

# Post Mortem Analysis Techniques of Fake Invoices

## Manipulated PDF documents



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# Reported fraud

## Detoured invoices

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- 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

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### 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-1.5
1 0 obj
...
endobj
2 0 obj
...
endobj
... .. obj
...
endobj

obj ... ..
/Type /XRef
/Index [0 113]
/Size 113
/W [1 3 1]
/Root 110 0 R
/ID [<C173A17AE5> ...]
startxref offset
%%EOF

# PDF internals

Why bothering with these details?

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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 → track original files
  - Manipulation left overs of the "attacker"

# Detoured invoices

Practical invoice.pdf analysis

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## 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

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

### 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 pdftinfo

---

```
pdftinfo 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 pdftinfo

---

## 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

---

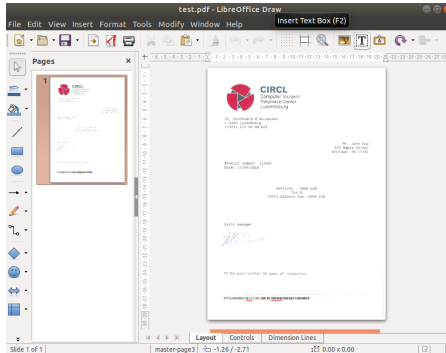
What is at object 1?

```
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

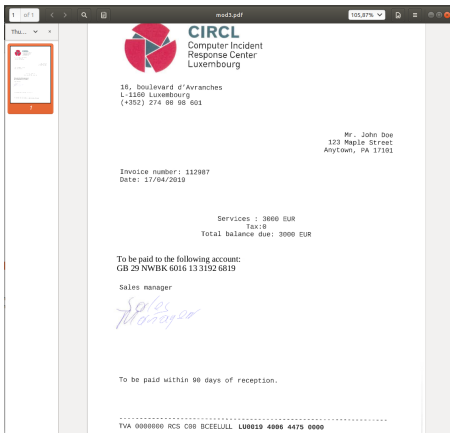
## Checking document modifications

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

# Detoured invoices

## Checking document modifications



# Detoured invoices

## Checking document modifications

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### 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.

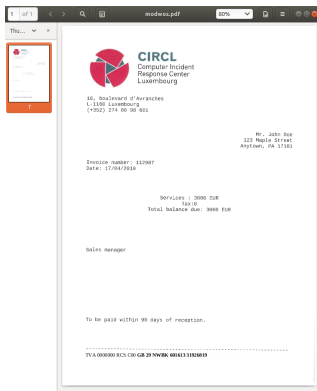
-----  
TVA 0000000 RCS C00



# Detoured invoices

## Adding signature scans

---



## Adding signature scans



Mr. John Doe  
123 Maple Street  
Anytown, PA 17280

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

AlberA

TVA 0000000 RCS C00 R0000000 0000000000 0000000000

# 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?

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