Jumping the air gap

15 years of nation-state effort

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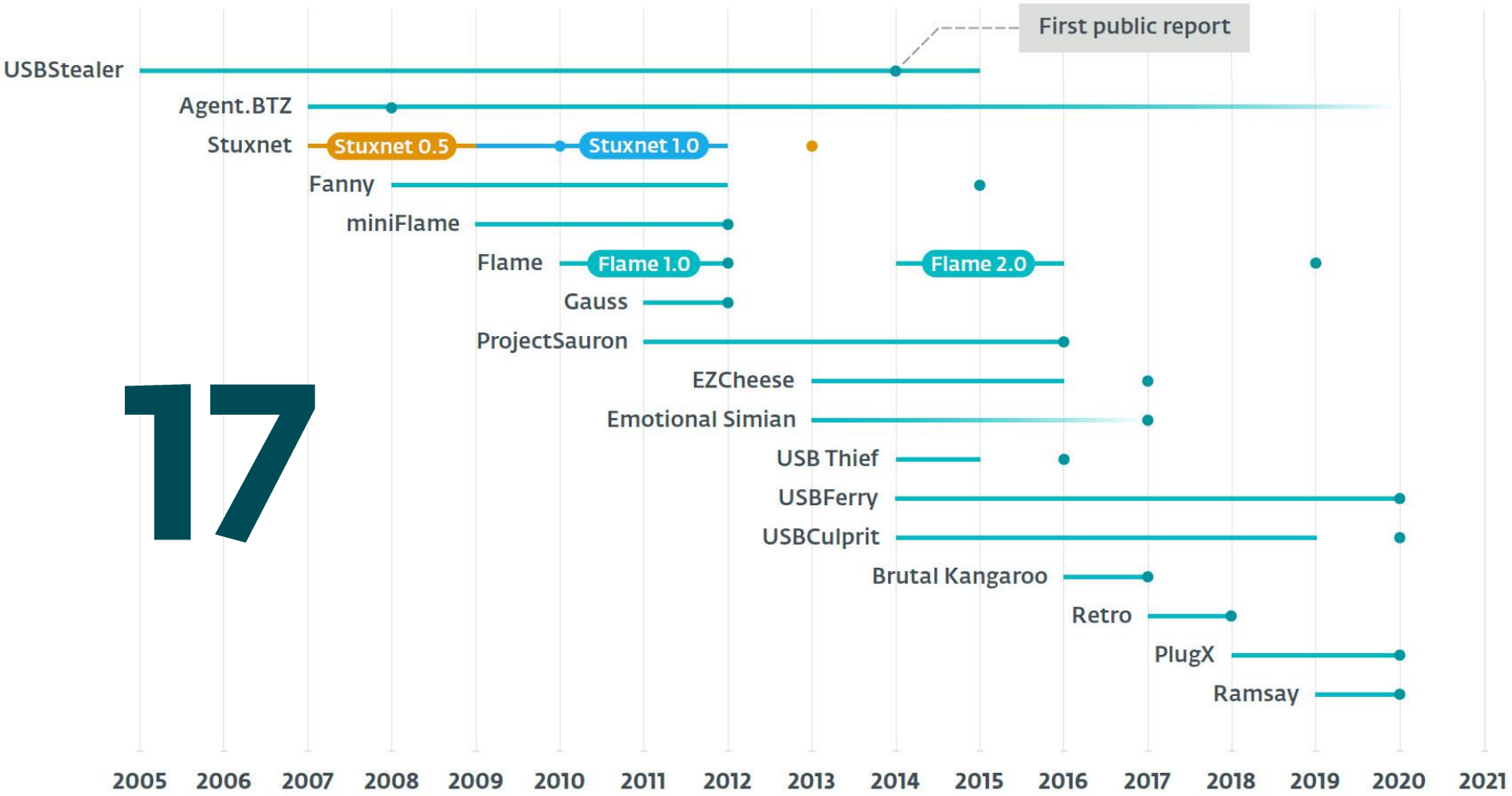
Malware, or a set of malware components acting together (a framework), that implements an ***offline, covert communication mechanism between an air-gapped system*** *and the attacker*



