro 6850 were applicable in this experiment. For Experiment 2, XRY writes this information in files at the root of the folder. Although it alters the outcome of the experiment, some forensics data is still available to be examined. RIM Blackberry 8703e, Blackberry 7103, Blackberry 8530, and the Symbian Nokia Nuron already performed in Experiment 2, and the Apple iPhone, HTC Aria, and HTC TouchPro 6850 will perform in this experiment. To assist with folders that change in content, the researcher has deign a lookup tables with unique IDs that tells the status from test state 1 to test state 2 in Table 1[5-9].

Table 1: Unique ID Lookup Table

Cat	Unique ID	Test State 1 to Test State 2
Browser	B-IO	Initial to Open Browser Window
	B-OG	Open Browser Window to Google Search
	B-GC	Google Search to Close Browser Window
	B-OC	Open Browser Window to Close Browser Window
	B-GD	Google Search to Delete History and Bookmarks
	B-CD	Close Browser Window to Delete History
Contact	C-IN	Initial to New Contact
	C-NA	New Contact to Altered Contact
	C-AD	Altered Contact to Deleted Contact
MMS	M-IR	Initial to Received MMS message
	M-IS	Initial to Sent MMS message
	M-RO	Received MMS message to Opened MMS message
	M-RD	Received MMS message to Deleted MMS message
	M-SD	Sent MMS message to Deleted MMS message
Pic	P-IN	Initial to New Picture
	P-ND	New Picture to Deleted Picture
SMS	S-IR	Initial to Received SMS message
	S-IS	Initial to Sent SMS message
	S-RO	Received SMS message to Opened SMS message
	S-OD	Received SMS message to Deleted SMS message
	S-SD	Sent SMS message to Deleted SMS message
Call	V-IP	Initial to Placed Call
	V-IRA	Initial to Received Answered Call
	V-IRU	Initial to Received Unanswered Call
	V-IDC	Initial to Deleted Call log
	V-PDC	Placed Call to Deleted Call log
	V-RUDM	Received Unanswered Call to Deleted Missed Call
Miscellaneous	A-ISA	Initial to Stop All Apps (TouchPro 6850 only)
	J-IJB	Initial to Jailbreak (iPhone only)
	J-JBDM	Jailbreak to Delete SMS (iPhone only)
	L-IL	Initial to Passcode Enabled (iPhone only)
	L-LnS	Passcode Enabled to no SIM (iPhone only)
	Vmail-IR	Initial to Received Voicemail (iPhone only)
	Vmail-RL	Received Voicemail to Listened to Voicemail (iPhone only)
	Vmail-LD	Listened to Voicemail to Deleted Voicemail (iPhone only)

2 EXPERIMENT 2: Average in Change Content

XRY writes a specific set of information to each examination file. As an aside, these files were counted in the analysis of the results. XRY also alters the state of most of the devices or instructs the examiner to do so before experimentation began. Following is an outline of the extraction media, the data limitations, and the changes made to each device.

The recommended media connection for the Apple iPhone is by microUSB cable. XRY v6.1 is unable to support the extraction of SIM calls, SMS, or contacts, tasks, PC & device clock, retrieval of the phone number of the device, and any data from the memory card. Email extraction is partially supported, but only if the device is jailbroken and MMS is only supported on an iPhone OS of 3.0 or later. XRY makes no changes to memory, but in order to extract the maximum amount of data from the device, the state of memory has to be altered by jailbreaking the device. The Apple iPhone used in this experiment was examined both pre and post jailbreak so that the results of each could be compared [3].

The HTC Aria has the same recommended connection as all the other devices; microUSB cable. The following items for data extraction are not supported: pictures, audio, video, files, tasks, and notes. XRY partially supports email, but fully extracts SIM contacts and SMS, device contacts, calls, SMS, MMS, calendar events, and memory card data. XRY makes no changes to memory but before extraction can begin, the examiner must ensure that "USB debugging" is enabled which will alter the current state of the device [3].

