

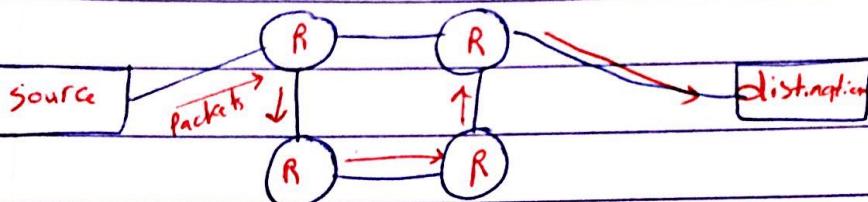
Network layer

* Network Protocols in every host & Router

* why we use Network layer ??

1. Forwarding: move Packets from input router to output router

2. Routing: determine routing traffic from source to destination (using shortest routing Algorithm)



* IP protocols:

1. IPv4 : 32 bit

2. IPv6 : 128 bit

* IP Usage

1. Identifies host

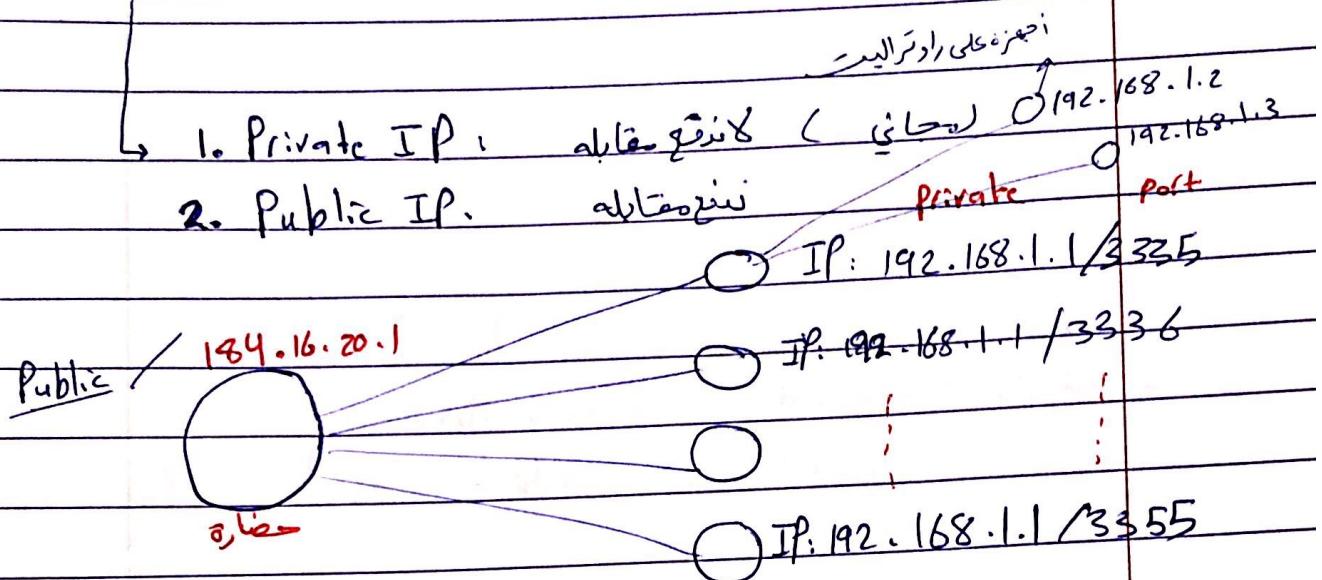
2. Interface connection between host & router
, between router & Physical link.

3. naming System

* In order to avoid the waste of IP address the ISP (Internet Service Provider).

1. Subnetting

2. NAT (Network address Translation)



Private IP's : 10.0.0.0 - 10.255.255.255
: 172.16.0.0 - 172.31.255.255.
: 192.168.0.0 - 192.168.255.255

2) NAT (PAT)

NAT Translation Table

Port	Public	Private	
	138.76.29.7	10.0.0.1	3345
		10.0.0.2	3345
		10.0.0.3	3345

له نفس ال port , Publ. ينبع Private من *

PAT : Port Address Translation

2) static NAT : ترجمة ثابتة من Private to Public *

Public IP → Private IP (1)
(2)

3) dynamic NAT : Private goes to Public as *

Public IP → Private IP
Public IP → Private IP
Public IP → Private IP

it Public goes to many Private IPs *

* How we can get private IP??

