# “I can’t go back to yesterday, because I was a different person then”

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"I can't go back to yesterday because I was a different person then" - Lewis Carroll(English Author, mathematician)

Life is like a game, unfortunately, you can't save and reload it - Chun Feng (Virus Researcher)

You still need to continue your life ! ☺

# Topics

- Hard Disk Recovery Card
  - What is a Hard Disk Recovery Card
  - How does it work
- Malware that targets Hard Disk Recovery Cards - Dogrobot
  - How does Dogrobot penetrate the protection offered by Hard Disk Recovery Cards
  - Why does it target Hard Disk Recovery Cards
  - What is its final goal

# Hard Disk Recovery Cards (You *can* go back to yesterday)

A system restore facility that can protect/restore hard disk data(MBR, partition table, files etc)

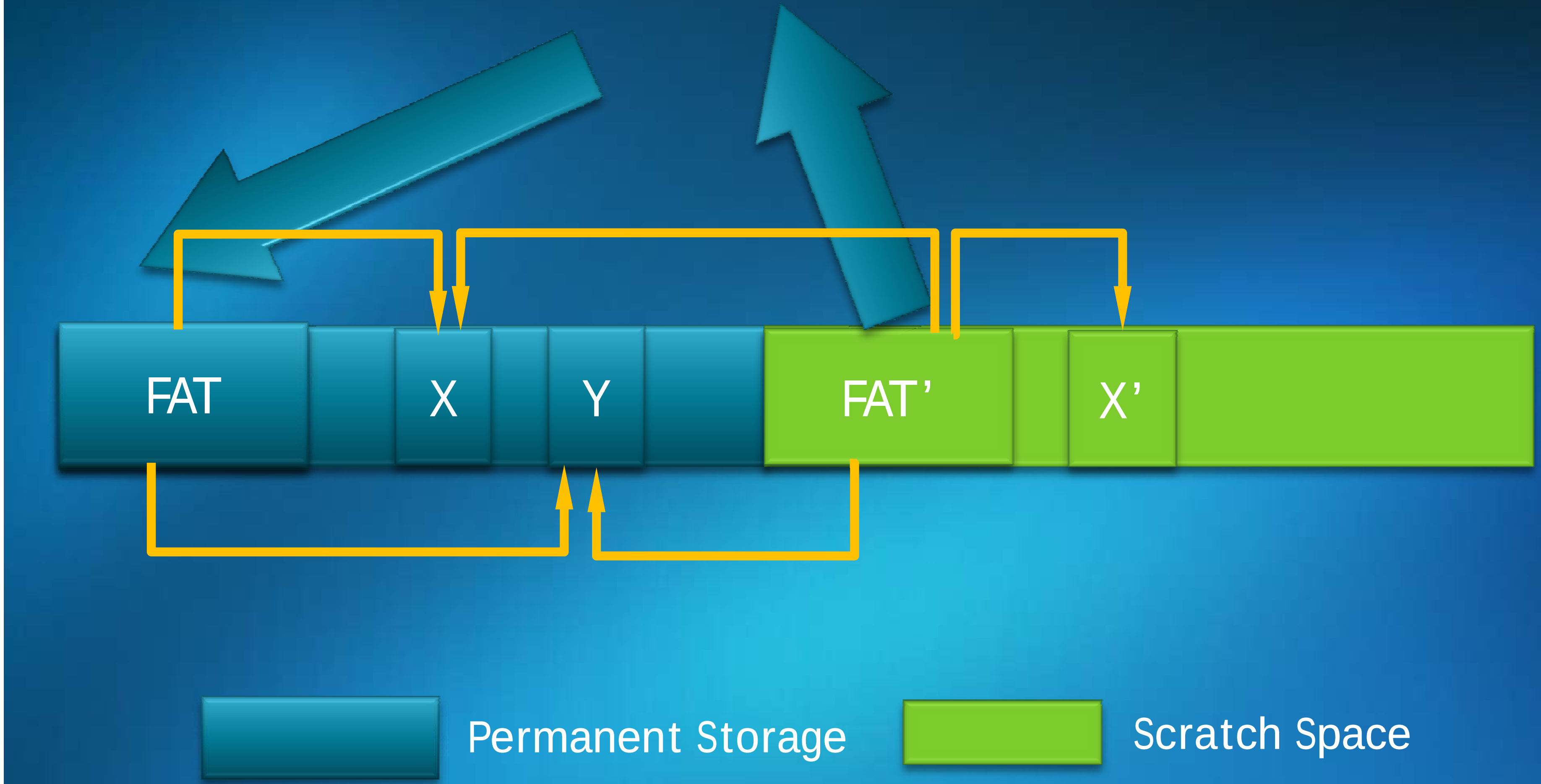
- preserves checkpoints on a hard disk
- reverts back to checkpoints(manual/auto)

# Hard Disk Recovery Cards

Widely used by computers with public access(e.g., in Computer Labs, Internet Cafés, etc.)