Strong attribution

DarkHotel

- **Retro** 2017-2019
- **Ramsay** 2019-2020

Equation Group

- **Fanny** 2008-2012

Sednit

- **USBStealer** 2005-2015

Goblin Panda

- **USBCulprit** 2014-2019

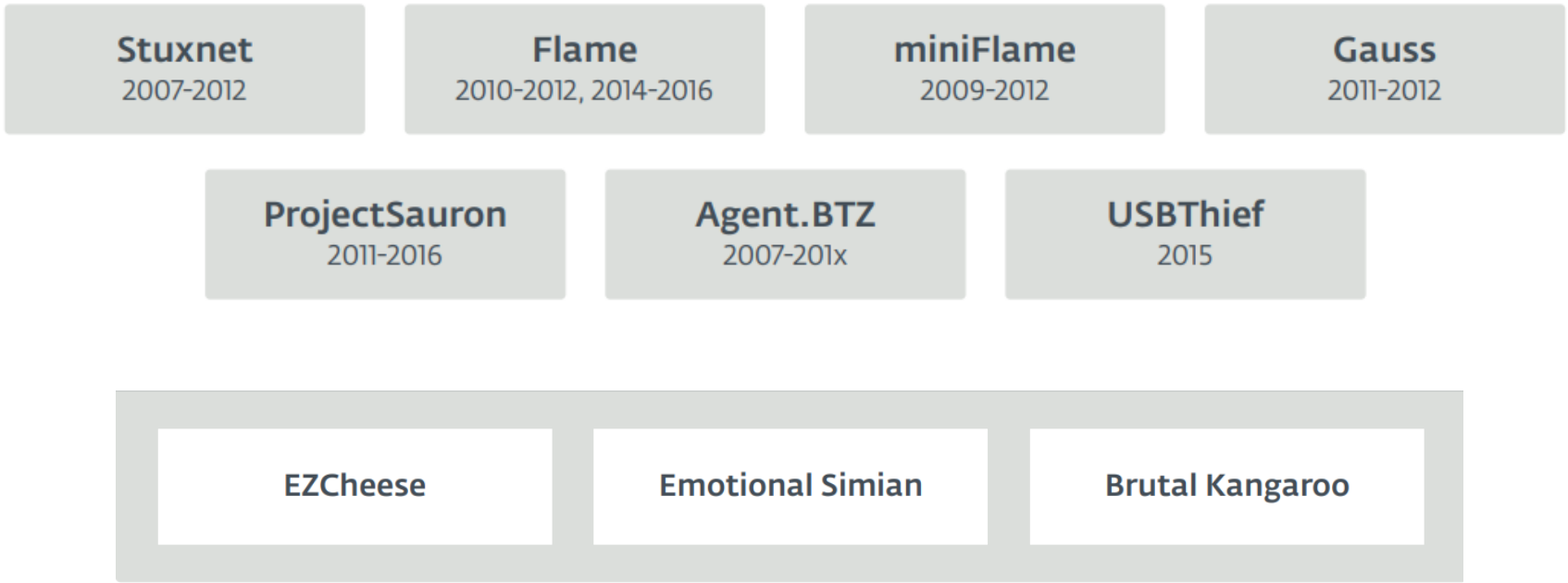
Tropic Trooper

- **USBFerry** 2014-2020

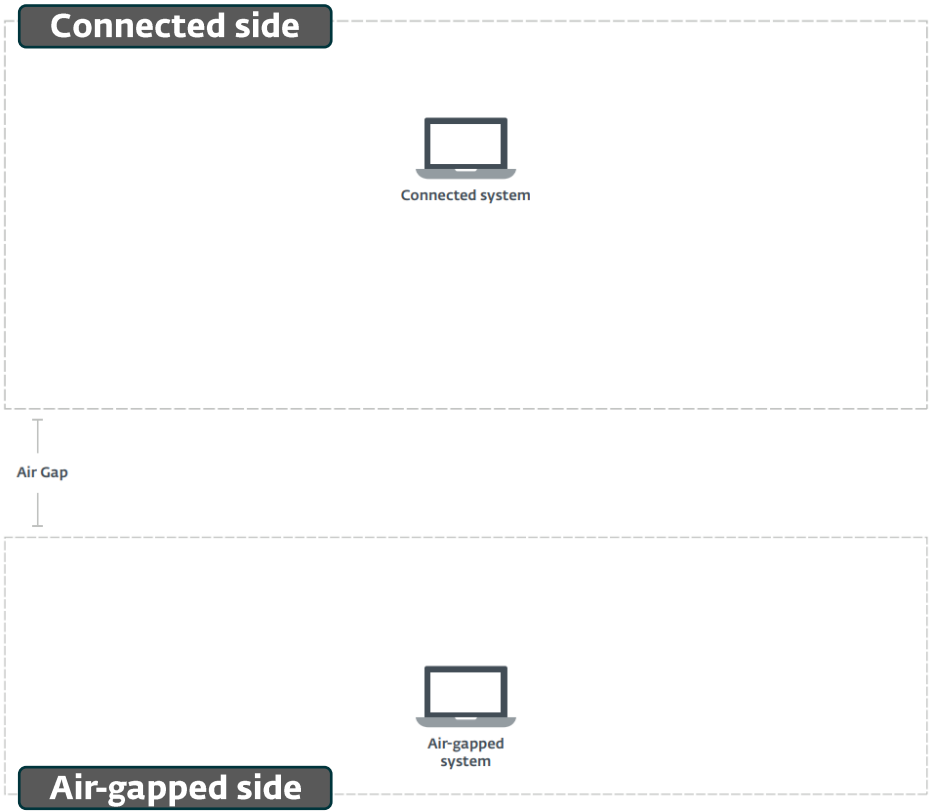
Mustang Panda

