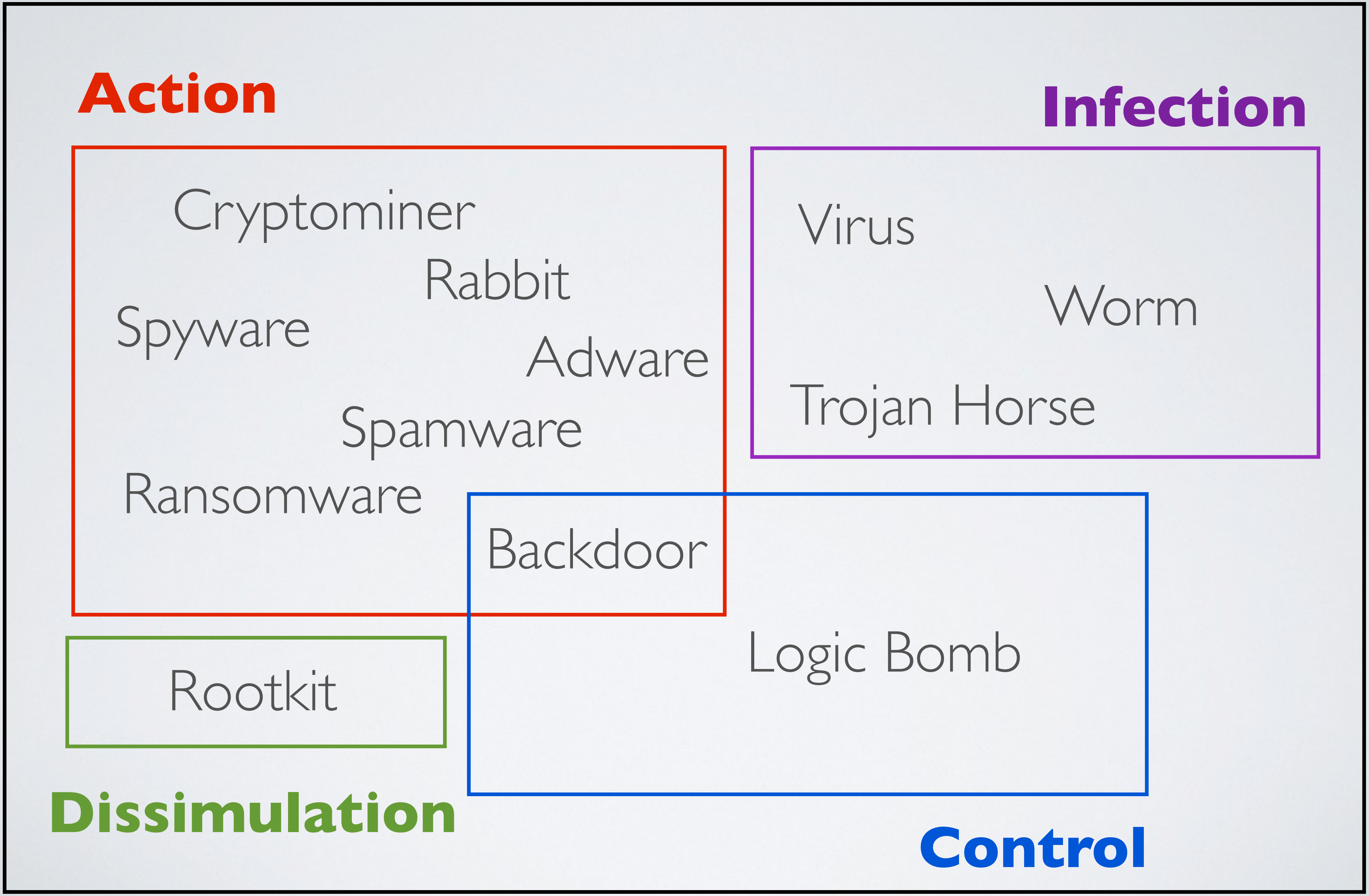
Malicious Code

Thierry Sans

Malware



Action

Cryptominer

Rabbit

Spyware

Adware

Spamware

Ransomware

Backdoor

Infection

Virus

Worm

Trojan Horse

Logic Bomb

Rootkit

Dissimulation

Control

Action

- performs unsolicited operations on the system

- **Rabbit** exhausts the hardware resources of a system until failure
- **Backdoor** allows an attacker to take control of the system bypassing authorization mechanisms
- **Spyware** collects information
- **Spamware** uses the system to send spam
- **Ransomware** restricts access to system’s data and resources and demands for a ransom
- **Adware** renders unsolicited advertisement

