

Table of contents

- Origins of Internet
- Impacts of Internet
- What is Internet?
- Key concepts in networking
- How does Internet work?
- Summary and conclusions

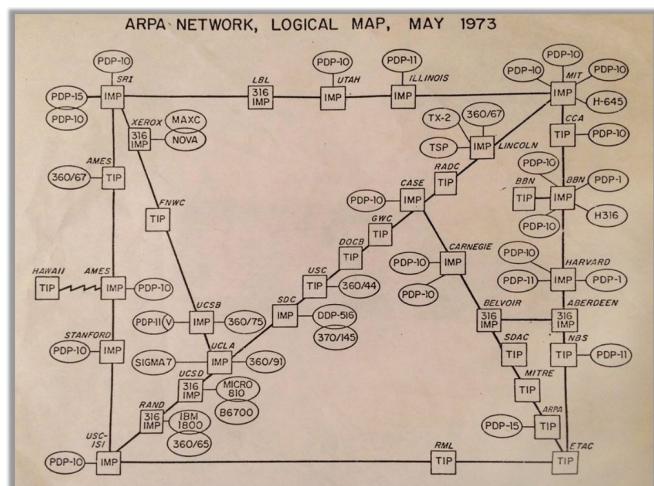
ARPANET : It is first operational packet switching network. It was designed for researchers and military institutions to share information across geographically dispersed locations. ARPANET initially connected few universities and research Centers and eventually grew up into a large network.

network.

Packet switching means information is broken into smaller manageable packets before being sent on the internet. Each packet travels independently on the internet and may take different paths to

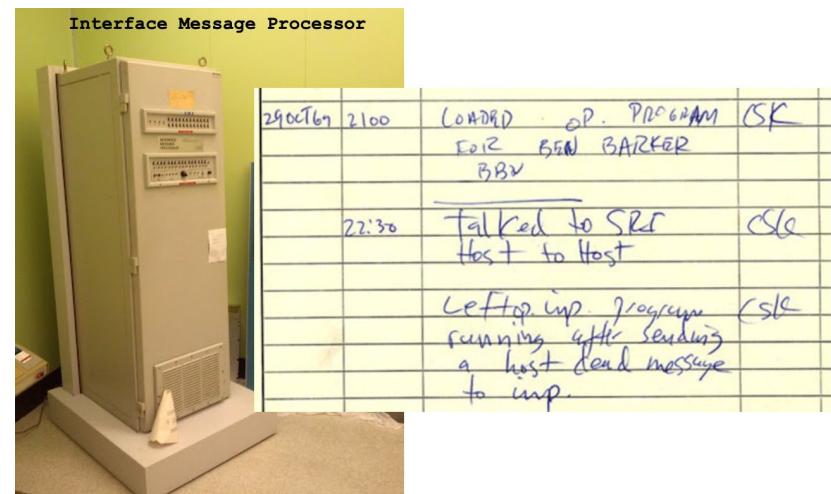
2

Origins of Internet



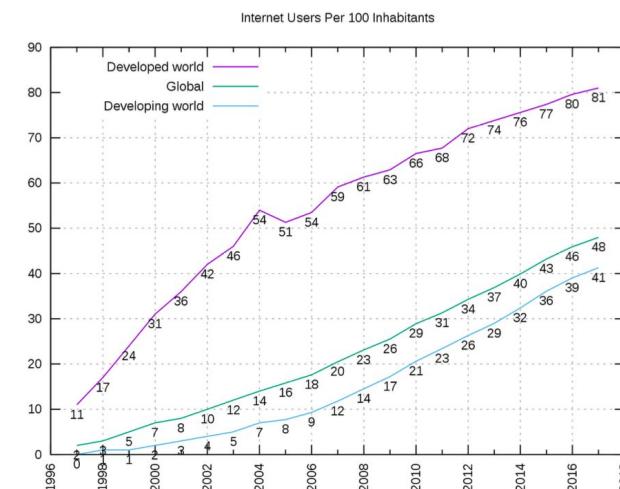
4

Origins of Internet



3

Origins of Internet



5

Impacts of Internet

- Design of Internet
 - Is the reason for its impact?

Router vs Gateway : Router assumes parties on both sides work on same

Net neutrality : Earlier different internet traffic was being treated differently i.e.

Real time traffic is prioritised compared to non real time traffic. Broadcasting

Best effort packet delivery service : Ex. 100 mbps (It is not guaranteed, but it is an assurance that they will try their best.)