- Prevents ongoing  tampering with system configuration
- Restores system after infection

# How Hard Disk Recovery Cards Work? (Copy-on-Write)



FAT

X

Y

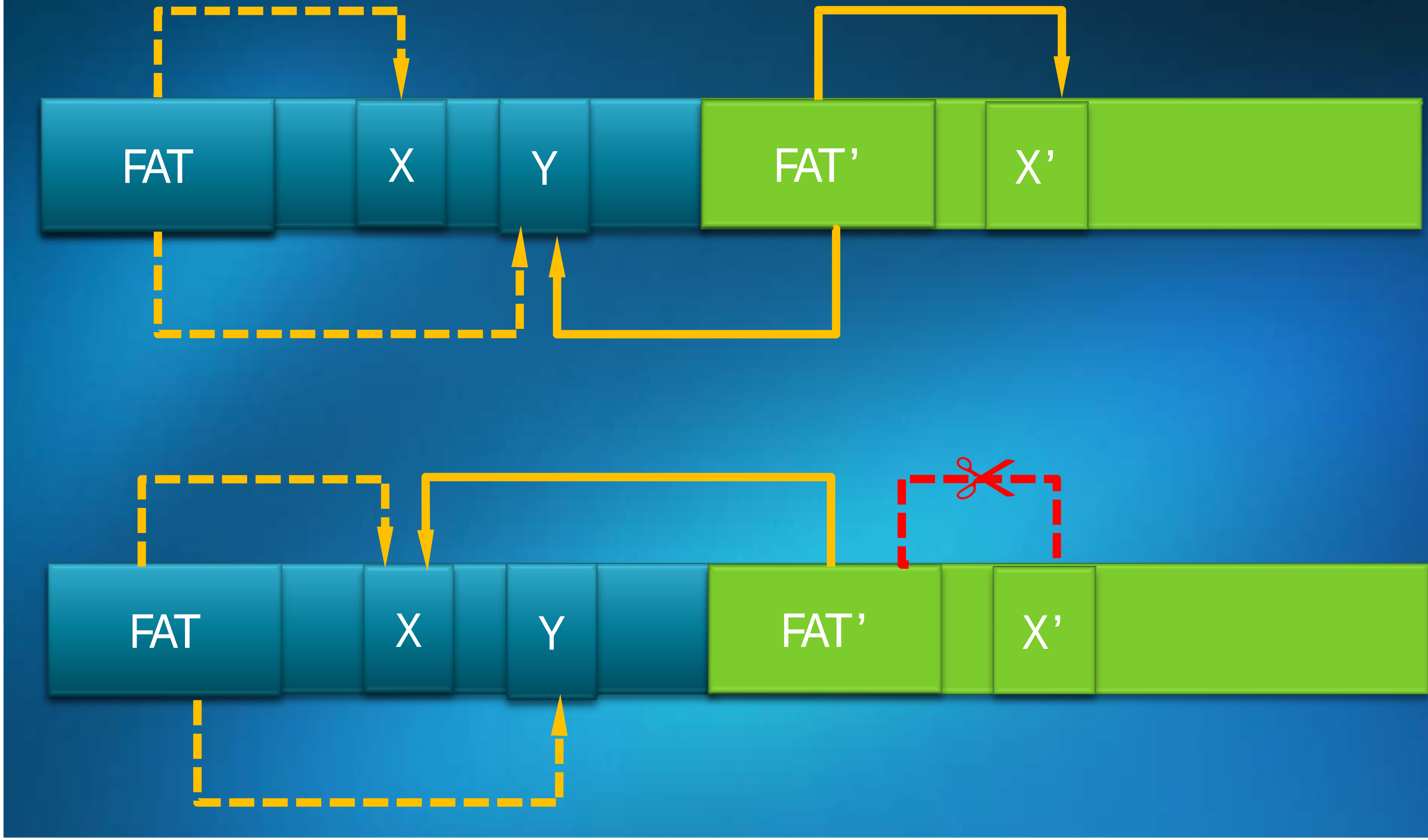
FAT’

X’

