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INFO-6065

Ethical Hacking & Exploits

Lecture 04

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Agenda

- Scanning Networks
- Types of Scanning
- More on Scanning Tools
- Lab 04 Overview

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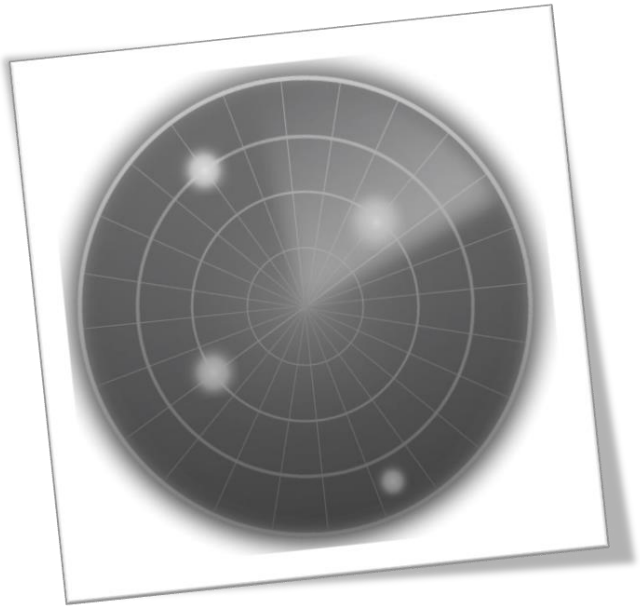
Warning

- This is course is **NOT** designed to teach you how to be a hacker
- You are **NOT** allowed to use the tools and techniques we will be covering outside of the isolated lab environment
- Use of these tools on the rest of the College's network would constitute an **Academic Offence**
- The College has full pack capture capabilities to track down illegal activity

Scanning

Scanning Networks



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Types of Scanning

- Discovery Scanning
  - Identifying live hosts on the network
- Port Scanning
  - Determining what ports are open on the hosts
- Fingerprinting
  - Determining what services are running behind the ports
- Vulnerability Scanning
  - What services have vulnerabilities that can be exploited

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Scanning Tools

There are many tools can scan at multiple layers of the OSI model and some work better than others at specific layers…

Tools available include:

Nmap Scapy, ARPing, NetDiscover, Metasploit, ICMP, fping, hping3, Dmitry, Netcat, Ncat, Amap xProbe2, Python sockets, Onsixtyone, SNMPwalk, Nessus, OpenVAS, MSF auxiliary modules, etc.

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Scanning Tools

Different protocols run at different layers of the OSI model (some cross layers, sort of)

- We will go into why you might want to scan at one layer over another

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OSI Layers

You should be familiar with the OSI model from previous courses:

- Layer 7 – Application
- Layer 6 – Presentation
- Layer 5 – Session
- Layer 4 – Transport
- Layer 3 – Network
- Layer 2 – Data Link
- Layer 1 – Physical

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Layers / Protocols

Application Layer

- Layer 7

Protocols include:

- HTTP port 80
- FTP ports 20 & 21
- Telnet port 23
- SSH port 22
- DNS port 53
- DHCP ports 67 & 68

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Layers / Protocols

Presentation Layer

- Layer 6
  - ASCII, PDF, PNG, XLSX, TLV, etc.

The presentation layer takes care of the syntax that controls how transferred data is displayed between connected systems (serialization)

