

BISSAM

Automatic Vulnerability Identification of Office Documents

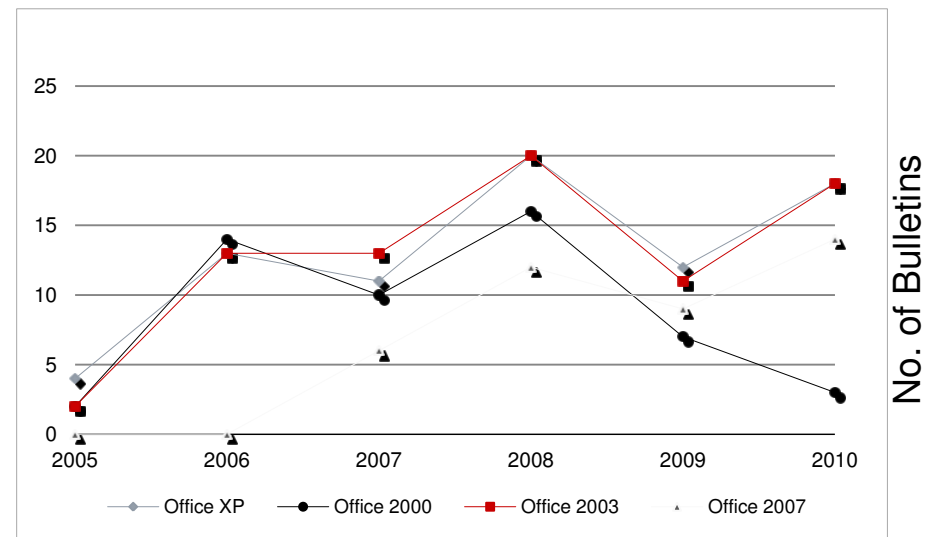
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Siemens CERT

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Motivation

- Malware increasingly focuses on client applications
 - Security in Operating Systems is improving
 - Circumventing perimeter security controls
 - Microsoft Office documents are widely used

- Complex file formats lead to vulnerabilities

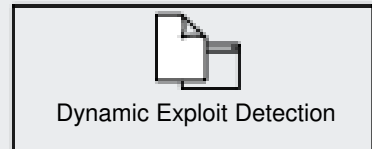


Source: Microsoft TechNet

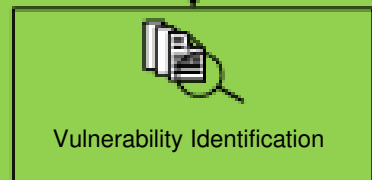
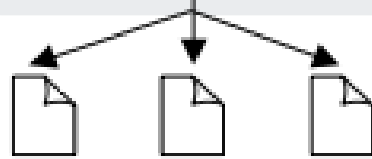
Motivation

- During malware-related incidents, the following questions are necessary to answer
 - Is the document malicious at all?
 - Is it exploiting a 0-day or a known vulnerability?
 - If known, which vulnerability is actually using?
 - Which update remediates this security flaw?
- Today's analysis tools either use manually created vulnerability signatures or concentrate on malware behavior

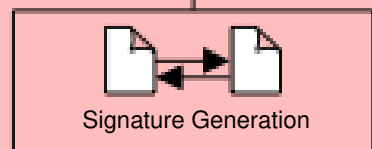
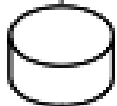
System Overview



- Multiple Sandboxes
- Running different Microsoft Office Versions
- Detection of “Forbidden Behavior”