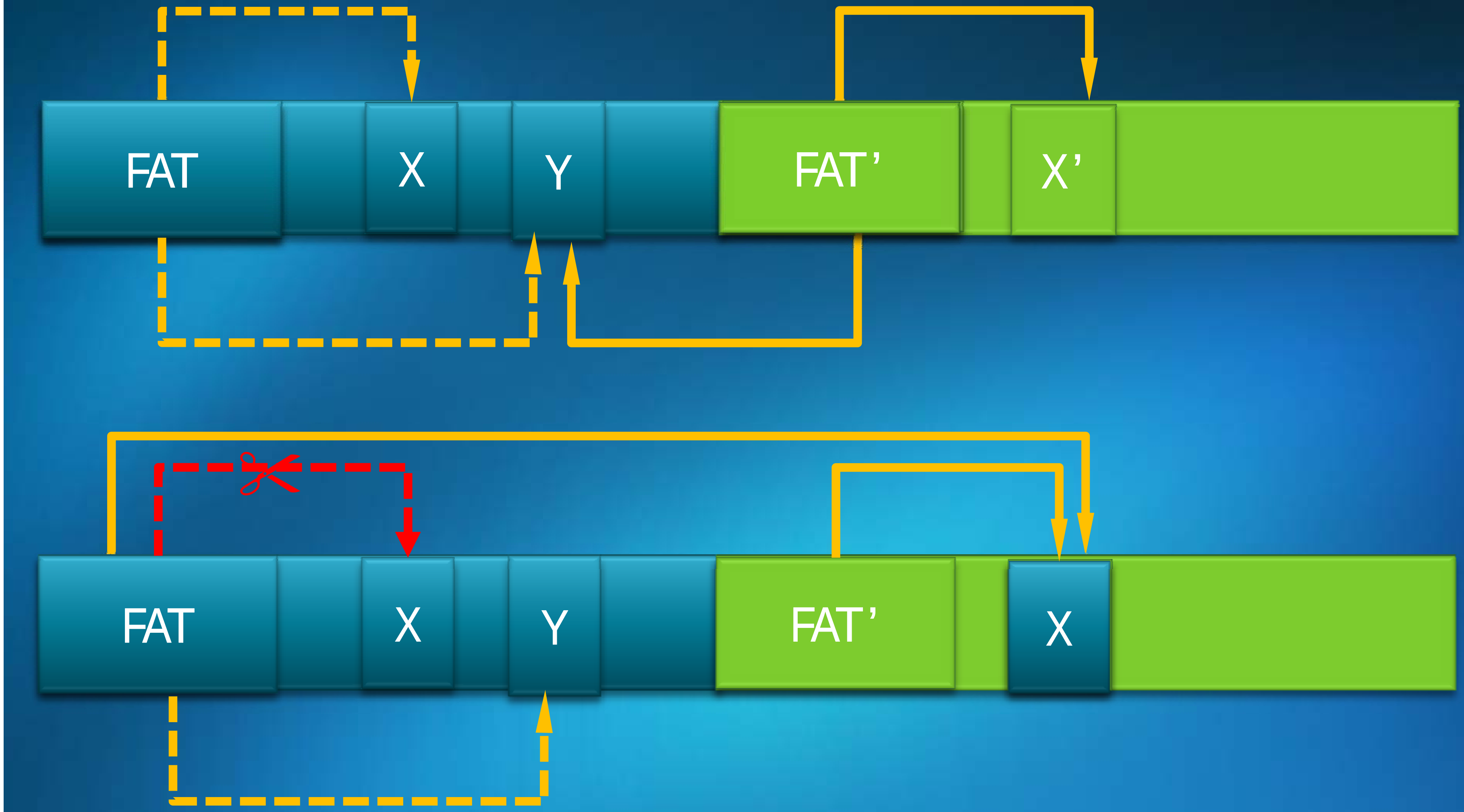
🟦 Permanent Storage

🟩 Scratch Space

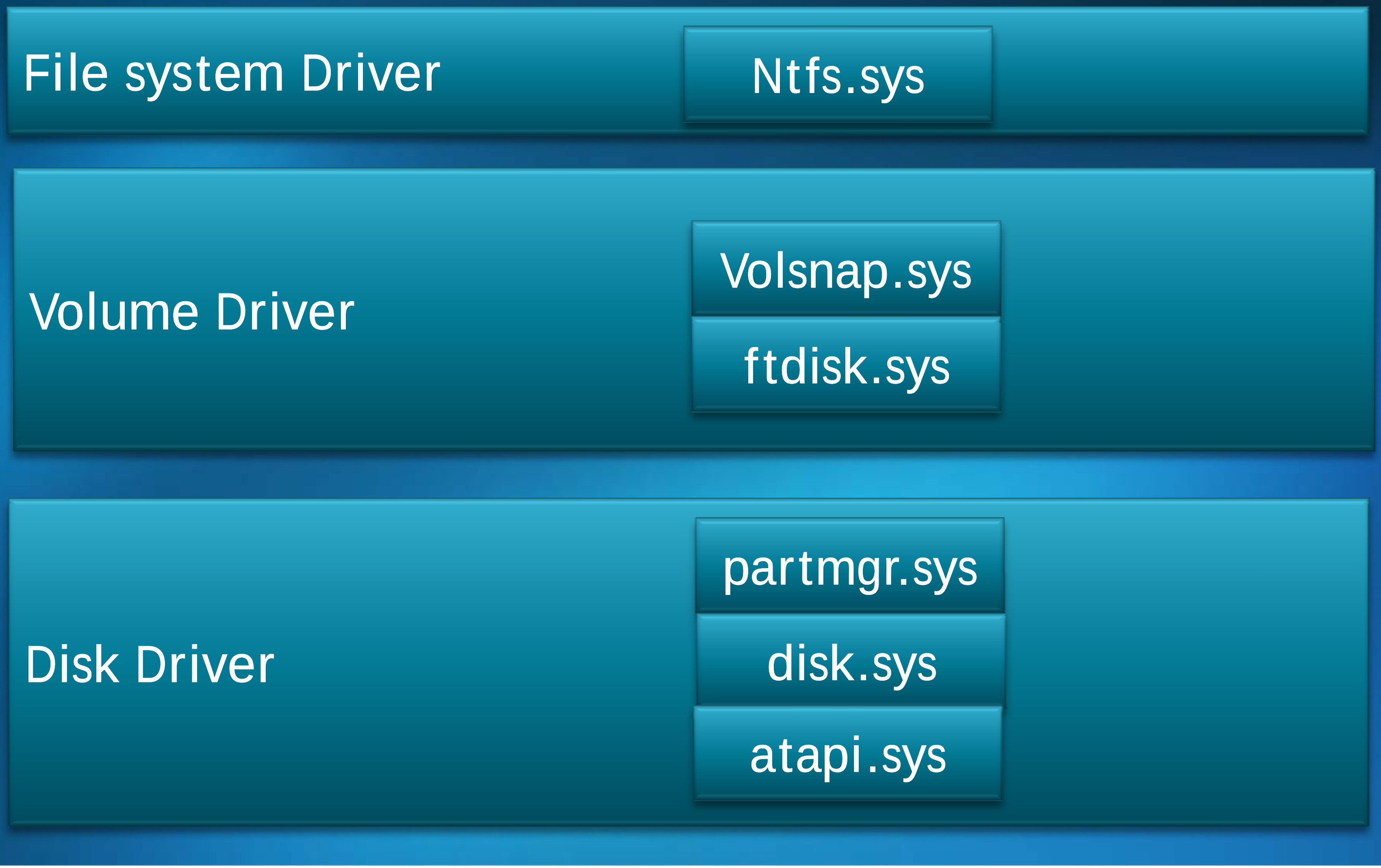
# How Hard Disk Recovery Cards Work? (revert operation)



