BTI 7261: Threat Landscape

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Cyber attacks and actors

Software vulnerabilities

Part I: Cyber Attacks and Actors

Attacker origins

- Insider
- Ex-insider (“disgruntled former employee”)
- Competitor
- Hacktivist
- Criminal
- State actor
- *Researcher*

Attacker objectives

- Fame
- Stealing information (business secrets, credentials)
- Modifying information (e.g. bank transactions)
- Abusing infected systems (e.g. spamming)
- Attacking other systems (origin obfuscation)
- Hiding (avoid detection, achieve long-term persistence)
- Contact command and control (C2) for instructions

Vulnerability origins

- Hardware (host, network)
- Software (host, network)
- Humans
- Environment

Attack strategies

- Large scale attack: attack a large, untargeted population. Even if the success rate is low, the absolute number of infections and the resulting revenue can be high. (“cyber crime”)
- Targeted attack: attack a few, selected users or their machines. Select high-value target first, then learn about it as much as possible for a precision strike (“Advanced persistent threat”)

Defense strategies

- Access control (physical, logical)
- Deterrance (legal, counter-attacks, auditing, accounting)
- Redundancy
- Obfuscation
- Comprehension (simplification, transparency, education)
- Monkey wrench / havoc
- Defense-in-depth

Part II: Software vulnerabilities

Technical vulnerabilities

There are many types of technical vulnerabilities in various parts of an IT system:

- Misconfigured firewalls
- Hardware bugs
- Automatically executed software from CD/USB stick on old W32 systems
- etc.

The probabily most important class of technical vulnerabilities are software bugs.

Typical bugs

Software is often used to display data obtained over the network:

1. User downloads file (PDF, MP4, etc.)
2. User selects software to open file
3. Software parses file
4. Bug ⇒ malicious code execution

Common bugs include problems in the parsing or rendering logic, or scripting functionality supported by the document format in combination with an interpreter that is insufficiently sandboxed.

Data and code

The central goal for an attack is to turn data into code. Memory of a process contains data and code! Thus:

- Existing code may interpret the data (intentionally or unintentionally), thereby allowing certain code sequences to be executed.
- Existing code may be caused to jump to the data (once data page is set to executable).
- Execution may be passed to another program (shell, interpreter) that will parse and run it.

Example exploit: SQL injection

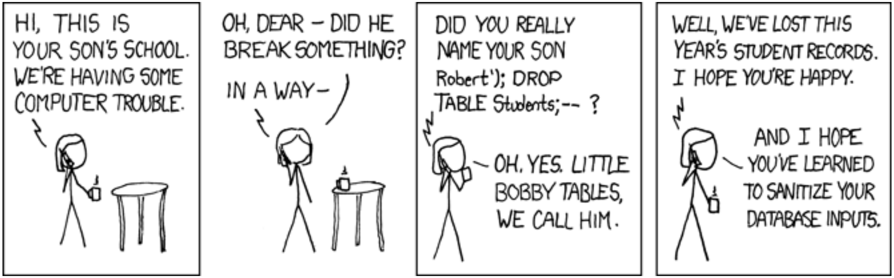
In a PHP script, hopefully far, far away:

```
SELECT (user, first_name, last_name)
FROM students
WHERE (user == ’$user’);
```

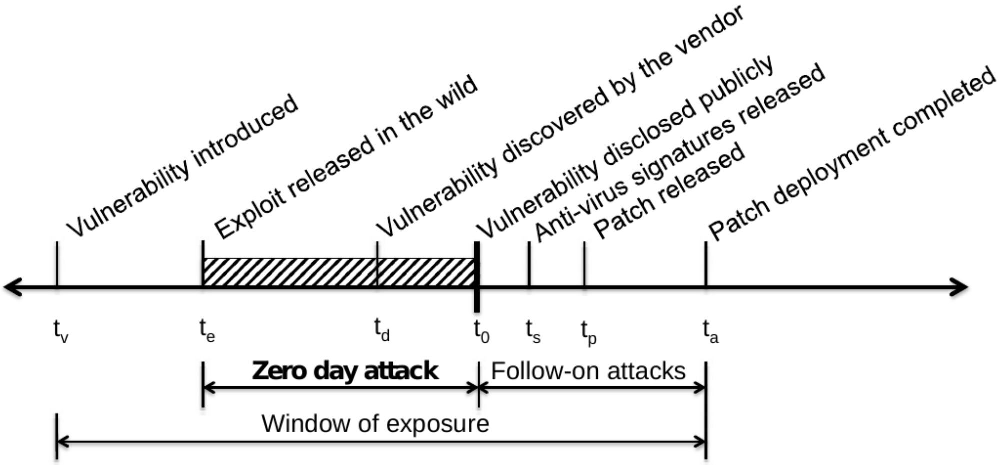
Input:

```
Robert’); DROP TABLE students;--
```

