DIGITAL FORENSIC RESEARCH CONFERENCE

Introducing the Microsoft Vista Log File Format

By

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Presented At

The Digital Forensic Research Conference

DFRWS 2007 USA Pittsburgh, PA (Aug 13th - 15th)

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Introducing the Microsoft Vista Event Log File Format.

cum sapientia protegimus

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Vista Event Log Files.
Agenda.

1. Introduction

2. The Outer Structure

3. The Inner Structure – Binary XML
3.1 Token
3.2 Substitution
3.3 Templates

4. Forensic Practice
4.1 Carving
4.2 Interpretation of a Single Record

5. Conclusion

Vista Event Log Files.
Introduction.

- “Crimson” 2005, now “Windows Event Logging”
- truly new event logging service
- log file format obviously differs from that of NT family
- no parsers available beside the logging service
  - Vista required for analysis
  - doesn’t operate on fragments of files

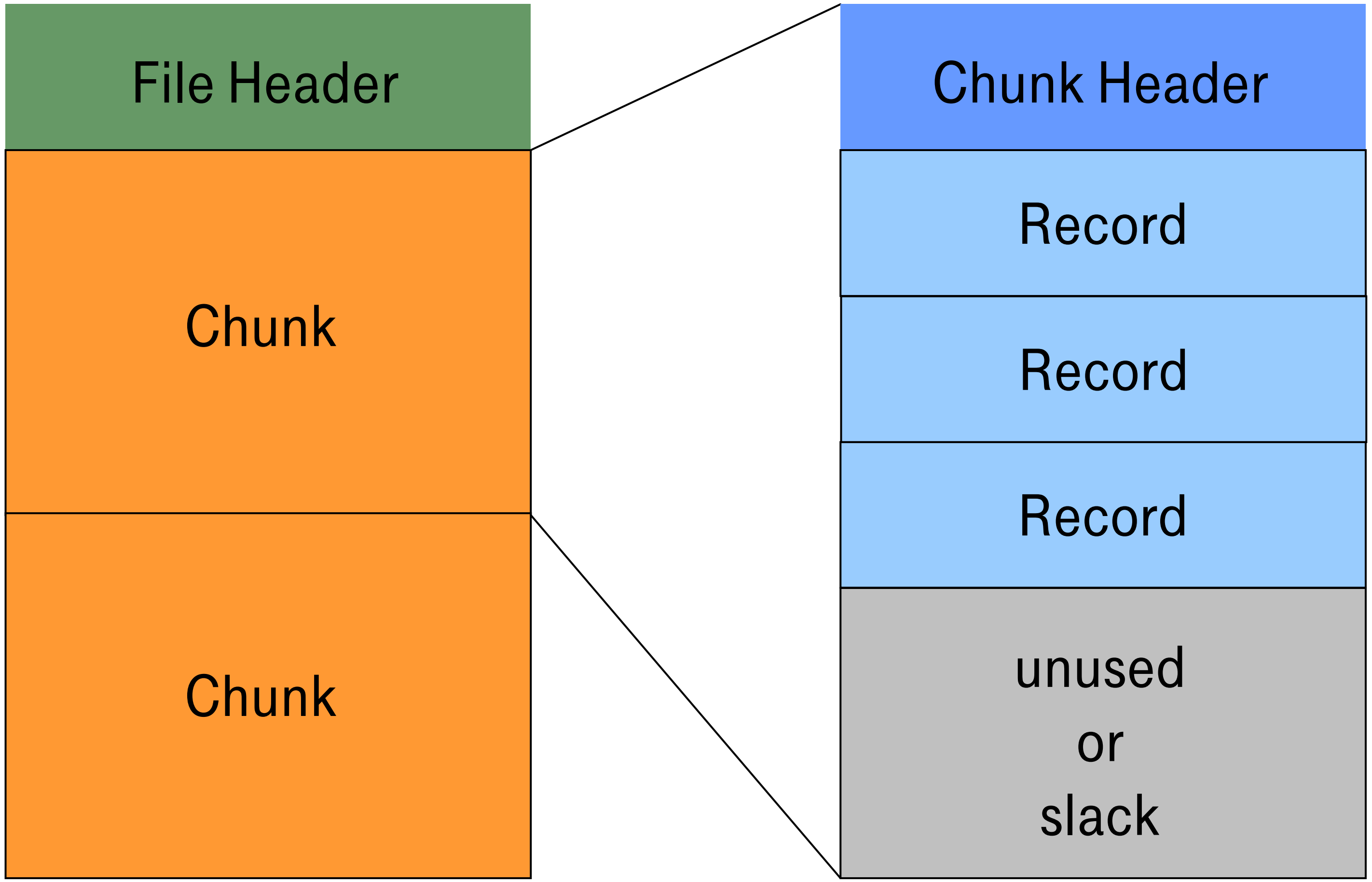
Vista Event Log Files.
Method.

- must not use any material that is under NDA
- no decompilation, restricted by German IP law
- clean-room analysis
  - clean install of Microsoft Vista Ultima RTM
  - normal system activity
    - 17 non-empty files, 2616 records
    - compare binary and textual representation
  - special conditions
    - flooding
    - unclean shutdown

Vista Event Log Files.
Tools.

- Scripts for the 010 Editor
  - outer structure (file to record)
  - SubstitutionArray
  - http://computer.forensikblog.de/files/010_templates/
- Framework (Perl) around a recursive-descent parser
  - outer structure
  - known system tokens, known data types
  - http://computer.forensikblog.de/files/evtx/EvtxParser-1.0.0.zip

The Outer Structure.
Overview.



The Outer Structure.
File.

- file header is permanently mapped into memory
- size 4096 bytes (= 1 physical memory page)
- only 128 Bytes are in use
- magic string “ElfFile”, 0x00
- version 3.1 (NT Event Log uses 1.1, Crimson 2.1)
- count of chunks
  number of current chunk
- flags (DIRTY, FULL)
- integrity protected by CRC32 check sum

The Outer Structure.
Chunk.

- from all chunks only the current one is mapped into memory
- size 64 kiB
- magic string “ElfChnk”, 0x00
- numbers of first/last event record
- integrity protected by CRC32 check sum

The Outer Structure.
Event Record.

- magic string 0x2a 0x2a 0x00 0x00
- length near beginning and at the end
- record number (uint64)
- timestamp (FILETIME, 100ns since Jan 1st, 1601, 00:00:00)
- XML (“inner structure”)

Binary XML.
Schema.

XML schema has been published on the MSDN web site.

```
<Events>
   <Event>
      <System>
         <EventID>1</EventID>
         <TimeCreated SystemTime="2006-10-
           08T09:21:28.415Z"/>
         <EventRecordID>573</EventRecordID>
         …
      </System>
      <EventData>
      …
      </EventData>
   </Event>
</Events>
```

Binary XML.
Problems with Textual XML.

- disk utilization
  - low entropy
- CPU utilization
  - calculating block length
  - check for well-formedness

Solution: binary XML

- commonly found on smartphones

Binary XML.
Tokenization.

XML language elements are replaced by tokens.

- system tokens („operators“)
- application tokens („operands“)
  - element/attribute names
  - XML templates

Binary XML.
Tokenization.

Encoding of a start element tag:

< EventID >

becomes

#OpenStartElementTag#

EventID

#CloseStartElementTag#

Binary XML.
Tokenization.

Encoding of a container element:

<EventID>1234</EventID>

becomes

#OpenStartElementTag#

EventID

#CloseStartElementTag#

1234

#EndElementTag#

Binary XML.
Tokenization.

Value	Meaning	Example
0x00	EndOfBXmlStream	
0x01	OpenStartElementTag	< name >
0x02	CloseStartElementTag	< name >
0x03	CloseEmptyElementTag	< name />
0x04	End Element Tag	</ name >
0x05	Value	attribute = “value”
0x06	Attribute	attribute = “value”
0x0c	TemplateInstance	
0x0d	NormalSubstitution	
0x0e	OptionalSubstitution	
0x0f	StartOfBXmlStream	

Binary XML.
Substitution.

Separating structure from content:

<EventID> 1234 <EventID/>

becomes

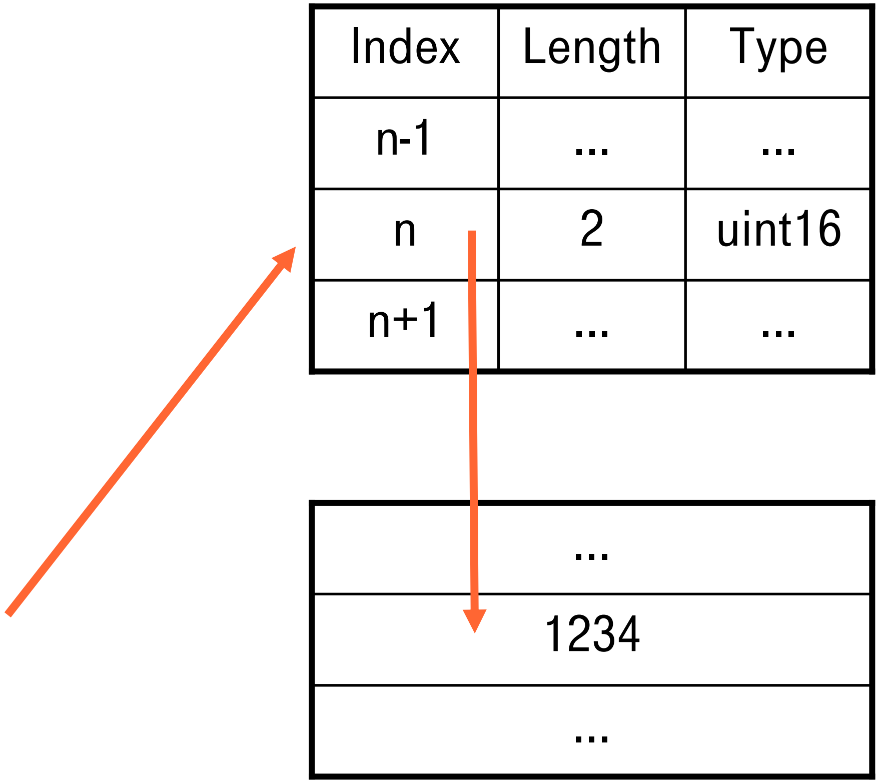
#OpenStartElementTag#

EventID

#CloseStartElementTag#

#NormalSubstitution# *Index n*

#EndElementTag#



Index	Length	Type
n-1	...	...
n	2	uint16
n+1	...	...

