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Volatile Memory Based Forensic Artifacts & Analysis

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Abstract: *Today's technology grows its roots in positive and negatives both directions. Cyber criminals are always get one step ahead then the investigator. Digital forensics in the live environment is the biggest challenge. Acquisition of live artifacts on running system needs expertise to achieve expected results. One of the most important areas where every forensic analyst looks into is Memory, i.e. RAM - Random Access Memory. RAM is a volatile memory which flushes when system is shut down or restart. So before shutting down the system Memory dump should be taken. It is very important aspect for carving information resided into the volatile memory.[1] Here a role of a volatile memory analysis in digital forensics and the importance of the physical memory analysis is proposed. It is very useful in real time evidence acquisition analysis. Further we have introduced some of the tools and techniques used in acquisition and analysis of memory.*

Keywords— *Memory Forensics; RAM Analysis; Artifacts; Live Forensics; Volatile memory artifacts*

INTRODUCTION

Live memory acquisition and analysis does not have that much attention, which is given to other acquisition and analysis techniques in the area of digital forensics. Live Memory Analysis can be very much productive for analysis. Live Memory Analysis can give a large number of details. It requires a greater amount of care than the other methods of analysis. [2]

Live Memory Analysis plays an important role in the field of Digital Forensics. It can give the details about the running processes and applications in the system. Passwords can also be obtained using this analysis technique. The details, which are not stored on the hard drive of the system, can also be obtained with this technique. Live Memory Analysis can be very useful in Malware Analysis. Malware leaves some traces that can be analyzed by live memory acquisition. [3]

MEMORY DUMP TOOLS FOR DIFFERENT OPERATING SYSTEM

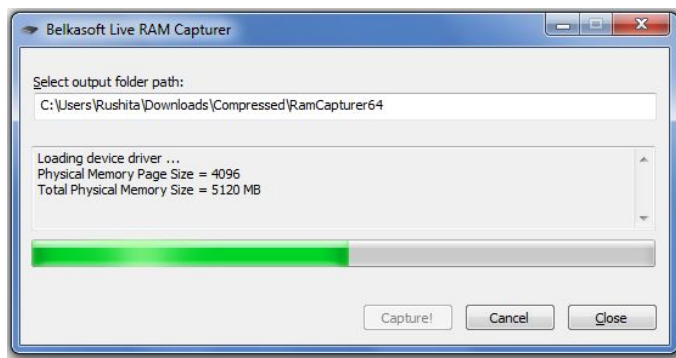
Here the list of memory acquisition tools for Windows/Linux/Unix operating system. That tools have capabilities to fetch memory based potential evidences.[4] Random Access Memory fetching & dumping to specific directory process can be easy with the following tool.

WINDOWS BASED TOOLS

Belkasoft Live RAM Capturer

A free volatile memory forensic tool to dependably extract the entire content of the volatile memory of a computer. Memory dumps captured with this tool are generally analyzed using the tool of Belkasoft only named Live RAM Analysis in Belkasoft Evidence Center.

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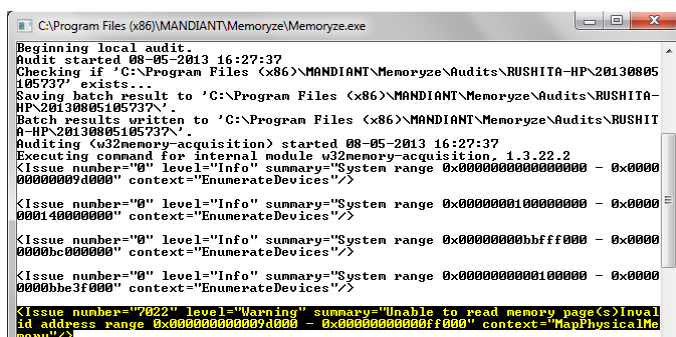
BELKSSOFT LIVE RAM CAPTURER

ManTech Memory DD

It acquires a forensic image of physical memory and stores it as a raw binary file. To check data integrity and help in the preservation of the evidence, the information captured by ManTech Memory DD is checked by the MD5. The binary file can be analyzed using outer tools to identify.