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ASCII Table

Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char	Decimal	Hex	Char
0	0	[NULL]	32	20	[SPACE]	64	40	@	96	60	`
1	1	[START OF HEADING]	33	21	!	65	41	A	97	61	a
2	2	[START OF TEXT]	34	22	"	66	42	B	98	62	b
3	3	[END OF TEXT]	35	23	#	67	43	C	99	63	c
4	4	[END OF TRANSMISSION]	36	24	$	68	44	D	100	64	d
5	5	[ENQUIRY]	37	25	%	69	45	E	101	65	e
6	6	[ACKNOWLEDGE]	38	26	&	70	46	F	102	66	f
7	7	[BELL]	39	27	'	71	47	G	103	67	g
8	8	[BACKSPACE]	40	28	(	72	48	H	104	68	h
9	9	[HORIZONTAL TAB]	41	29	)	73	49	I	105	69	i
10	A	[LINE FEED]	42	2A	*	74	4A	J	106	6A	j
11	B	[VERTICAL TAB]	43	2B	+	75	4B	K	107	6B	k
12	C	[FORM FEED]	44	2C	,	76	4C	L	108	6C	l
13	D	[CARRIAGE RETURN]	45	2D	-	77	4D	M	109	6D	m
14	E	[SHIFT OUT]	46	2E	.	78	4E	N	110	6E	n
15	F	[SHIFT IN]	47	2F	/	79	4F	O	111	6F	o
16	10	[DATA LINK ESCAPE]	48	30	0	80	50	P	112	70	p
17	11	[DEVICE CONTROL 1]	49	31	1	81	51	Q	113	71	q
18	12	[DEVICE CONTROL 2]	50	32	2	82	52	R	114	72	r
19	13	[DEVICE CONTROL 3]	51	33	3	83	53	S	115	73	s
20	14	[DEVICE CONTROL 4]	52	34	4	84	54	T	116	74	t
21	15	[NEGATIVE ACKNOWLEDGE]	53	35	5	85	55	U	117	75	u
22	16	[SYNCHRONOUS IDLE]	54	36	6	86	56	V	118	76	v
23	17	[ENG OF TRANS. BLOCK]	55	37	7	87	57	W	119	77	w
24	18	[CANCEL]	56	38	8	88	58	X	120	78	x
25	19	[END OF MEDIUM]	57	39	9	89	59	Y	121	79	y
26	1A	[SUBSTITUTE]	58	3A	:	90	5A	Z	122	7A	z
27	1B	[ESCAPE]	59	3B	;	91	5B	[	123	7B	{
28	1C	[FILE SEPARATOR]	60	3C	<	92	5C	\	124	7C	|
29	1D	[GROUP SEPARATOR]	61	3D	=	93	5D	]	125	7D	}
30	1E	[RECORD SEPARATOR]	62	3E	>	94	5E	^	126	7E	~
31	1F	[UNIT SEPARATOR]	63	3F	?	95	5F	_	127	7F	[DEL]

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Encoding

BINARY	DEC	HEX	ASCII
0100 0001 =	65	41	= A
0101 0010 =	82	52	= R
0101 0100 =	84	54	= T

BINARY
0100 0001 0101 0010 0101 0100

DECIMAL
65 82 84

HEX
41 52 54

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Unicode Encoding

The Unicode Consortium (Unicode Inc.) coordinates the Unicode Standard

https://*en.wikipedia.org/wiki/Unicode_Consortium*

Members include:

- Adobe Systems
- Apple
- Facebook
- Google
- IBM
- Microsoft
- Netflix
- SAP SE
- Oman's Ministry of Endowments and Religious Affairs

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Layers / Protocols

Session Layer

- Layer 5 – Responsible for communication synchronization

Protocols include:

- NetBIOS
- RPC
- SMB
- NFS
- SOCKS (port 1080)

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Layers / Protocols

Transport Layer

- Layer 4

Protocols include:

- TCP
- UDP
- SCTP
- AH

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Layers / Protocols

Network Layer

- Layer 3

Protocols include:

- IPv4
- IPv6
- IGMP
- ICMP
- ESP
- IPSec

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Layers / Protocols

Data-link Layer

- Layer 2

Protocols include:

- ARP
- RARP
- ATM
- MPLS
- L2TP

```
┌──(root㉿artmack)-[/]
└─# macchanger -h
GNU MAC Changer
Usage: macchanger [options] device

  -h,   --help                  Print this help
  -V,   --version               Print version and exit
  -s,   --show                  Print the MAC address and exit
  -e,   --ending                Don't change the vendor bytes
  -a,   --another               Set random vendor MAC of the same kind
  -A                            Set random vendor MAC of any kind
  -p,   --permanent             Reset to original, permanent hardware MAC
  -r,   --random                Set fully random MAC
  -l,   --list[=keyword]        Print known vendors
  -b,   --bia                   Pretend to be a burned-in-address
  -m,   --mac=XX:XX:XX:XX:XX:XX
        --mac XX:XX:XX:XX:XX:XX  Set the MAC XX:XX:XX:XX:XX:XX
```

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Layers / Protocols

Physical Layer

- Layer 1
  - The actual data on the wire, or other media

Protocols include:

- Digital Subscriber Line
- Infrared
- Bluetooth
- Ethernet

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OSI Layers of Most Interest

- We have discussed in other courses that the Internet was initially designed to allow trusted end points to communicate
- Many of the lower layer protocols still exhibit behaviors based on the initial idea of trust
  - For example, many protocols are designed to send a response, regardless of whether a connection is allowed
  - This lets you determine what hosts are running on the network
- Layers 4, 3 and 2 are the most useful in terms of Scanning

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OSI Layers of Most Interest

Layer 2 Scanning

- Advantages
  - Very fast and reliable scans
- Disadvantages
  - Limited to finding systems on the network segment you are connected to (non-routable)
  - Single broadcast domain
- At layer 2 we are primarily using ARP requests to find live hosts

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OSI Layers of Most Interest

Layer 3 Scanning

- Advantages
  - Slower that layer 2 scanning, but still relatively fast
  - Can be used to discover systems on network segments other than the one your system is connected to (routable)
- Disadvantages
  - Layer 3 protocols are often discarded by firewalls
    - Both standalone appliances and host-based software
- At layer 3 we are primarily using ICMP (Internet Control Message Protocol) to discover hosts
  - ICMP echo requests and replies

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OSI Layers of Most Interest

Layer 4 Scanning (TCP)

- Advantages
  - Like layer 3 scanning it can be used to discover remote systems (routable)
  - It is harder to filter than ICMP requests, so you get results more reliably
- Disadvantages
  - Stateful firewalls are effective at blocking TCP traffic
  - Layer 4 scans can be very time consuming
    - There are 65,536 ports after all

- A large variety of TCP scans are available

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OSI Layers of Most Interest

Layer 4 Scanning (UDP)

- Advantages
  - Like layer 3 scanning it can be used to discover remote systems (routable)
  - Can be used to discover hosts when TCP is being filtered
- Disadvantages
  - Can produce inconsistent results based on the port and service you are scanning
    - UDP probe requests can get a ICMP port-unreachable response letting you know the system is live, or the service may simply reject the unsolicited traffic
  - As with TCP, layer 4 scans can be very time consuming

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Why Teach Hacking?

- You need to know how attacks occur to be able to protect your organization from them
- Organizations often don't see the need to spend money on security until they have been compromised
  - Doing a penetration test can often show management where the holes are, and give them a reason to approve spending money on closing these holes

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Are We Teaching Hacking?

- It is more technically accurate to say we are teaching Penetration Testing Methodologies or Ethical Hacking
- The term “Hacking” has developed a bad reputation over the years
  - It used to designate people who tried to find ways to get a product to do something it wasn’t intended to do
  - Over the years hacking has become associated with only the negative, and often illegal aspects

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Types of Hackers

White Hat

- Breaks security for non-malicious purposes
- Often legally hacks their own environment, or the environment of others to test security

Black Hat

- Breaks security for malicious purposes
- Many/most of their activities are illegal

Grey Hat

- Breaks security for less easily definable reasons
  - Finding flaws, then notifying companies
    - May be trying to get a bounty for the hack, or the fix
  - Hacktivism

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Dual Nature of Tools

- Most tools can be used for good or bad
- Password Cracking Tools
  - It is obviously wrong to use a password cracking tool to break into a privileged account.
  - If you use the same tool to check the strength of your password policies, you are protecting the organization
    - Always ensure you have permission
- "Hacking" tools can be used to test for a wide variety of problems
  - Firewall Policies, SQL Server configuration, etc.

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Recognizing Attacks

- Knowing what it looks like when you are under attack helps you protect the organization
  - If you see a ping sweep one day, followed by some targeted port scans later in the week, you are probably going to see an attack in the near future
- The more tools and techniques you have used, the greater the chance you will recognize an attack when it is happening
  - Even if you are simply interpreting the results of an automated tool such as an IPS

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Legal Concerns

- You need to be very careful when doing any pen-testing or ethical hacking activities
- Laws change depending on where you are performing the activities and whether you are working in the public, or private sector
- You need to make sure you are authorized to perform a pen-test or ethical hacking before you begin

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Personal Lab Setup

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Reasons to Build a Lab

- I have mentioned numerous times that you need to be very careful where you use pen-testing tools
- Creating an isolated lab environment gives you the ability to practice, research and learn how to use the tools without worrying about breaking any laws
  - If the lab is completely isolated, you also don't need to be in G Building to use these tools