...
1234
...

Binary XML.
Templates.

After the separation step many records share a common XML structure.

The structure is defined once (“template”) and applied multiple times.

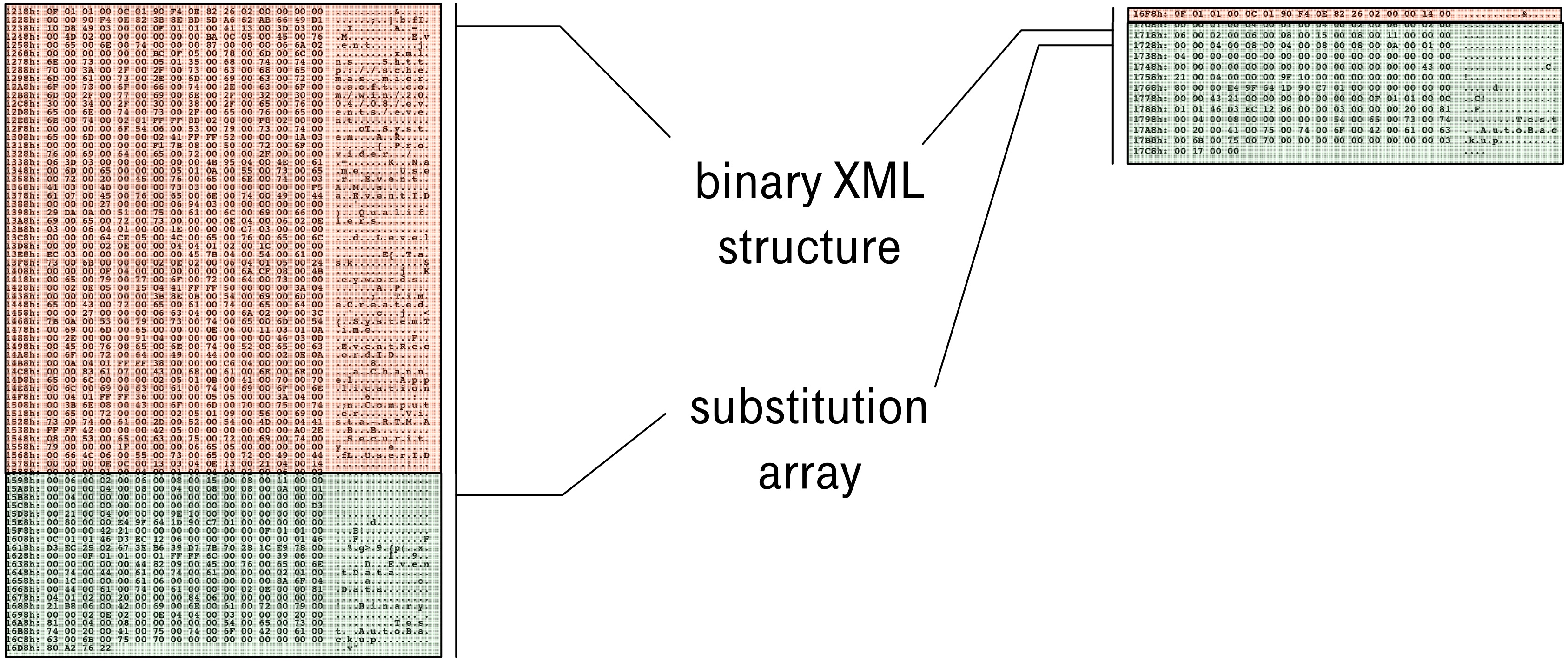
Example:

- the same event message is submitted twice
- only timestamp and record number will differ

Binary XML.
Templates.