The HTC TouchPro 6850 is not listed as a supported device, but is recognized as a Windows Mobile 6 device upon connecting it to XRY using a media USB cable. There are three other TouchPro devices reported to be supported that extract all features except SIM calls and device notes. Due to security settings, IMEI, IMSI, and SIM SMS may not be extracted. XRY makes changes to the device by installing an XRY plug-in to the root of the memory of the phone and is executed from there. There is an option to install the plug-in on a memory card in order to avoid altering the state of the device. Regardless of installation choice, the plug-in is said to be uninstalled automatically [3].

In order to compute the difference in the number of files where the content differs, each folder structure representing each test was inputted into the DiffMerge software along with its comparison test folder structure. DiffMerge returned the number of identical, "Iden", and different files, "Diff", the number of files without peers, "W/P", and the number of folders, "# Folds". The percent difference, "% Δ", in the number of files where the content changed was computed by adding the number of different files and files without peers and dividing by the total number of files within the folder structure. This number is then divided by 100. "Num of Diff" is the number of differences from test state 1 to state 2 and "Cat%Δ" is the number that is categorically different [9].

The HTC Aria report 1 file as identical, 4 files as different, and 0 files as being without peers in Table 2. These four files listed as different are the same log files found in the HTC TouchPro 6850 file structure. The 1 file on the HTC Aria that is identical to all the other tests is also a JPG file containing a picture of an HTC Aria. Examination of the 4 files revealed the same results as did looking at the 4 HTC TouchPro 6850 files being reported as different. The percentage is the same for the HTC Aria with smartphone categories of SMS, Call, Contact, and Browser.

Since the HTC TouchPro 6850 is not listed as a supported device, not much data was extracted from the device in Table 3. Throughout all 16 tests, there were a total of 4 files found listed under the different category. There were 0 identical and 0 without peers. When examining these 4 files, it was discovered that they were all generated by XRY and are all types of log files: Case Data.txt, Device-General Information.txt, Summary.txt, and XRY System-Log.txt. When examining the 4 files to discover the differences, it was found that they are minor changes such as date and time of extraction. It is not known what types of files are being manipulated. It is possible that only the size of the log files are changing, therefore providing results as seen in the first experiment. Therefore, the amount of change in the number of files per test gives us an average change percentage of 100% for each smartphone category as follows: Picture, Contact, and Browser.

Table 2: HTC Aria % Change in Folder Content by Device and Category

		Num of Diff				
Test ID	Iden	Diff	W/P	# Folds	% Δ	Cat % Δ
S-IS	1	4	0	1	80%	80%
S-SD	1	4	0	1	80%	
V-IP	1	4	0	1	80%	80%
V-PDC	1	4	0	1	80%	
C-IN	1	4	0	1	80%	80%
C-NA	1	4	0	1	80%	
C-AD	1	4	0	1	80%	
B-IO	1	4	0	1	80%	
B-OC	1	4	0	1	80%	
B-GD	1	4	0	1	80%	
B-DDB	1	4	0	1	80%	

Table 3: HTC TouchPro 6850: % Change in Folder Content by Device and Category

		Num of Diff				
Test ID	Iden	Diff	W/P	# Folds	% Δ	Cat% Δ
P-IN	0	4	0	0	100%	100%
P-ND	0	4	0	0	100%	
C-IN	0	4	0	0	100%	100%
C-AD	0	4	0	0	100%	
W-ILAN	0	4	0	0	100%	100%
B-IO	0	4	0	0	100%	100%
B-OG	0	4	0	0	100%	

B-GD	0	4	0	0	100%	
B-DBO	0	4	0	0	100%	
B-CD	0	4	0	0	100%	
V-IP	0	4	0	0	100%	100%
V-PDC	0	4	0	0	100%	
S-IS	0	4	0	0	100%	100%
S-SD	0	4	0	0	100%	
A-ISA	0	4	0	0	100%	100%
M-IS	0	4	0	0	100%	100%