# How  Hard Disk Recovery Cards Work?  (commit operation)



# The implementation of Hard Disk Recovery Cards ( Windows File System Overview)



File system Driver

Ntfs.sys

Volume Driver

Volsnap.sys

ftdisk.sys

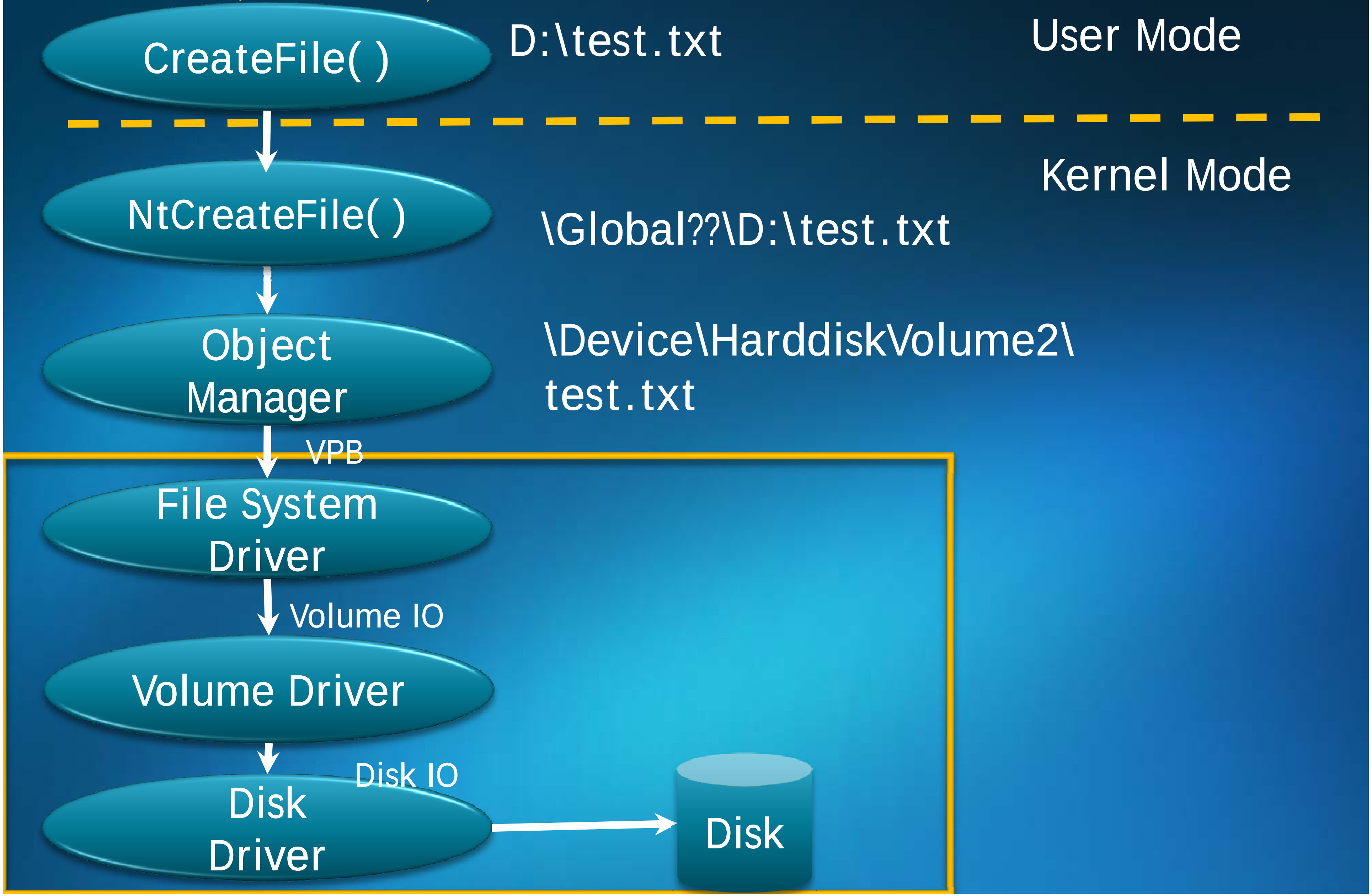
Disk Driver

partmgr.sys

disk.sys

atapi.sys

# The implementation of Hard Disk Recovery Card Windows File System Overview(Continued)



CreateFile( )

D:\test.txt

User Mode

Kernel Mode

NtCreateFile( )