1. manually by system Admin (for Printers)

2. DHCP: Dynamic Host Configuration
Protocols (for internet)

Local Host:

"Local Host or loop back address"

: its an IP address that specifies the local Computer

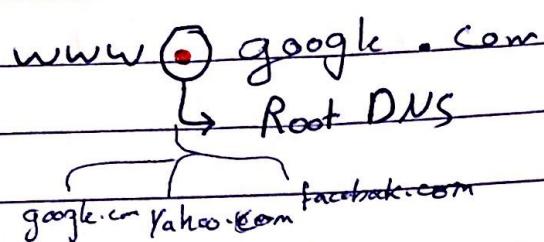
Example on Local Host: 127.0.0.1 (IPv4)
::1 in (IPv6)

CMD → Ping 127.0.0.1 جستجوی خود به سیستم
; این آدرس را می بینیم که در سیستم وجود دارد
= همیشه آدرس Local Host است

> Ping Local Host -4- // IPv4 → IPv6 زیرا
-6- آدرس Local Host است
IPv6 بطبع

DNS: (Domain name Server) or system

; Used to map between IP & domain name



* which Application use DNS??

HTTP : Http:// www-Yahoo.com → IP: 212.14.10.0

- 1) Browser extract host name (Yahoo.com)
- 2) Send host name to DNS
- 3) DNS does look up & return IP address
- 4) Browser send HTTP Get to IP address (HTTP Browser)

Inet address lib (in Java) : (Internet address(Ip))

java.net.InetAddress

1. encapsulate IP address & the domain name
For the same address
2. Inet address handle IPV4 & IPV6 address

```
import java.net.InetAddress  
import java.net.UnknownHostException;
```

```
public class InetAddress IPFinder
```

```
{
```

```
    public static void main() throws Exception {
```

```
        InetAddress ia =
```

```
        try {
```

```
            ia = InetAddress.getLocalHost();
```

- الحالات الممكنة للعنوان
- ١) return my private IP (192.168.1.10) localhost
 - ٢) return (127.0.0.1) loop back
 - ٣) return nothing when we have high protection & firewall

```
s.o.println("Localhost" + ia);
```

```
} catch (Exception e) {
```

```
s.o.println("nothing");
```

```
}
```

ia = InetAddress. getLoopBack();

s.o.p("loopBack" + ia);
127.0.0.1

ia = InetAddress . getByName("www.google.com");
* www.google.com / 213.14.16.1

s.o.p("google address" + ia);
www.google.com / 172.14.10.1

InetAddress [] aia = InetAddress.getAllByName
("www.yahoo.com");

for(int i=0 ; i < aia.length ; i++) {
s.o.p("Address" + i + ":" + aia[i]);
[Address 0 : www.yahoo.com/87.248.100.215]
[Address 1 : www.yahoo.com/87.248.100.216] #

محطيات الارواد السابقة ←
Local Address || LoopBack
address (اعنوان) ||
array (ارجاع)

Domain Name (النطاق)

Root

.com/edu/net/gov

InetAddress

UnknownHostException

public class InetAddressFinder { * HostName

public static void main() throws

UnknownHostException

ما يندر في

string

=

InetAddress a = InetAddress.getByName("31.13.92.36")

S.o.p(a.getHostByName())

HN IP

Type A (HN > IP)

facebook 31.13.92.36

facebook.com

in type A IP

in type CName

alix 31.13.92.36

IP مرتبط بـ HN

CN alias

IP

Type CName

ربط الـ CN بـ IP

الاسم المسمى بـ CN

IP

S.o.p(a.getCanonicalHostName())

method Reachable

InetAddress.isReachable()

S.o.p(a.isReachable(5));

// false

milliseconds

true

true

V4 or V6 go to IP ١١ إيجاد #

لـ lib
البيانات

Public class InetAddressVersionTest {

 Public static void main () throws UnknownHostException {

}

 InetAddress ia = InetAddress.getByName ("www.google.com")

 byte [] a = ia.getAddress();

↓

بيانات

Byte

 if (a.length == 4) {

 System.out.println ("The address belong to IPv4");

 if it has 4 bytes then it's IPv4

* If IPv4 : 4 byte = array [1:4] *

 else if (a.length == 16) {

 System.out.println ("The Address belong to IPv6");

* If IPv6 : 16 byte = array [1:16] *

(Section 8)