- **PlugX** 2018-2020

Controversial attribution



Connected frameworks



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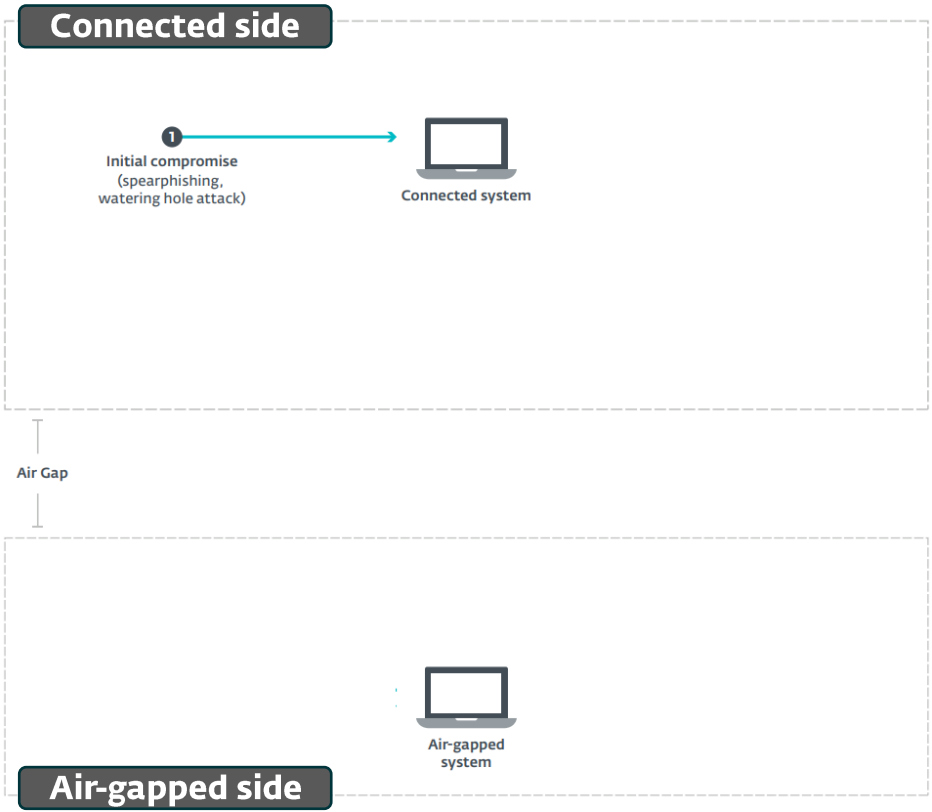

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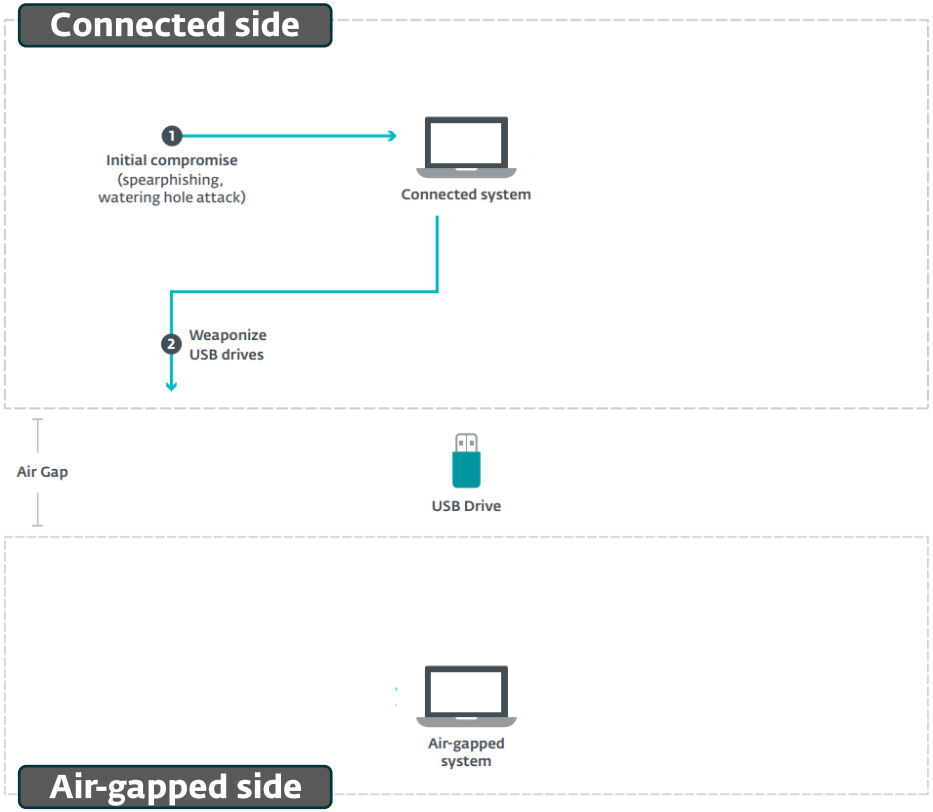
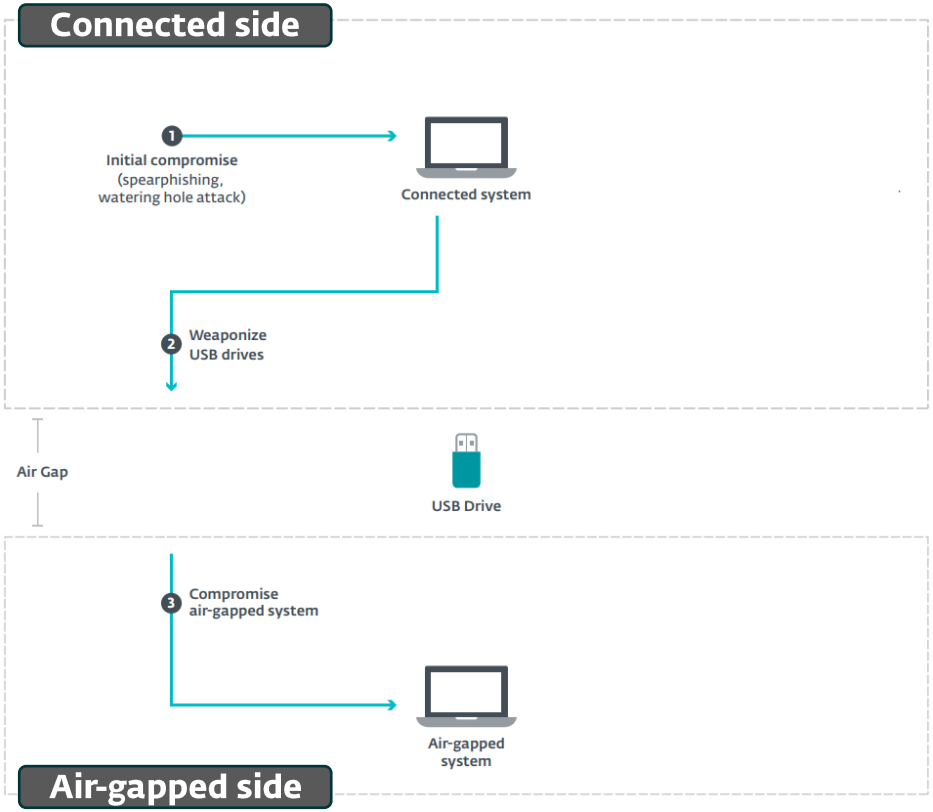
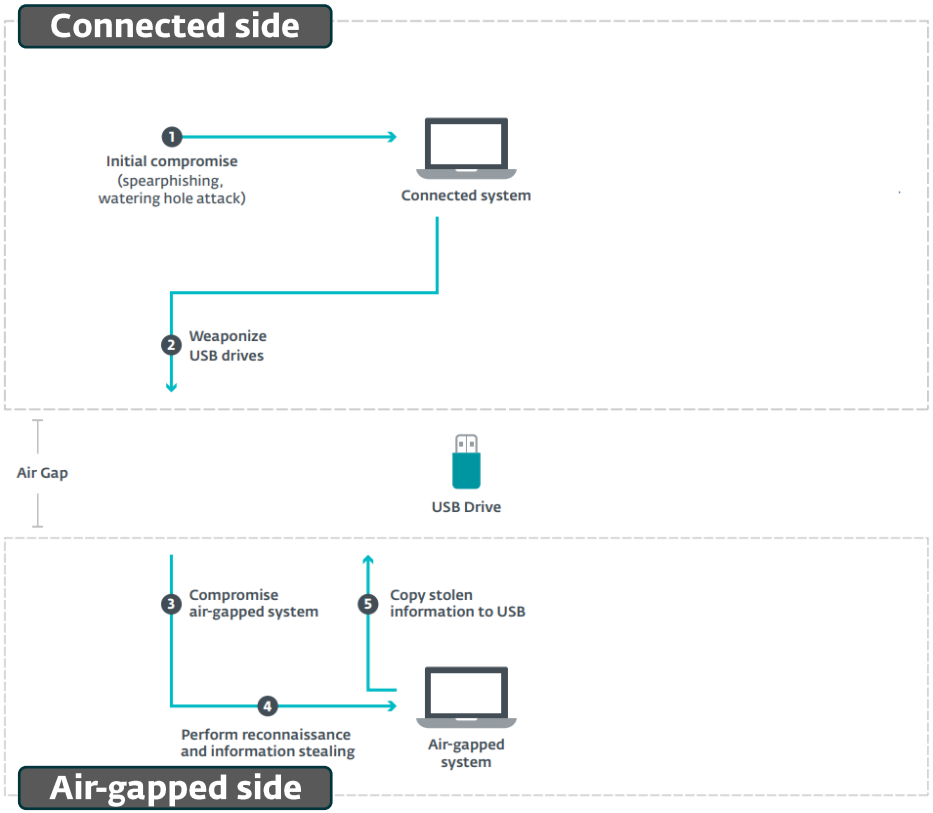