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Network Level Isolation

- LAN segments give you the highest degree of isolation
  - No virtual NIC on the host machine
  - VMs can only communicate with other VMs on the LAN segment
  - Packet captures will only see the traffic on the LAN segment, not your host machine
    - Reduces the background noise and lets you see what is actually happening

Note: You may periodically require a NAT connection for Kali to do upgrades or add packages

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VMWare Network Types

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Virtual Network Details

Bridged

- Connected to your laptops physical NIC
- No isolation
- VMware doesn't provide DHCP

Host Only

- Connected to virtual NIC on laptop
- Isolated from the Internet
- VMware provides DHCP
- VMs on network can talk to each other and host computer

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Virtual Network Details

Custom vmnet (most similar to host-only)

- Connected to virtual NIC on laptop
  - Created when you create the custom vmnet
- Isolated from the Internet
- VMware provides DHCP
- VMs on network can talk to each other and host computer

LAN Segment

- No virtual NIC on laptop
- Completed isolated from laptop
- VMware doesn't provide DHCP

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Virtual Network Details

NAT

- Connected to a virtual NIC on laptop
- Internet connectivity
- VMware provides DHCP
- VMs on network can talk to each other, host computer and the Internet

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Configuration Notes

When you are working with VMs you should power the VM down before changing the network type

- Moving from NAT to Bridged for example
- It may work without powering off, but it is better to power the VM off

Always confirm network connectivity before proceeding to more advanced steps

- ipconfig
- ifconfig
- ping

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Setting Hostnames in Linux

When you are changing the hostname on a Linux machine you need to edit a specific file:

- /etc/hostname
- This is the name of the file that holds the value for the hostname

You can use a variety of tools to edit the file

- VI (command line)
- Nano (command line)
- Gedit (GUI tool)
- Leafpad (GUI tool)

I don't mind which tool you use during the labs as long as you manage to make the appropriate change

- You do need to be comfortable with VI though

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Changing IPs in Linux

Temporary and permanent methods to change your IP:

- Temporary Method: (not recommended)
  - ifconfig eth? 10.0.0.10 netmask 255.255.255.0
    - You will notice the question mark, this means you need to provide this value
    - You can use ifconfig alone to determine this value
- Permanent Method: (recommended)
  - edit /etc/network/interfaces
  - save
  - reboot

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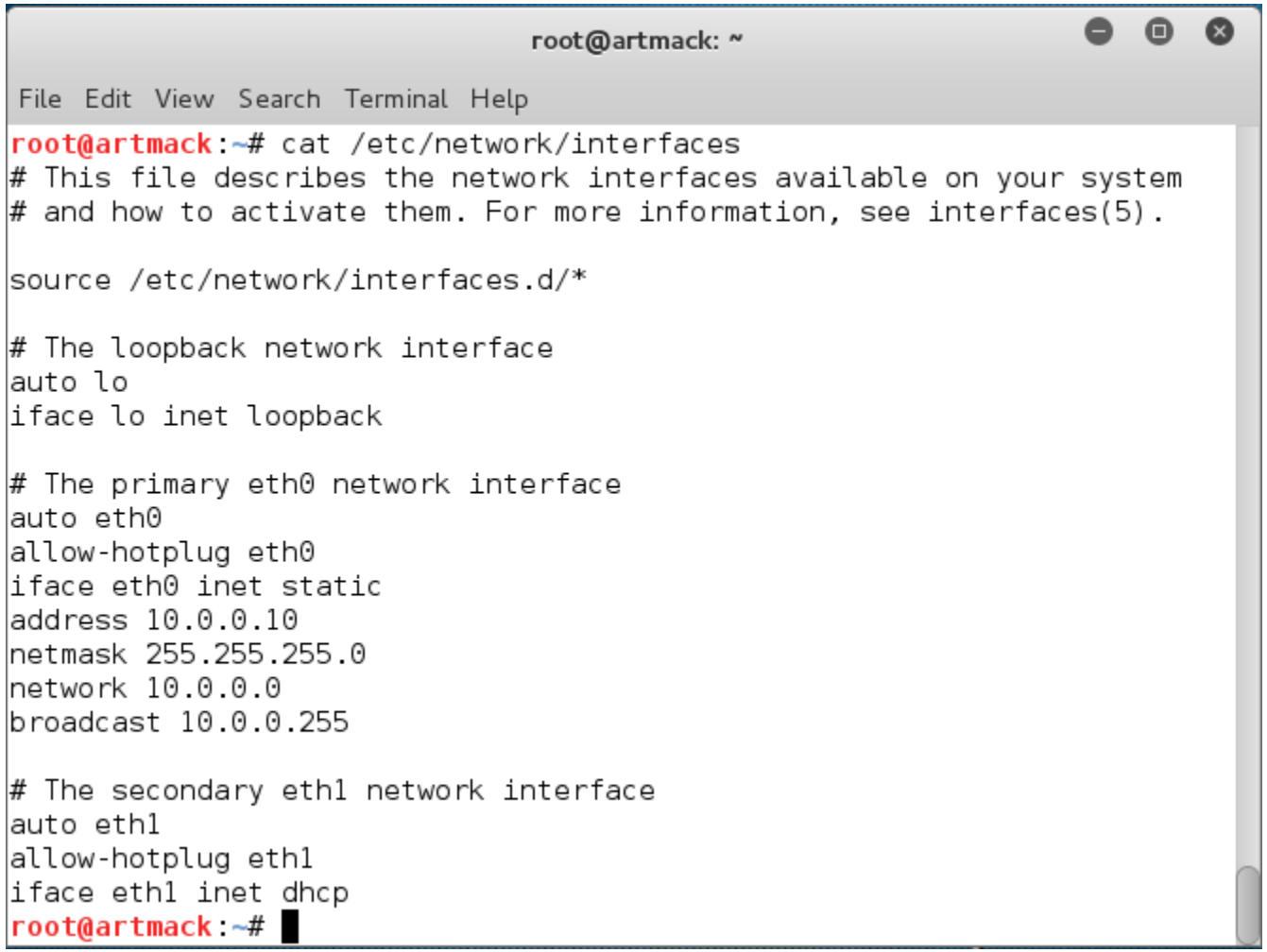
/etc/network/interfaces