Downy wrens

TPU 172.114 - 18.10 / 32 = 4 Bgfr
IPR (00:2F:---) 18-16Byfr
IPR 8

Normal

asymmetrical mouth markings

sharp yellow & black V-shaped throat

yellow breast

breast

في بلدان مختلفين؟ Domain Name

..... عواني جوغرافية بالازون : ex

```
import java.net.  
public class InetAddressCompare {  
    public static void main() throws  
        unknown  
        InetAddress ] 21:b  
    }  
}
```

InetAddress Ps = InetAddress.getByName("www.google.ps")
InetAddress Jo = InetAddress.getByName("www.google.jo")

العنوان IP / IP المطلوب

www.google.ps / IP (142.250.186.99) for Ps
stomail (142.250.186.131) for Jo

if (Ps.equals(Jo)) { } ⇒ string is

sop ("is Same IP"); } ⇒ في الواقع

else بتساءل العنوانين

sop ("not Same IP"); } }

ia. getByName = => String

www.google.com / 142.250.186.99 // Method output

ia.getHostAddress () => String

142.250.186.11

ia.getHostAddress () => String

www.google.com

ia.getAddress () :

byte ترجع

؟

IPMethods الـ main lib

1) work as IP planner : address book

2) work as IP Analyzer , analyze (IP) → GUI

InetAddress a = InetAddress.getByName ("www.yahoo.com")

String s = a.toString();

s.o.p(s)

string IP بيفاتح كيرو لا يدخل احواه

لما نقل من نظام لـ IP اخافط على آخر العنوان يعني النقل

"Network Interface type"

* Network Interface Controller (NIC) :-

a computer hardware that connects computer to Network

ex:

- 1) Network Card : NIC
- 2) Ethernet : (RJ) Jack
- 3) Wireless : (Wi-Fi)
- 4) Computer Bus :

Network Interfaces

1) ~~* * NIC~~

2) ~~* * Network interface devices:~~

↳ Mobile Phone

3) Virtual Network Interface:

a bstract virtualized representation
of computer Network interface

1) Virtual switch
2) Virtual Router
3) Virtual Network

simulation
+
VMW
virtual Machine Software
Linux
N₂ → C++
N₃

4) Loop Back Interface : a virtual Network interface
that connect host to it self

127.0.0.1

loop back interface



Interfaces كليكي

cmd : > IPConfig \Rightarrow تطبيق لعرض أذونات الشبكة والسائل (windows) DHCP || DNS ، عروض تطبيقات الخصم ، معلومات

> Ifconfig \Rightarrow in Linux ifconfig

نعرف عن كل الاجهزة بالشبكة، الاجهزة التي تعرف عن كل الاجهزة بالشبكة، الاجهزة التي تعرف عن كل الاجهزة بالشبكة

import java.net.NetworkInterface;

import java.net.SocketException;

import java.net.Enumeration;

Public class InterfaceFinder {

Public static void main() throws SocketException

{

Socket في كل اجهزة في الشبكة

of socket في العالم الخارجي

Enumeration interfaces = NetworkInterface.get

Enumeration obj (NetworkInterface) \Rightarrow NetworkInterface();
obj (NetworkInterface) \Rightarrow NetworkInterface();
Enumeration \Rightarrow NetworkInterface
Enumeration \Rightarrow NetworkInterface

array list \Rightarrow list of interfaces

while (interfaces.hasMoreElements()) {

cast \Rightarrow enumeration \Rightarrow list of interfaces

NetworkInterface n = (NetworkInterface) interfaces.nextElement();
System.out.println(n);

???

تعريف介面 interface
Localhost یعنی interface یعنی چیزی که

```
import java.net.InetAddress  
import java.net.NetworkInterface  
import java.io.IOException
```

public class LocalHostInterface {

public static void main() throws IOException {

InetAddress addr = InetAddress.getLocalHost();
Local Host یعنی مکانیک

NetworkInterface ni = NetworkInterface.getByName(
InetAddress(addr))

NetworkInterface یعنی درجه در درجات
INetAddress() is Interface یعنی اینترفیس
interface یعنی برجع

(اخراجی خارجی) (البروج) ← eth1 WAN1
display Name یعنی نام ← شرح طبعی Name

s.o.p("localhost" + addr);

s.o.p("InterfaceName:" + ni.getName());
العنوانی البروجی اخراجی

s.o.p("DisplayName:" + ni.getDisplayName());