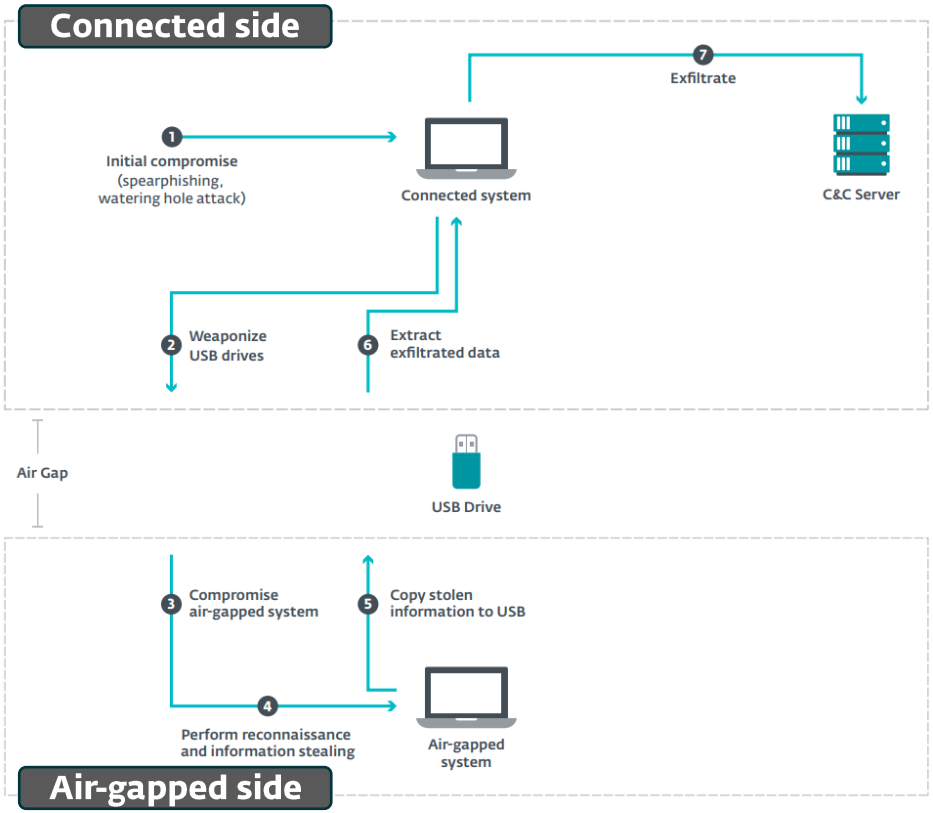
Connected frameworks



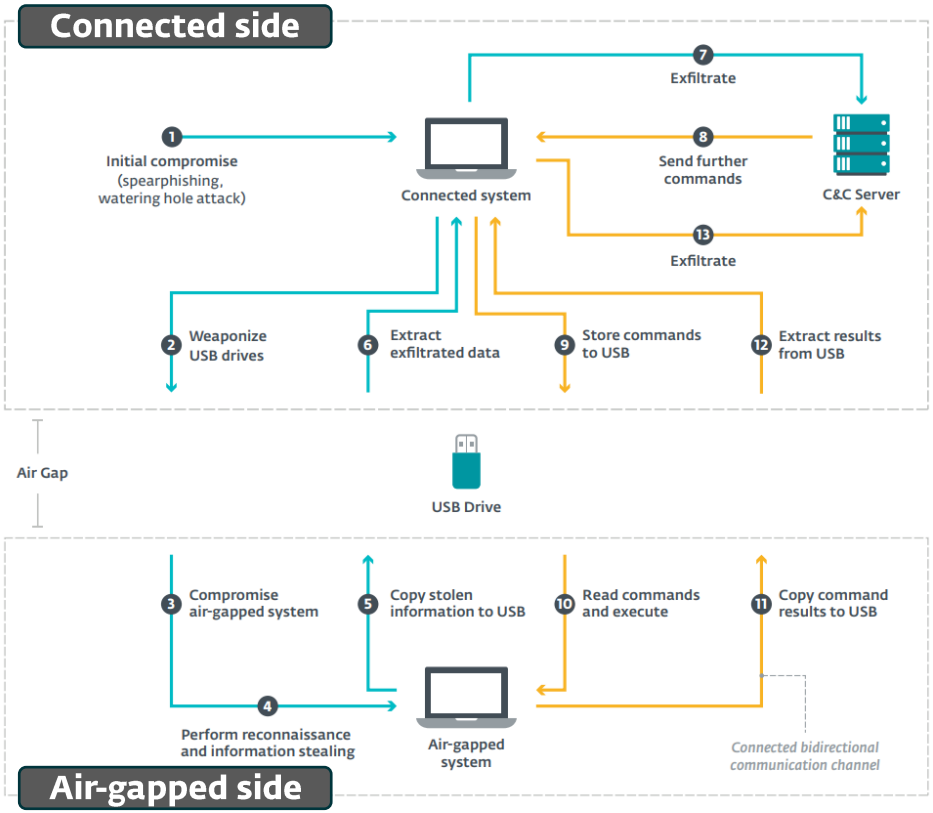
Connected frameworks



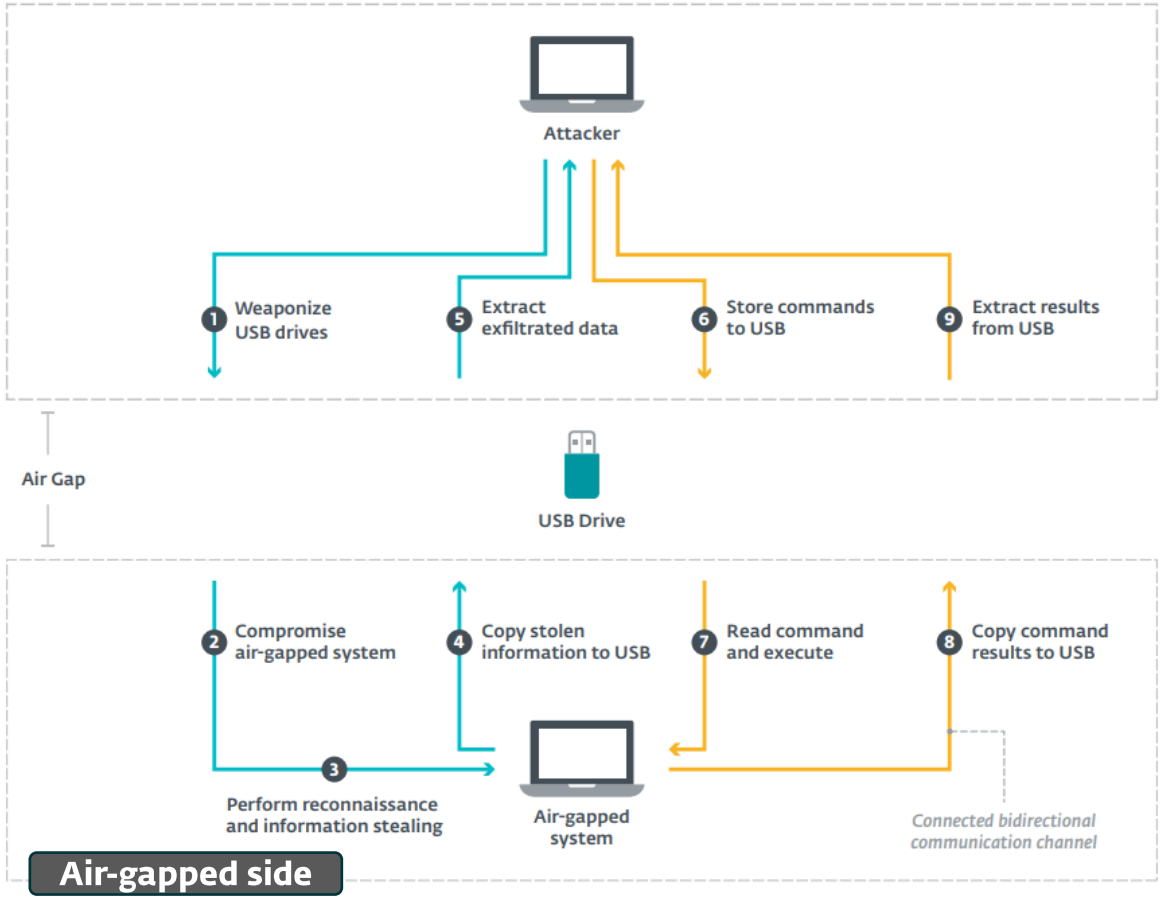
Connected frameworks



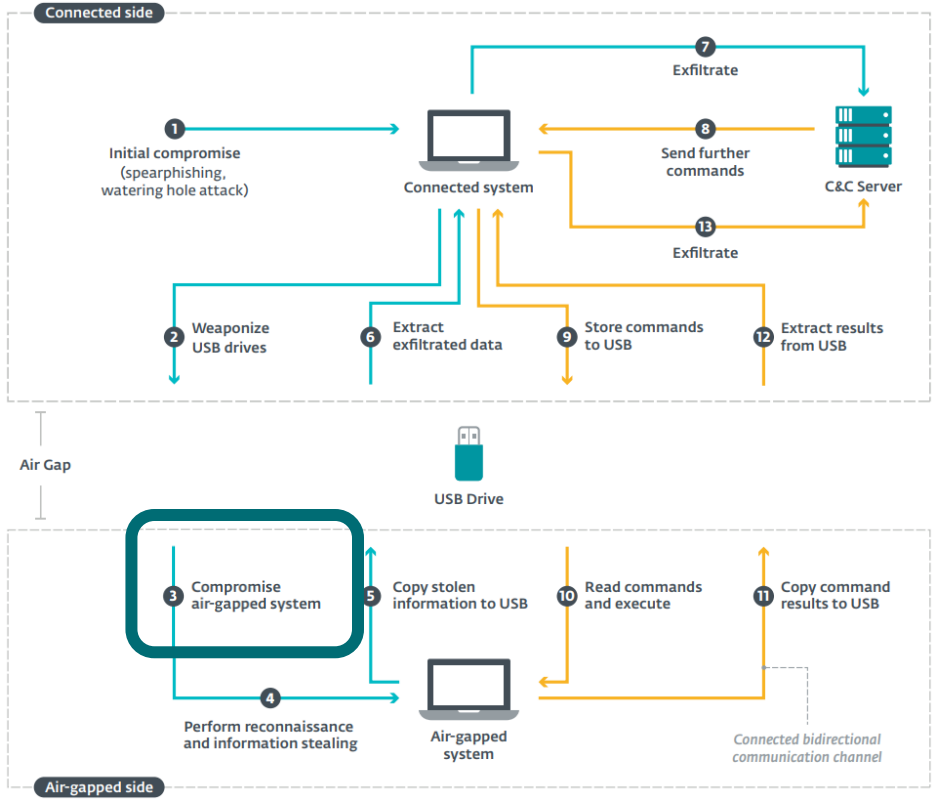
Connected frameworks



Offline frameworks



Air-gapped side: Initial execution vectors



Automated execution

Advisory date	CVE	Vulnerability name	Exploited in the wild
2010-08-02	CVE-2010-2568	Shortcut Icon Loading Vulnerability (remote code execution)	Fanny, Stuxnet, Flame, Gauss, miniFlame
2019-08-13	CVE-2019-1188	LNK Remote Code Execution Vulnerability	
2019-09-10	CVE-2019-1280	LNK Remote Code Execution Vulnerability	
2020-03-10	CVE-2020-0684	LNK Remote Code Execution Vulnerability	
2020-02-11	CVE-2020-0729	LNK Remote Code Execution Vulnerability	
2020-06-09	CVE-2020-1299	LNK Remote Code Execution Vulnerability	
2020-07-14	CVE-2020-1421	LNK Remote Code Execution Vulnerability	

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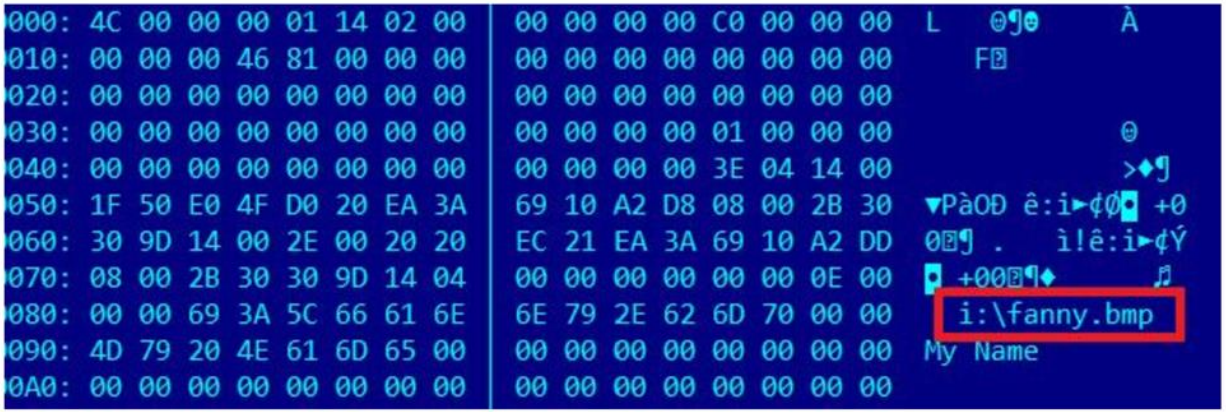
Automated Execution

What's so Fanny?

This PrivLib-boosted Worm, which spreads using the Stuxnet LNK exploit and the filename "fanny.bmp" was compiled on Mon Jul 28 11:11:35 2008, if we are to trust the compilation timestamp. It arrived in our December 2008 collection from the wild, so the compilation might very well be correct.