Dissimulation

- avoid detection by anti-malware programs

Rootkit hides the existence of malicious activities

Infection

- penetrate a system and spread to others

Replication

- copy itself to spread

- **Virus** contaminates existing executable programs
- **Worm** exploits a service's vulnerability

Subterfuge

- based on user's credulity

- **Trojan Horse** tricks the user to execute the malicious code

Control

- activate the malicious code

- **Backdoor** communicates with command & control servers allowing an attacker to control the virus
- **Logic Bomb** activates the malicious code when certain conditions are met on the system

The history of malicious code

Chronology

- 70's - The era of the first self-replicating programs
- 80's - The era of maturity and first pandemics
- 90's - The era of self-modifying virus and macro viruses
- 00's - The era of Trojan horses and internet worms
- 10’s - The era of cyber-warfare viruses

70's - The era of the first self-replicating programs

The era of the first self-replicating programs (70's)

ANIMAL (a popular game)

- Replication through the filesystem
- No effect

Simple Joke

Creeper (and **Reaper**) on Tenex OS (Arpanet)

- Replication through a modem and copied itself to the remote system
- Displays the message
  `I'M THE CREEPER : CATCH ME IF YOU CAN`

Disruptive

The **Rabbit** program

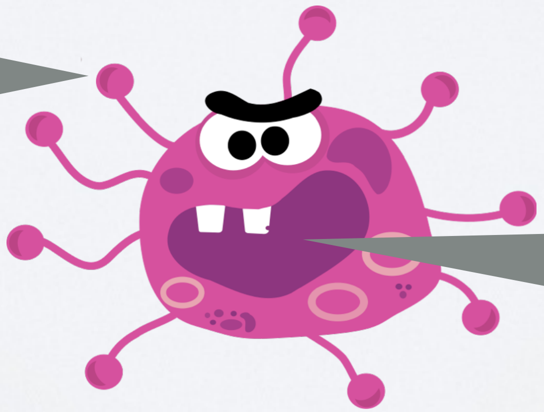
- Replication through the filesystem
- Reduces system performance till crashing

Destructive

Anatomy of a Virus

A **virus** can be

- a malicious code embedded in an existing program and replicates itself by infecting other programs through the filesystem or the network
- a program that exists by itself and replicates through the filesystem or network



Infection vector
how the virus penetrate the system

The payload
what the virus does

80's - The era of maturity and first pandemics

1987 - the beginning of pandemics

Jerusalem (MS-DOS)

- Destroys all executable files on infected machines upon every occurrence of Friday the 13th

SCA (Amiga)

- Displays a text every 15th boot
- 40% of the Amiga owners were infected

Christmas Tree EXEC (IBM/PC)

- Displays a snow flow animation
- Paralyzed several international computer networks in December 1987

The first anti-virus softwares (end of 80's)

Virus scanner (detection)

- Signature based -
  Using a signature database of existing viruses
- Behavior based
  Looking for suspicious code patterns that can be used by viruses

Virus removal tools (sanitation)

- Cleaning the memory and the filesystem

Avoiding detection

Cascade (1987)

- The virus encrypts itself with a cryptographic key and changes this key when replicating itself

✓ Each instance of the virus does not look the same

➡ This is the emergence of polymorphic viruses

90's - The era of self-modifying virus and macros viruses

The era of self-modifying virus (90's)

The **Chameleon** family (1990)

Ply (1996)

- DOS 16-bit based complicated polymorphic virus with built-in permutation engine

Anatomy of a "polymorphic" virus

A **polymorphic virus** mutates when replicating (but keeps the original algorithm intact)

- By using cryptography
- By injecting garbage code
- By doing permutations within certain instructions or block of instructions
- By using code obfuscation technique

How to detect it?

