Studying copy-on-read and copy-on-write techniques on block device level to aid in large environment forensics

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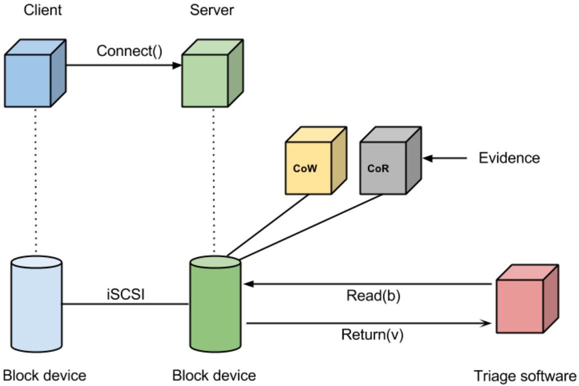
Background

Forensics on cloud solutions and large environments

- Sheer volume of data
- (Remote) Acquisition is very hard
  - Making a copy of all data is impossible
  - Making data available remotely is a long procedure

Concept



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Research

Focus on server block device level

- Copy only relevant data to local storage
  - Copy-on-Read
- Enable live forensics without interfering with original block device
  - Copy-on-Write

Important aspects

- Data integrity
- Reproducible
- Storable

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Research

What is a good way to mount block devices read only and store read and changed data in separate sparse files?

- *What methods exist that allow copy-on-write and copy-on-read on block device level?*
- *Can these methods be effectively used to do remote data acquisition while storing read- and changed data locally?*
- *If necessary, how can an existing method be modified in order to meet the requirements of this research?*

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Related Research

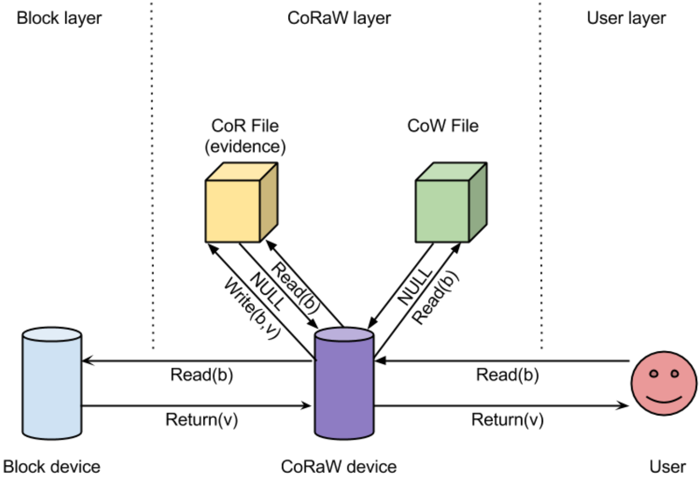
- Forensic mount tool Xmount[1]
- NIST Cloud Computing Forensic Science Challenges[2]

Existing methods

Methods that either support copy-on-read or copy-on-write

- Xmount
- Fusecow
- Bcache

Ideal situation



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Proof of concept[1]

Both Xmount and Fusecow

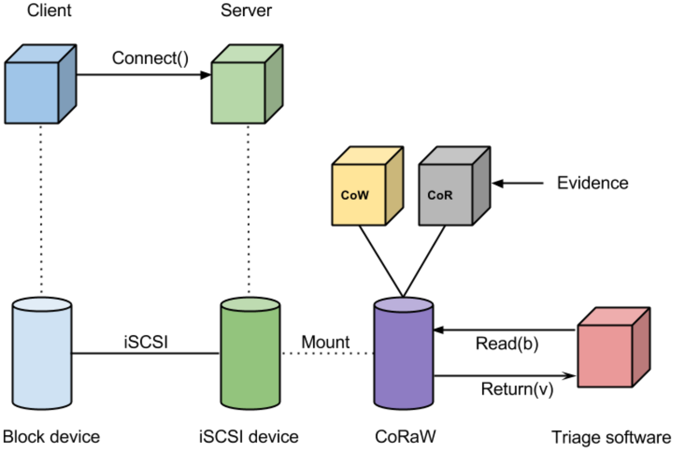
- Open source
- C
- GPL

Scope

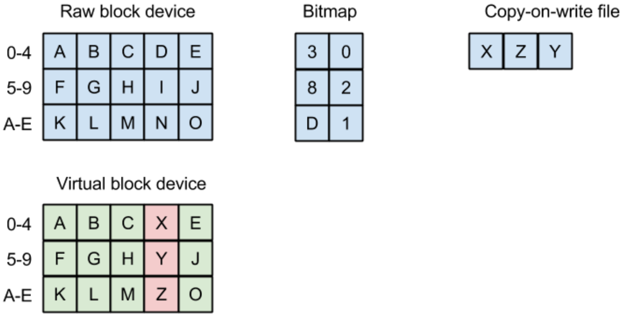
- Copy-on-read file
- Read only feature

[1] Sources on github[3]

Detailed concept



Copy-on-write implementation (existing)