Source: Securelist - Kaspersky

Non-automated execution: Unknowingly triggered

Main techniques:

- Abuse of Windows AutoRun/AutoPlay feature, via malicious autorun.inf files
- Planting decoy files to lure potential victims
- Rig existing files with malicious code or exploits

Non-automated execution: Unknowingly triggered

Stuxnet's autorun.inf

```
00041000: 0D0A5B61 75746F72 756E5D0D 0A6F626A  ..[autorun]..obj
00041010: 65637444 65736372 6970746F 723D7B42  ectDescriptor={B
00041020: 33313535 33372D36 3341422D 39353132  315537-63AB-9512
00041030: 2D393941 392D3246 34363737 32333541  -99A9-2F4677235A
00041040: 34347D0D 0A                          44}...
00041050: 636F6D6D 616E643D 2E5C4155 544F5255  command=.\AUTORU
00041060: 4E2E494E 460D0A                5C4D656E  N.INF..    \Men
00041070: 753D4025 77696E64 6972255C 73797374  u=@%windir%\syst
00041080: 656D3332 5C736865 6C6C3332 2E646C6C  em32\shell32.dll
00041090: 2C2D3834 39360D0A                    ,-8496..
000410A0:     0D0A 55736541 75746F50 4C41593D    ..UseAutoPLAY=
000410B0: 300D0A                               0..
```

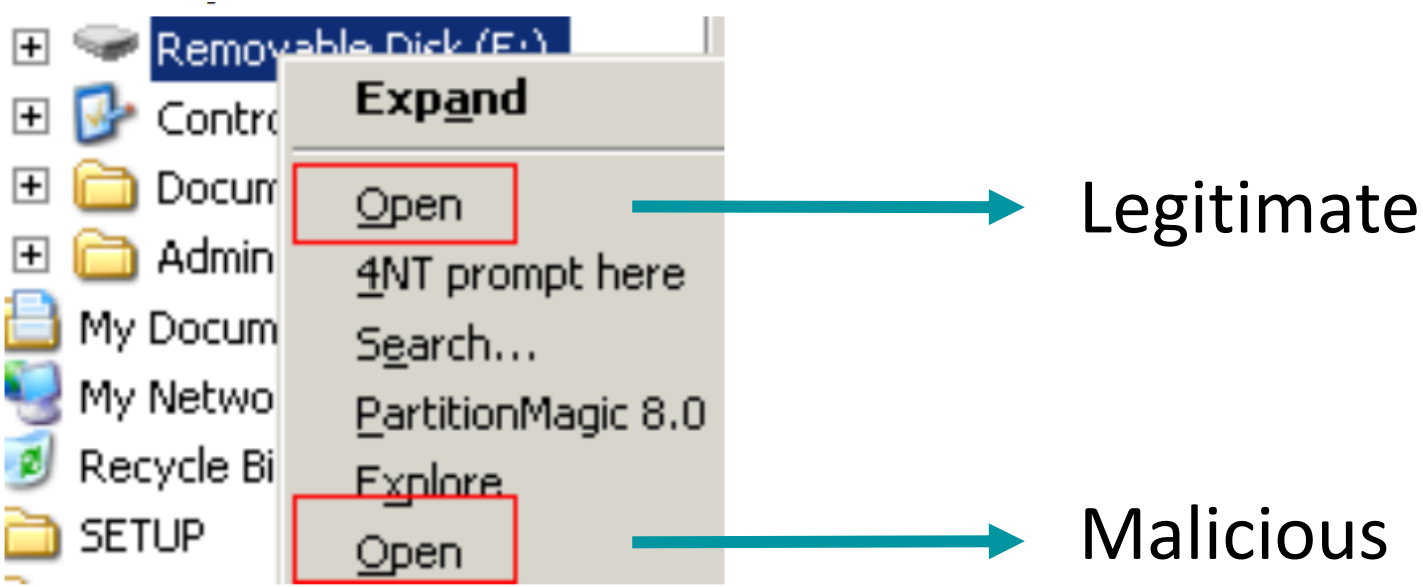
Source: Symantec

Non-automated execution: Unknowingly triggered

Stuxnet's autorun.inf instructions:

Source: Symantec

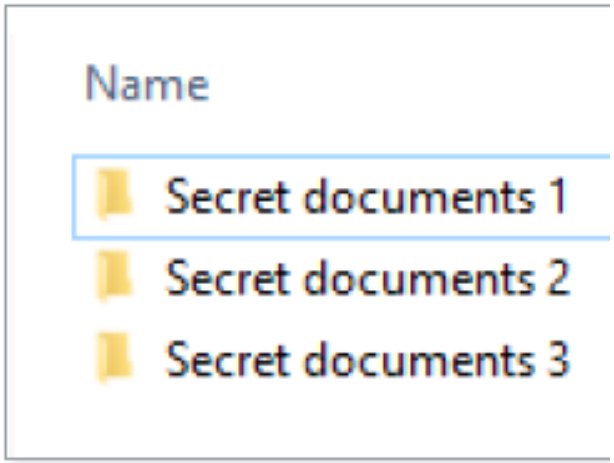
Non-automated execution: Unknowingly triggered



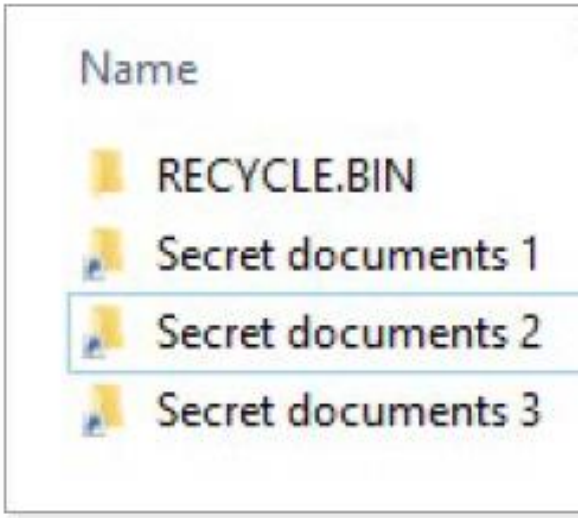
Source: Symantec

Non-automated execution: Unknowingly triggered

Clean



Weaponized



Non-automated execution: deliberately triggered

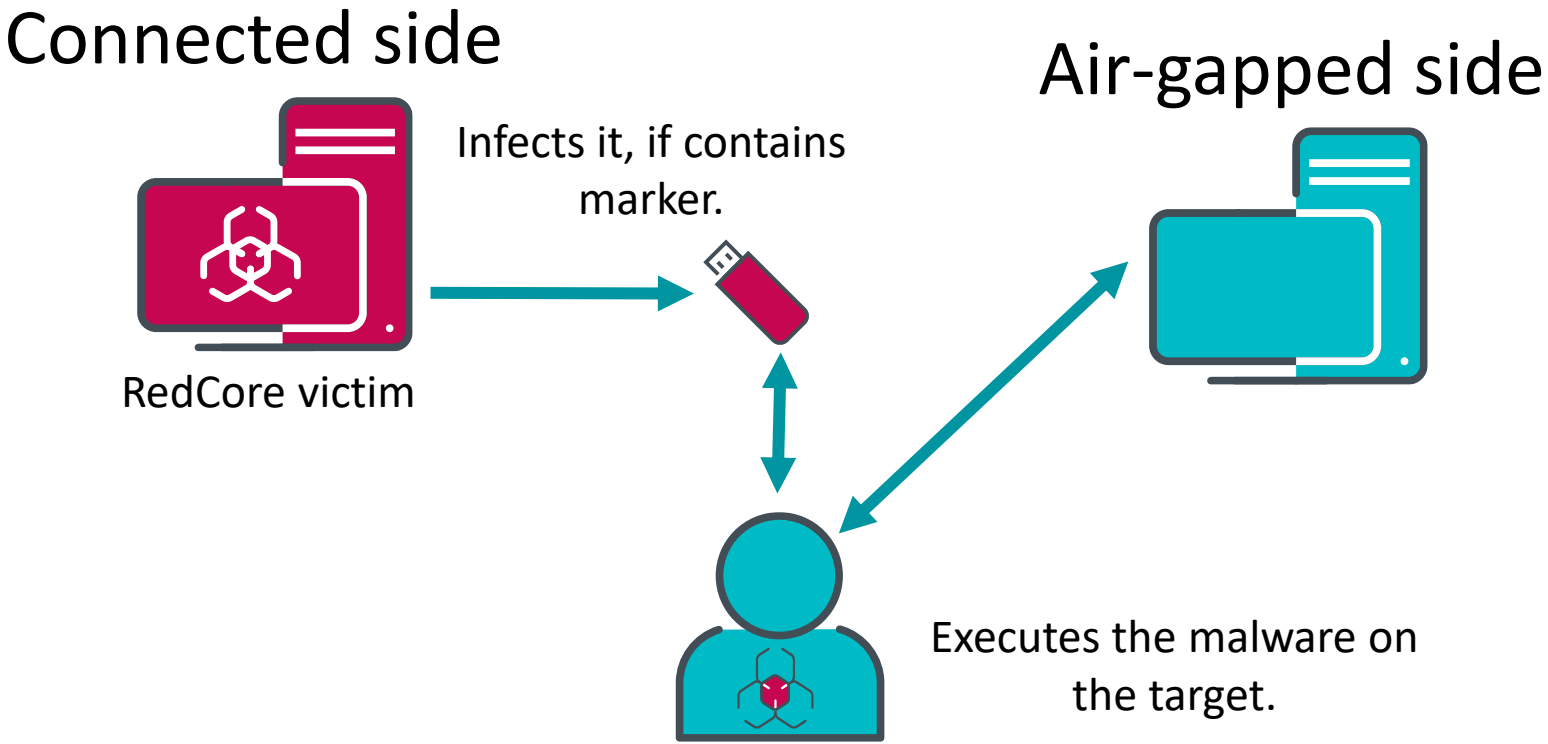
Non-automated execution: deliberately triggered

