IPv6

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IP overview

- **IP** (Internet Protocol) – an L3 protocol in the ISO/OSI model
- An intermediate protocol, however very important
- Relays data across network boundaries
- Negotiates different physical layer technologies
- Establishes the Internet

IP address

- ▶ Each host (a network participant, except L2/L1 devices) has an unique IP address
- ▶ Usually you don't use it directly (*and there's a reason for that!*)
- ▶ Nonetheless it's a neccesary part of a communication process
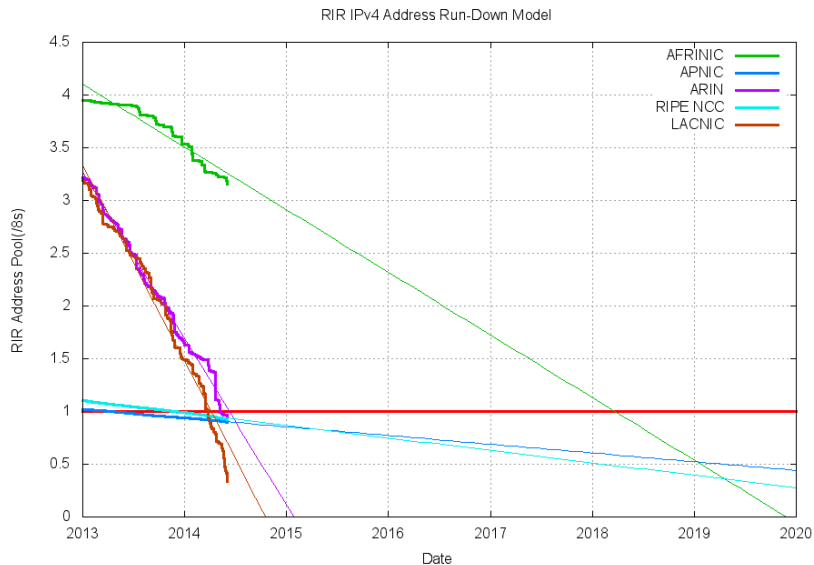- ▶ For example, you can't call the phone if you don't know it's number

IP address

- IPv4 – still 96% of the traffic
- Addresses are 32 bit sized
- $2^{32} \approx 4$ billion addresses
- It's a lot?

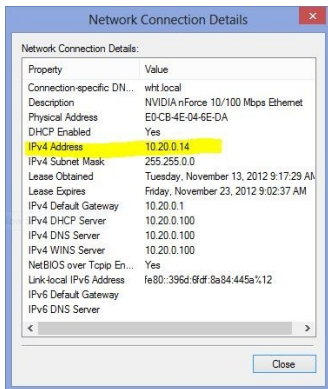- Feature phones
- POS terminals
- Sensors
- It's a lot? **Nope.**

IPv4 address exhaustion

RIR IPv4 Address Run-Down Model

Popular solutions

- Two popular solutions: Proxy and NAT
- Like a call center: one number, many phones.

Network Connection Details

Network Connection Details:

Property	Value
Connection-specific DN...	wht.local
Description	NVIDIA nForce 10/100 Mbps Ethernet
Physical Address	E0-CB-4E-04-6E-DA
DHCP Enabled	Yes
IPv4 Address	10.20.0.14
IPv4 Subnet Mask	255.255.0.0
Lease Obtained	Tuesday, November 13, 2012 9:17:29 AM
Lease Expires	Friday, November 23, 2012 9:02:37 AM
IPv4 Default Gateway	10.20.0.1
IPv4 DHCP Server	10.20.0.100
IPv4 DNS Server	10.20.0.100
IPv4 WINS Server	10.20.0.100
NetBIOS over Tcpip En...	Yes
Link-local IPv6 Address	fe80::396d:6fdf:8a84:445a%12
IPv6 Default Gateway	
IPv6 DNS Server	

Close

Class	Private Address Range
A	10.0.0.0 to 10.255.255.255
B	172.16.0.0 to 172.31.255.255
C	192.168.0.0 to 192.168.255

What's the problem?

- Relies on higher-level protocols
- Slower than a simple routing
- The main drawback: an address is not unique anymore.
- Cannot accept incoming connections
- Often called a "grey" IP address
- Conclusion: an IPv4 address is just a bunch of numbers nowadays, that's the reason why you don't use it directly.

DON'T SLEEP!

IPv6

- Since 1996
- 2^{128} addresses, or approx. $3.4 \cdot 10^{38}$

An IPv4 address (dotted-decimal notation)

172 . 16 . 254 . 1

⬇ ⬇ ⬇ ⬇

10101100.00010000.11111110.00000001

One byte =Eight bits

Thirty-two bits (4 x 8), or 4 bytes

An IPv6 address   (in hexadecimal)

2001:0DB8:AC10:FE01:0000:0000:0000:0000

⬇ ⬇ ⬇ ⬇

2001:0DB8:AC10:FE01:: Zeroes can be omitted

0010000000000001:0000110110111000:1010110000010000:1111111000000001:

0000000000000000:0000000000000000:0000000000000000:0000000000000000

Minor changes

- ARP $\Rightarrow$ NDP
- Broadcast via multicast
- DHCP $\Rightarrow$ SLAAC
- IPv6 routers do not perform fragmentation
- TTL $\Rightarrow$ Hop limit

IPv6 adoption rate