6

Impacts of Internet

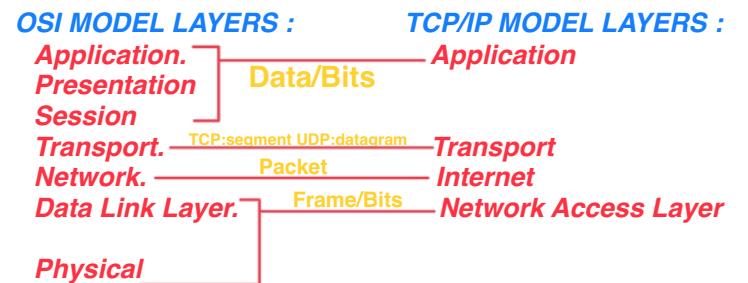
- Internet is a tense place



8

Impacts of Internet

- Design of Internet
 - Supports growth and fosters innovation?



7

Impacts of Internet

- Internet is a tense place



9

Impacts of Internet

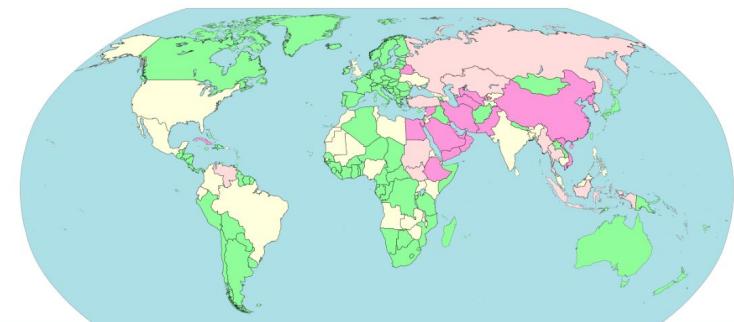
- Internet is a tense place



10

Impacts of Internet

- Internet is a tense place



Internet censorship and surveillance by country (2018)

[Legend:
Pink: Pervasive censorship and/or surveillance
Light pink: Substantial censorship and/or surveillance
Green: Little or no censorship and/or surveillance
Yellow: Selective censorship and/or surveillance
Grey: Not classified / No data]

11

Impacts of Internet

- Design of Internet
 - Creates or exacerbates these tensions?

What is Internet?

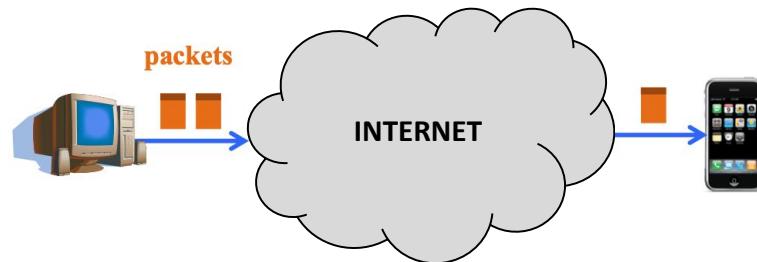
- Internet is a
 - Publicly accessible network of interconnected computer networks
 - Transmit data by packet switching using standard Internet Protocol
 - Network of networks
 - Consists of many smaller domestic/academic/business/govt networks
 - Carry various information and services

12

13

What is Internet?

- Best-effort packet delivery service



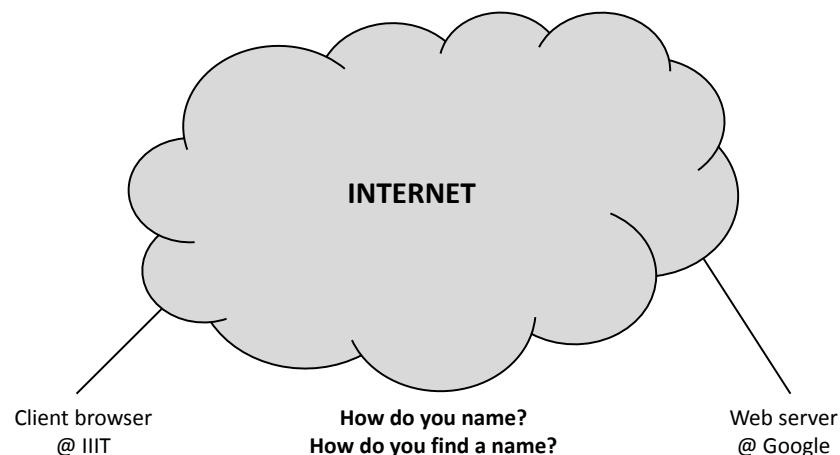
14

What is Internet?