First record

Second record



```
1218h: 0F 01 01 00 0C 01 90 F4 0E 82 26 02 00 00 00 00  ..........&.....
1228h: 00 00 90 F4 0E 82 3B 8E BD 5D A6 62 AB 66 49 D1  ......;..].b.fI.
1238h: 10 D8 49 03 00 00 0F 01 01 00 41 13 00 3D 03 00  ..I.......A..=..
1248h: 00 4D 02 00 00 00 00 00 00 BA 0C 05 00 45 00 76  .M...........E.v
1258h: 00 65 00 6E 00 74 00 00 00 87 00 00 00 06 6A 02  .e.n.t........j.
1268h: 00 00 00 00 00 00 BC 0F 05 00 78 00 6D 00 6C 00  ..........x.m.l.
1278h: 6E 00 73 00 00 00 05 01 35 00 68 00 74 00 74 00  n.s.....5.h.t.t.
1288h: 70 00 3A 00 2F 00 2F 00 73 00 63 00 68 00 65 00  p.:././.s.c.h.e.
1298h: 6D 00 61 00 73 00 2E 00 6D 00 69 00 63 00 72 00  m.a.s...m.i.c.r.
12A8h: 6F 00 73 00 6F 00 66 00 74 00 2E 00 63 00 6F 00  o.s.o.f.t...c.o.
12B8h: 6D 00 2F 00 77 00 69 00 6E 00 2F 00 32 00 30 00  m./.w.i.n./.2.0.
12C8h: 30 00 34 00 2F 00 30 00 38 00 2F 00 65 00 76 00  0.4./.0.8./.e.v.
12D8h: 65 00 6E 00 74 00 73 00 2F 00 65 00 76 00 65 00  e.n.t.s./.e.v.e.
12E8h: 6E 00 74 00 02 01 FF FF 8D 02 00 00 F8 02 00 00  n.t.............
12F8h: 00 00 00 00 6F 54 06 00 53 00 79 00 73 00 74 00  ....oT..S.y.s.t.
1308h: 65 00 6D 00 00 00 02 41 FF FF 52 00 00 00 1A 03  e.m....A..R.....
1318h: 00 00 00 00 00 00 F1 7B 08 00 50 00 72 00 6F 00  .......{..P.r.o.
1328h: 76 00 69 00 64 00 65 00 72 00 00 00 2F 00 00 00  v.i.d.e.r.../...
1338h: 06 3D 03 00 00 00 00 00 00 4B 95 04 00 4E 00 61  .=.......K...N.a
1348h: 00 6D 00 65 00 00 00 05 01 0A 00 55 00 73 00 65  .m.e.......U.s.e
1358h: 00 72 00 20 00 45 00 76 00 65 00 6E 00 74 00 03  .r. .E.v.e.n.t..
1368h: 41 03 00 4D 00 00 00 73 03 00 00 00 00 00 00 F5  A..M...s........
1378h: 61 07 00 45 00 76 00 65 00 6E 00 74 00 49 00 44  a..E.v.e.n.t.I.D
1388h: 00 00 00 27 00 00 00 06 94 03 00 00 00 00 00 00  ...'............
1398h: 29 DA 0A 00 51 00 75 00 61 00 6C 00 69 00 66 00  )...Q.u.a.l.i.f.
13A8h: 69 00 65 00 72 00 73 00 00 00 0E 04 00 06 02 0E  i.e.r.s.........
13B8h: 03 00 06 04 01 00 00 1E 00 00 00 C7 03 00 00 00  ................
13C8h: 00 00 00 64 CE 05 00 4C 00 65 00 76 00 65 00 6C  ...d...L.e.v.e.l
13D8h: 00 00 00 02 0E 00 00 04 04 01 02 00 1C 00 00 00  ................
13E8h: EC 03 00 00 00 00 00 00 45 7B 04 00 54 00 61 00  ........E{..T.a.
13F8h: 73 00 6B 00 00 00 02 0E 02 00 06 04 01 05 00 24  s.k............$
1408h: 00 00 00 0F 04 00 00 00 00 00 00 6A CF 08 00 4B  ...........j...K
1418h: 00 65 00 79 00 77 00 6F 00 72 00 64 00 73 00 00  .e.y.w.o.r.d.s..
1428h: 00 02 0E 05 00 15 04 41 FF FF 50 00 00 00 3A 04  .......A..P...:.
1438h: 00 00 00 00 00 00 3B 8E 0B 00 54 00 69 00 6D 00  ......;...T.i.m.
1448h: 65 00 43 00 72 00 65 00 61 00 74 00 65 00 64 00  e.C.r.e.a.t.e.d.
1458h: 00 00 27 00 00 00 06 63 04 00 00 6A 02 00 00 3C  ..'....c...j...<
1468h: 7B 0A 00 53 00 79 00 73 00 74 00 65 00 6D 00 54  {..S.y.s.t.e.m.T
1478h: 00 69 00 6D 00 65 00 00 00 0E 06 00 11 03 01 0A  .i.m.e..........
1488h: 00 2E 00 00 00 91 04 00 00 00 00 00 00 46 03 0D  .............F..
1498h: 00 45 00 76 00 65 00 6E 00 74 00 52 00 65 00 63  .E.v.e.n.t.R.e.c
14A8h: 00 6F 00 72 00 64 00 49 00 44 00 00 00 02 0E 0A  .o.r.d.I.D......
14B8h: 00 0A 04 01 FF FF 38 00 00 00 C6 04 00 00 00 00  ......8.........
14C8h: 00 00 83 61 07 00 43 00 68 00 61 00 6E 00 6E 00  ...a..C.h.a.n.n.
14D8h: 65 00 6C 00 00 00 02 05 01 0B 00 41 00 70 00 70  e.l........A.p.p
14E8h: 00 6C 00 69 00 63 00 61 00 74 00 69 00 6F 00 6E  .l.i.c.a.t.i.o.n
14F8h: 00 04 01 FF FF 36 00 00 00 05 05 00 00 3A 04 00  .....6.......:..
1508h: 00 3B 6E 08 00 43 00 6F 00 6D 00 70 00 75 00 74  .;n..C.o.m.p.u.t
1518h: 00 65 00 72 00 00 00 02 05 01 09 00 56 00 69 00  .e.r........V.i.
1528h: 73 00 74 00 61 00 2D 00 52 00 54 00 4D 00 04 41  s.t.a.-.R.T.M..A
1538h: FF FF 42 00 00 00 42 05 00 00 00 00 00 00 A0 2E  ..B...B.........
1548h: 08 00 53 00 65 00 63 00 75 00 72 00 69 00 74 00  ..S.e.c.u.r.i.t.
1558h: 79 00 00 00 1F 00 00 00 06 65 05 00 00 00 00 00  y........e......
1568h: 00 66 4C 06 00 55 00 73 00 65 00 72 00 49 00 44  .fL..U.s.e.r.I.D
1578h: 00 00 00 0E 0C 00 13 03 04 0E 13 00 21 04 00 14  ............!...
1588h: 00 00 00 01 00 04 00 01 00 04 00 02 00 06 00 02  ................
1598h: 00 06 00 02 00 06 00 08 00 15 00 08 00 11 00 00  ................
15A8h: 00 00 00 04 00 08 00 04 00 08 00 08 00 0A 00 01  ................
15B8h: 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
15C8h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 D3  ................
15D8h: 00 21 00 04 00 00 00 9E 10 00 00 00 00 00 00 00  .!..............
15E8h: 00 80 00 00 E4 9F 64 1D 90 C7 01 00 00 00 00 00  ......d.........
15F8h: 00 00 00 42 21 00 00 00 00 00 00 00 0F 01 01 00  ...B!...........
1608h: 0C 01 01 46 D3 EC 12 06 00 00 00 00 00 00 01 46  ...F...........F
1618h: D3 EC 25 02 67 3E B6 39 D7 7B 70 28 1C E9 78 00  ..%.g>.9.{p(..x.
1628h: 00 00 0F 01 01 00 01 FF FF 6C 00 00 00 39 06 00  .........l...9..
1638h: 00 00 00 00 00 44 82 09 00 45 00 76 00 65 00 6E  .....D...E.v.e.n
1648h: 00 74 00 44 00 61 00 74 00 61 00 00 00 02 01 00  .t.D.a.t.a......
1658h: 00 1C 00 00 00 61 06 00 00 00 00 00 00 8A 6F 04  .....a........o.
1668h: 00 44 00 61 00 74 00 61 00 00 00 02 0E 00 00 81  .D.a.t.a........
1678h: 04 01 02 00 20 00 00 00 84 06 00 00 00 00 00 00  .... ...........
1688h: 21 B8 06 00 42 00 69 00 6E 00 61 00 72 00 79 00  !...B.i.n.a.r.y.
1698h: 00 00 02 0E 02 00 0E 04 04 00 03 00 00 00 20 00  .............. .
16A8h: 81 00 04 00 08 00 00 00 00 00 54 00 65 00 73 00  ..........T.e.s.
16B8h: 74 00 20 00 41 00 75 00 74 00 6F 00 42 00 61 00  t. .A.u.t.o.B.a.
16C8h: 63 00 6B 00 75 00 70 00 00 00 00 00 00 00 00 00  c.k.u.p.........
16D8h: 80 A2 76 22                                      ..v"
```

```
16F8h: 0F 01 01 00 0C 01 90 F4 0E 82 26 02 00 00 14 00  ..........&.....
1708h: 00 00 01 00 04 00 01 00 04 00 02 00 06 00 02 00  ................
1718h: 06 00 02 00 06 00 08 00 15 00 08 00 11 00 00 00  ................
1728h: 00 00 04 00 08 00 04 00 08 00 08 00 0A 00 01 00  ................
1738h: 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ................
1748h: 00 00 00 00 00 00 00 00 00 00 00 00 00 00 43 00  ..............C.
1758h: 21 00 04 00 00 00 9F 10 00 00 00 00 00 00 00 00  !...............
1768h: 80 00 00 E4 9F 64 1D 90 C7 01 00 00 00 00 00 00  .....d..........
1778h: 00 00 43 21 00 00 00 00 00 00 00 0F 01 01 00 0C  ..C!............
1788h: 01 01 46 D3 EC 12 06 00 00 03 00 00 00 20 00 81  ..F.......... ..
1798h: 00 04 00 08 00 00 00 00 00 54 00 65 00 73 00 74  .........T.e.s.t
17A8h: 00 20 00 41 00 75 00 74 00 6F 00 42 00 61 00 63  . .A.u.t.o.B.a.c
17B8h: 00 6B 00 75 00 70 00 00 00 00 00 00 00 00 00 03  .k.u.p..........
17C8h: 00 17 00 00                                      ....
```

binary XML structure

substitution array

Binary XML.
Summary.

- 3-step process
  - tokenization
  - substitution
  - templates
- results in compact binary XML

Forensic Practice.
Carving – Whole File.

- header with magic string „ElfFile“
- no footer
- file size = 4 kiB + chunks * 64 kiB
- use evtxdump.pl or system service to transform the carved (binary) file into text

Forensic Practice.
Carving – Single Chunk.

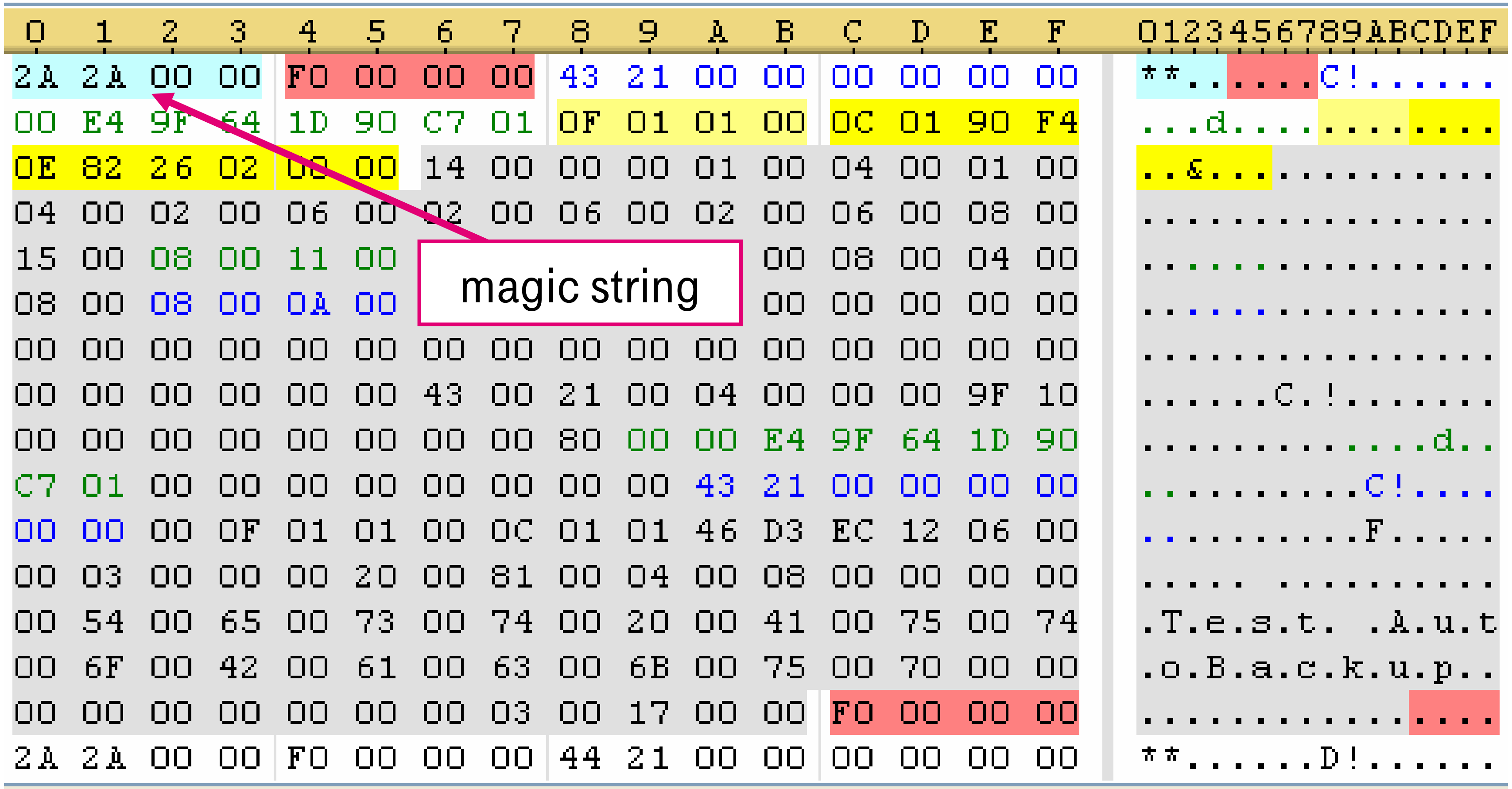
- header with magic string „ElfChunk“
- no footer
- size = 64 kiB
- use evtxdump.pl to transform into text

Forensic Practice.
Carving – Single Record.