Table 4: Apple iPhone: % Change in Folder Content by Device and Category

		Num of Diff				
Test ID	Iden	Diff	W/P	# Folds	% Δ	Cat% Δ
J-IJB	1	9	71023	4430	99.999	62.7 %
J-JBDM	54784	6410	14645	4355	27.763	
M-IS	55041	16484	19345	4743	39.429	34.0 %
M-SR	64563	7626	17901	4833	28.335	
M-RO	64394	8101	17354	4800	28.331	
M-OD	54869	16644	19404	4774	39.649	
S-IS	66276	7096	15628	4731	25.533	25.3 %
S-SR	65933	7407	15714	4728	25.963	
S-RO	66815	6679	15464	4769	24.892	
S-OD	66750	6802	15431	4743	24.986	
Vmail-IR	55774	7520	14409	2590	28.222	27.9 %
Vmail-RL	56215	7557	13601	2550	27.345	
Vmail-LD	55599	8125	13581	2611	28.078	
V-RUDM	55796	7770	13636	2648	27.727	28.2 %
V-DMR	55745	7630	14054	2648	28.005	
V-IP	56133	7553	13620	2587	27.389	
V-PDC	56496	7168	13596	2637	26.875	
P-IN	56298	7332	13772	2644	27.265	27.3 %
P-ND	56257	7539	13609	2614	27.321	
B-DBO	39193	23142	16021	2686	49.981	46.6 %
B-OG	37100	24862	17000	2656	53.015	
B-GC	53427	9142	16024	2577	32.021	
B-CD	38285	24222	16124	2679	51.311	
C-IN	38529	24032	16044	2679	50.984	61.1 %
C-NA	53619	9008	15976	2679	31.785	
C-AD	1	61678	18030	2680	99.999	
L-IL	1	61942	17607	2637	99.999	75.0 %
L-LnS	39531	23567	15284	2637	49.566	

The Apple iPhone is the only device where the total number of folders per test fluctuates between 2,550 and 4,833 seen in Table 4. The number of folders throughout all other tests for every other device remains the same. Given the limitations of extraction by XRY, it is not surprising that the HTC Aria only contain 1 folder for each of the forty tests and HTC TouchPro 6850 contains 0 folders.

XRY writes a total of 13 log files to each folder representing each test for the Apple iPhone as follows: Calls.txt, Case Data.txt, Device-General Information.txt, Device-Keyboard Cache.txt, Files-Archives.txt, Files-Audio.txt, Files-Documents.txt, Files-Pictures.txt, Files-Unrecognized.txt, Files-Videos.txt, Messages-SMS.txt, Summary.txt, and XRY System-Log.txt. Due to the amount of data retrieved from the Apple iPhone tests, it is infeasible to discuss each. Therefore, only the most interesting tests will be mentioned in the text and readers can refer to Table 2 for further review.

According to XRY, if the Apple iPhone is jailbroken, XRY is able to extract more data. Test J-IJB which compares the Apple iPhone in its pre-jailbroken and post jailbroken state, reveals that 99.99% of the files contained different content. 1 of the files is identical, 9 of the files are different, and 71,023 of the files did not have peers. With only 1 file identical, and 9 different, it can be concluded that the remainder of the files did not exist in the pre-jailbreak folder structure. Therefore, the claim that XRY can extract more data from a jailbroken device seems to be supported. Of the 6 smartphone categories, the greatest amount of content change takes place in the Contact Category, and the least amount of content change takes place in the SMS Category. On average, The Contact Category reports 30,716 files as identical, 31,573 files as different, and 16,683 files without peers. This means that 61.1% of the contents of the files in this category change. On average, the SMS Category reports 66,444 files as identical, 6,996 files as different, and 15,559 files without peers. This means that 25.3% of the content of the files in this category change. Following is the remainder of the categories coupled with the average amount of change per category from least amount of change to most: Picture-27.3%, Call-28.2%, MMS-34%, and Browser-46.6%.
HTC TouchPro 6850 and the HTC Aria all have the same amount of categorical change and therefore this experiment does not assist in devising an order of examination for these

devices for Experiment 2. Table 4 shows that the categorical order of manual examination for the Apple iPhone that will result in the least file manipulation is as follows: SMS, Picture, Voicemail, Call, MMS, Browser, and Contact.