GUI یعنی الطبقه الورقة
خطاب علی الزر اخراجی (ذئاب)

getByName()
getByInetAddress()

enbu Inet Address Network Interface

العنوان + الوجه + العبرة

interface II رج. A
display name

name

(interface) العواجهةInterfaces *

```
import java.net.InterfaceAddress;  
import java.net.NetworkInterface;  
import java.net.SocketException;  
import java.  
import java.  
import java.
```

```
public class InterfaceInfo {
```

```
    public static void main() throws SocketException {  
        Enumeration<NetworkInterface> en =  
            NetworkInterface.getNetworkInterfaces();
```

```
        while (en.hasMoreElements()) {
```

```
            NetworkInterface ni = en.nextElement();
```

```
            System.out.println("Display Name" + ni.getDisplayName());
```

```
            System.out.println("Name" + ni.getName());
```

```
            System.out.println("LoopBack" + ni.isLoopback());
```

نحوه IP address (العنوان الريفي)

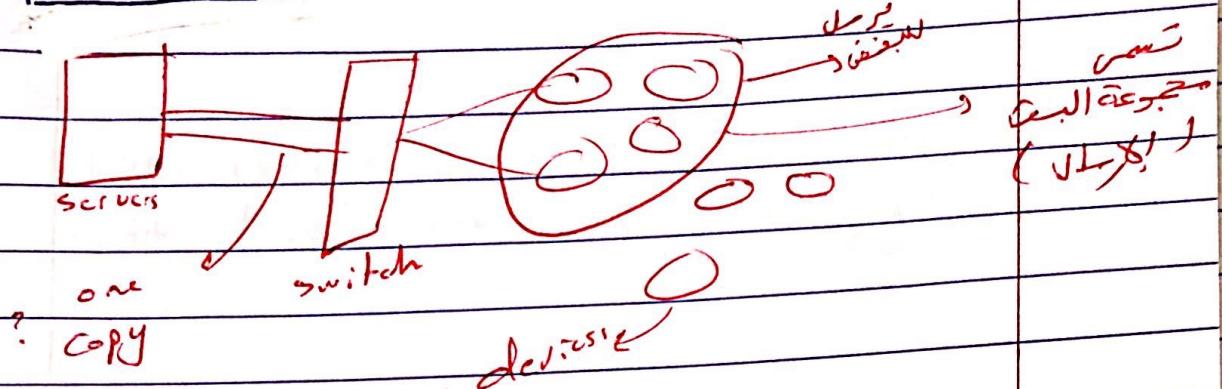
```
            System.out.println("Active" + ni.isUp());
```

نحوه running (الواجهة فعالة)

```
            System.out.println("MultiCast" + ni.supportsMulticast());
```

نحوه MultiCast (ارسال متعدد)

Multicast: Send to some devices



→ Multicast Addresses العنوانين

224.0.0.0 to 239.255.255.255

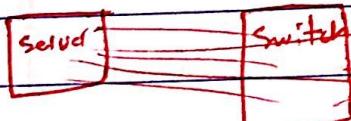
Type D

Broadcast
Multicast
Unicast

العنوانين

بيانات
بيانات
بيانات

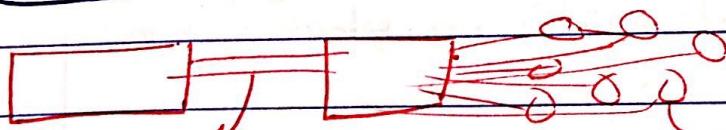
Unicast:



فقط عزيز

Band width
(over Head)

Broad Cast:



doesn't need it

one
copy

رسائل الجميع في كل جهاز

* الرسائل من الرسائل

why we need MultiCast ؟

1) unicast Problems: instreaming takes all the Bandwidth (make multi copy)

2) BroadCast Problems: instreaming Send data to all nodes in Network

3) MultiCast: So developers Create MultiCast which send [one copy to nodes who requested this data]

Multicast IP and ⇒ multicast IP
224.0.0.0 — 239.255.255.255 type-1

Point to Point [بروتوكول النقطة إلى النقطة]
Protocol

S.o.p ("Point to Point": n. is Point to Point ()).

digital, Analog is تحويل للموجات : PPP
Point to Point Protocol (PPP)

Constructing direct connection
between two Points to convert from analog to digital
(DSL)