- header with magic string 0x2a 0x2a 0x00 0x00
- no fixed footer
- size is variable, but known

Forensic Practice.

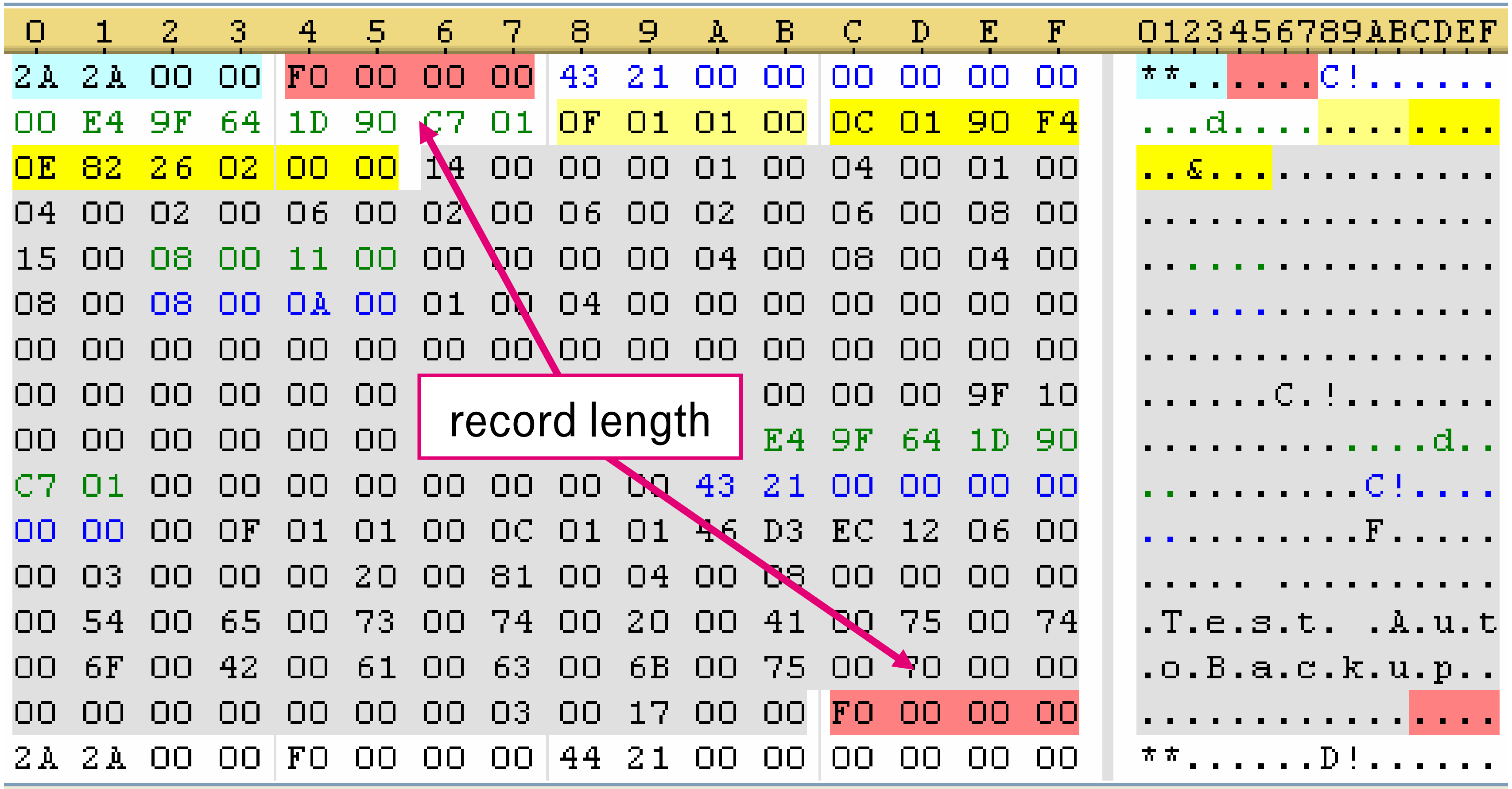
Interpretation of a Single Record.



```
0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F    0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00                00 08 00 04 00   ................
08 00 08 00 0A 00                00 00 00 00 00   ................
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 43 00 21 00 04 00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00 00 00 80 00 00 E4 9F 64 1D 90   .............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

magic string

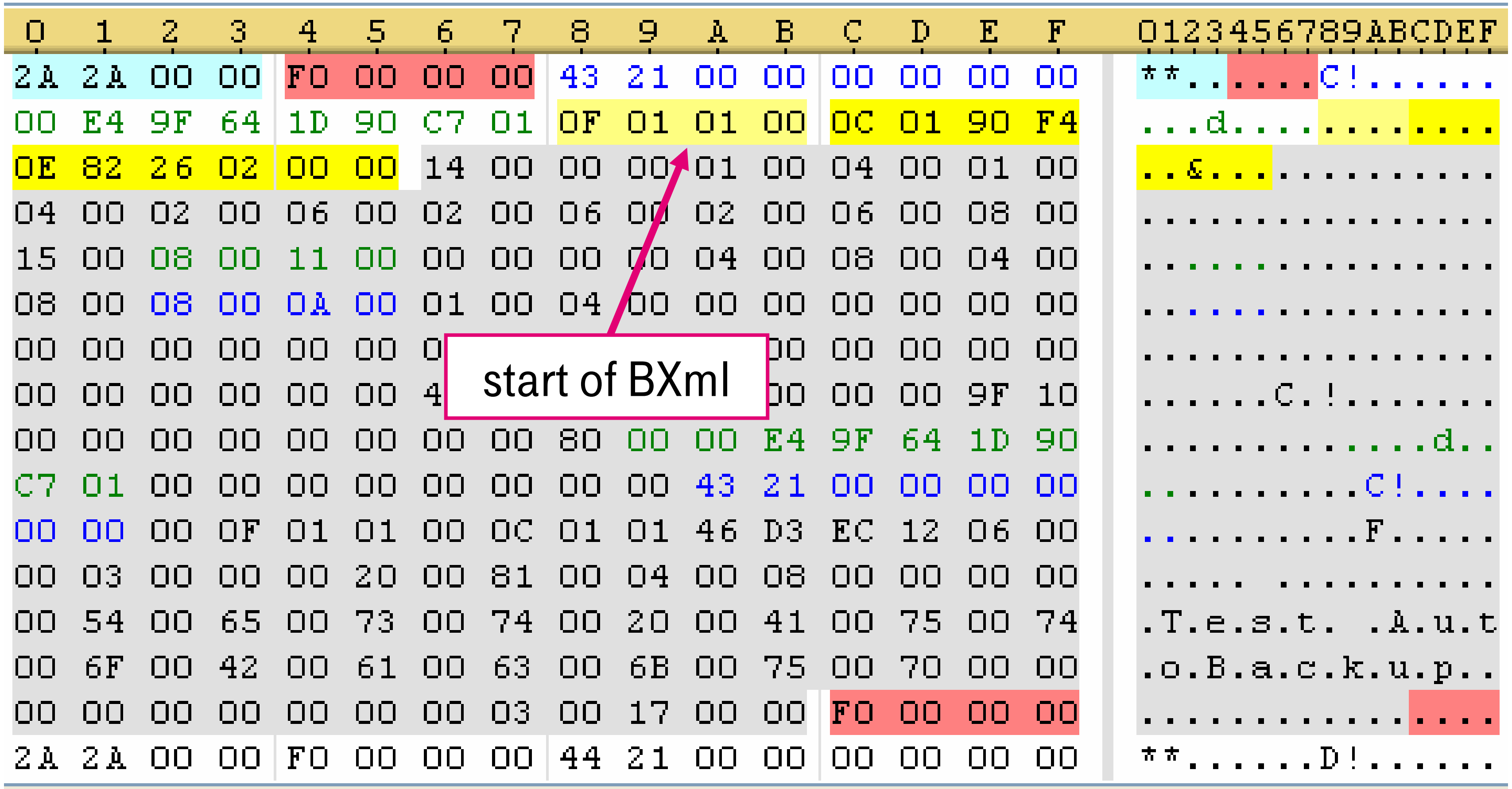
Forensic Practice.
Interpretation of a Single Record.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00   ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
00 00 00 00 00 00                00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00                E4 9F 64 1D 90   .............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

record length

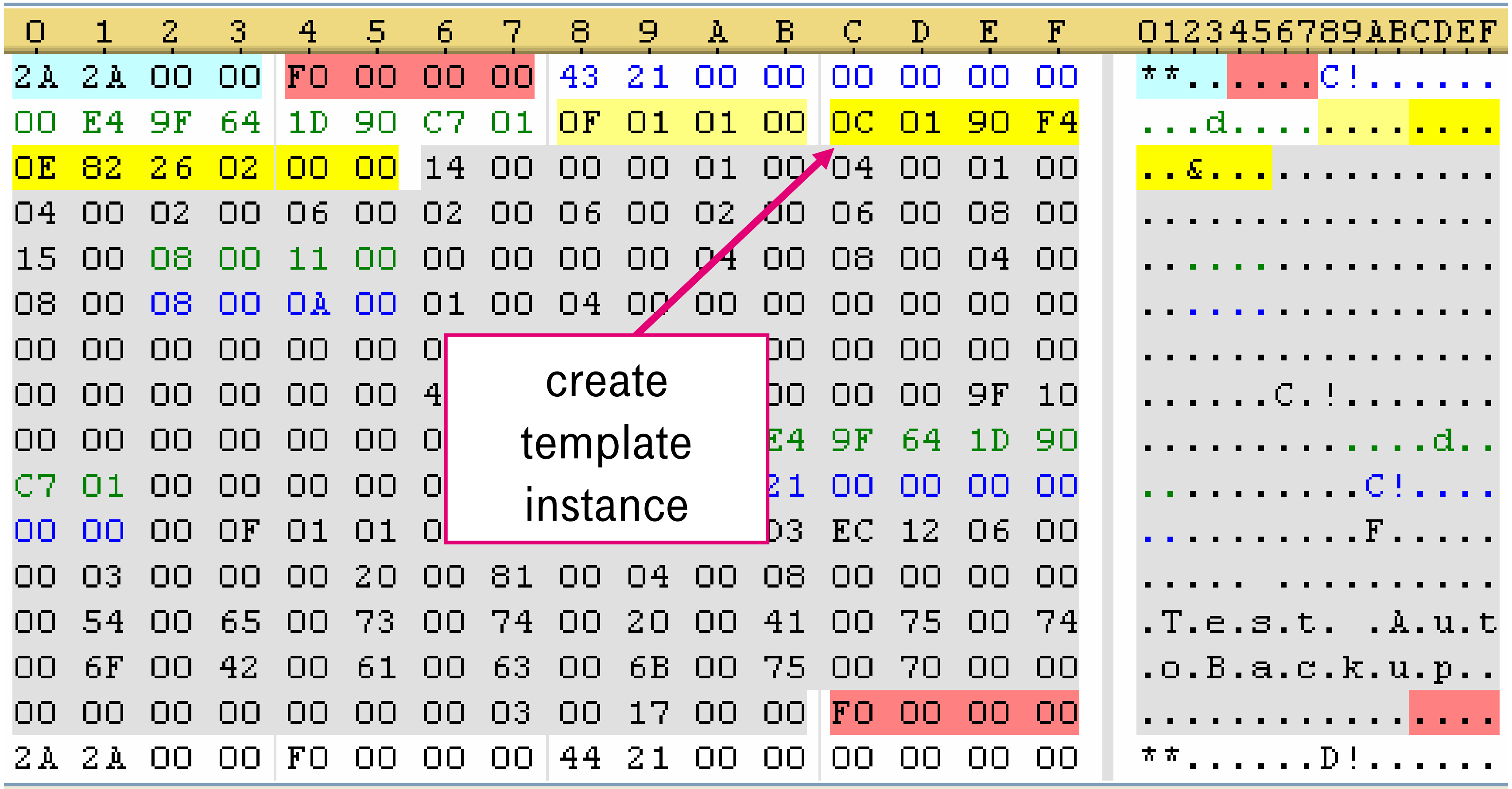