Table 5: Categorical Percent Difference

Category	TEST ID	Apple iPhone		RIM BB8530		RIM BB8703		HTC TouchPro 6850		HTC Aria		Nokia 5230	
		%Δ	Avg.	%Δ	Avg.	%Δ	Avg.	%Δ	Avg.	%Δ	Avg.	%Δ	Avg.
Browser	B-IO	.0001	.0006	.087	.086	N/A	N/A	.004	.0374	0	.856	N/A	N/A
	B-OG	.0001		0		N/A		.054		1.211		N/A	
	B-GC	.001		0		N/A		.031		1.196		N/A	
	B-OC	.0009		0		N/A		.085		0		N/A	
	B-GD	.0012		0		N/A		.031		2.701		N/A	
	B-CD	.0002		0		N/A		.019		.002		N/A	
Contact	C-IN	.0001	.0024	.106	.079	.904	.673	11.348	4.092	.348	.232	315.96	141.3
	C-NA	.0005		.013		.111		0		.022		70.486	
	C-AD	.0064		.119		1.006		.0001		.325		238.82	
MMS	M-IR	.0016	.0013	N/A	2.06	N/A	N/A	N/A	.195	N/A	N/A	N/A	.058
	M-IS	.0008		2.02		N/A		.195		N/A		.058	
	M-RO	.0003		N/A		N/A		N/A		N/A		N/A	
	M-RD	.001		N/A		N/A		N/A		N/A		N/A	
	M-SD	.0026		2.103		N/A		N/A		N/A		N/A	
Pic	P-IN	.0006	.0004	0	0	N/A	N/A	.075	6.4	N/A	N/A	50.66	40.86
	P-ND	.0002		0		N/A		12.721		N/A		34.35	
SMS	S-IR	.0015	.0007	11.21	4.15	0	1.187	N/A	.00006	N/A	.774	N/A	.058
	S-IS	.00004		.126		1.194		.001		.777		.058	
	S-RO	.0002		0		0		N/A		N/A		N/A	
	S-OD	.0001		0		0		N/A		N/A		N/A	
	S-SD	.0018		.218		1.18		.00001		.771		N/A	
Call	V-IP	.0002	.0004	.157	.183	1.032	1.025	.002	.002	.623	.621	N/A	N/A
	V-IRA	.0005		N/A		N/A		N/A		N/A		N/A	
	V-IRU	.0003		N/A		N/A		N/A		N/A		N/A	
	V-IDC	.0003		.197		1.022		.002		.619		N/A	
	V-PDC	.0003		.197		1.022		.002		.619		N/A	
	V-RUDM	.0004		N/A		N/A		N/A		N/A		N/A	
Miscellaneous	A-ISA	N/A	13.53	N/A	.092	N/A		.873	.873	N/A	N/A	N/A	N/A
	E-IE	N/A		N/A		0		N/A		N/A		N/A	
	E-ELAN	N/A		N/A		0		N/A		N/A		N/A	
	J-IJB	94.49		N/A		N/A		N/A		N/A		N/A	
	J-JBDM	.0017		N/A		N/A		N/A		N/A		N/A	
	L-IL	.0001		N/A		N/A		N/A		N/A		N/A	
	L-LnS	.0004		N/A		N/A		N/A		N/A		N/A	
	N-IDN	N/A		0		N/A		N/A		N/A		N/A	
	Vmail-IR	.001		N/A		N/A		N/A		N/A		N/A	
	Vmail-RL	.001		N/A		N/A		N/A		N/A		N/A	
	Vmail-LD	.001		N/A		N/A		N/A		N/A		N/A	
	W-ILAN	N/A		.092		0		N/A		N/A		N/A	
	W-LAN	N/A		0		0		N/A		N/A		N/A	

*Blackberry 7105 not applicable to be examined due to a malfunction with the device.

The Miscellaneous Tests all result in the greatest amount of content change to the XRY folder structure of the Apple iPhone.