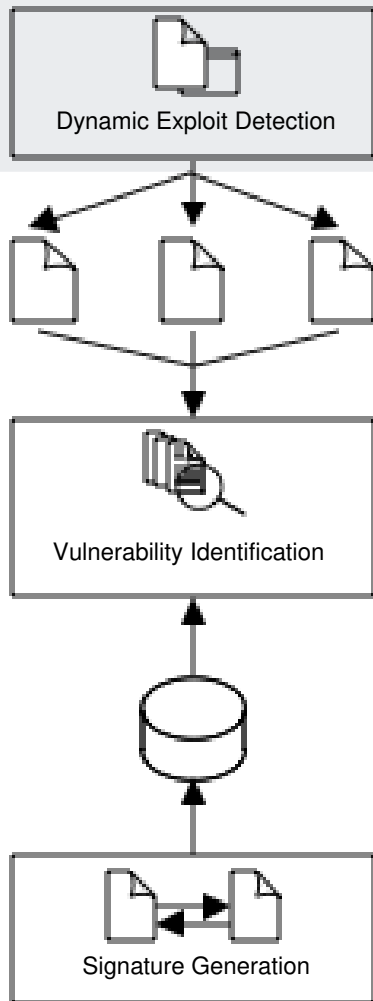


- Analysis of “Detection Logs“
- Mapping of “Forbidden Behavior” to Security Patches



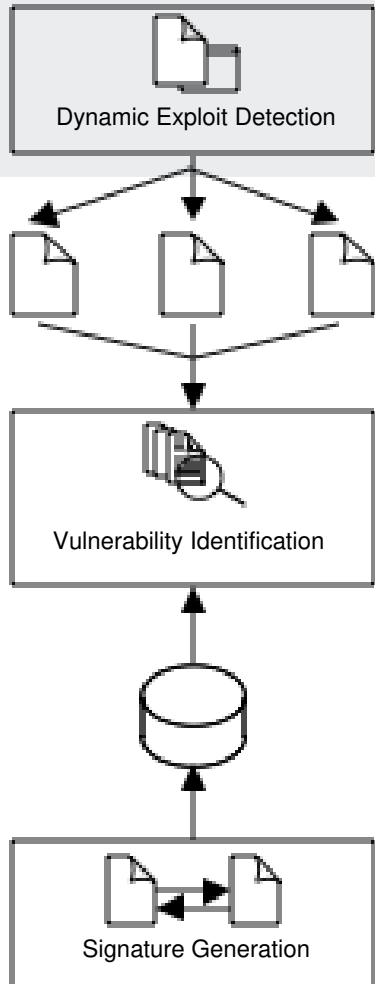
- Signatures automatically generated from Security Patches

System Overview – Automatic Exploit Detection

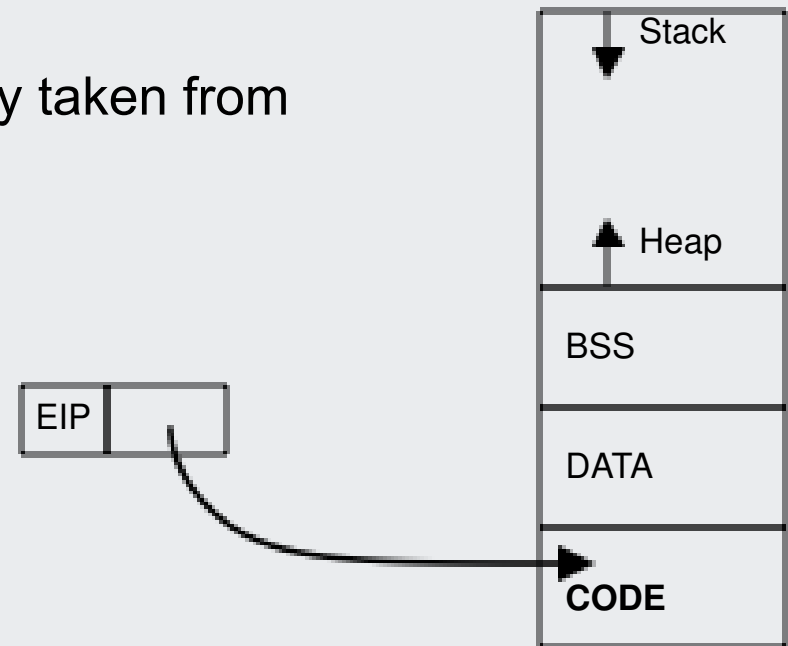


- Document is executed in several sandboxes, currently:
 - Office 2003, SP1, SP2, SP3
 - Office 2007, SP1, SP2
- Documents are deployed to each machine
- The execution of the application is monitored and logged by BISSAM using PIN