Forensic Practice.
Interpretation of a Single Record.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00   ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 0                00 00 00 00 00   ................
00 00 00 00 00 00 4                00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00 00 00 80 00 00 E4 9F 64 1D 90   .............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

start of BXml

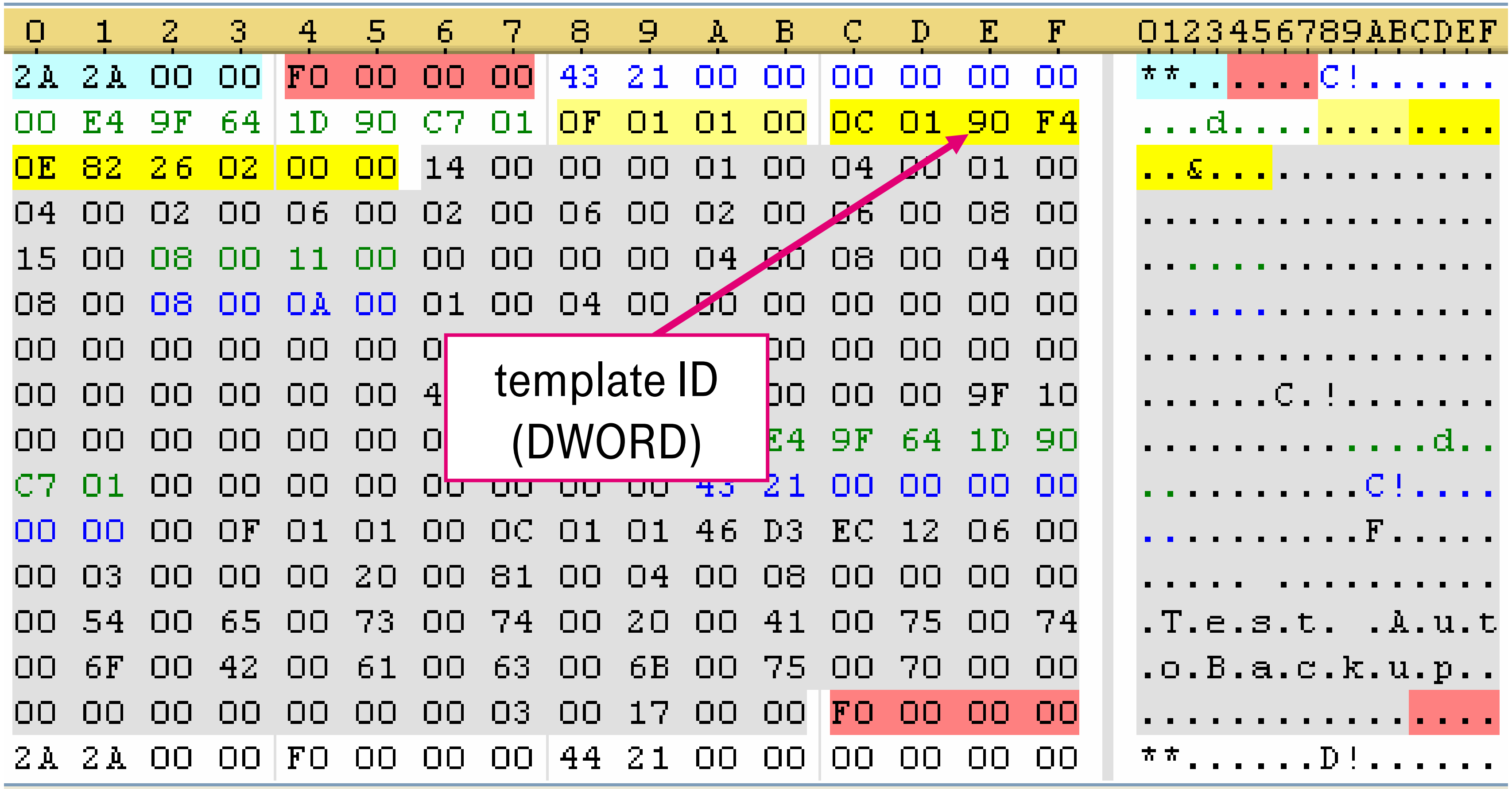
Forensic Practice.
Interpretation of a Single Record.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00   ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 0             00 00 00 00 00   ................
00 00 00 00 00 00 4             00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00 0             E4 9F 64 1D 90   .............d..
C7 01 00 00 00 00 0             21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 0             03 EC 12 06 00   ...........F....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

create template instance

Forensic Practice.
Interpretation of a Single Record.

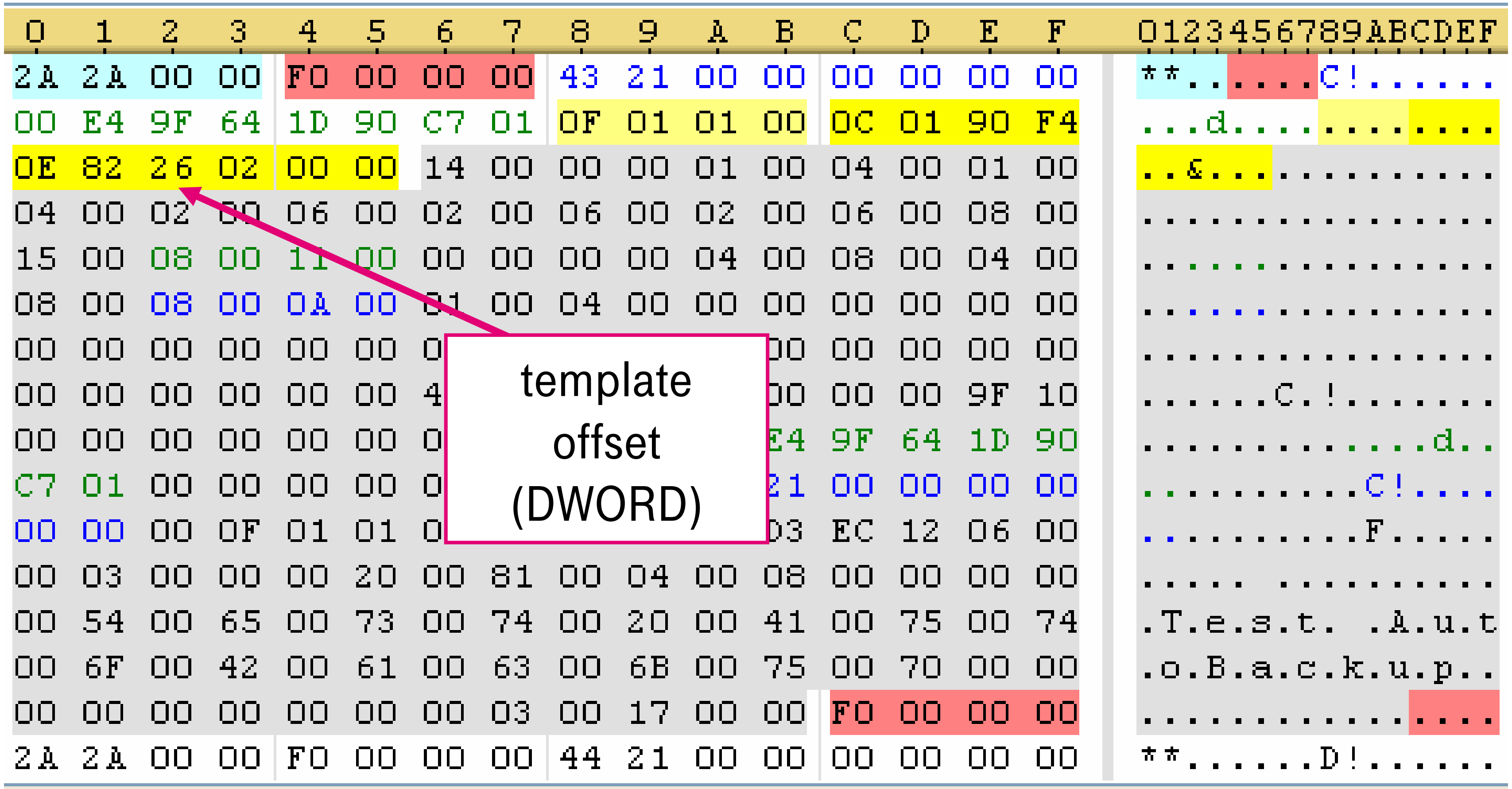