T/F \Rightarrow virtual \leftarrow Interface \Rightarrow ~~نحوه~~ *

S.o.p("virtual": ni.isVirtual());

هل الـ interface قيمته افتراضية / هو نوعٌ افتراضي
[VMW] virtual Machine software

second بطبع مع بقى رأيت البيانات من هنا *

S.o.p("MTU": ni.getMTU());

[MTU]: maximum transaction unit

maximum size for sending Packets

- (ال) مقدار الأقصى للرسائل

للموضوع
العلاقة بها

* Fragmentation $\xrightarrow{\text{Sender}} \text{Receiver}$



Reassembly $\xrightarrow{\text{Receiver}}$ Receiver

كيف يتم تقطيع ال FRAG /reasaling

IP	length 4000 Byte	ID=x	frag flag=0	offset = 0	Data	Packed 1, 20 bytes
----	---------------------	------	-------------	------------	------	-----------------------

when MTU = 1500 Byte

عندما يُرسل packet، حيث لا تزيد عن 1500Byte ← flag=0 || 16Bit
أو كل باكيت يحتوي على 1500Byte

20Byte مع تطبيق بروتوكول IP

1500Byte = كل باكيت يحتوي على كل باكيت يحتوي على كل باكيت

↓
MTU

بالنسبة

IP	length 150	ID=x	flag=1	offset=0	Data
----	---------------	------	--------	----------	------

20Byte
↓
Data
1480Byte
↓
offset = 184
→ bytes

flag=1, b=1 (الباكيت الثاني)

long انقل 1Byte | long offset
offset → long = 8Byte.

9000 byte

- 1480

2520 → (ج)

integer = 4Byte

Char = 1Byte

long = 8Byte
= $\frac{1480}{8 \text{ Byte}} = 185$

IP	length 1500 B	ID=x	flag=1	offsets 185	data	2520 1480
----	------------------	------	--------	----------------	------	--------------

↓
1480 byte data

↓
(185 - 369)

↓
1040

IP	length 1060	ID=x	flag=0	offsets 370	Data	IP 20B
----	----------------	------	--------	----------------	------	-----------

↓
1040 18 bytes

IP N 20B

(بروكاست / متعدد خالقين + / المتسلسل المتسلسل)

s.o.p ("Hardware Address" + ni.getHardwareAddress());

(جاري 6) ترتيب عرض درج عرض

list < InterfaceAddress > list = ni.getInterfaceAddresses();

Interface IP 192.168.2.5

Iterator < InterfaceAddress > it = list.iterator();

IP عرض موصوع ترجع

while (it.hasNext()) {

InterfaceAddress ia = it.next();

s.o.p ("IP Address" + ia.getAddress());

{IP جاري 20، interface IP 11 & host}

s.o.p ("Network Prefix" + ia.getNetworkPrefix());

Network 11 جاري 20

Network . Network . Network . Host

24

8

s.o.p ("Broadcast" + ia.getBroadcast());

Broadcast جاري 20

Unicast: بروتوكول اتصال جاري 15

Broadcast: جاري 20 اجهزة (جاري 1)، جاري

Multicast: جاري 20 ...

while list^b
S.C.P(=);

while enumeration

} main

} class

getAddress // IP address
InetAddress // IPv4 or IPv6

getAddress // IP address
InterfaceAddress // IPAddress

= MAC

divided to two sections

1) OUI (Manufacturer)

2) NIC (picun) Network Interface Card

* Contains 48 bit \rightarrow 6 bytes

01:23:4F:6B:89:Ac] 6 bytes \leftarrow all for

01.23.4F.6B.89.Ac]

0123.4F6B.89Ac] \leftarrow Cisco

01234F.6B89Ac]

العنوان (العنوان) Localhost_N Mac address مطبع

```
public class MacFinder {  
    public static void main ()
```

{

InetAddress add = InetAddress.getLocalHost();
add في الخنزير LocalHost معرفة

NetworkInterface in = NetworkInterface.getByName
InetAddress add;

الخادم IP على Interface لـ add

byte [] mac = in.getHardwareAddress();

for (int i = 0 ; i < mac.length ; i++) {

if (i < mac.length - 1) {

s . o . Format ("% 2x % s" , mac [i] , " - ");

(string like what it is going to be)

- اطبع

other way
one by one

of
this

2F - 28 - c1 - F3 - 10 - B2

} else

s . o . Format ("% 2x % s" , mac [i] , " ");

}

}

}