\Global??\D:\test.txt

Object Manager

\Device\HarddiskVolume2\test.txt

VPB

File System Driver

Volume IO

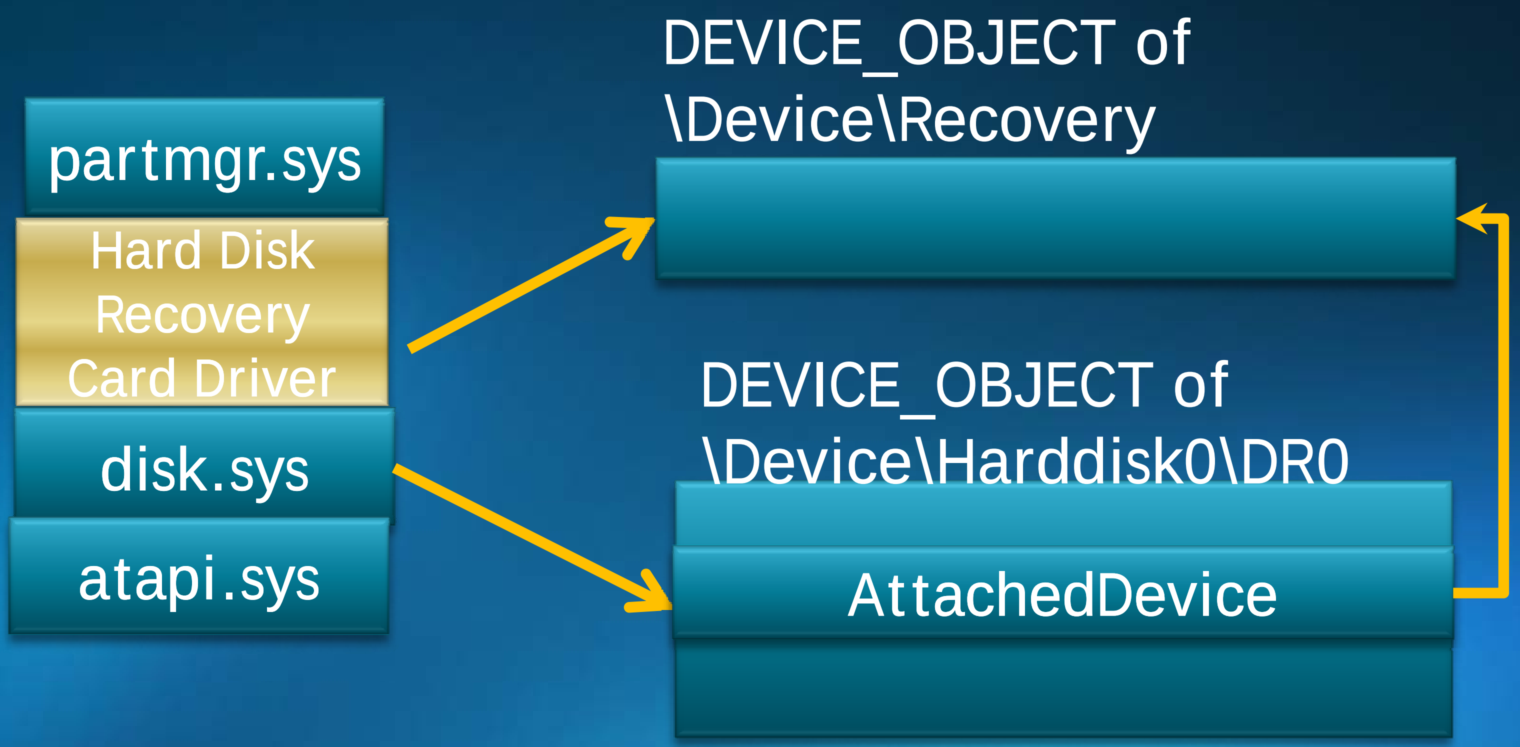
Volume Driver

Disk IO

Disk Driver

Disk

# The implementation of Hard Disk Recovery Cards (disk filter driver)



partmgr.sys

Hard Disk Recovery Card Driver

disk.sys

atapi.sys

DEVICE_OBJECT of \Device\Recovery

DEVICE_OBJECT of \Device\Harddisk0\DR0

AttachedDevice

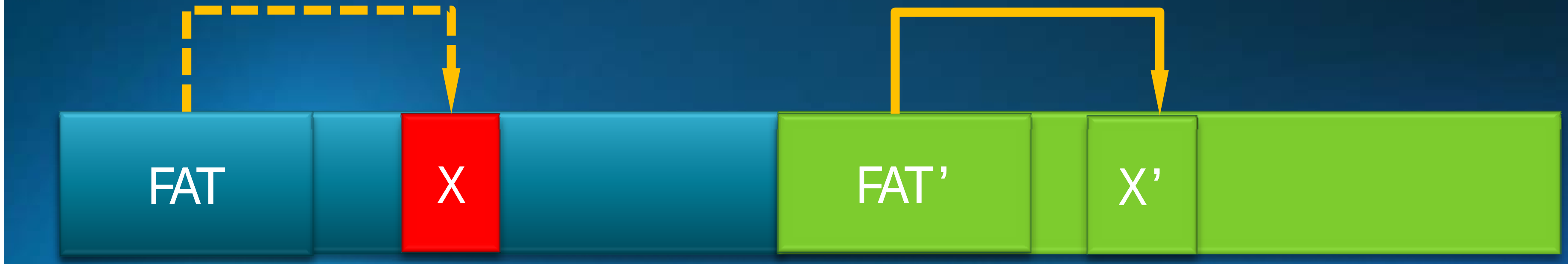
\Device\Recovery is attached onto \Device\Harddisk0\DR0

# I can’t go back to yesterday (emergence of Dogrobot)

- 1st Sample observed in September 2007
- Penetrates the protection offered by Hard Disk Recovery Cards and overwrites system file(e.g., userinit.exe, conime.exe)
- Caused 8 Billion RMB (1.2 Billion USD) loss to Internet Cafés in China