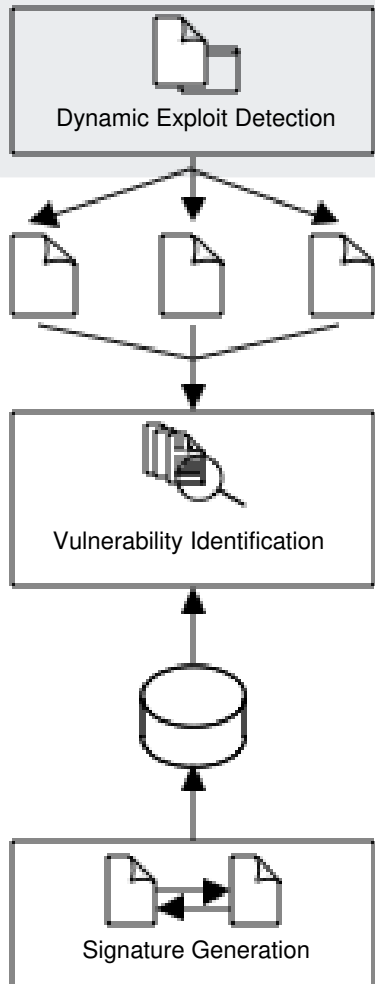
System Overview – Automatic Exploit Detection



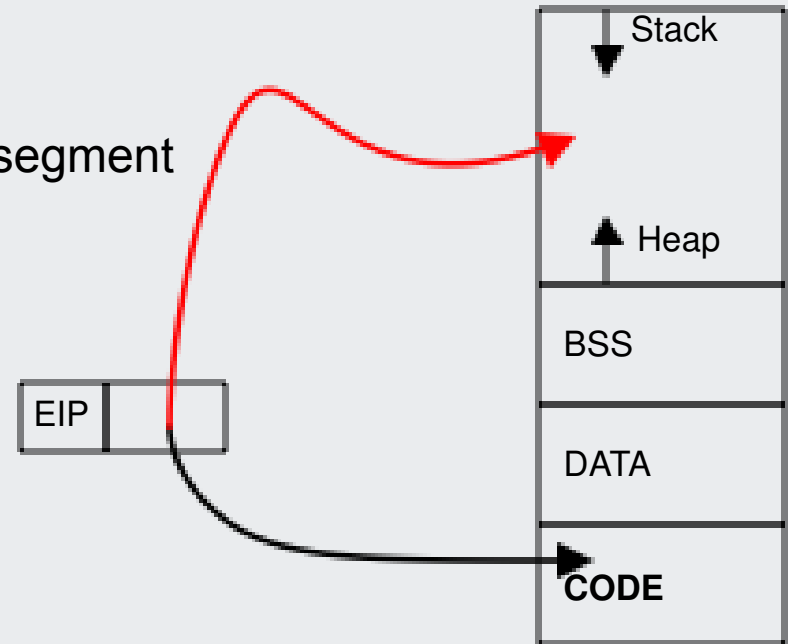
- Exploits can be detected by monitoring the instruction pointer (EIP)
- The EIP holds the address of the next instruction
- Instructions are usually taken from the CODE segment



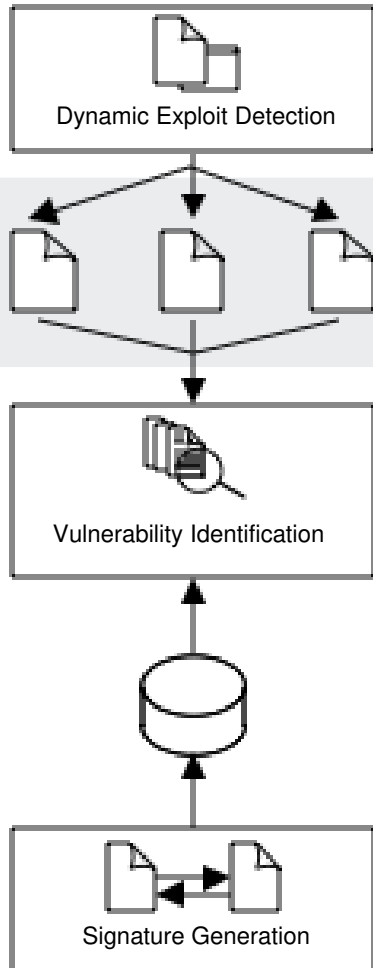
System Overview – Automatic Exploit Detection