Mandiant Memoryze

Mandiant's Memoryze is free memory forensic software that helps incident responders find evil in live memory. Memoryze can acquire and/or analyze memory images, and on live systems, can include the paging file in its analysis.



Belksoft Live Ram Capturer

FTK Imager[11]

A tool that creates a forensic image of computer data without affecting original evidence and hashes for file integrity. FTK imager creates a bit-by-bit image, including unallocated space and slack space.

WinPmem

It is used for capturing raw memory images, Microsoft crashdump files for windbg and volatility. In this tool memory acquisition is done using MnMapIoSpace method.

Windows Memory Reader

It is a simple command-line utility to capture the contents of physical RAM. Results are stored in a Windows crash dump file or a raw binary file.

DumpIt

It is used to generate a physical memory dump of Windows machines. The raw memory dump is generated in the current directory, only a confirmation question is prompted before starting.

Autopsy

It is open source digital investigation tool that run on Windows, Linux, OS X, and other Unix systems. It is used to analyze disk images and perform in-depth analysis of file systems.

LINUX BASED TOOLS

LiME

Linux Memory Extractor allows the acquisition of volatile memory from linux and linux based devices. LiME allows full memory captures from Android devices.

UNIX BASED TOOLS

Mac Memory Reader

It is a simple command-line utility to capture the contents of physical RAM, letting investigator to gather volatile state information. Results are stored in either a Mach-O binary file or a raw-format file

Mac Memory Dumper

Mandiant Mac Memory Dumper is a memory forensic program that allows the user to find incident responders in live memory. Mandiant Mac Memory Dumper can acquire and/or analyze memory images, and on live systems, can include the paging file in its analysis.

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OSXPmem

The OSX Memory Imager is an open source tool to acquire physical memory on an Intel based Mac. It consists of 2 components:

osxpmem - parses the accessible sections of physical memory and writes them to disk in a specific format.

pmem.kext - provides read only access to physical memory. After loading it into the kernel it gives a device file called /dev/pmem/ from which physical memory can be read.

CONCEPT OF MEMORY FETCHING & DUMPING FOR FORENSIC PURPOSE

While the discussion is going on the memory fetching some

concepts are required to be clear before starting the evidence analysis:

First: The memory dump must not be unintentionally altered by the investigator - for this issue dump memory with MD5 or SHA-1 hash for maintaining integrity of potential evidence.

Second: The stored memory dump is depends upon RAM Size and virtual paging. E.g. if RAM is 4 GB and by default virtual paging size is 2 GB then the 4 GB RAM dump is approx 6 GB. It includes virtual memory also while dump volatile memory.

ARTIFACTS IDENTIFIED FROM RAM ANALYSIS OF SYSTEM

Following artifacts can be fetch out from memory dump. [5]

Protected program details

Running processes and services

System information

Data about logged in users

Registry details

ARP cache and network connections

Fragments of conversation (chat), communication in social networks

Latest web browsing activities including private browsing detail,

Webmail system communication

Recently viewed multimedia

Running malicious codes

Passwords of the mail accounts

VOLATILE MEMORY CARVING & ARTIFACT ANALYSIS METHODOLOGY

Memory Capture

FTK Imager, a free tool is used to capture the RAM. The steps is performed as below,[9]

Go to “File” menu and select “Capture Memory

It will prompt a dialogue box where we have to choose destination path for the memory dump.[10]

We can also create pagefile.sys and AD1 file for analysis if needed.

Then select “Capture Memory”.

Memory capture GUI

Memory Analysis

For analyzing the memory use any hex editor like WinHex or wxHexEditor. Autopsy forensic tool can be also used for the same. Here wxHexEditor is used for memory analysis.

Now open wxHexEditor and open the memory dump which you have taken form FTK Imager. It will show in 2 parts. On the right side we get the string values of information stored in

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the memory and on the left side we will get the hex values for the strings to analyze the string values.