- Power at edge
 - End-to-end principle
 - Communication/protocol operations should occur at endpoints
 - Whenever possible
 - Programmability
 - New network services can be added at any time, by anyone
 - With programmable end hosts
 - Eventually, end hosts became powerful and ubiquitous

What is Internet?

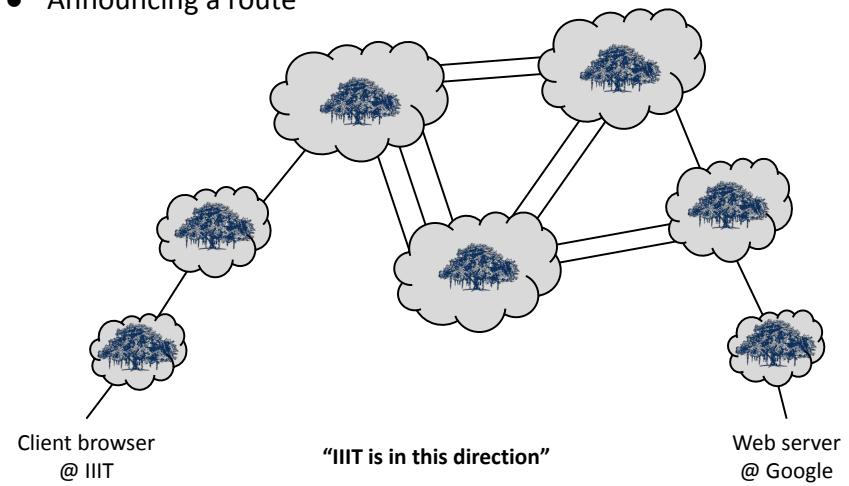
- Internet is a network of networks



16

What is Internet?

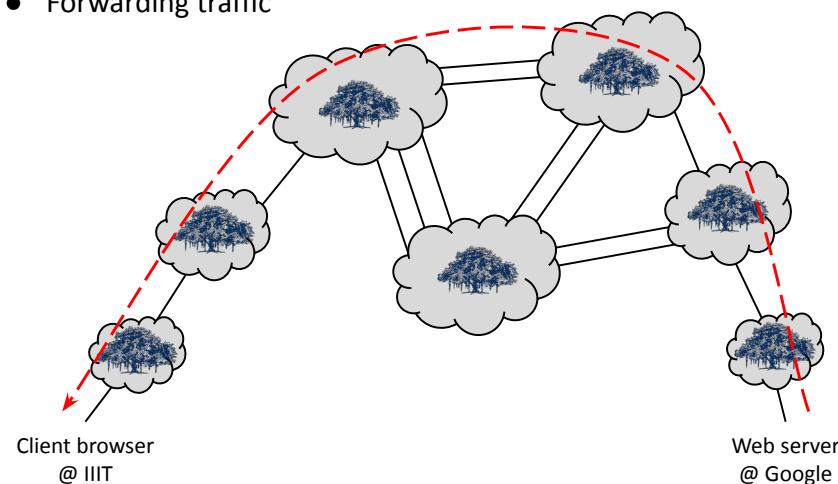
- Announcing a route



17

What is Internet?

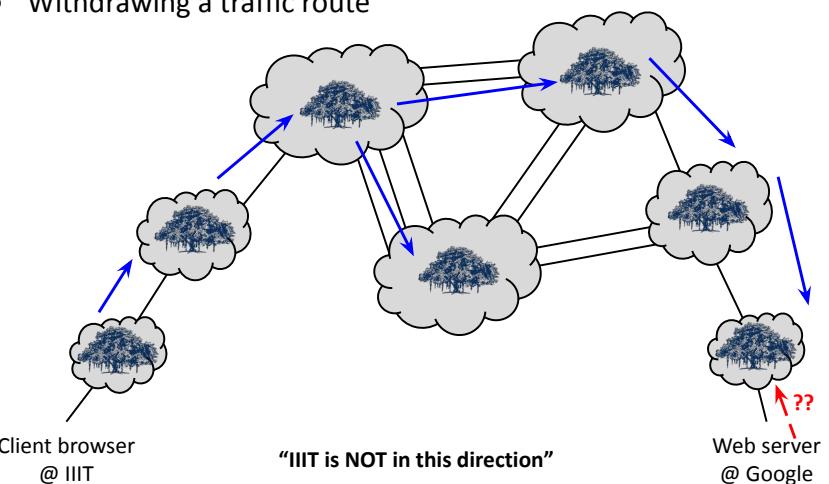
- Forwarding traffic



18

What is Internet?