```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00   ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 0              00 00 00 00 00   ................
00 00 00 00 00 00 4              00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00 0              E4 9F 64 1D 90   ..............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

template ID (DWORD)

Forensic Practice.

Interpretation of a Single Record.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00   ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 0             00 00 00 00 00   ................
00 00 00 00 00 00 4             00 00 00 9F 10   ......C.!.......
00 00 00 00 00 00 0             E4 9F 64 1D 90   ..............d..
C7 01 00 00 00 00 0             21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 0             D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

template offset (DWORD)

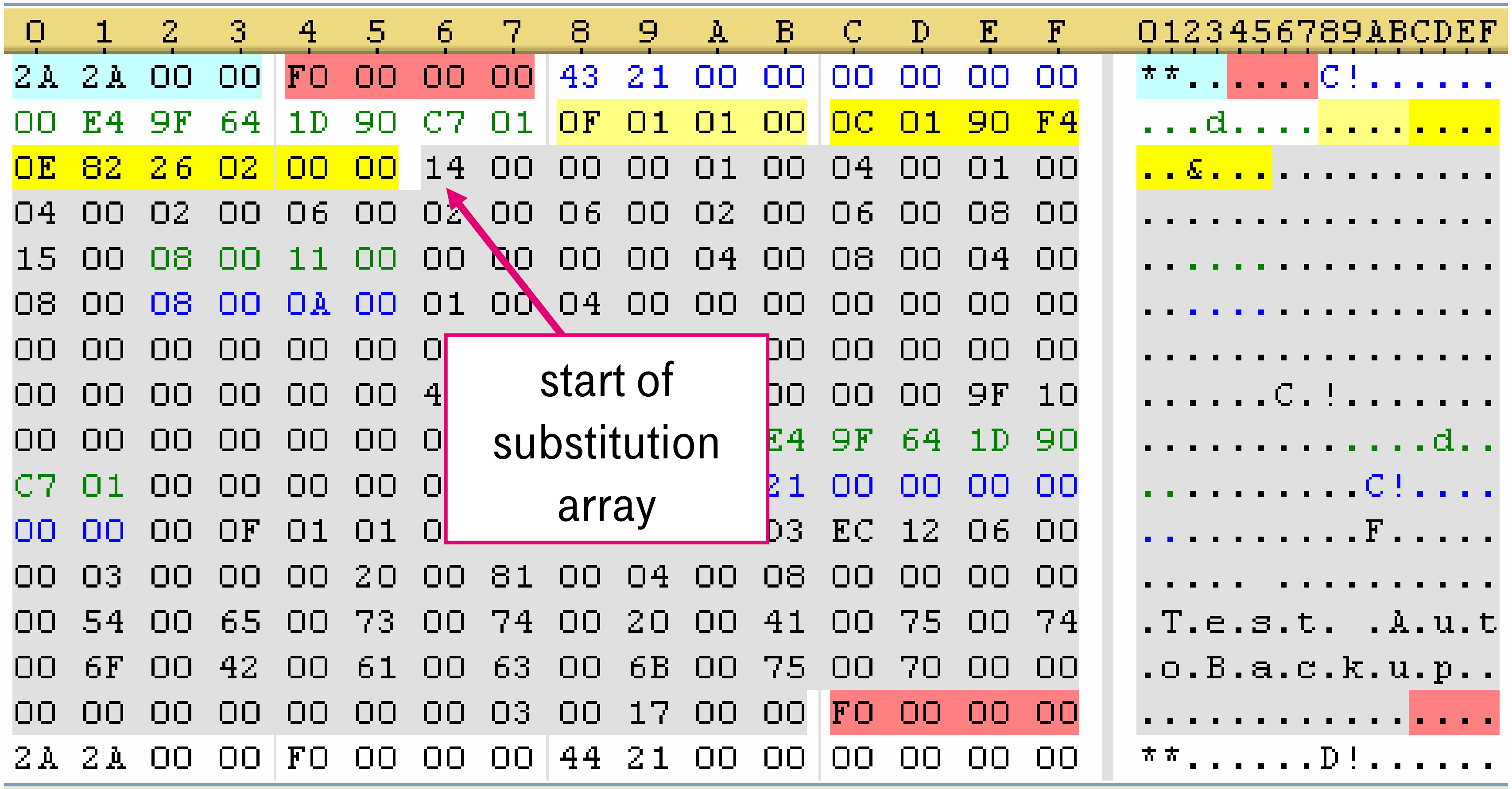
Forensic Practice.
Interpretation of a Single Record.

- Problem: XML template requested, but not available
- XML schema: „System“ is a mandatory element
- observation: static mapping between element/attribute and index into substitution array
- use evtxtemplates.pl to view:

```
<Event xmlns="...">
  <System>
    <EventID Qualifiers="#4 (type 6, optional)#">
      #3 (type 6, optional)#
    </EventID>
```

Forensic Practice.