➡ By detecting code patterns used for the self-modification

Macro Viruses

A **macro virus** is written in scripting languages used by some office applications (can be cross-platform)

- Written in VBS, embedded in a MS-office document, activated when the document is open (autoload function)

Concept (1995)

Melissa (1999)

- March 26 1999, Melissa shut down e-mail systems that got clogged with infected e-mails

00's - The era of Trojan horses and internet worms

Anatomy of a Trojan horse

A **Trojan horse** is a program that disguise itself as a legitimate program or file

- In most cases, Trojan horses replicate themselves through emails

The big stars among trojan horses

VBS/Loveletter ILOVEYOU (2000)

- Caused 5.5 to 10 billion dollars in damage

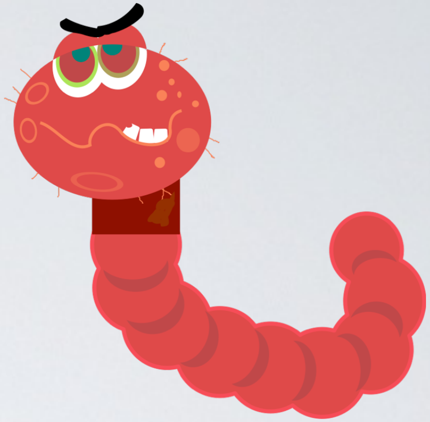
Sobig (2002)

- Sobig.F set a record in sheer volume of e-mails

MyDoom (2002)

- Broke the record set by Sobig.F

Anatomy of a worm



A **worm** exploits a security flaw (often of a network service) to infect the machine and replicates itself through the network

- ➡ Very fast infection (does not need the user to be activated)
- ➡ Has a payload as well (more or less harmful)

Factors

- The wide adoption of internet
- The global network is a good medium for virus pandemics
- The multiplication of internet applications and services
- Fast publication of program vulnerabilities
- Slow release of corrective patches
- Slower adoption of these patches (not automatic)

Code-Red (2001)

- Exploits a security flaw (buffer overflow) of Microsoft IIS web server (MS01-033) patched one month earlier
- In few days, 359 000 machines infected

Nimda (2001)

- Exploits another security flaw of MS-IIS
- The Internet's most widespread worm so far (the most part of the infection was done in 22min)

Klez (2001)

- Exploits a security flaw of Microsoft Internet Explorer layout engine used by Outlook and IE
- Infection through email attachment however the user does not have to open this attachment to get infected

SQL-Slammer (also called **Sapphire**) (2002)

- Exploits a security flaw in MS-SQL servers for which a patch had been released six months earlier (MS02-039)
- Infected 75,000 machines in 10 minutes causing caused a massive denial of service and dramatically slowed down global Internet traffic

Sasser (2002)

- Exploiting a buffer overflow of Microsoft LSASS on Windows 2000 and XP systems
- Many companies had to shut down their services

Blaster (also known as **Lovesan**) (2003)

- Exploits a security flaw in DCOM-RPC services on Windows 2000 and XP
- Was supposed to do SYN flood on August 15, 2003 against port 80 of windowsupdate.com

Welchia (also known as **Nachia**) (2003)

- Exploits the same security flaw than Blaster
- Corrects the security flaw by patching the system

Conficker (2008)

- Exploits a security flaw in NetBIOS
- Disables auto-update
- Embeds a dictionary password cracker and a backdoor to turn the machine into a “bot”
- Believed to be originated from Ukraine and/or Russia

10's - The era of cyber-warfare malware & Ransomware

The first cyber-warfare virus

W32.Dozor (July 2009)

- A virus that created a botnet dedicated to perform a DDoS attack South Korea and US government website on July 4th
- Believed to be originated from China and/or North Korea

Stuxnet (Sept 2010)

- A very sophisticated virus that targets SCADA systems (supervisory control and data acquisition)
- Believed that it took down 4000 nuclear centrifuges in Iran
- Believed to be originated from the USA and Israel

Flame also called **Skywiper** (May 2012)

- An *espionage* virus that embeds sophisticated spywares
- Believed to be originated from the USA (*Olympic Games* defense program)

Another trend - Ransomware

Reveton (2012)

- Displays a message from the law enforcement agency saying that you have pirated software and child pornography on your machine
- Ask you to pay a fine using a prepaid cash service

CryptoLocker (2013)

- Encrypt specific files on your machine with a 2048 RSA key
- Ask you to pay a ransom with Bitcoins

"Ransomware attacks grew by 500% in 2013 and turned vicious"

source : *Symantec Internet Security Threat Report 2014*

... and it turned vicious

WannaCry and **Petya** (2017)

- Use a vulnerability found in the NSA hacking toolkit leak
- Researcher have found a "kill switch"
  (until we discovered that he was the author of the malware)
- Paralyzed hospitals in UK and trains in Germany

Late 10's - the emergence of IoT malware and Cryptominers

Mirai (2016)

- Infects IoT devices
- Most powerful DDoS attacks to date

Coinhive (2018)

- Javascript embedded in website (either legitimately or not) and popular malware as well