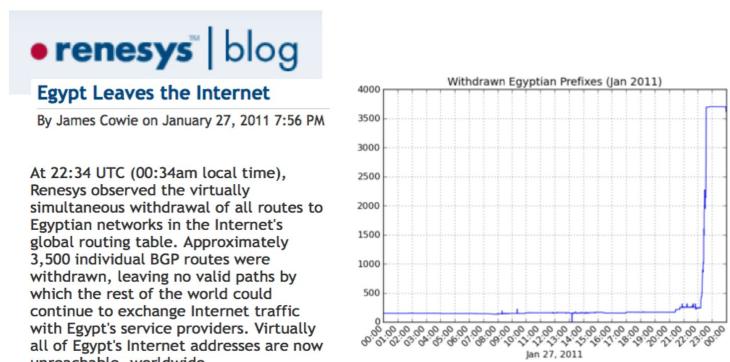
- Withdrawing a traffic route



19

What is Internet?

- Withdrawing a traffic route



20

Key concepts in networking

- Abstraction through protocol layering
 - Layers partition system
 - Each layer **solely** relies on services from layer below
 - Each layer **solely** exports services to layer above
 - Interface between layers defines interaction
 - Hides implementation details
 - Layers can change without disturbing other layers

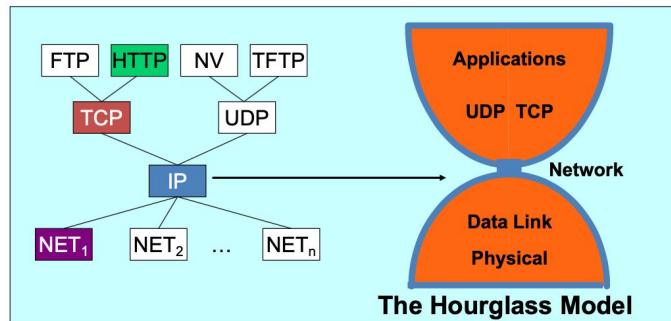
Application
Transport
Internet
Network Access Layer

Application
Application-to-application channels
Host-to-host connectivity
Link hardware

21

Key concepts in networking

- Internet Protocol (IP) suite
 - Thin Network layer facilitates interoperability



22

Key concepts in networking

- Application: HyperText Transfer Protocol

GET /path/to/resource/ HTTP/1.1
Host: www.cs.xyz.edu
User-Agent: Mozilla/5.0
CRLF

Request

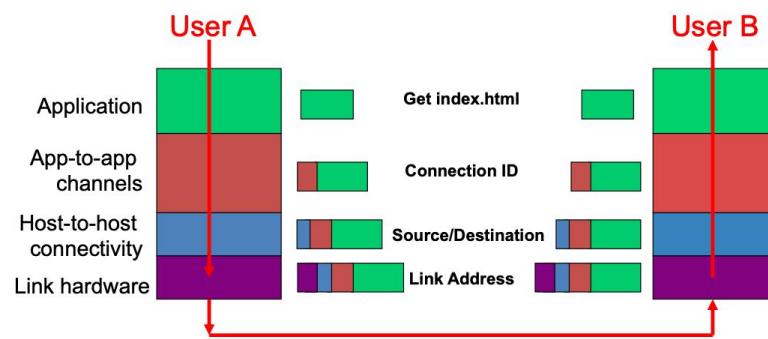
HTTP/1.1 200 OK
Date: Wed, 11 Aug 2021 09:28:28 GMT
Server: Apache/2.4.41
Last-Modified: Fri, 06 Aug 2021 04:46:59 GMT
Content-Length: 23
CRLF
Site under construction