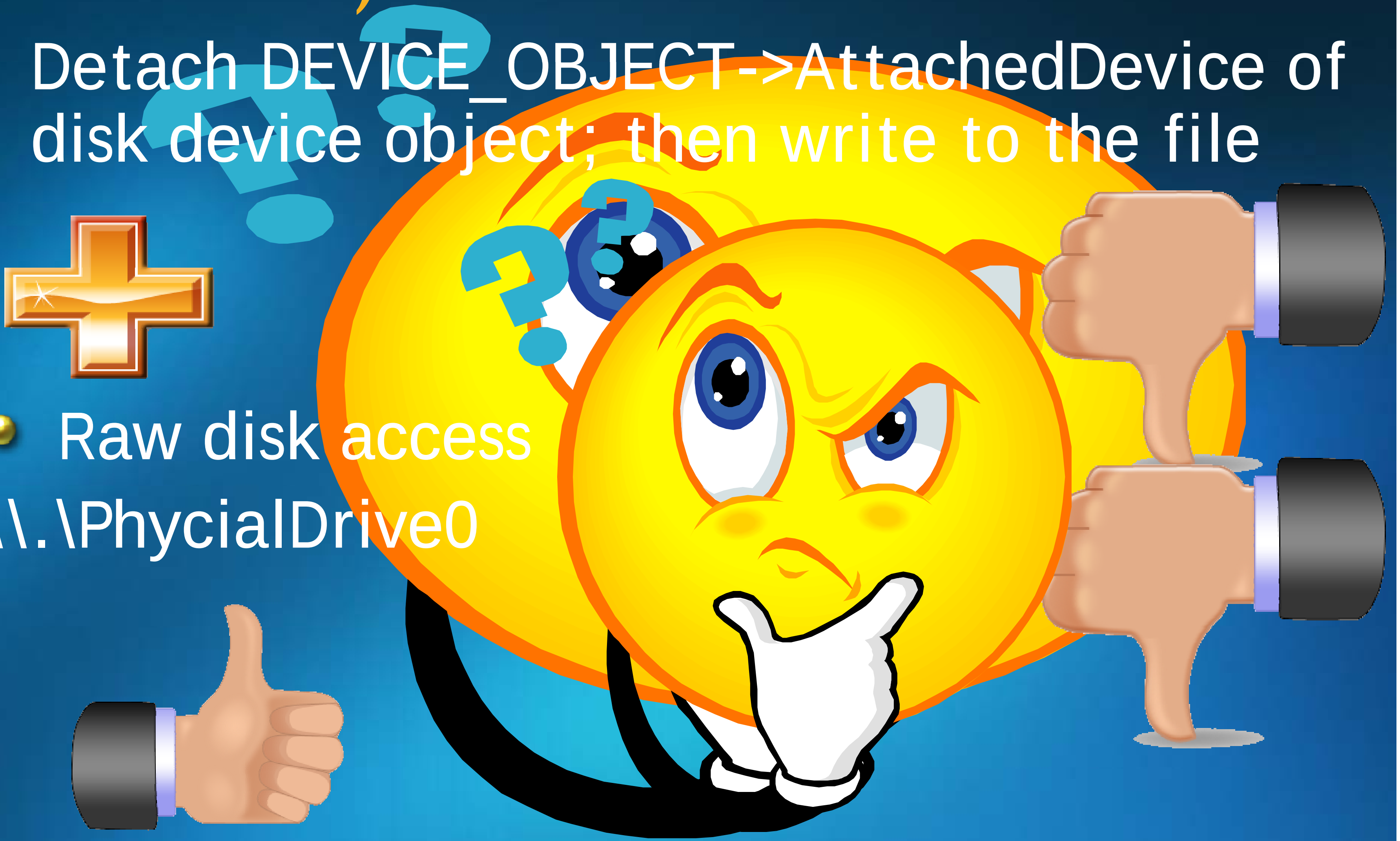
# Penetrating the protection offered by Hard Disk Recovery Card s

## Defeating “Copy-on-write”



# Penetrating Hard Disk Recovery Cards (method 1)

- Detach DEVICE_OBJECT->AttachedDevice of disk device object; then write to the file



- Raw disk access

\\.\PhycialDrive0

# Penetrate Hard Disk Recovery Card (method 2)

Unusual Disk read/write via disk.sys:

~~IRP_MJ_READ/IRP_MJ_WRITE~~

IRP_MJ_INTERNAL_DEVICE_CONTROL

construct SCSI_REQUEST_BLOCK structure to perform disk read/write

# Penetrate Hard Disk Recovery Card (method 3)

Another Unusual Read/Write via disk.sys

~~IRP_MJ_READ/IRP_MJ_WRITE~~

~~IRP_MJ_INTERNAL_DEVICE_CONTROL~~

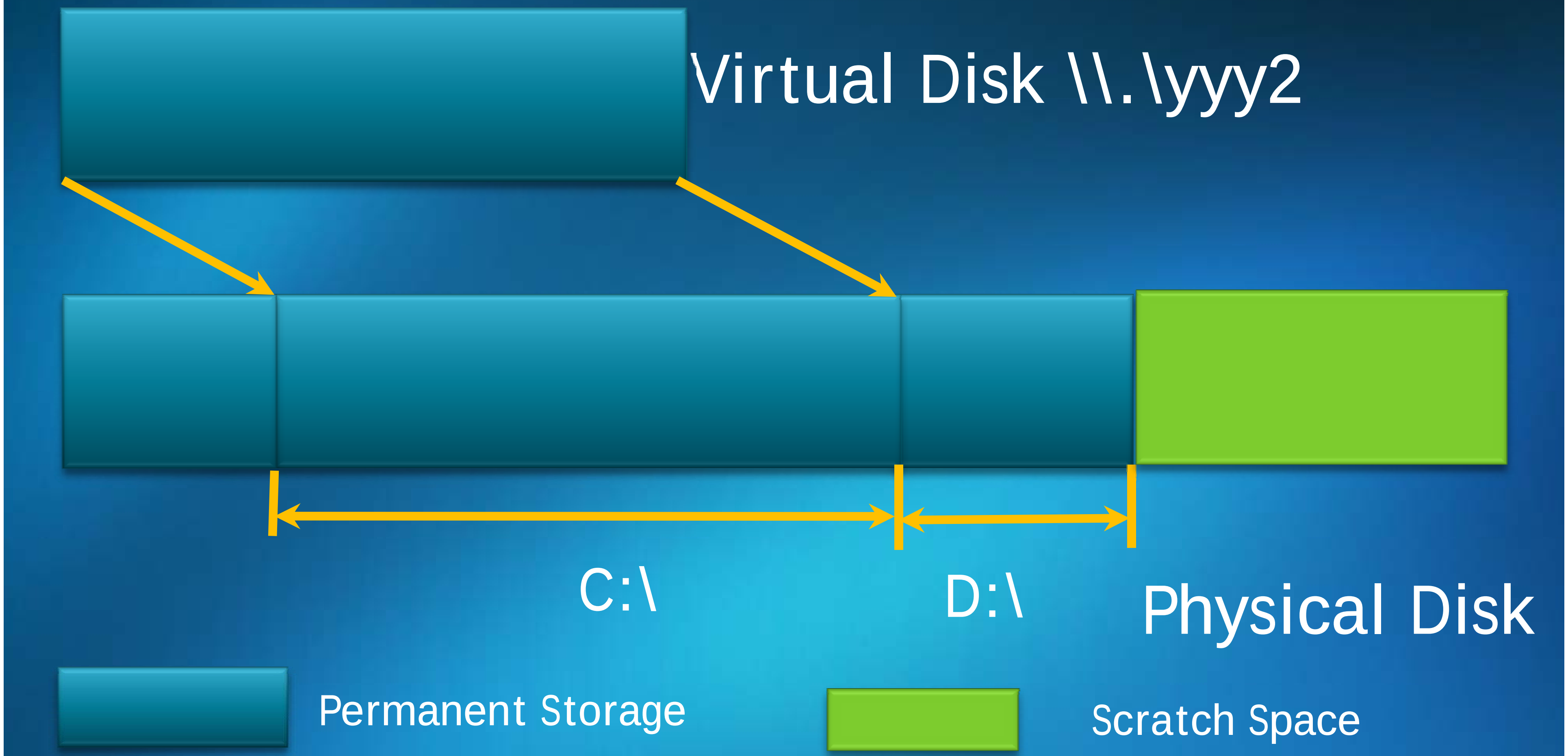
IRP_MJ_DEVICE_CONTROL with I/O Control Code:

- IOCTL_SCSI_PASS_THROUGH
- IOCTL_ATA_PASS_THROUGH
- IOCTL_IDE_PASS_THROUGH

# Raw Disk Sectors Access Limits

- Built-in file system parsing code ☹
- Does not function on compressed drive ☹
- Can only overwrite existing file, not add new files ☹

# Penetrate Hard Disk Recovery Card (Virtual Disk technique)



Virtual Disk \\.\yyy2

C:\

D:\

Physical Disk

Permanent Storage

Scratch Space

# Penetrating Hard Disk Recovery Cards (Virtual Disk technique)

- Disk read/write in virtual disk will be mapped to physical disk(permanent storage) (via unusual read/write)

Dogrobot can manipulate the files like

- Copy(“C:\\dogrobot.exe”, “\\.\yyy2\windows\system32\userinit.exe”, ...)

The file system of
\\.\yyy2 will be
mounted the same as
c: volume

# Penetrating Hard Disk Recovery Cards (Virtual Disk technique)

- Create new files ☺
- Compressed drive support ☺
- 3rd party file system support ☺

Code is based on open source Filedisk

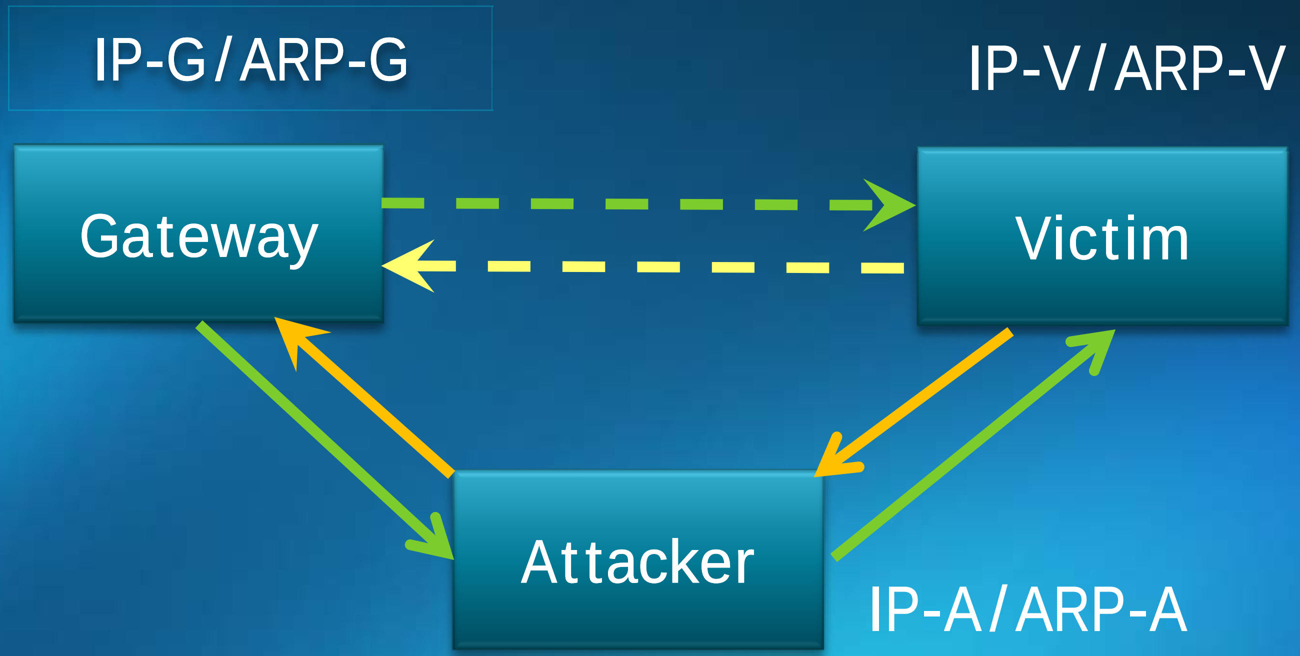
http://www.acc.umu.se/~bosse/

# Who let the dog out ?(Distributing Dogrobot)

- Via exploits( 0 day exploits, e.g. MS09-032)
- Via removable drives (using autorun.inf)
- Via ARP cache poisoning