Raw block device

0-4	A	B	C	D	E
5-9	F	G	H	I	J
A-E	K	L	M	N	O

Bitmap

3	0
8	2
D	1

Copy-on-write file

X	Z	Y

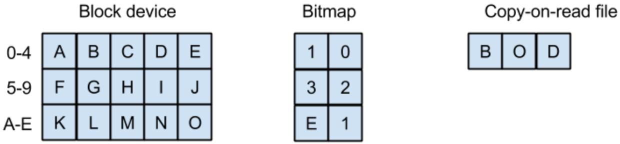
Virtual block device

0-4	A	B	C	X	E
5-9	F	G	H	Y	J
A-E	K	L	M	Z	O

write(3,X); write(D,Z); write(8,Y)

- Fusecow has two separate files
- Xmount puts bitmap into header of CoW file

Copy-on-read implementation



Block device

0-4	A	B	C	D	E
5-9	F	G	H	I	J
A-E	K	L	M	N	O

Bitmap

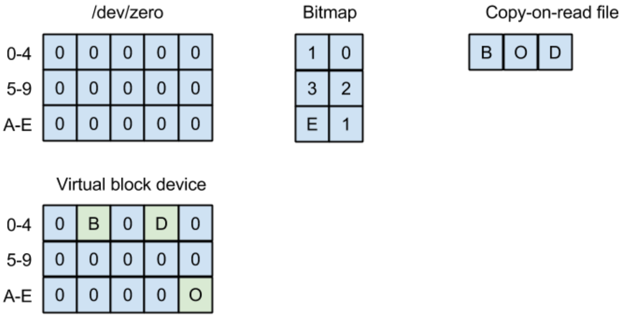
1	0
3	2
E	1

Copy-on-read file

B	O	D

read(1); read(E); read(3)

Copy-on-read implementation remount



/dev/zero

0-4	0	0	0	0	0
5-9	0	0	0	0	0
A-E	0	0	0	0	0

Bitmap

1	0
3	2
E	1

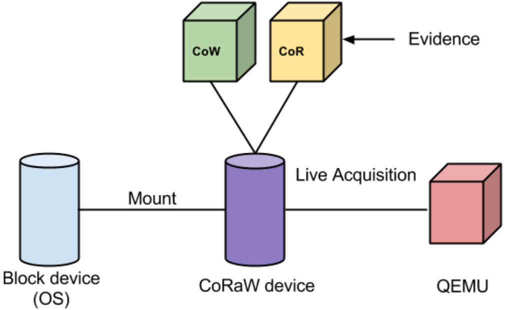
Copy-on-read file

B	O	D

Virtual block device

0-4	0	B	0	D	0
5-9	0	0	0	0	0
A-E	0	0	0	0	O

Test setup



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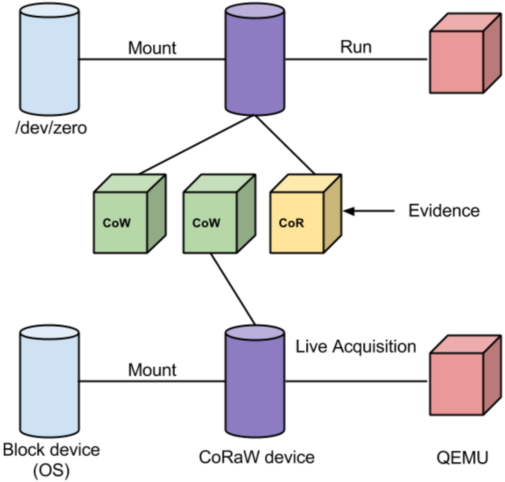
Test setup



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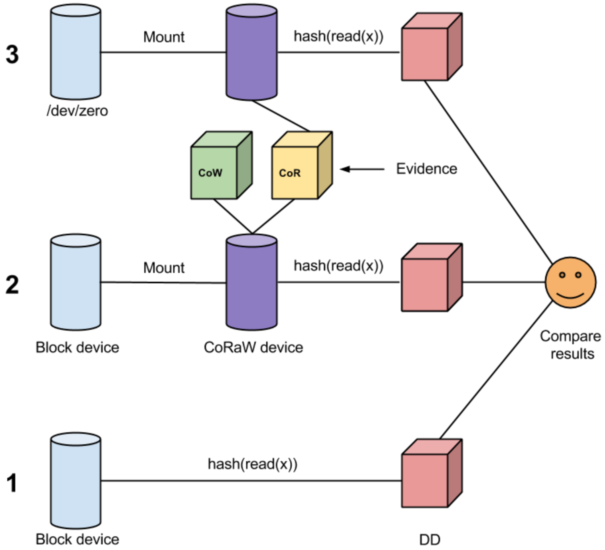
Second test setup



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Results

QEMU

- Fusecoraw works flawless

DD

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  - For now Read only or Copy-on-Read file as Copy-on-Write file

DD

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  - Requires future work

DD

Results

QEMU

- Fusecoraw works flawless
- Xmount has trouble remounting as it performs lots of tests
  - For now Read only or Copy-on-Read file as Copy-on-Write file
  - Requires future work

DD

- Both techniques work as expected, hashes match.

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Conclusion

- Both proof-of-concepts perform a good job
    - Remounting writable works only with Fusecoraw
    - No issue for current concept
- Read data is persistent
- Fusecoraw recommended if writable remounting is desired
- Xmount recommended if not

Future Research

- Fusecoraw
- Xmount
- Integrate in concept

Questions

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