Cycldek: Bridging the (air) gap

APT REPORTS 03 JUN 2020 16 minute read

Source: Securelist - Kaspersky

Non-automated execution: deliberately triggered



Non-automated execution: deliberately triggered

Non-automated execution: deliberately triggered

NppPlugin.dll

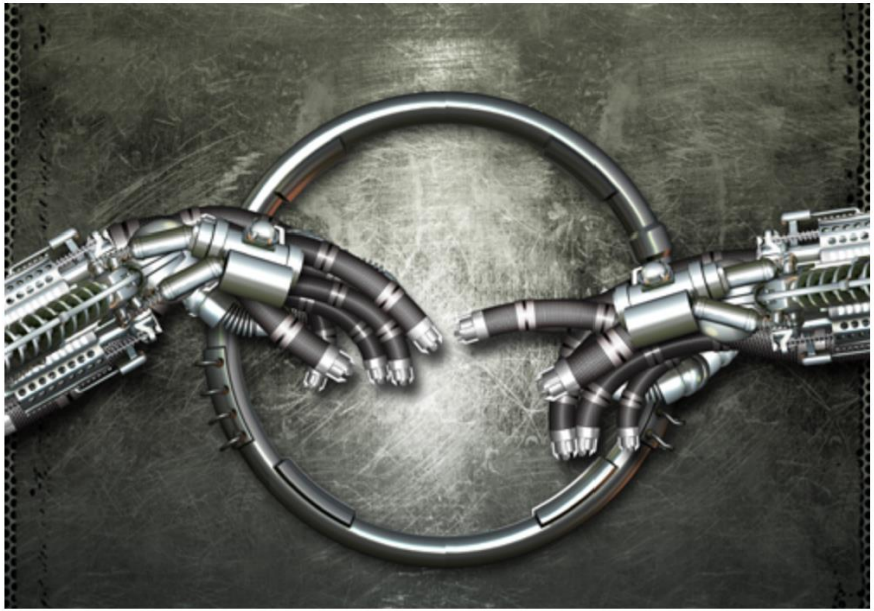
HealthCheck.exe

RichEd20.dll

Communication Protocols and Exfiltration

A Fanny Equation: “I am your father, Stuxnet”

APT REPORTS 17 FEB 2015 12 minute read



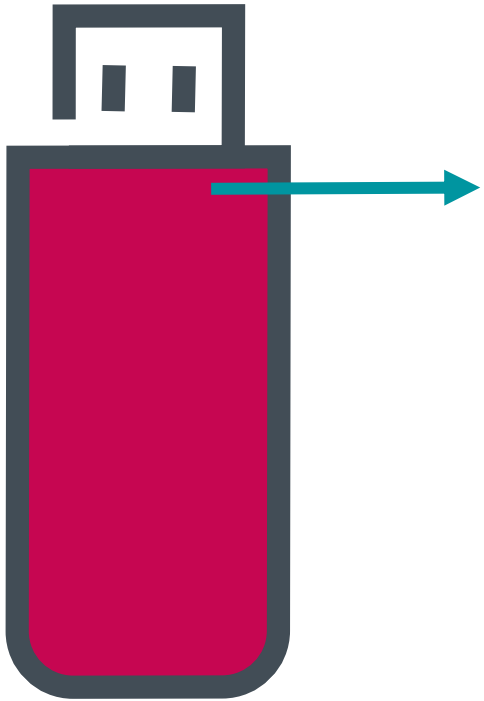
Source: Securelist - Kaspersky

Communication Protocols and Exfiltration

FAT Specification. Directory structure:

Descriptive name of field	Offset (byte)	Size (bytes)	Description
DIR_Name	0	11	"Short" file name limited to 11 characters (*8.3 format*).
DIR_Attr	11	1	Legal file attribute types are as defined below: ATTR_READ_ONLY 0x01 ATTR_HIDDEN 0x02 ATTR_SYSTEM 0x04 ATTR_VOLUME_ID 0x08 ATTR_DIRECTORY 0x10 ATTR_ARCHIVE 0x20

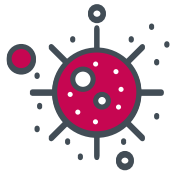
Communication Protocols and Exfiltration



Invalid directory entry

```
51 50 40 98 2D B4 CE 06 00 00 00 18 00 9C 1E 00 | QP@▌-´Î▫ . . . ▫ . ▌ .
02 00 02 00 00 00 00 00 00 00 00 00 00 00 00 00 |  . . . . . . . . . . . . .
```