Response

23

Key concepts in networking

- Layer encapsulation in HTTP

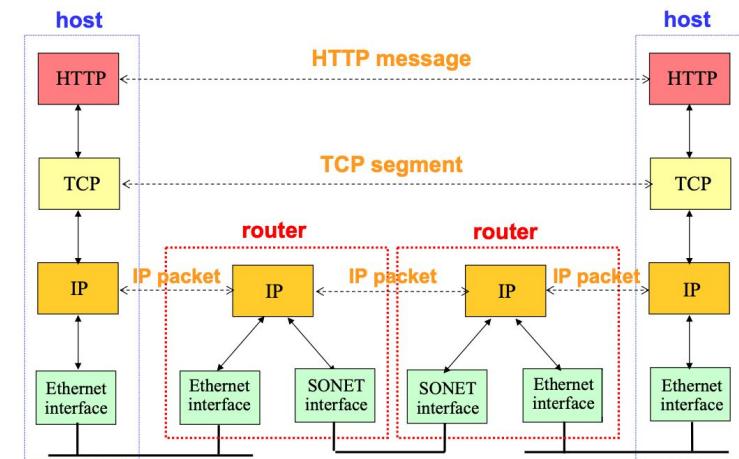


sage should
TCP/IP over Ethernet : data goes as Ethernet frames.
TCP/IP over SONET : data goes in as optical symbols.
[SONET : Synchronous Optical Network]

24

Key concepts in networking

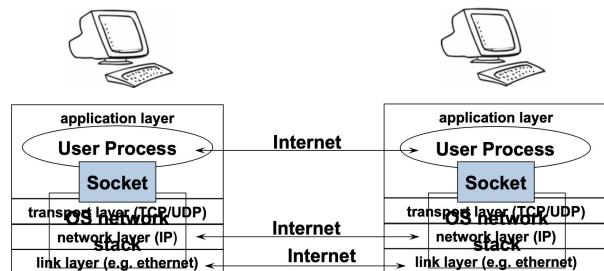
- End hosts vs router



25

Key concepts in networking

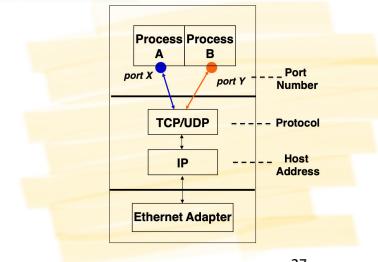
- Socket and process communication
 - Interface that OS provides to its networking subsystem



26

Key concepts in networking

- Socket and process communication
 - Receiving host
 - Destination **address** that uniquely identifies host
 - IP address: 32-bit ("1.2.3.4")
 - Receiving socket
 - Host may be running many different processes
 - Destination **port** that uniquely identifies socket
 - Port number: 16-bit ("80")



27

Key concepts in networking

- Central concepts
 - Naming
 - What to call computers, services, protocols, etc.
 - Layering
 - Abstraction is key to managing complexity
 - Protocols
 - Speaking same language
 - Syntax and semantics
 - Resource allocation
 - Dividing scarce resources among competing parties
 - Memory, link bandwidth, wireless spectrum, paths

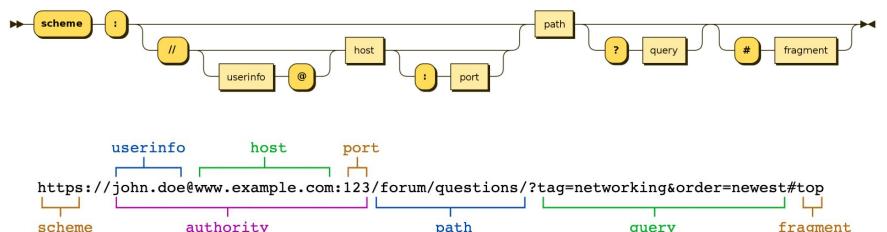
28

Key concepts in networking

- Uniform Resource Identifier (URI)
 - Unique sequence of characters
 - Identifies a logical or physical resource used by web
 - Real-world objects (e.g., people, places) → **URN**
 - Information resources (e.g., webpages, books) → **URL**

URN : Uniform Resource Name and URL : Uniform Resource Locator are both the forms of URI.

- Syntax
 - URI = scheme://authority[path[?query][#fragment]]
 - authority = [userinfo@]host[:port]



29

Key concepts in networking

- Uniform Resource Name (URN)
 - Type of URI
 - Provide only a unique name
 - Without means of locating/retrieving resource/information
 - URN identifies an item, e.g., ISBN of a book
It means say URN helps in identifying a book in the real world.