Modern Malicious Code

Thierry Sans

How to create a new malware? 3 step process

1. **Create the malware’s payload**

2. Make the malware undetectable

3. Spread the malware

The malware payload

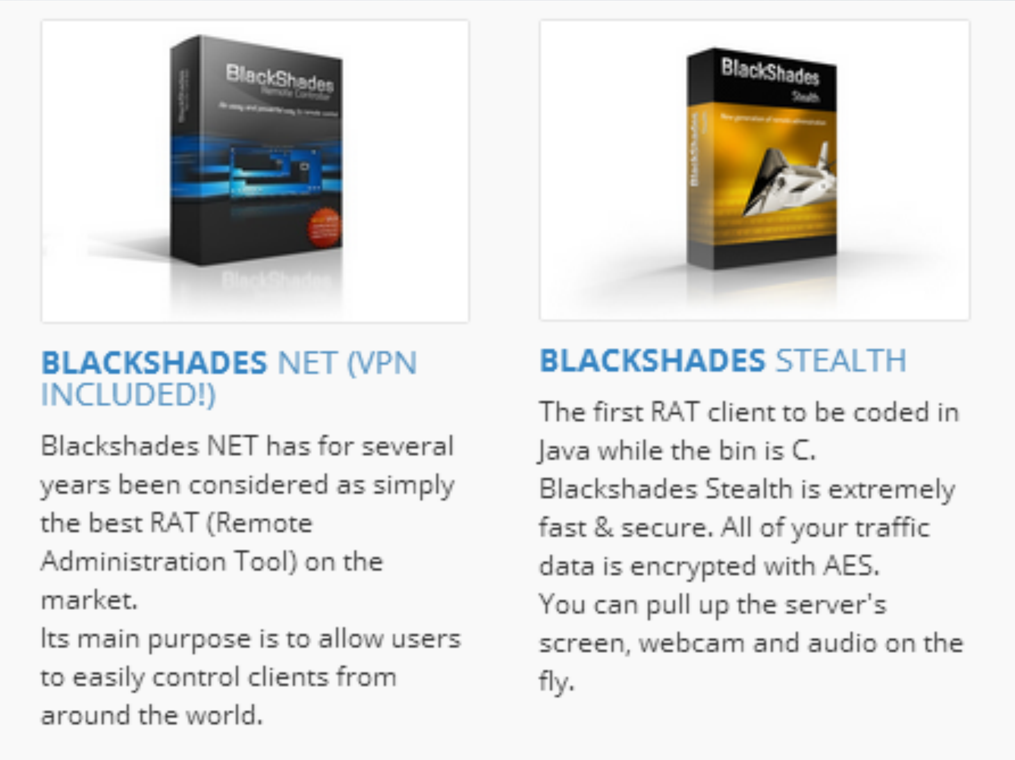
- Take control of the victim's device turning it into a **zombie/bot**
- Act as a **spam relay** or **DDoS relay**
- Steal **personal information**
  including passwords, credit card numbers, banking credentials
- **Click bot :** generating web traffic
- **Cryptominer**
- **Ransomware**
- … and so on

Remote Administration Tool/ Trojan (RAT)

Basically a **remote administration tool** with

- stealth features
- and specific functionalities such as :
  - camera controller
  - hardware destroyer
  - password / credit card loggers
  - … and so on

Buy a RAT as a COTS*



BLACKSHADES NET (VPN INCLUDED!)

Blackshades NET has for several years been considered as simply the best RAT (Remote Administration Tool) on the market.
Its main purpose is to allow users to easily control clients from around the world.