- Attackers force the EIP to execute instructions from other segments
- BISSAM detects this by monitoring each instruction
- If the EIP leaves a legal segment BISSAM generates the necessary log files



System Overview – Automatic Exploit Detection



Trace.log

```

...msvcrt.dll:2009363160,msvcrt.dll:2009363171,msvcrt.dll:2009363173,msvcrt.dll:200936348
4,WINWORD.EXE:805331138,WINWORD.EXE:805574942,WINWORD.EXE:810004582,WIN
WORD.EXE:812760928,WINWORD.EXE:812760939,WINWORD.EXE:812760978,WINWOR
D.EXE:812760988,WINWORD.EXE:810004592,mso.dll:818672096,mso.dll:818672122,mso.
dll:818672141...
  
```

Shellcode.log

```

...
0: 0x044986E1:: 90          :nop
0: 0x044986E2:: 90          :nop
0: 0x044986E3:: 90          :nop
0: 0x044986E4:: db df      :fcmovnu st0, st7
0: 0x044986E6:: d9 74 24 f4 :fnstenv ptr [esp-0xc]
...
  
```

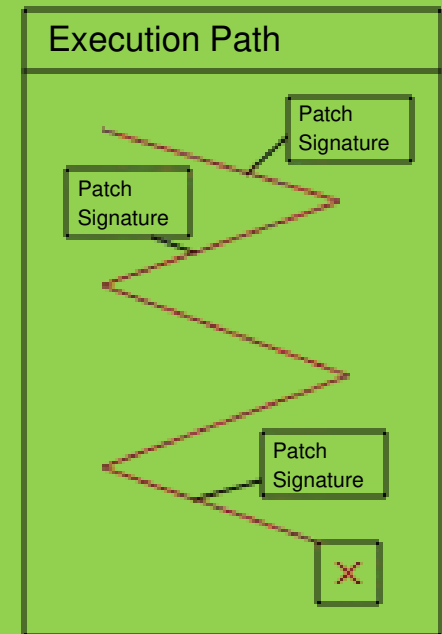
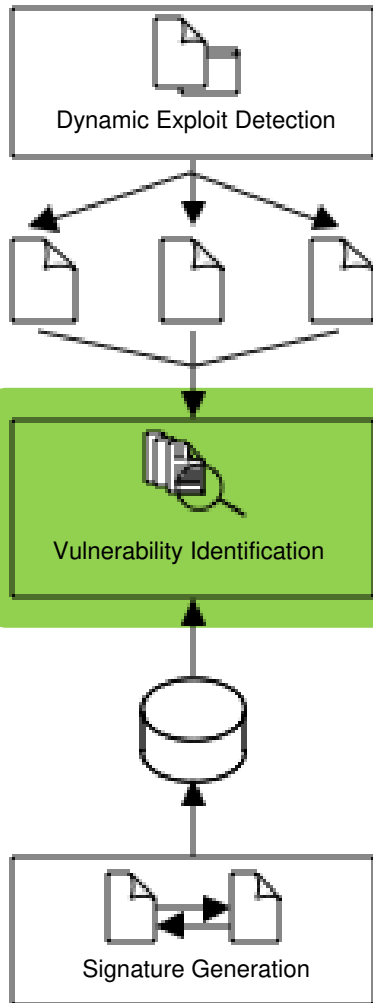
Instructions.log

```

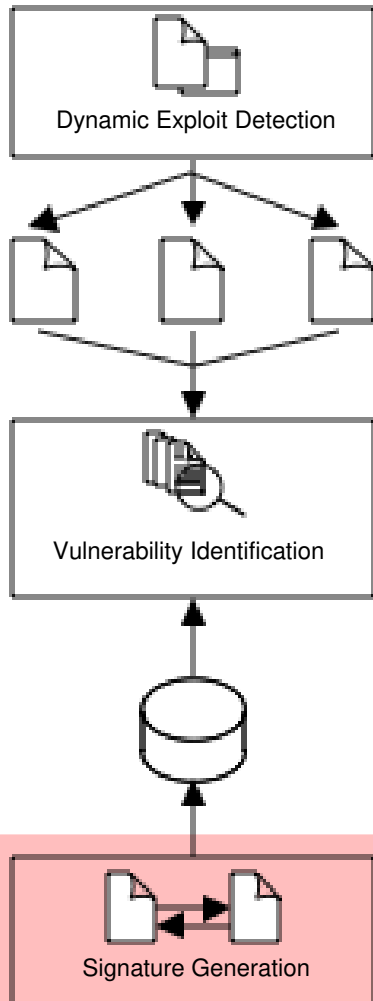
...
0: 0x30003136::WINWORD.EXE 0f 85 8f 93 a6 00 :jnz 0x30a6c4cb
0: 0x3000313C::WINWORD.EXE c3          :ret
0: 0x3016D46E::WINWORD.EXE 5f          :pop edi
0: 0x3016D46F::WINWORD.EXE 5e          :pop esi
0: 0x3016D470::WINWORD.EXE c9          :leave
0: 0x3016D471::WINWORD.EXE c2 28 00     :ret 0x28
  