Hidden storage space



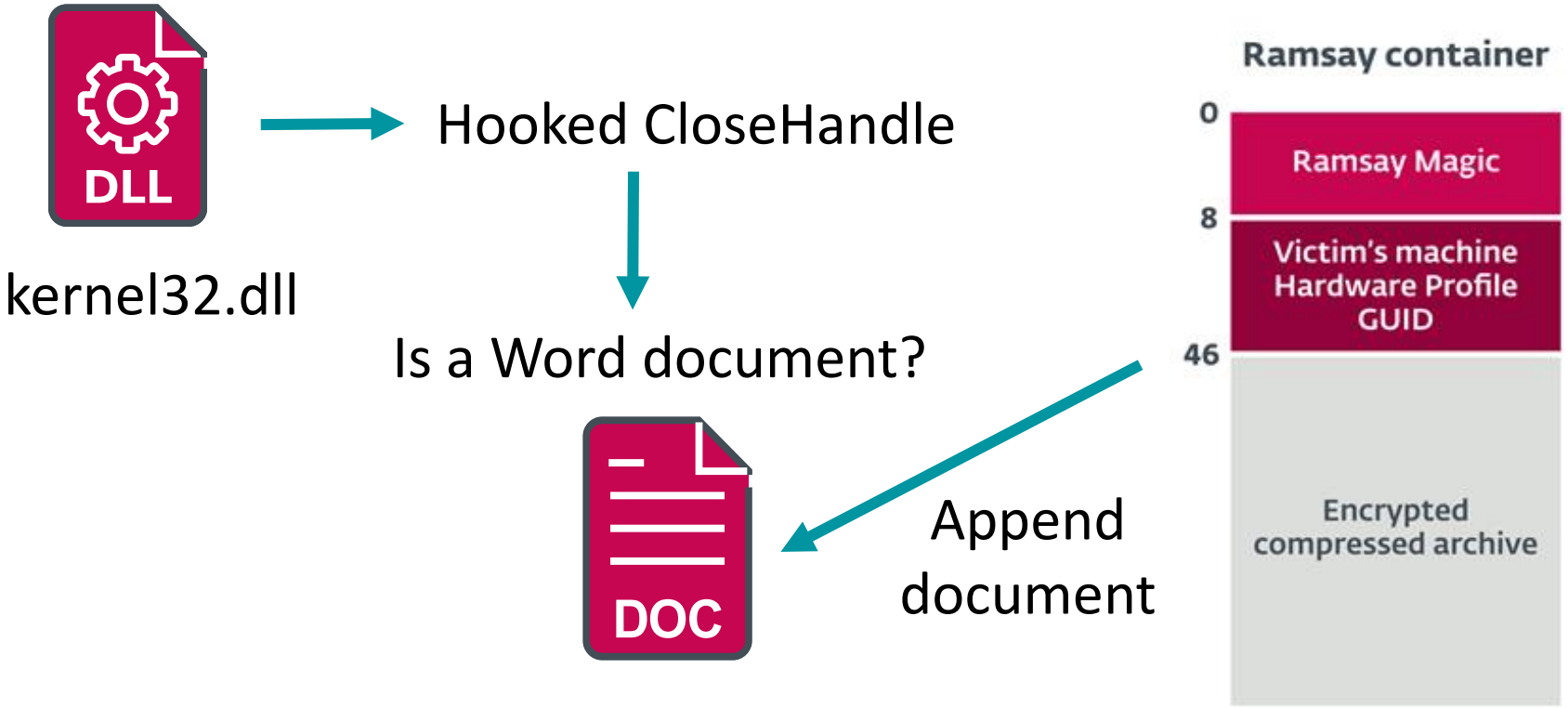
Modules

Commands

Stolen data

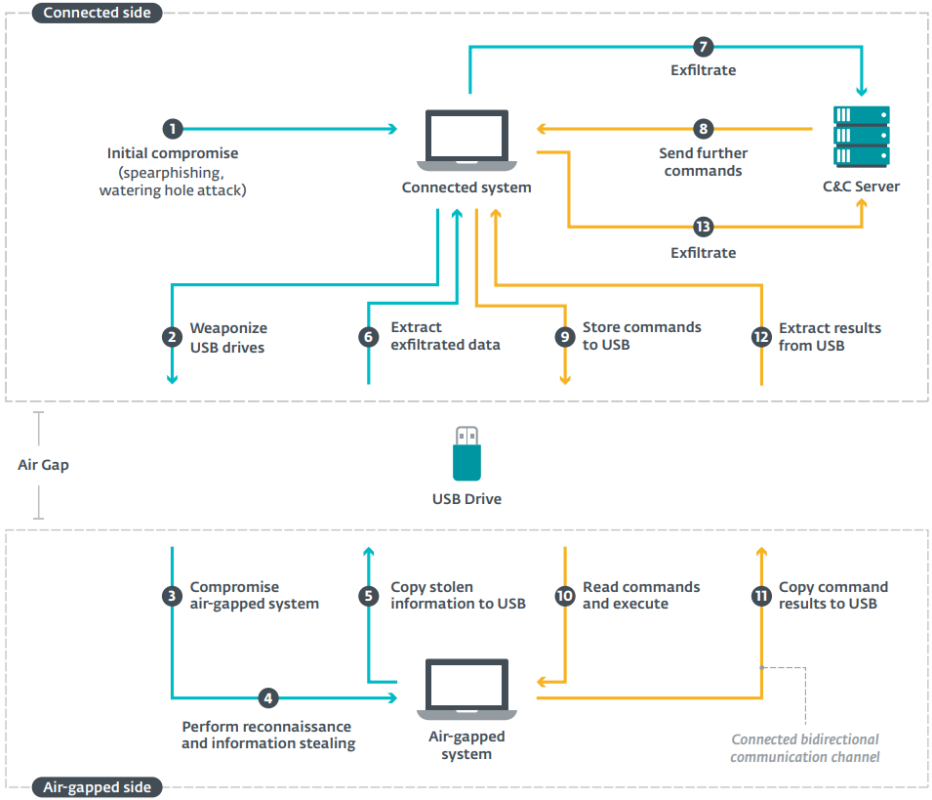
Communication Protocols and Exfiltration

