Post Mortem Analysis Techniques of Fake Invoices

Manipulated PDF documents

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Reported fraud

Detoured invoices

- Supplier sends payment reminders to customers
- Customer answers that he paid,showing a proof of payment
- Supplier says that it is not his bank account details

Reported fraud

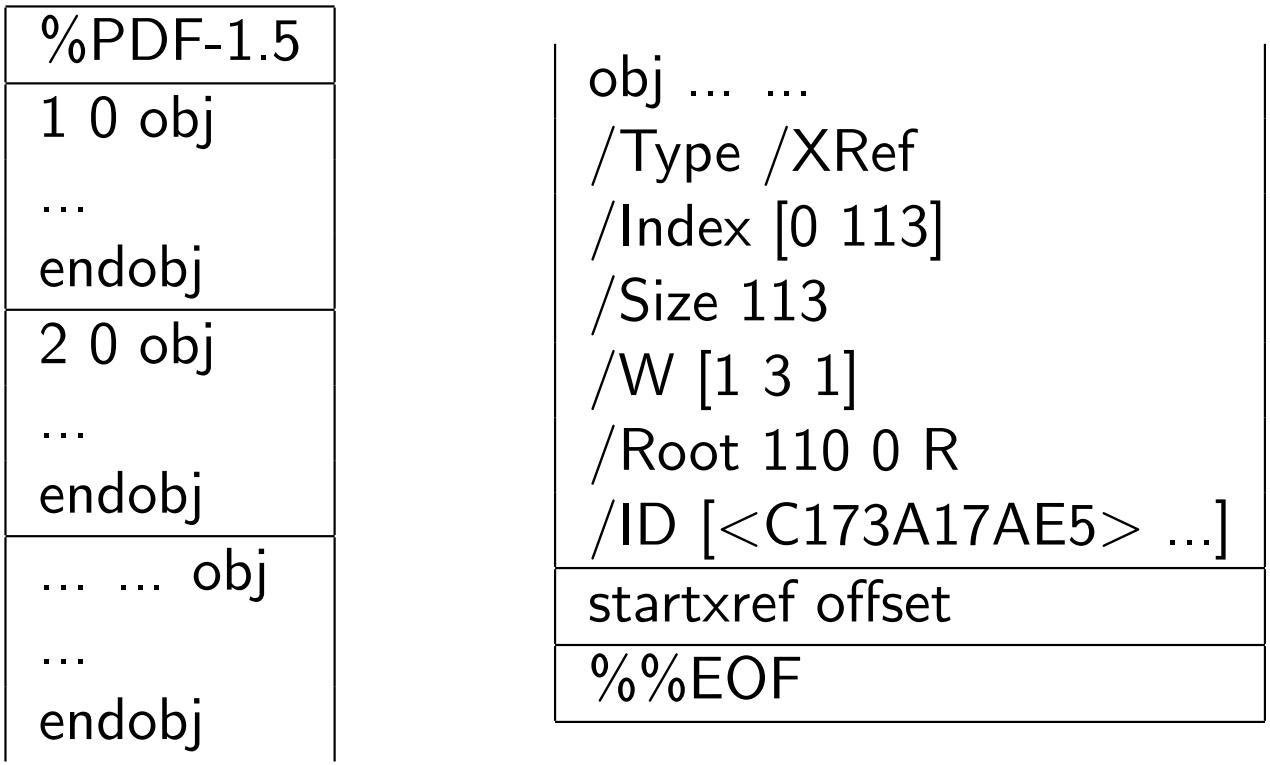
Detoured invoices

Open questions

- Was the invoice created from scratch?
  - By the accounting system itself?
  - By a third party tool?
- By a manipulation of an existing invoice
  - By the accounting system itself?
  - By a third party tool?
    - Where was the original invoice created?
    - Where was it intercepted?
    - Under which form was it intercepted? (scan, office documents)

PDF internals

PDF data structure



PDF internals

Why bothering with these details?

because of ...