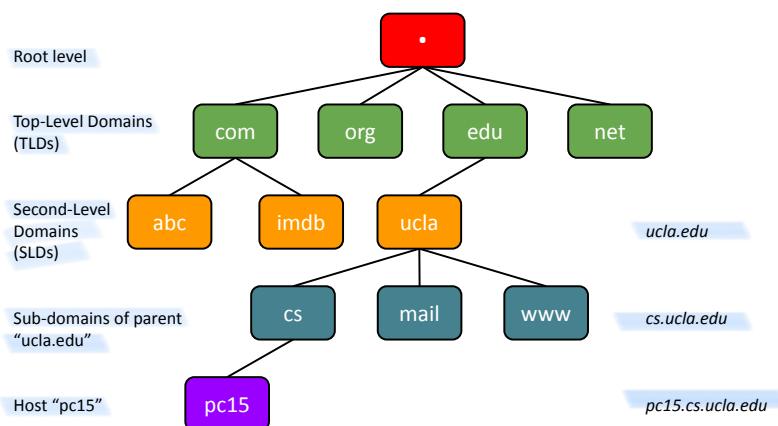
Dynamic IP : This IP address changes periodically. Most ISPs provide dynamic up addresses tp their residential customers for general home usage whenever they connect to ISP's network.

Static IP : This is remains constant over time. It doesn't change whenever your device or or router reconnects to internet. Often used for hosting websites, servers where consistent IP address address is necessary.

According to definition : Subdomain has to be a file or folder and cannot be a host machine. In reality it is different. [A subdomain is a DNS- based way to direct users to specific part of the website. They are not files or folders themselves but can be used to access the specific directories on the server. Subdomains can point to different host machines on the internet.]

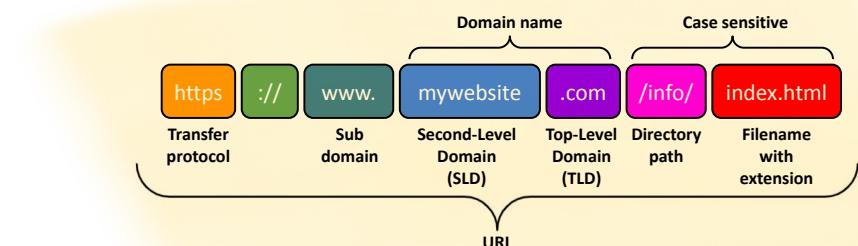
Key concepts in networking

- Domain Name System (DNS)
 - Serves as phone book for Internet
 - Translate human-friendly computer hostnames into IP addresses



Key concepts in networking

- Uniform Resource Locator (URL)
 - Type of URI
 - Provide means of locating/retrieving resources/information
 - URL provides a method for finding resources/information, e.g., web



31

Key concepts in networking

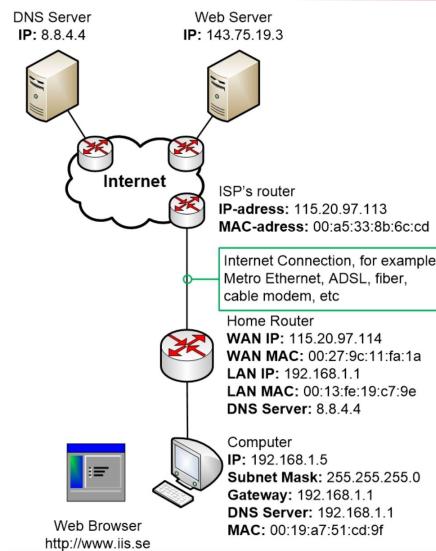
- Dynamic Host Configuration Protocol (DHCP)
 - A server service that dynamically assigns, or leases, IP addresses and related IP information to network clients
 - Each client gets
 - Unique IP address
 - Subnet mask
 - Default gateways
 - Domain Name System (DNS) server addresses

Devices on the same network can communicate with each other using the host names, as they are par of the same isolated network, where their names are unique. We can access a device named laptop from another device's file explorer by just typing "\laptop".

Subdomain will help you organise the contents. It is a folder or a file.[Example is organising based on brach in a college, i.e. .ele, .com, .mec, etc.] subdomain can also be a computer.

How does Internet work?

0. Sample setup



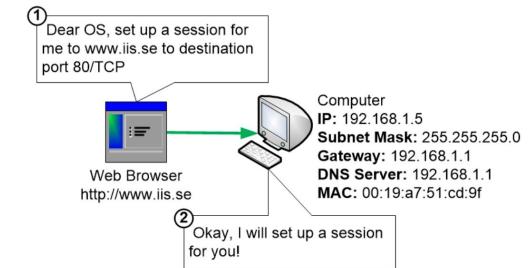
34

How does Internet work?