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Metasploitable2

- Created by Rapid7, the same people who created Metasploit
- Ubuntu Linux distribution that has vulnerabilities built into it
- Great tool for demonstrating common vulnerabilities
- Much easier to get repeatable results with a tool like metasploitable2
- We will talk more about metasploitable2 when we start doing some specific exploits

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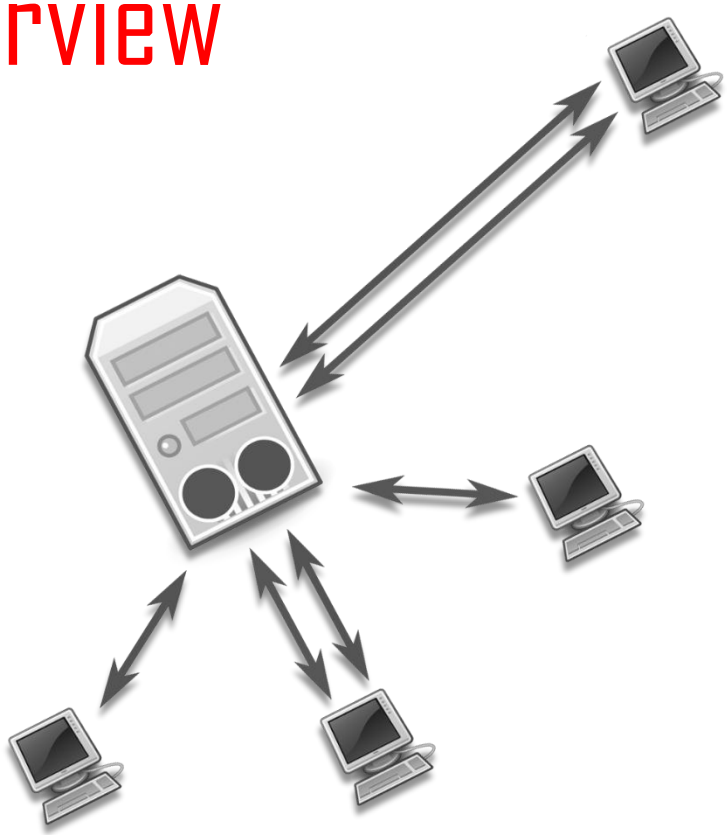
Lab 04 Overview



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Lab 04 Overview

- Comparing nmap results
- Angry IP Scanner
- Wireshark
- Netdiscover
- Bash Scripting
- Challenge Script