- Many different PDF format variants
- `www.adobe.com/devnet/pdf/pdf_reference_archive.html`
- Not all tools interpret them correctly
- Tools strip potential valuable information
  - Comments left by the creator software
  - Generation IDs $\rightarrow$ track original files
  - Manipulation left overs of the "attacker"

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

Filename	invoice.pdf
Number of bytes	27758
MD5 hash	04a18e4a2b3baf08bd5cb33121842b22

Questions

- What version has the PDF?
- How many objects the PDF has?
- What value has is the startxref offset?
- What is at is location?
- How many objects are in the xref table?

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

Filename	invoice.pdf
Number of bytes	27758
MD5 hash	04a18e4a2b3baf08bd5cb33121842b22

Getting PDF version with standard unix tools

```
file invoice.pdf

head -c 9 invoice.pdf
```

Using pdfid.py from Didier Stevens

```
pdfid.py invoice.pdf
```

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

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Counting objects with standard unix tools

```
strings invoice.pdf | grep "endobj" | wc -l
```

Using pdfid.py from Didier Stevens

```
pdfid.py invoice.pdf
```

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

Filename	invoice.pdf
Number of bytes	27758
MD5 hash	04a18e4a2b3baf08bd5cb33121842b22

Getting the startxref offset with standard unix tools

```
OFFSET=‘strings invoice.pdf | grep -A 1 "startxref" |
    tail -n 1‘
```

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

Filename	invoice.pdf
Number of bytes	27758
MD5 hash	04a18e4a2b3baf08bd5cb33121842b22

Determining xref table with standard unix tools

```
OFFSET=‘strings invoice.pdf | grep -A 1 "
    startxref" | tail -n 1‘
dd if=invoice.pdf bs=1 skip=$OFFSET | less
```

Detoured invoices

Practical invoice.pdf analysis

Data to be analyzed

Filename	invoice.pdf
Number of bytes	27758
MD5 hash	04a18e4a2b3baf08bd5cb33121842b22

Determining the number of items in the xref table with standard unix tools

```
OFFSET=‘strings invoice.pdf | grep -A 1 "
    startxref" | tail -n 1‘
dd if=invoice.pdf bs=1 skip=$OFFSET | head -n 2 |
    tail -n 1 | cut -d ’ ’ -f2
```

Detoured invoices

Extracting PDF metadata with pdfinfo

```
pdfinfo invoice.pdf

Title: SSMILE_prin19041715230
Creator: SMILE_printer
Producer: KONICA MINOLTA bizhub C458
CreationDate: Wed Apr 17 16:23:17 2019 CEST
ModDate: Wed Apr 17 16:23:17 2019 CEST
Page size: 595 x 841 pts
File size: 27758 bytes
PDF version: 1.4
...
```

Detoured invoices

Extracting PDF metadata with pdfinfo

Open questions

- Is the creator known?
- Is the producer known?
- Are the timestamps in a valid time frame?
- Does the file size correspond?

Caution

- All elements in a PDF could be manipulated
- The integrity is not guaranteed

PDF dissection

Getting an overview with the tool pdfid.py

```
pdfid.py invoice.pdf

PDFiD 0.2.1 invoice.pdf
 PDF Header: %PDF-1.4
 obj 37
 endobj 37
 stream 16
 endstream 16
 xref 1
 trailer 1
 startxref 1
 /Page 1
 /JavaScript 0
 /OpenAction 1
 /AcroForm 0
```

Checking active components

Items frequently used to load malware

- OpenAction
- JavaScript
- AcroForm

Checking active components

OpenAction

```
python pdf-parser.py -s openaction invoice.pdf
obj 37 0
 Type: /Catalog
 Referencing: 2 0 R, 34 0 R, 1 0 R

  <<
    /Type /Catalog
    /Pages 2 0 R
    /Metadata 34 0 R
    /OpenAction [ 1 0 R /Fit ]
  >>
```

Checking active components

OpenAction

```
    /OpenAction [ 1 0 R /Fit ]
```

Object number	1
Generation number	0
Indirect reference	R
Fit	Display instructions