The search option is there for a particular query to find. So it will be easier for user to get the information quickly. Search can be done for the email accounts, services and processes running in the system, applications opened in the system. Here focus is on the most sensitive information and that is the credentials of email accounts and other social networking accounts.

Offset	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F		
0x12607472	33	6B	43	45	75	35	36	6D	72	50	57	39	45	41	30	73	4A	70	67	2D	44	6B	58	5A	74	33	B3C6256789ABCDEF0123456789AB	
0x12607500	50	47	6A	36	32	31	52	39	48	6C	37	4F	54	46	41	68	58	61	61	6D	6E	6F	6A	6B	6C	6D	6E	6F
0x12607528	50	55	42	72	35	48	59	56	63	56	5D	37	18	36	6A	61	2D	54	4F	5A	39	74	59	30	74	59	30	
0x12607556	77	49	66	62	47	59	49	39	35	65	57	5F	43	6F	68	4D	35	43	38	46	4A	73	61	HCU01d2V5E6C3fPgEusdcm2Jea	4A	73	61	
0x12607584	48	53	50	68	32	32	56	33	63	67	30	44	43	38	66	47	53	75	63	64	63	61	63	9AC6256789ABCDEF0123456789AB	9AC6256789ABCDEF0123456789AB	9AC6256789ABCDEF0123456789AB	9AC6256789ABCDEF0123456789AB	
0x12607612	5F	39	43	26	70	34	42	63	73	67	30	12	66	42	63	68	4D	35	43	38	46	4A	73	61	63	61	63	
0x12607640	68	6E	65	63	74	69	6F	6C	79	67	75	74	75	65	25	33	41	32	30	32	61	69	6C	checkedDomain=youtu.beEmail	checkedDomain=youtu.beEmail	checkedDomain=youtu.beEmail	checkedDomain=youtu.beEmail	
0x12607668	63	68	65	63	68	64	44	6F	6D	79	67	73	70	75	74	75	65	25	33	41	32	61	69	6C	checkedDomain=youtu.beEmail	checkedDomain=youtu.beEmail	checkedDomain=youtu.beEmail	
0x12607696	32	76	69	64	68	64	61	76	65	33	63	23	76	61	63	26	50	73	73	77	64	6D	65	63	61	63		
0x12607724	68	74	67	62	61	68	64	63	68	65	66	67	67	69	62	49	62	49	62	49	62	49	62	49	62	49	62	
0x12607752	50	65	72	73	69	73	74	65	6E	74	43	6F	6B	69	65	30	75	63	76	27	6D	6F	77	6E	PersistentCookieIn=6mShom	PersistentCookieIn=6mShom	PersistentCookieIn=6mShom	
0x12607780	3D	31	00	05	BD	A2	F7	EB	04	01	00	01	00	01	00	42	00	01	00	41	00	00	6C	00	1	2	3	
0x12607808	69	03	00	01	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
0x12607836	06	0F	00	72	00	6D	20	75	00	72	00	6C	00	60	00	63	00	00	00	00	00	00	00	00	00	00	00	
0x12607864	64	00	00	72	00	6D	20	75	00	72	00	6C	00	60	00	63	00	00	00	00	00	00	00	00	00	00	00	
0x12607892	2E	67	6F	67	6C	2E	63	6D	2F	53	62	76	69	6														

Gmail Username and Password can be search out through memory dump.

Now perform search for the gmail account and credentials for that account can be easily identified. It is not necessary that the account should be opened in the browser. The detail of the account though the user is not logged on can be extract. If user logged in through private browsing mode, then also the detail about the account can be identified. Full emails and chats with the date and time can also be extract through serching. Investigator also can listed out all the contacts of that account.

[illegible]

Another potential evidence chat conversation of the user is also there in the memory dump.

[illegible]

Chat conversation

Social networking site facebook credentials can also got through Live RAM analysis.