BLACKSHADES STEALTH

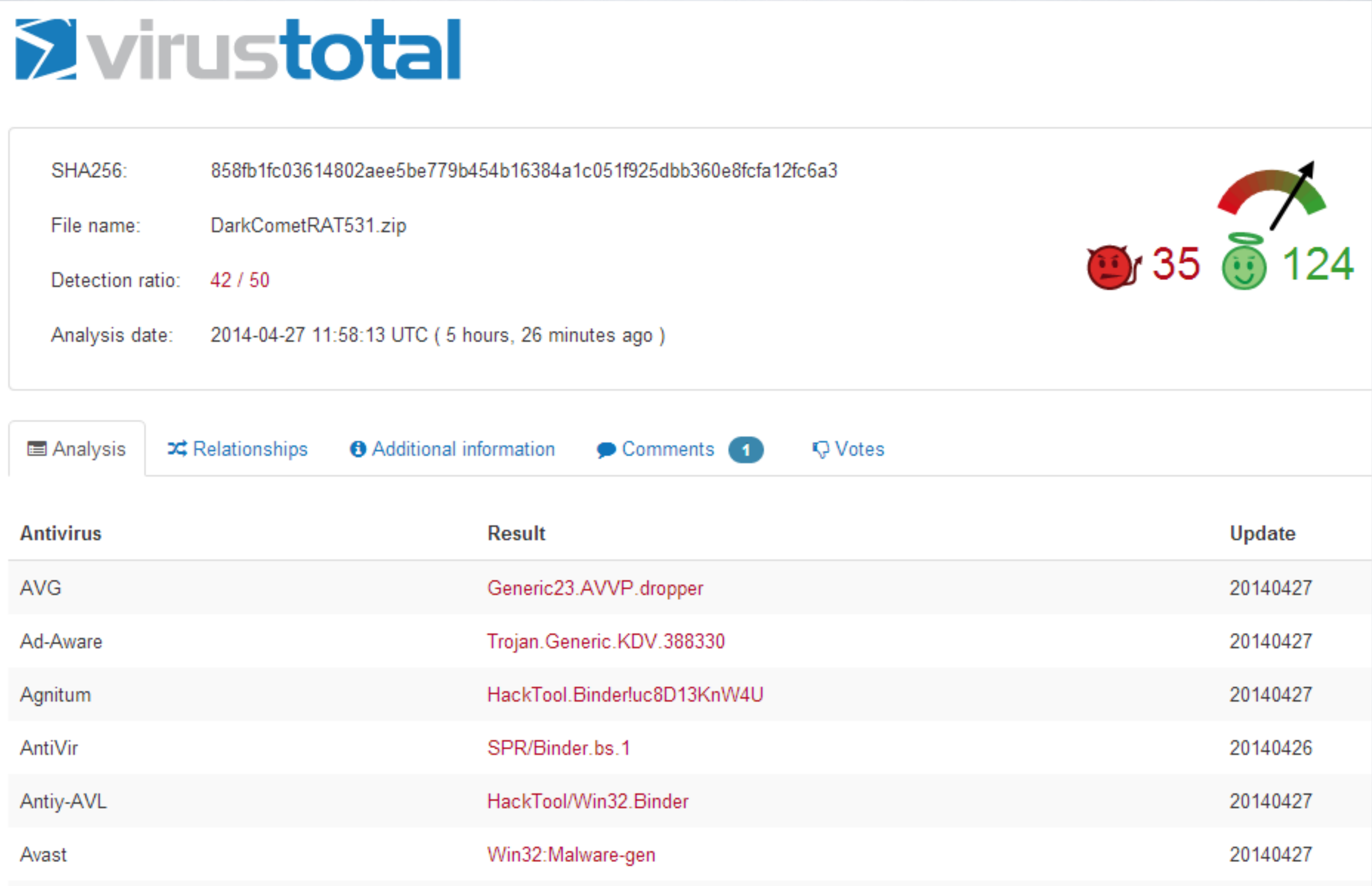
The first RAT client to be coded in Java while the bin is C.
Blackshades Stealth is extremely fast & secure. All of your traffic data is encrypted with AES.
You can pull up the server's screen, webcam and audio on the fly.

Some RAT Builders

- **Zeus** (2007) initially $700, now open source
- **DarkComet** (2008), open source
- **BlackShades** (2010) can now be purchased from an official company $49 - $56

* Commercial Off-The-Shelf

Are we done yet?



SHA256: 858fb1fc03614802aee5be779b454b16384a1c051f925dbb360e8fcfa12fc6a3

File name: DarkCometRAT531.zip

Detection ratio: 42 / 50

Analysis date: 2014-04-27 11:58:13 UTC (5 hours, 26 minutes ago)

Antivirus	Result	Update
AVG	Generic23.AVVP.dropper	20140427
Ad-Aware	Trojan.Generic.KDV.388330	20140427
Agnitum	HackTool.Binder!uc8D13KnW4U	20140427
AntiVir	SPR/Binder.bs.1	20140426
Antiy-AVL	HackTool/Win32.Binder	20140427
Avast	Win32:Malware-gen	20140427