Checking active components

OpenAction

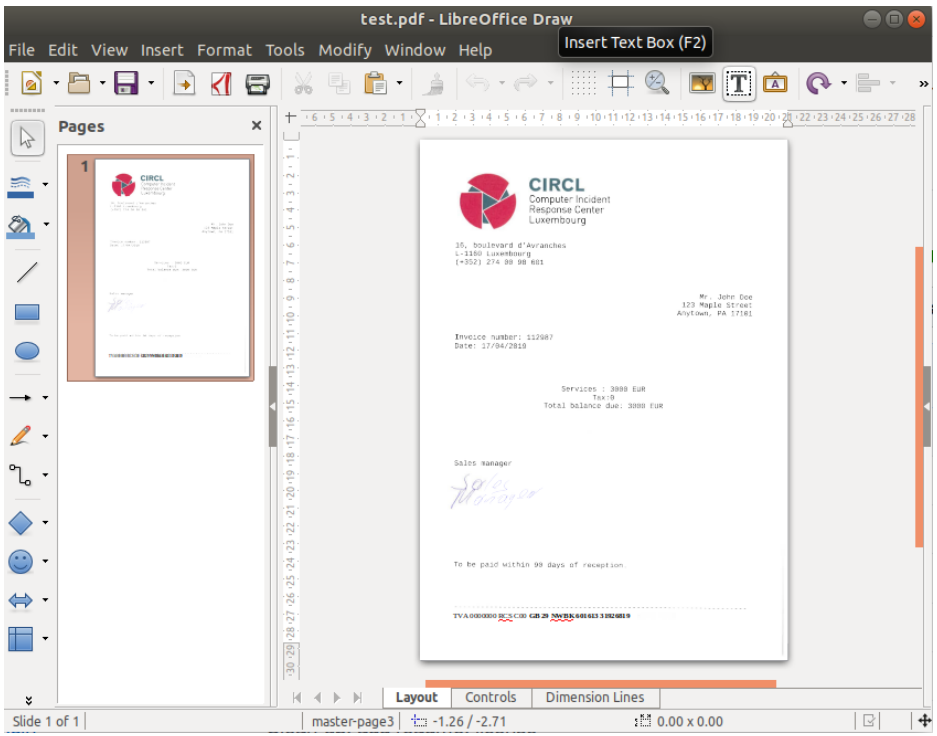
What is at object 1?

```
python pdf-parser.py invoice.pdf -o 1
obj 1 0
 Type: /Page
 Referencing: 2 0 R, 3 0 R, 4 0 R
  <<
    /Type /Page
    /Parent 2 0 R
    /MediaBox [ 0 0 595.000 841.000 ]
    /Resources
      <<
        /ProcSet [ /PDF /Text /ImageB /ImageC /ImageI ]
        ...
```

Detoured invoices

Checking document modifications

- Tools for manipulating PDF documents: LibreOffice, Preview on MacOS, Adobe Acrobat
- Low skills are needed for doing these manipulations