3 EXPERIMENT 1 RESULTS:

Analyzing the smartphone category allows one to evaluate which devices are more like others. Given these results, the Preliminary Toolset of PIFPM can be designed with respect to the amount of change that takes place within each category. To assist in this effort, the average percent of change by category is computed in Table 5 [5, 9].

Ranking the devices by the average amount of change that takes place in each category allows us to name the area of each device where file size will be affected the least and the most by manual manipulation. Only the order of examination for the Apple iPhone is stated with the most confidence given that it is the only device that contained results for each test. The following results are based solely on change to file size and the results shown in Table 5. When examining the Apple iPhone manually, data from pictures or calls should be extracted first. The order of examination for the remainder of the data is as follows: browser, SMS, MMS, contacts. When examining the Blackberry 8530, the order should be as follows: picture, contact, browser, call, MMS, and SMS. The data provide an order as follows for the Blackberry 8703e: contact, call, and SMS. The remainder of the categories contains no results. The author believes that if the device yielded results for each test as did the Blackberry 8530, the order would be the same. This will be taken under consideration when manipulating PIFPM. The order of examination for the HTC TouchPro should be as follows: SMS, call, browser, MMS, contact, and Picture. Both the HTC Aria and the Nokia 5230 have categories that contain no results and both therefore show four of the six categories in their order of examination. Contact, call, browser, and SMS is the order in which the HTC Aria should be examined while the Nokia 5230 should be examined as follows: SMS or MMS, picture, and contact [5, 9].

4 EXPERIMENT 2 RESULTS:

Given the results, the PIFPM has been modified to incorporate a model for manual examination. The altered design is derived with the results from Experiment 2 superseding those of Experiment 1 unless there is only 1 test result available in one specific smartphone category. If this is the case, the results from Experiment 1 will take precedence. If there are several categories in Experiment 2 that result in the same average percentage of content change, Experiment 1 will take precedence as well. The rule of thumb is that the more files available for comparison in Experiment 2, the stronger the results [5, 9].
The categorical examination order of each smartphone is given in Table 6 [5, 9]. It shows the examination orders from Experiments 1 & 2 and also the actual examination order. Both experiments found that manual manipulation of the Contact Category results in the greatest amount of file size change as well as the greatest amount of content change to the Apple iPhone. Both the HTC TouchPro 6850 and the HTC Aria have the same final order as the first experiment because the smartphones had the same amount of categorical change. With the smartphone data from Experiment 1 & 2, Figure 1 shows the resulting changes to the manual analysis phase.

In Figure 1, the smartphone manufacturers are listed here. Call Category and Browser Category are not listed for Android and MMS Category and Picture Category are not listed for Symbian because the smartphones are not supported by XRYv6.1. Three have the same category as manual analysis one when placing Apple, Symbian, and WMD for Experiments 1 and 2; SMS. This only happens with the Apple iPhone 3, Symbian Nokia Nuron, or WMD HTC TouchPro 6850 is used [9]. The Call Category can be seen for manual analysis two in Android and WMD. Thirdly, there are two categories that are identical can be seen which are the Browser and Call Categories; Android, WMD, and Apple, RIM, respectively. The next category is the most interesting because all of the smartphones, data places MMS Category as manual analysis four

except Android. If Android had a MMS category, maybe all five smartphones would have MMS Category as manual analysis four. Number five did not have anything to report, and manual analysis six is the Contact Category for Apple and RIM.

Table 6: Manual Examination Order

Device	Experiment 1 Order	Experiment 2 Order	Final Order
Apple iPhone	Picture, Call	SMS	SMS
	Browser	Picture	Picture
	SMS	Call	Call
	MMS	MMS	MMS
	Contact	Browser	Browser
		Contact	Contact
HTC TouchPro 6850	SMS	--	SMS
	Call	--	Call
	Browser	--	Browser
	MMS	--	MMS
	Contact	--	Contact
	Picture	--	Picture
HTC Aria	Contact	--	Contact
	Call	--	Call
	Browser		Browser
	SMS		SMS