# ARP cache poisoning

- Man In the Middle attack

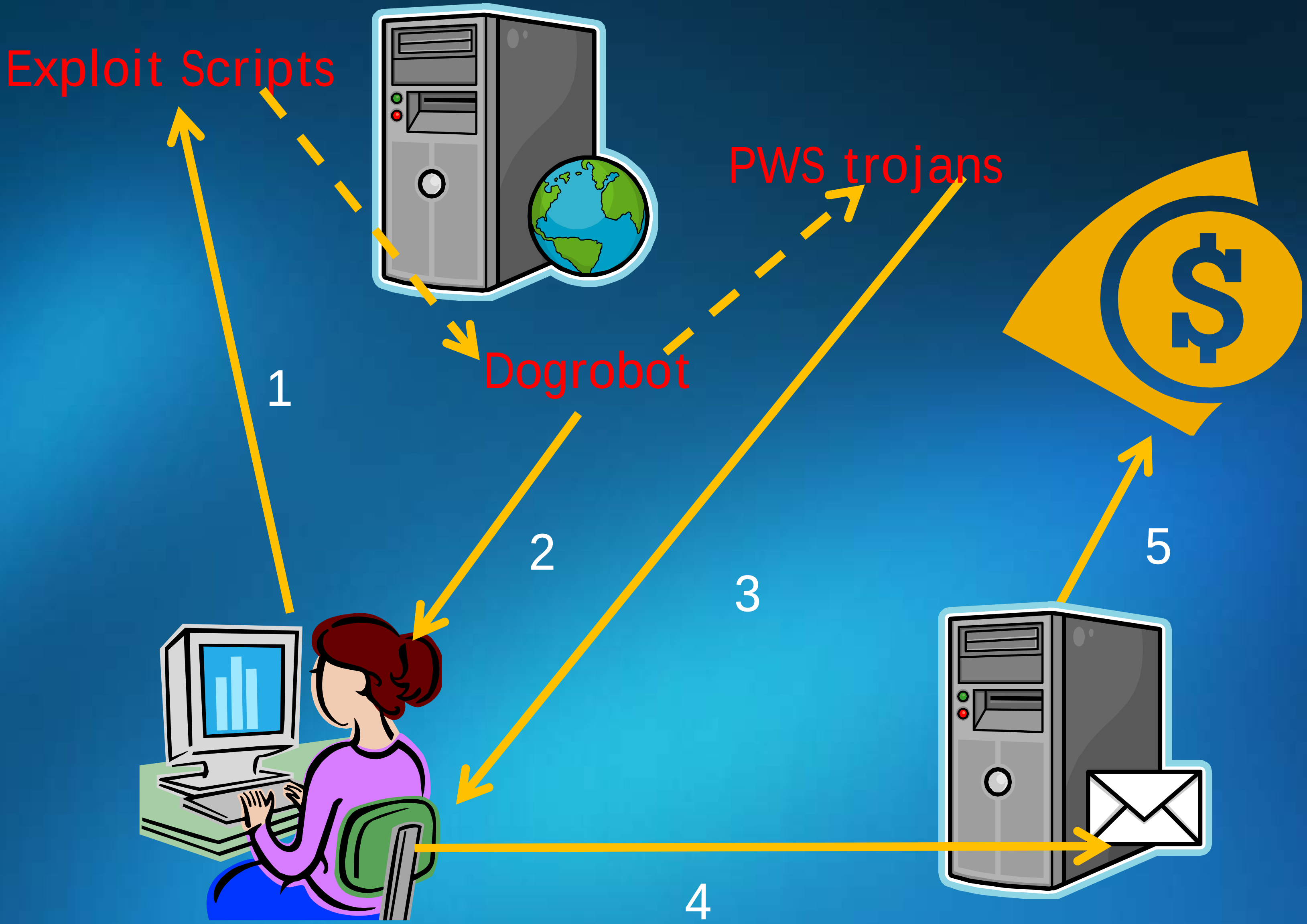


- Insert iframe with link to exploit script into HTTP(port 80) traffic

# What is the final target ?

- Designed to target Internet Cafés in China
  - Hard Disk Recovery Cards are widely used in Internet Café
  - ARP cache poisoning  is effective in Internet Café
- Sold as “black product in the black market”
- Downloads password stealing trojans (1:20)
  - Frethog
  - Lolyda
  - Zuten
  - Tilcun

# The operation of the black market



Exploit Scripts

PWS trojans

Dogrobot

1

2

3

4

5

# Black Market History

2006-2007

Viking

2007-2008

Dogrobot

# The real face of Dogrobot

- Downloads and protects PWS trojans
- Why does it target Internet Cafés ?
  Ideal place to steal online game passwords
  70% of password theft occurs in Internet Cafés(unofficial statistic)
- From the black market, for the black market

# Conclusion

- The 1st sample targeting Hard Disk Recovery Cards in the wild
- Designed specifically to target Internet Cafés in China
- From the black market, and for the black market
- I can’t go back to yesterday, but I will still enjoy today- because I still have tomorrow

# Q & A

欢迎提问

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