1. Computer wants to send traffic

Host can be a domain : Host can be associated with a domain if the host's IP address is registered in the DNS under that domain name.
Domain can be a host : A domain can be a host if it is tied to a specific IP address, essentially functioning as the

A domain can be attached to one or more IP addresses : Domain can have multiple records each pointing to

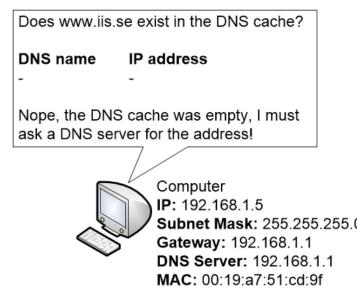


35

How does Internet work?

2. DNS

a. DNS cache

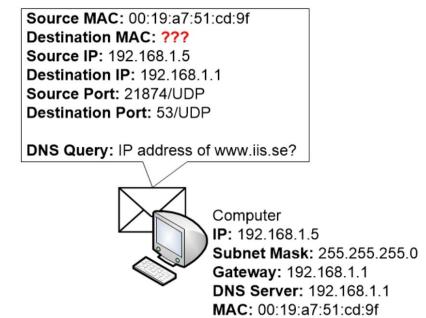


36

How does Internet work?

2. DNS

b. Putting a DNS query together

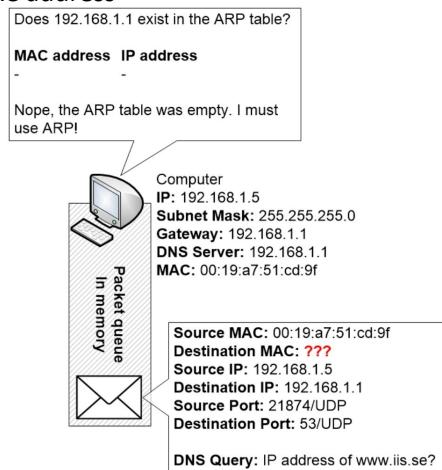


37

How does Internet work?

2. DNS

c. Check ARP table for a valid MAC address

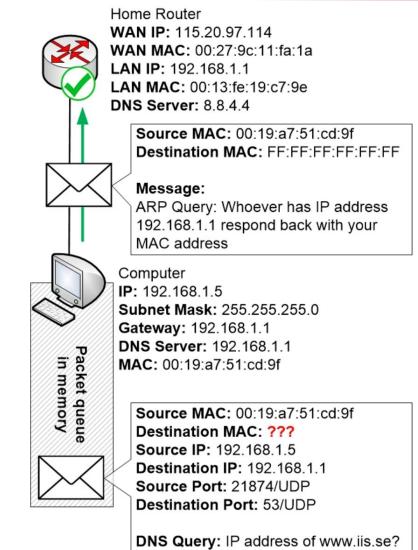


38

How does Internet work?

2. DNS

d. ARP request to network

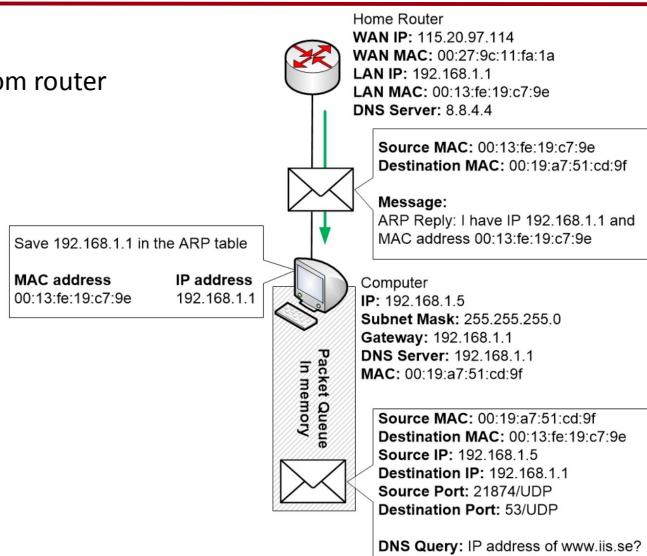


39

How does Internet work?

2. DNS

e. ARP reply from router

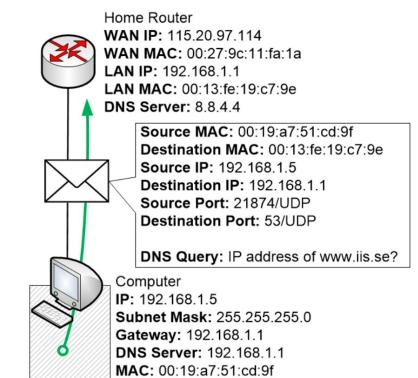


40

How does Internet work?