C:\Users\Rushta\Desktop\memdump.men

Offsec	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	
1475723704	41	44	47	44	4C	4B	4D	4D	40	49	44	42	4D	40	67	70	99	90	9C	88	10	00	ADDD	45	74	74	74	74	74	74	74	74	74
1475723732	40	3E	3E	00	00	00	00	00	00	00	00	00	00	00	00	70	FD	FF	6E	62	65	78	74	65	72	6E	62	62	62	62	62	62	
1475723760	61	6C	1E	61	68	61	60	69	68	64	2E	65	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74		
1475723780	72	70	68	70	3F	64	61	51	42	75	61	69	59	59	57	51	5F	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58	
1475723816	28	68	30	32	37	26	75	62	60	3D	36	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74	74		
1475723844	74	69	6D	67	2E	6F	63	62	34	76	69	62	75	62	54	5B	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	54	
1475723872	32	46	6D	61	78	72	65	66	61	75	75	74	2E	68	70	67	26	63	66	66	66	66	66	66	66	66	66	66	66	66	66	66	
1475723900	00	00	00	00	6C	73	64	30	41	56	72	68	45	43	25	65	60	61	6C	6D	6D	6D	6D	6D	6D	6D	6D	6D	6D	6D	6D	6D	
1475723928	69	64	61	76	65	31	33	36	25	34	70	49	48	6F	2E	69	6E	26	70	61	73	73	73	73	73	73	73	73	73	73	73	73	
1475723956	76	69	63	65	75	65	76	69	61	72	69	68	75	76	64	65	73	75	75	75	75	75	75	75	75	75	75	75	75	75	75	75	
1475723984	73	69	73	74	65	72	70	30	26	74	69	4D	75	74	68	65	6D	32	33	33	33	33	33	33	33	33	33	33	33	33	33	33	
1475724012	8E	64	30	31	31	34	31	34	35	74	35	5E	26	62	67	6A	73	31	33	33	33	33	33										

Facebook credentials

VI. CONCLUSION

Volatile memory analysis will be essential to the digital investigation process going forward. While there are many tools existing for live memory acquisition and analysis, it is still a comparatively new attempt in the area of digital forensics. As the tools become better and the actions more sound, analyst will have a new weapon to utilize during forensic investigations. In the future more work can be done on interpretation of RAM data in a human readable form.

Gmail email content can be search out through memory dump

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VII. REFERENCES

Mubarak Al-Hadadi and Ali AlShidhani, "Smartphone Forensics Analysis: A Case Study", International Journal of Computer and Electrical Engineering, Vol. 5, No. 6, December 2013.

CHANG Xu, TANG Xin-hua, WU Jian, "Forensic research on data recovery of android smartphone", 2nd International Conference on Computer Science and Electronics Engineering (ICCSEE 2013).

Freddie Witherden, "Memory Forensics over the IEEE 1394 Interface".

Vrizlynn L. L. Thing a,*, Kian-Yong Ng b, Ee-Chien Chang b, "Live memory forensics of mobile phones Vrizlynn L.", digital investigation7 (2010) S74eS82.

Liming Cai, Jing Sha ,Wei Qian, "Study on Forensic Analysis of Physical Memory", 2nd International Symposium on Computer, Communication, Control and Automation (3CA 2013).

B. D. Carrier and J. Grand, "A Hardware-Based Memory Acquisition Procedure for Digital Investigations" Journal of Digital Investigations, March 2004.

Microsoft, Inc., "Windows feature lets you generate memory dump file by using the keyboard", December 2007, <http://support.microsoft.com/kb/244139>.

H. Carvey, Windows Forensic Analysis, Burlington, MA: Syngress Publishing, 2007.

AccessData, "Forensic Toolkit 2.0", <http://www.accessdata.com/Products/ftk2test.aspx>.

AccessData, "http://www.accessdata.com/products/digital-forensics/live-response"

AccessData, "http://www.accessdata.com/services/digital-forensic-services/data-aquisition-preservation"



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