Communication Protocols and Exfiltration

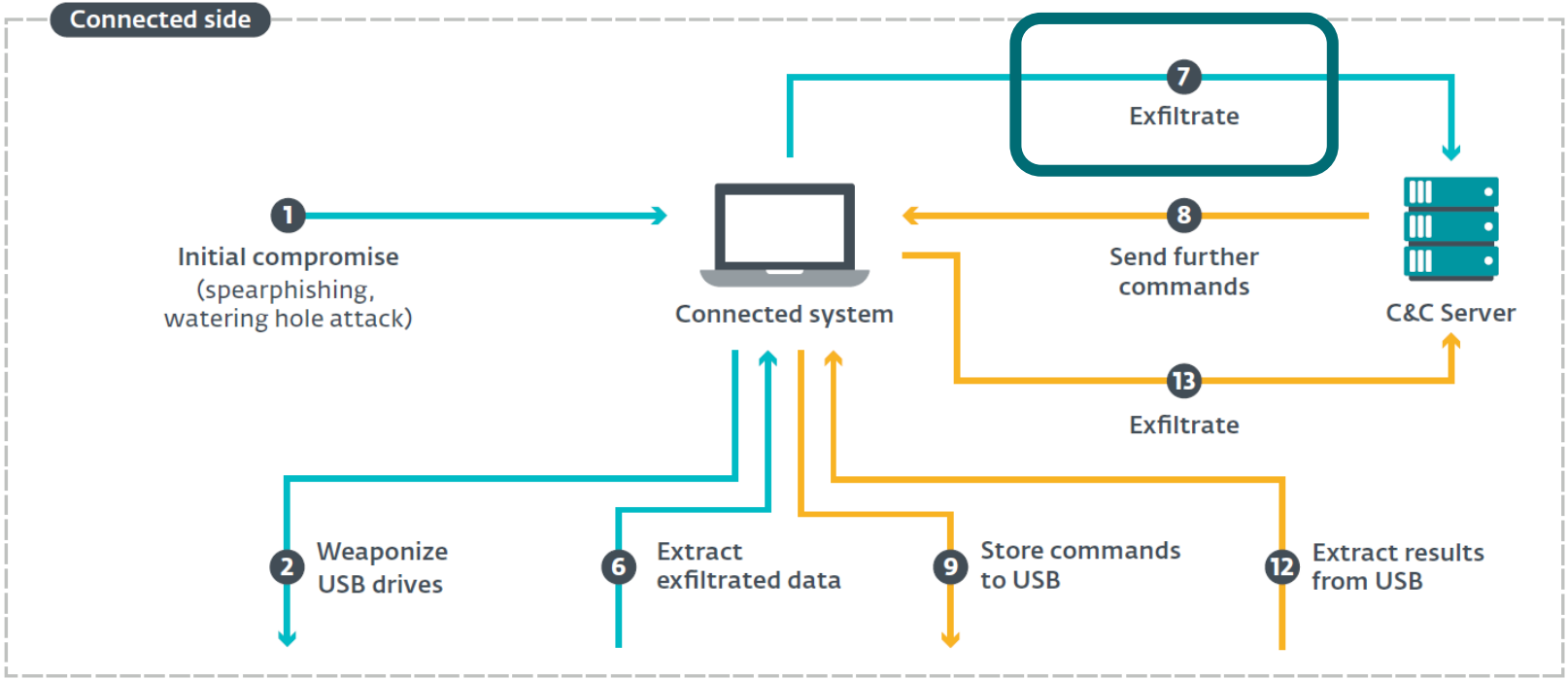


How to defend

Identifying air-gapped malware



Identifying the connected-side component



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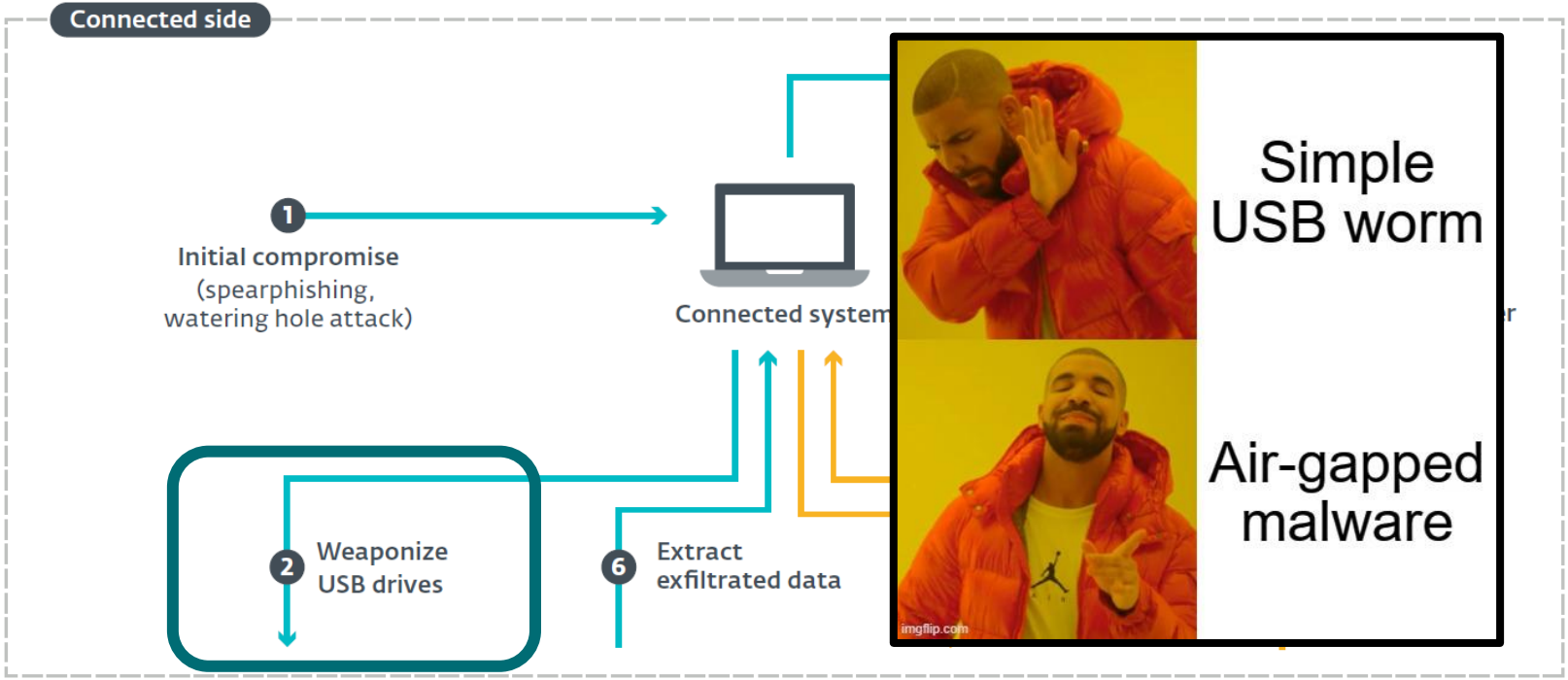
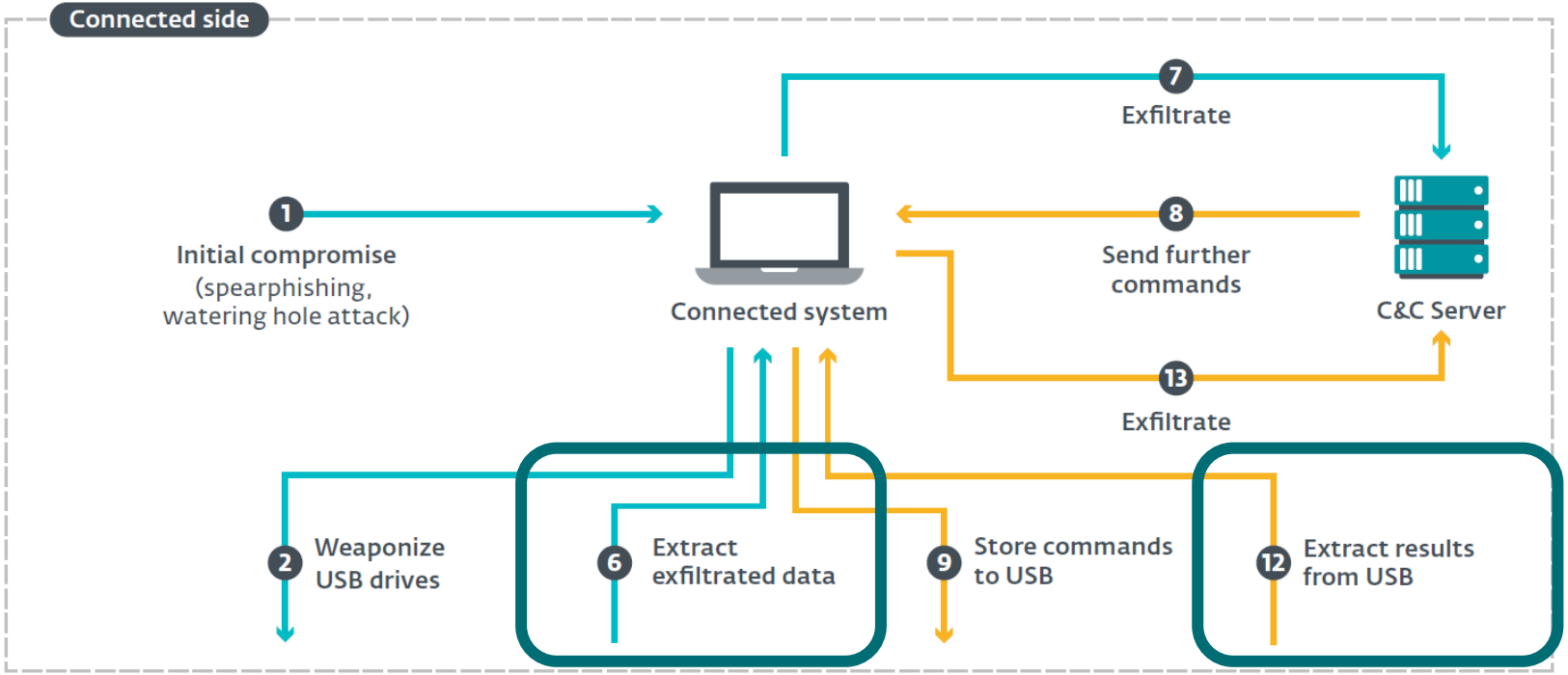
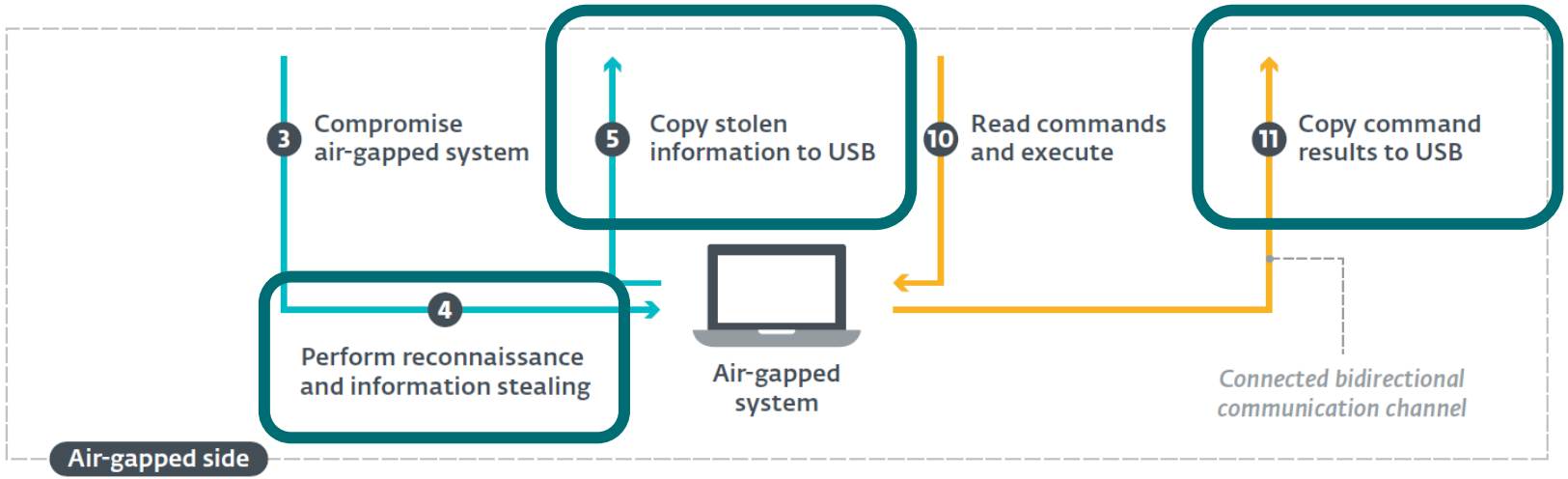


Identifying the connected-side component



Identifying the air-gapped side component



Challenges

Ramsay

Todo

- [x] prepare YARAs for VTI
  - [x] all known components
  - [ ] try to find the missing component that can communicate with Ramsay over the file-based protocol
  - [x] update YARA with last sample and run a retrohunt

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