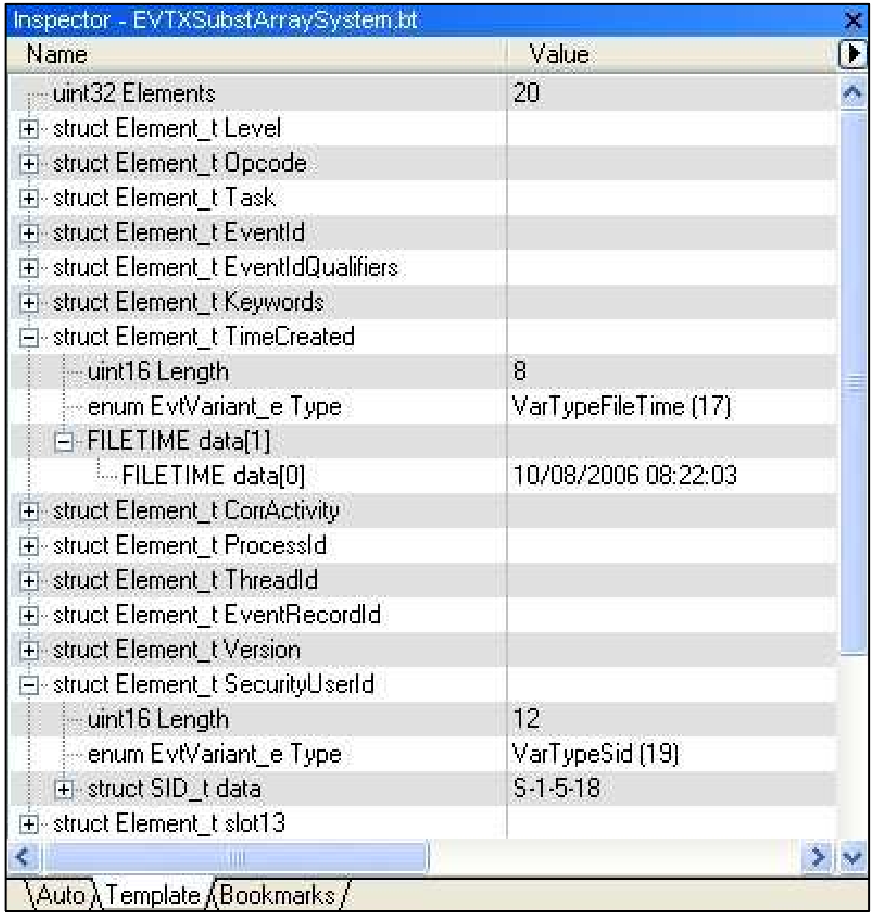
Interpretation of a Single Record – Locate SubstitutionArray.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F    0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00    **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4    ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00    ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00    ................
15 00 08 00 11 00 00 00 00 00 04 00 08 00 04 00    ................
08 00 08 00 0A 00 01 00 04 00 00 00 00 00 00 00    ................
00 00 00 00 00 00 0                00 00 00 00 00    ................
00 00 00 00 00 00 4                00 00 00 9F 10    ......C.!.......
00 00 00 00 00 00 0                E4 9F 64 1D 90    ..............d.
C7 01 00 00 00 00 0                21 00 00 00 00    ..........C!....
00 00 00 0F 01 01 0                03 EC 12 06 00    ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00    ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74    .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00    .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00    ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00    **......D!......
```

start of substitution array

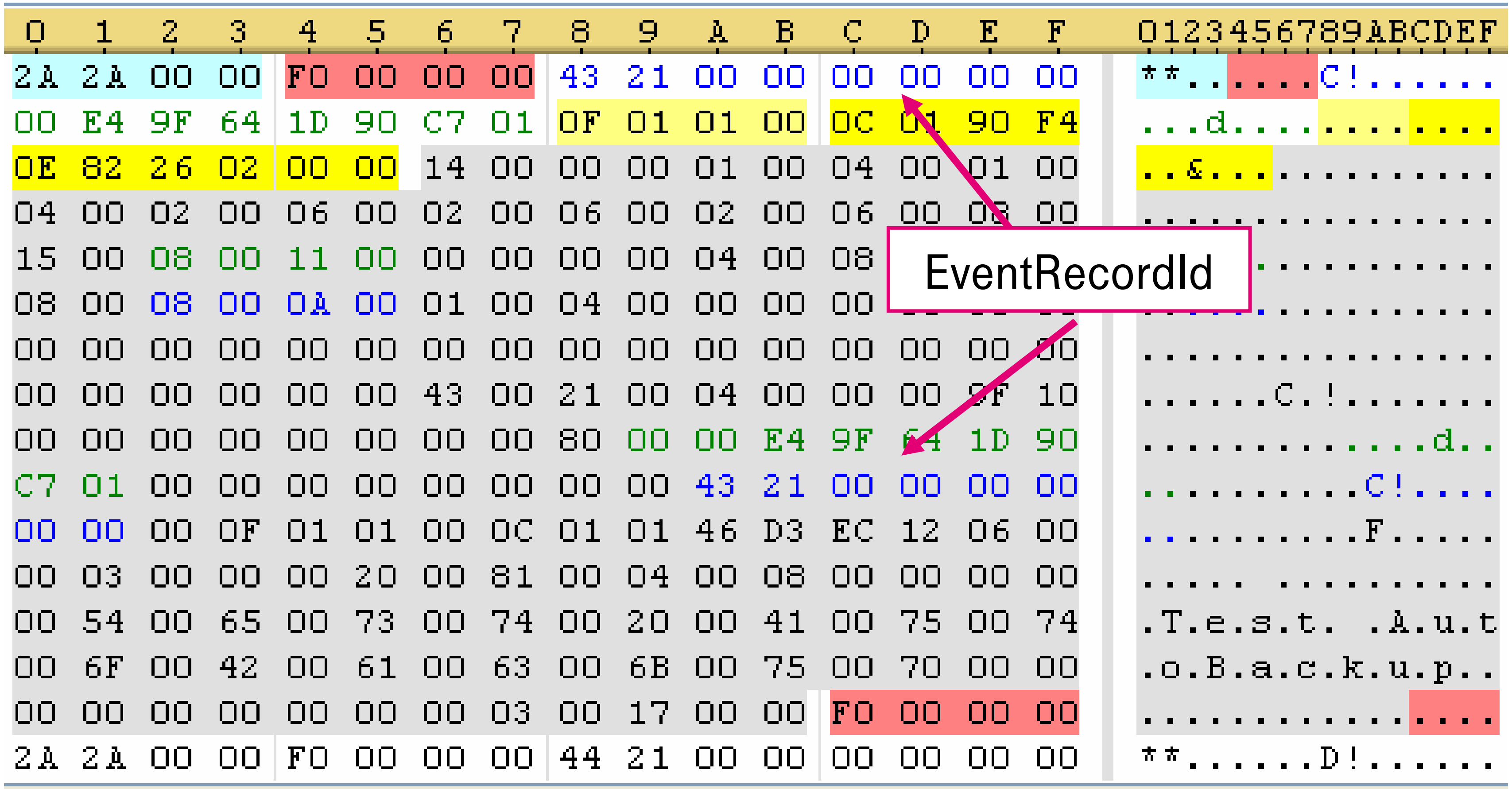
Forensic Practice.
Interpretation of a Single Record.



Inspector - EVTXSubstArraySystem.bt

Name	Value
uint32 Elements	20
struct Element_t Level	
struct Element_t Opcode	
struct Element_t Task	
struct Element_t EventId	
struct Element_t EventIdQualifiers	
struct Element_t Keywords	
struct Element_t TimeCreated	
uint16 Length	8
enum EvtVariant_e Type	VarTypeFileTime (17)
FILETIME data[1]	
FILETIME data[0]	10/08/2006 08:22:03
struct Element_t CorrActivity	
struct Element_t ProcessId	
struct Element_t ThreadId	
struct Element_t EventRecordId	
struct Element_t Version	
struct Element_t SecurityUserId	
uint16 Length	12
enum EvtVariant_e Type	VarTypeSid (19)
struct SID_t data	S-1-5-18
struct Element_t slot13	

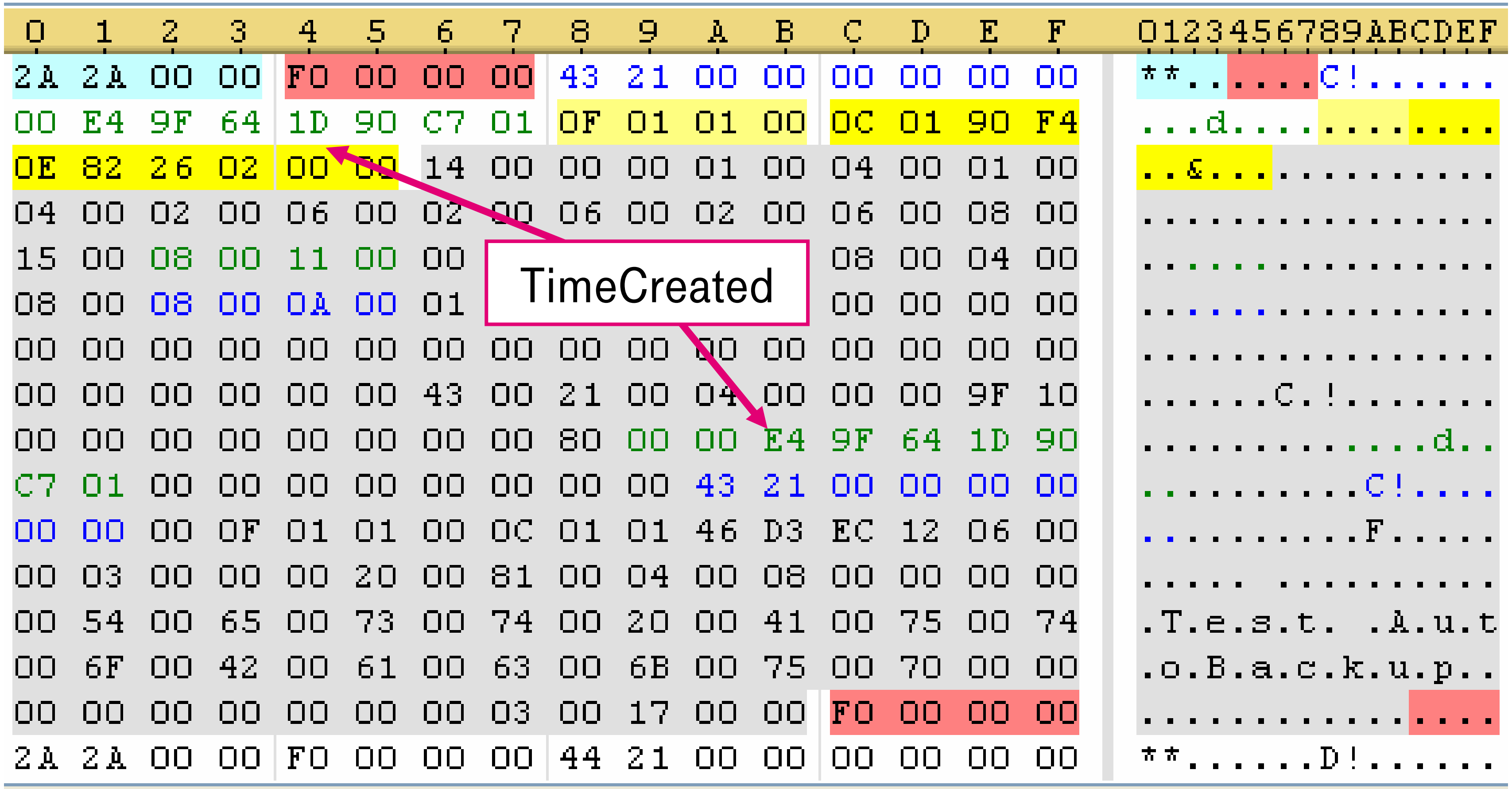
Forensic Practice.
Interpretation of a Single Record - Validation.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00   **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00   ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00   ................
15 00 08 00 11 00 00 00 00 00 04 00 08                 ..........
08 00 08 00 0A 00 01 00 04 00 00 00 00                 ..........
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00   ................
00 00 00 00 00 00 43 00 21 00 04 00 00 00 0F 10   ......C.!.......
00 00 00 00 00 00 00 00 80 00 00 E4 9F 64 1D 90   .............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00   ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00   ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00   ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74   .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00   .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00   ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00   **......D!......
```