```


System Overview – Vulnerability Identification

- Uses the logs from the dynamic exploit detection
- The patch is found by matching the execution path to the signatures
- A patch may remediate multiple vulnerabilities



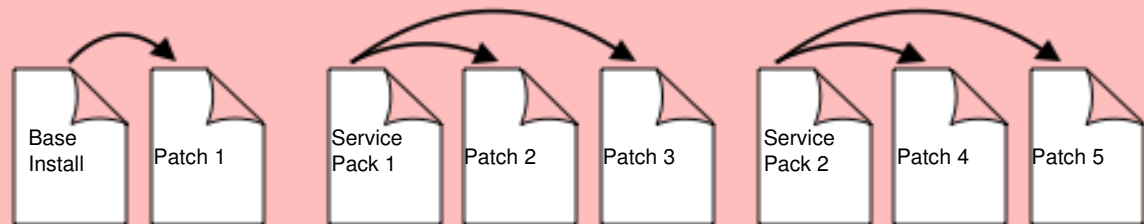
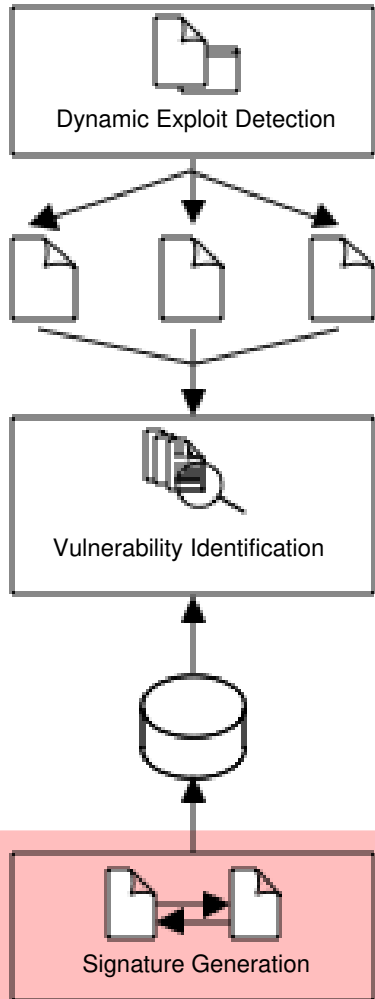
System Overview – Signature Generation



- Signatures must be generated automatically
- Signatures are generated by creating the binary difference between two security patches
- One patch is identified by multiple signatures
- One signature is a changed code block by the patch