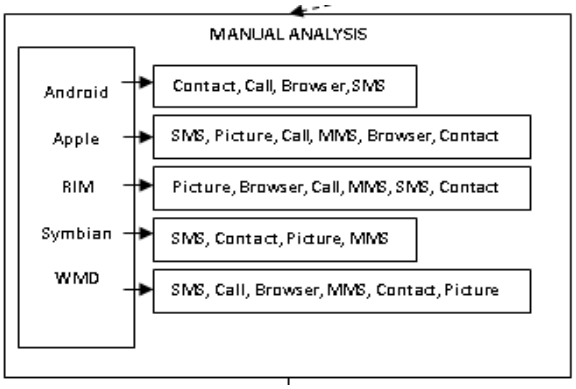

Figure 1: Manual Analysis Phase

5 CONCLUSIONS

The extendable framework will provide examiners with a process model for the purpose of inspecting any model smartphone conscious of the unique qualities belonging to each. After reviewing the models already established, it was discovered that no such model existed. After its development, the researcher conducted several quantitative studies in an effort to reveal any new information about the different smartphones. The researcher modified the design of PIFPM to include a path for manual examination based on the information discerned in the File Size Difference and the Average Change in Content experiments. The researcher plans to conduct future studies that will result in statistical significance.

PIFPM contributes to the area of Digital Forensics in several ways. Firstly, it is unique in that it is the only model of its kind that offers any type of process for examiners to follow when dealing with any model smartphone. There is no way we can standardize mobile device OS development so that there will never be another mobile OS to emerge. Because the model has been designed to be extendable in an effort to account for any make/model smartphone, it will not be obsolete when new operating systems are introduced. Secondly, PIFPM provides a standard process for all examiners to follow. Utilizing this model will provide a specific roadmap for smartphone examiners to follow just as computer forensic examiners have the DFWRS model. Lastly, although in its infancy, the model presents the opportunity for the refinement of smartphone forensic processes and may assist in launching the development of a forensically sound tool for any model smartphone.

REFERENCES

1 Dinesh N. Patil, Bandu B. Meshram, "Digital Forensic Analysis of Ubuntu File System',International Journal of Cyber-Security and Digital Forensics, vol. 4, no. 5, pp. 175 – 186, 2016.

2 W. Jansen, A. Delaitre, and L. Moenner. "Overcoming impediments to cell phone forensics." Hawaii International Conference on System Sciences, Proceedings of the 41st Annual. IEEE, pp. 483-483, 2008.

3 MicroSystemation, "Mobile Device Forensics," http://www.msab.com/support/useful-links (Current Aug. 29, 2017).

4 S.G. Punja and R.P. Mislan, "Mobile device analysis", Small Scale Digital Forensics Journal, vol. 2, no. 1, pp. 1-16, 2008.

5 F. Chevonne Thomas Dancer, "Analyzing and Comparing Android HTC Aria, Apple iPhone 3G, and Windows Mobile HTC TouchPro 6850," The 2016 International Conference on Computational Science and Computational Intelligence (CSCI), December 15-17, 2016, Las Vegas, USA.

6 F. Chevonne Thomas Dancer and David A. Dampier, "Refining the Digital Device Hierarchy," Journal of the Academy of Sciences, vol. 55, no. 4, October 2010.

7 F. Chevonne Thomas Dancer, David A. Dampier, "A Platform Independent Process Model for Smartphones Based on Invariants", SADFE, 2010, Systematic Approaches to Digital Forensic Engineering, IEEE International Workshop on, Systematic Approaches to Digital Forensic Engineering, IEEE International Workshop on 2010, pp. 56-60, doi:10.1109/SADFE.2010.

8 F. Chevonne Thomas Dancer; David A. Dampier; Jacqueline M. Jackson; and Natarajan V. Meghanathan, "A Theoretical Process Model for Smartphones," Proceedings: 2012 Second International Conference on Artificial Intelligence, Soft Computing and Applications, Chennai, India, 13-15, July 2012.

9 F. C. T. Dancer and G. W. Skelton, "To change or not to change: That is the question," Technologies for Homeland Security (HST), 2013 IEEE International Conference on, Waltham, MA, 2013, pp. 212-216.