EventRecordId

Forensic Practice.
Interpretation of a Single Record - Validation.



```
0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 F0 00 00 00 43 21 00 00 00 00 00 00  **......C!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4  ...d............
0E 82 26 02 00 00 14 00 00 00 01 00 04 00 01 00  ..&.............
04 00 02 00 06 00 02 00 06 00 02 00 06 00 08 00  ................
15 00 08 00 11 00 00                08 00 04 00  ................
08 00 08 00 0A 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 00 00 00 43 00 21 00 04 00 00 00 9F 10  ......C.!.......
00 00 00 00 00 00 00 00 80 00 00 E4 9F 64 1D 90  .............d..
C7 01 00 00 00 00 00 00 00 00 43 21 00 00 00 00  ..........C!....
00 00 00 0F 01 01 00 0C 01 01 46 D3 EC 12 06 00  ..........F.....
00 03 00 00 00 20 00 81 00 04 00 08 00 00 00 00  ..... ..........
00 54 00 65 00 73 00 74 00 20 00 41 00 75 00 74  .T.e.s.t. .A.u.t
00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00 00  .o.B.a.c.k.u.p..
00 00 00 00 00 00 00 03 00 17 00 00 F0 00 00 00  ................
2A 2A 00 00 F0 00 00 00 44 21 00 00 00 00 00 00  **......D!......
```

TimeCreated

Forensic Practice.
Interpretation of a Single Record.

Recovered data:

- EventID
- Keywords
- TimeCreated
- ProcessID
- ThreadID
- User SID
- Level, Task, Opcode
- Version

Lost data:

- XML namespace
- provider (data source)
- channel
- computer name

Conclusion.
Improvements.

- low memory load, only 68 kiB per log
  - the old service keeps the whole file in memory
- rich set of data types (strings, numbers, special types)
  - the old service only supports strings and binary
- XPath queries

- It’s less likely that administrators turn logging off.
- It’s more likely that programmers instrument their code for logging.

Conclusion.
Parsers.

- Vista Event Viewer Applet by Microsoft for uncorrupted files.
- EvtxParser
  - platform-independent (Perl)
  - works on corrupted files
  - some data types are missing
  - some system tokens are missing
    CDATA, PI, EntityRef?

Questions?

Thank You for Your Attention.

cum sapientia protegimus

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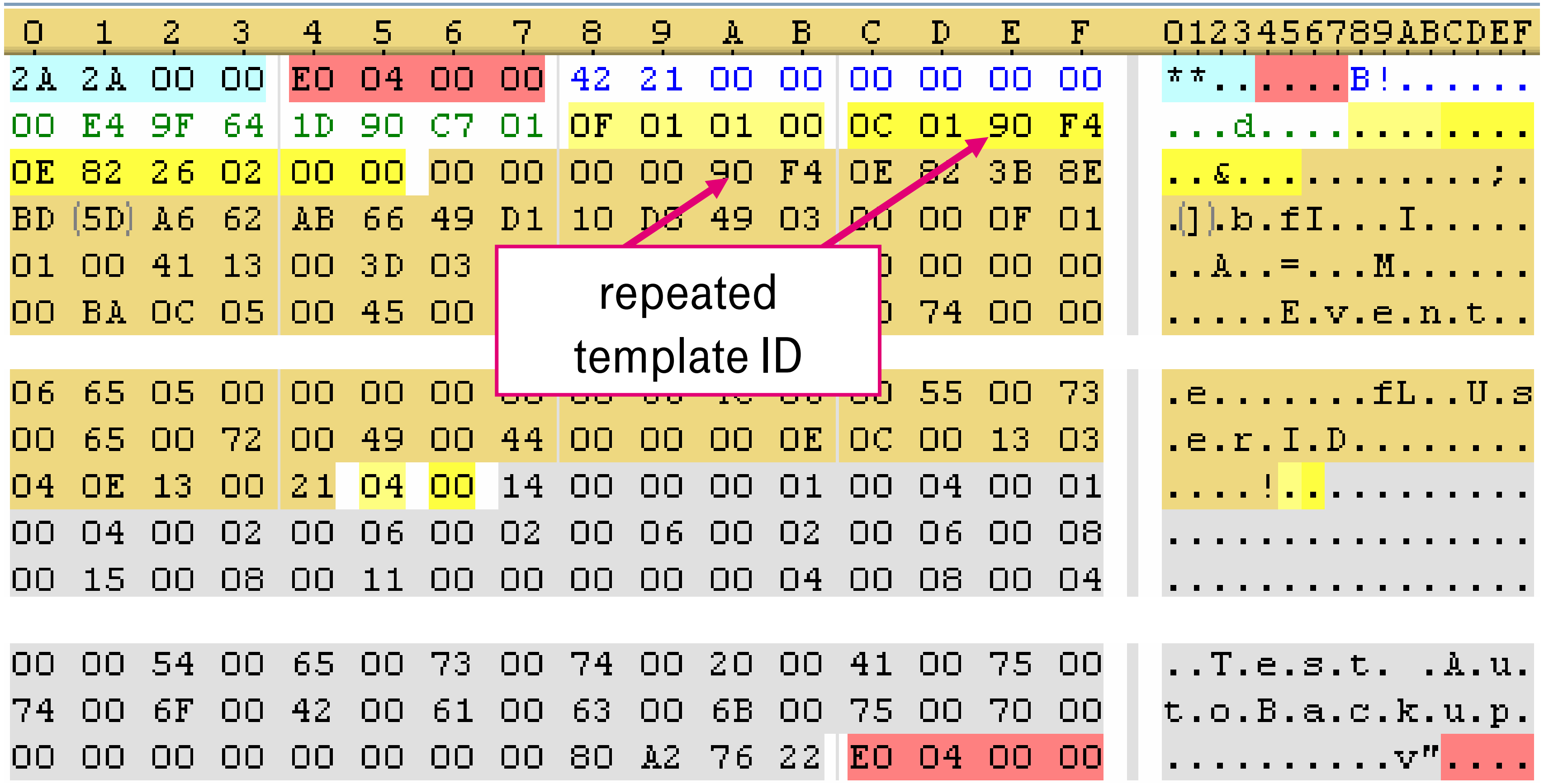
Forensic Practice.

Interpretation of a Single Record – Locate SubstitutionArray.



```
 0  1  2  3  4  5  6  7  8  9  A  B  C  D  E  F   0123456789ABCDEF
2A 2A 00 00 E0 04 00 00 42 21 00 00 00 00 00 00   **......B!......
00 E4 9F 64 1D 90 C7 01 0F 01 01 00 0C 01 90 F4   ...d............
0E 82 26 02 00 00 00 00 00 00 90 F4 0E 82 3B 8E   ..&...........;.
BD (5D) A6 62 AB 66 49 D1 10 D8 49 03 00 00 0F 01  .[].b.fI...I.....
01 00 41 13 00 3D 03                      00 00 00  ..A..=...M.......
00 BA 0C 05 00 45 00                      74 00 00  ......E.v.e.n.t..

06 65 05 00 00 00 00                      55 00 73  .e.......fL..U.s
00 65 00 72 00 49 00 44 00 00 00 0E 0C 00 13 03   .e.r.I.D........
04 0E 13 00 21 04 00 14 00 00 00 01 00 04 00 01   .....!..........
00 04 00 02 00 06 00 02 00 06 00 02 00 06 00 08   ................
00 15 00 08 00 11 00 00 00 00 00 04 00 08 00 04   ................

00 00 54 00 65 00 73 00 74 00 20 00 41 00 75 00   ..T.e.s.t. .A.u.
74 00 6F 00 42 00 61 00 63 00 6B 00 75 00 70 00   t.o.B.a.c.k.u.p.
00 00 00 00 00 00 00 00 80 A2 76 22 E0 04 00 00   ..........v"....
```

repeated template ID