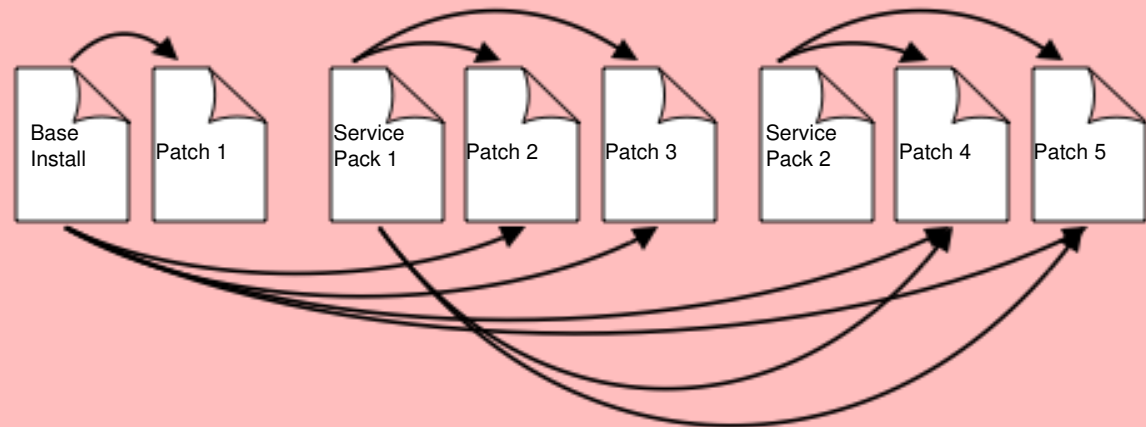
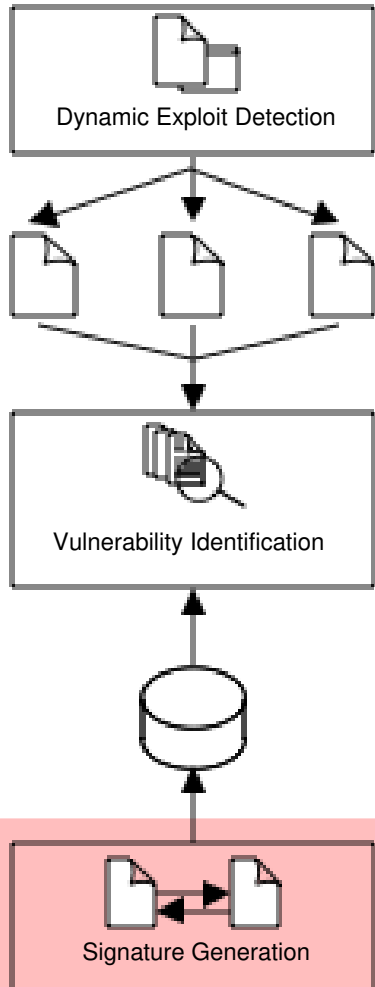
System Overview – Signature Generation

- The implementation uses vendor’s security patches (full-file patches)
- The signatures are created by binary comparing each file in the patch to the same file in the base installation



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Evaluation

- For the evaluation 7 documents were analyzed in depth
- Currently around 300 documents were analyzed

Document	Correct Patch	BISSAM	OfficeCat	OffVis
<i>CVE 2006 0022.ppt</i>	<i>MS06-028</i>	<i>MS06-028, MS06-058</i>	x	✓
<i>CVE 2006 2492.doc</i>	<i>MS06-027</i>	x	x	x
<i>CVE 2009 0556.ppt</i>	<i>MS09-017</i>	<i>MS09-017, MS10-004</i>	x	x
<i>CVE 2009 0563.doc</i>	<i>MS09-027</i>	<i>MS09-027, MS09-068 MS10-036</i>	x	x
<i>CVE 2009 1129.ppt</i>	<i>MS09-017</i>	<i>MS08-051, MS09-017</i>	x	x
<i>CVE 2009 3129.xls</i>	<i>MS09-067</i>	<i>MS09-067, MS09-021</i>	x	x
<i>CVE 2010 3333msf.doc</i>	<i>MS10-087</i>	<i>MS07-015, MS10-087</i>	x	x

Limitations & Future Work

- Improve the detection of malicious behavior
- Improve the security rating of binary changes
- Execution path log size affects the identification rate

Conclusion

- System was developed to
 - detect malicious documents
 - identify the vulnerability
- Evaluation showed that the system improves the Analysis compared to today's tools
- Saves a lot of analysis time
- Adaptable to other Applications
- Currently in productive use at Siemens CERT

Some Numbers

There are currently

- **519** Bulletins

mapped to

- **1069** CVE Numbers

for

- **2821** downloaded patches

that create a total set of

- **21.933.889** Signatures in the Database

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