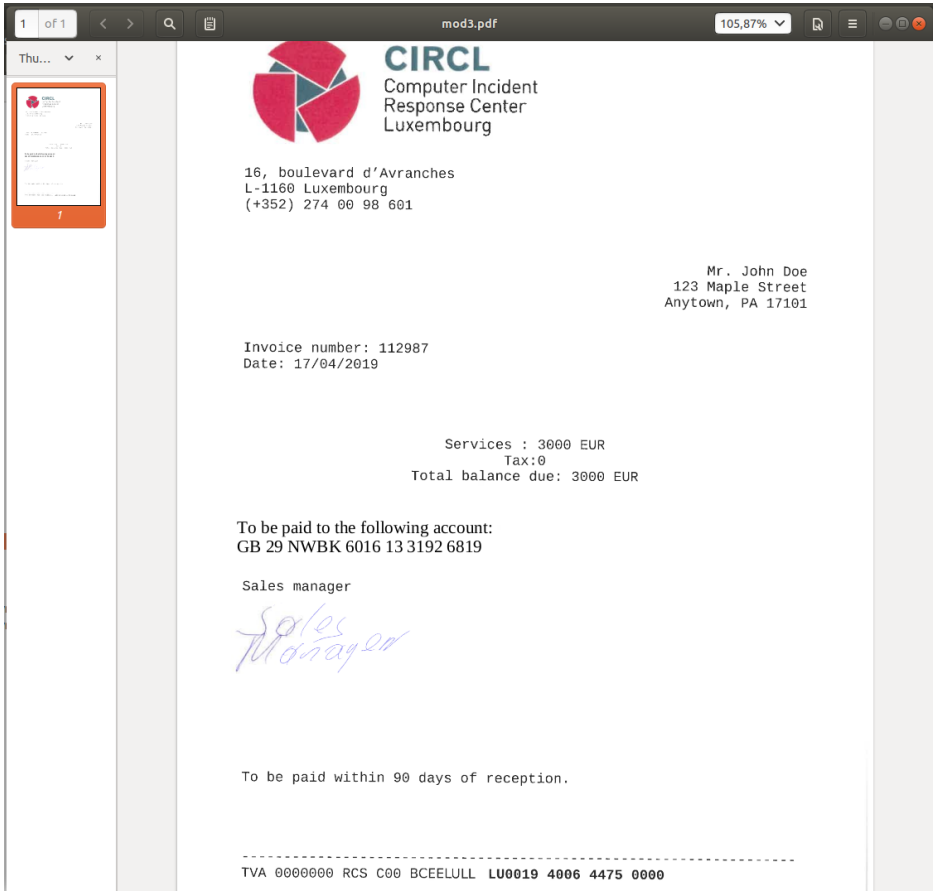
Detoured invoices

Checking document modifications

- Insert text boxes (add new bank account details, delivery addresses, ...)
- Adding overlays in the picture $\rightarrow$ hide some parts
- Add some signature scans
- ...

Detoured invoices

Checking document modifications



Detoured invoices

Checking document modifications

Checking for added text boxes

```
pdf-parser.py -s /fontfile mod1.pdf

    obj 56 0
 Type: /FontDescriptor
 Referencing: 54 0 R
  <<
    /Type /FontDescriptor
    /FontName /CAAAAA+LiberationSerif-Bold
    /Flags 4
    /FontFile2 54 0 R
  >>
```

Detoured invoices

Checking document modifications

- Which font descriptor corresponds to what?
- Dump the font file
- Display the glyphs
- Check the coordinates
- or ...
- Deactivate it and visualize

Detoured invoices

Checking document modifications

```
cat mod1.pdf | sed 's/58 0 obj/99 0 obj/g' > out
    .pdf
```

To be paid within 90 days of reception.

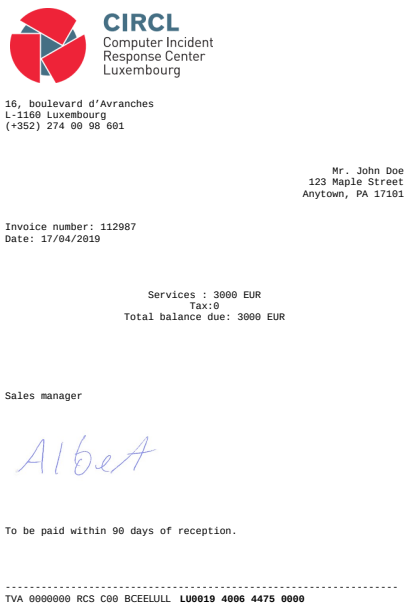
TVA 0000000 RCS C00

Detoured invoices

Adding signature scans

Detoured invoices

Adding signature scans



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Mr. John Doe
123 Maple Street
Anytown, PA 17101

Invoice number: 112987
Date: 17/04/2019

Services : 3000 EUR
Tax:0
Total balance due: 3000 EUR

Sales manager

To be paid within 90 days of reception.

TVA 0000000 RCS C00 BCEELULL **LU0019 4006 4475 0000**

Detoured invoices

Adding signature scans

Search for included images

```
pdf-parser.py -s /image invoice2.pdf

obj 5 0
 Type: /XObject
 Referencing: 7 0 R
 Contains stream

  <<
    /Type /XObject
    /Subtype /Image
    /Width 433
    /Height 180
```

Detoured invoices

Adding signature scans

Extract the image from the pdf document

```
pdf-parser.py -o 5 invoice2.pdf -d signature.png
```

Check the image

```
display signature.png
```

What can be shared?

- File meta information
  - Did other recipients received it?
  - Is it in a backups?
  - Was it in mailboxes?
  - Is it in shadow copies
  - ...
- Timestamps $\rightarrow$ get a time range of operations
- Bank account details
  - Prevent other transfers
  - Correlate cases