How to create a new malware? 3 step process

1. Create the malware's payload

2. **Make the malware undetectable a.k.a packing a malware**

3. Spread the malware

How antiviruses detect malware? 2 techniques

1. **Static Analysis**

➡ Scan program comparing it to a collection of signatures

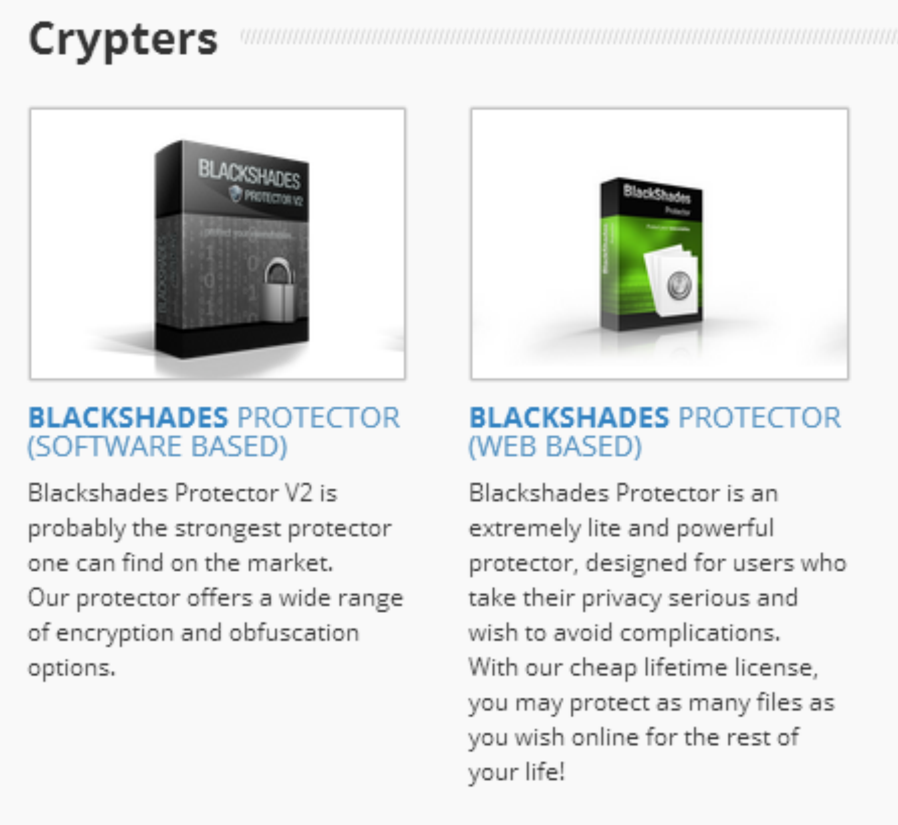
2. **Dynamic Analysis**

➡ Run program in a sandbox and infer from its behavior

Malware Crypter

- Encryption
- Code obfuscation
- Stealth mode to detect and bypass sandbox

Buy a Crypter as a COTS



Crypters

BLACKSHADES PROTECTOR (SOFTWARE BASED)

Blackshades Protector V2 is probably the strongest protector one can find on the market.
Our protector offers a wide range of encryption and obfuscation options.

BLACKSHADES PROTECTOR (WEB BASED)

Blackshades Protector is an extremely lite and powerful protector, designed for users who take their privacy serious and wish to avoid complications.
With our cheap lifetime license, you may protect as many files as you wish online for the rest of your life!

Some available Crypters

- **Byte Crypter** $35 for 3 months, $60 for lifetime
- **Datascrambler** $20 for 3 months, $40 for a year
- **BlackShades Crypter** from an official company $60 for 3 months, $100 for a year

How to create a new malware? 3 step process

1. Create the malware's payload
2. Make the malware undetectable
3. **Spread the malware**

Spread the malware using social engineering

➡ Trick people to download and install the malware

- tutorial about hacking that makes you install the malware
- video/chat player to access exclusive content or talk to exclusive people
- pirated software on P2P networks

Spread the malware using through a webpage

- ➡ Exploit a browser/plugin vulnerability to automatically download and install the malware on the victim’s device

Exploits bundle and other services

1. **Exploit bundle** : $25/day, $400/month, up to $3,000
   - ➡ program to embed into a webpage

2. **Bulletproof host** : $15–250 per month
   - ➡ hosting service to bypass any kind of IP filtering anti-spam, anti-virus, anti-malware, law enforcement, search engine anti-malware service and so on

3. **Traffic** : $4–10 per 1,000 unique hits
   - ➡ attract people to visit the infected webpage

   Installs $12 – $550 per 1000 infections
   - ➡ use a spreading service also called Pay-Per-Install (PPI)

Conclusion

Creating a malware, making it undetectable and spreading it would normally be difficult and require a good deal of expertise

However, the cyber underground market makes this process accessible to the mass given a small amount of money