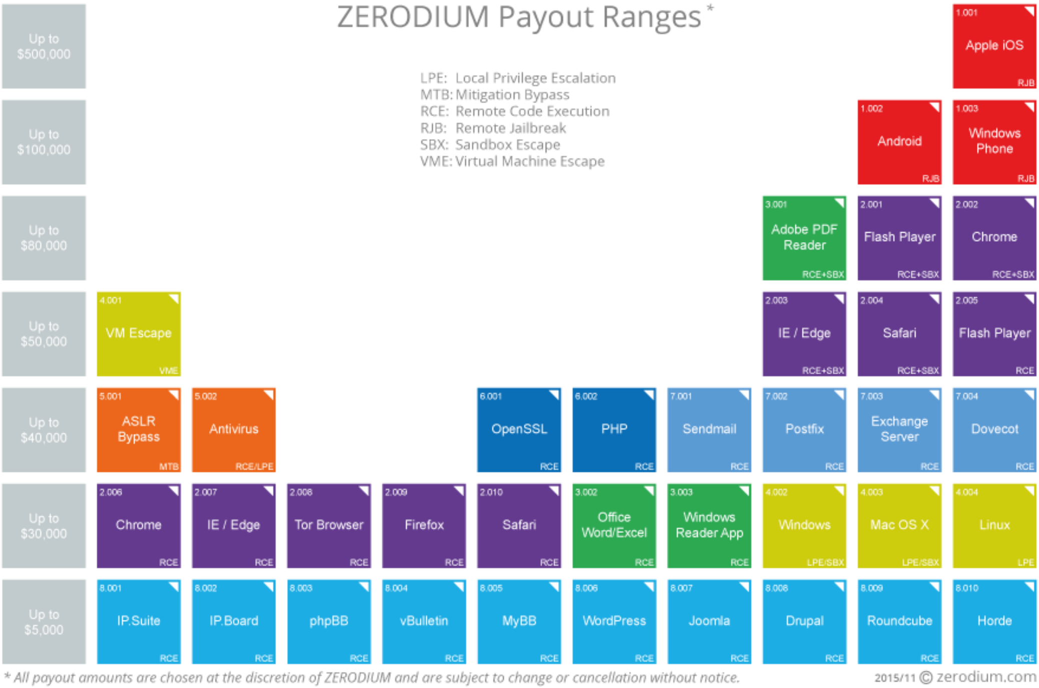
XKCD


HI, THIS IS YOUR SON'S SCHOOL. WE'RE HAVING SOME COMPUTER TROUBLE.
OH, DEAR – DID HE BREAK SOMETHING?
IN A WAY–
DID YOU REALLY NAME YOUR SON Robert'); DROP TABLE Students;-- ?
OH. YES. LITTLE BOBBY TABLES, WE CALL HIM.
WELL, WE'VE LOST THIS YEAR'S STUDENT RECORDS. I HOPE YOU'RE HAPPY.
AND I HOPE YOU'VE LEARNED TO SANITIZE YOUR DATABASE INPUTS.

Vulnerability timeline


Vulnerability introduced
Exploit released in the wild
Vulnerability discovered by the vendor
Vulnerability disclosed publicly
Anti-virus signatures released
Patch released
Patch deployment completed
t_v
t_e
t_d
t_0
t_s
t_p
t_a
Zero day attack
Follow-on attacks
Window of exposure

Capitalism



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LPE: Local Privilege Escalation
MTB: Mitigation Bypass
RCE: Remote Code Execution
RJB: Remote Jailbreak
SBX: Sandbox Escape
VME: Virtual Machine Escape

Up to $500,000										1.001 Apple iOS RJB
Up to $100,000									1.002 Android RJB	1.003 Windows Phone RJB
Up to $80,000								3.001 Adobe PDF Reader RCE+SBX	2.001 Flash Player RCE+SBX	2.002 Chrome RCE+SBX
Up to $50,000	4.001 VM Escape VME							2.003 IE / Edge RCE+SBX	2.004 Safari RCE+SBX	2.005 Flash Player RCE
Up to $40,000	5.001 ASLR Bypass MTB	5.002 Antivirus RCE/LPE			6.001 OpenSSL RCE	6.002 PHP RCE	7.001 Sendmail RCE	7.002 Postfix RCE	7.003 Exchange Server RCE	7.004 Dovecot RCE
Up to $30,000	2.006 Chrome RCE	2.007 IE / Edge RCE	2.008 Tor Browser RCE	2.009 Firefox RCE	2.010 Safari RCE	3.002 Office Word/Excel RCE	3.003 Windows Reader App RCE	4.002 Windows LPE/SBX	4.003 Mac OS X LPE/SBX	4.004 Linux LPE
Up to $5,000	8.001 IP.Suite RCE	8.002 IP.Board RCE	8.003 phpBB RCE	8.004 vBulletin RCE	8.005 MyBB RCE	8.006 WordPress RCE	8.007 Joomla RCE	8.008 Drupal RCE	8.009 Roundcube RCE	8.010 Horde RCE

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