2. DNS

f. Send off DNS query



41

How does Internet work?

2. DNS

- g. Home router checks its DNS cache

Is www.iis.se previously known and exists in the DNS cache?
DNS name IP address -
Nope, the DNS cache was empty. I must ask my DNS Server

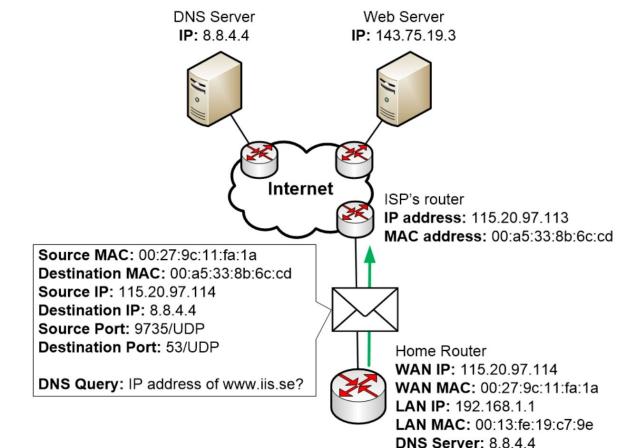
Home Router
WAN IP: 115.20.97.114
WAN MAC: 00:27:9c:11:fa:1a
LAN IP: 192.168.1.1
LAN MAC: 00:13:fe:19:c7:9e
DNS Server: 8.8.4.4

42

How does Internet work?

2. DNS

- h. Home router prepares and sends away its DNS query

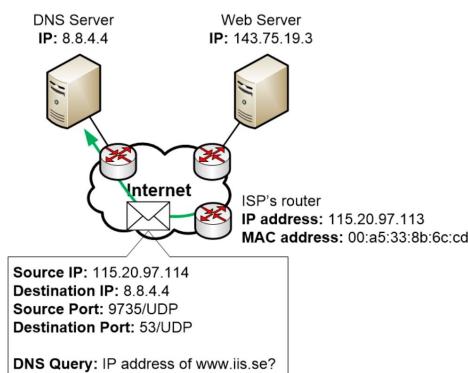


43

How does Internet work?

2. DNS

- i. DNS query is routed over Internet

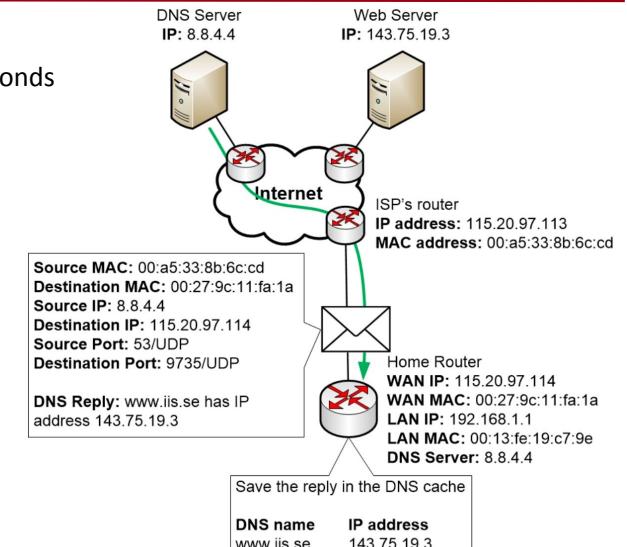


44

How does Internet work?

2. DNS

- j. DNS server responds

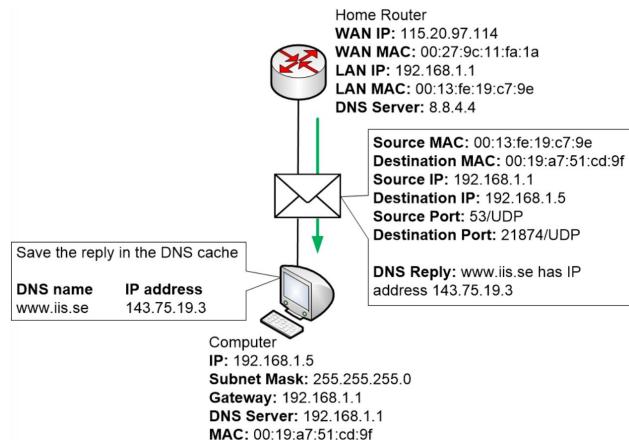


45

How does Internet work?

2. DNS

- k. Home router can send a DNS reply to computer

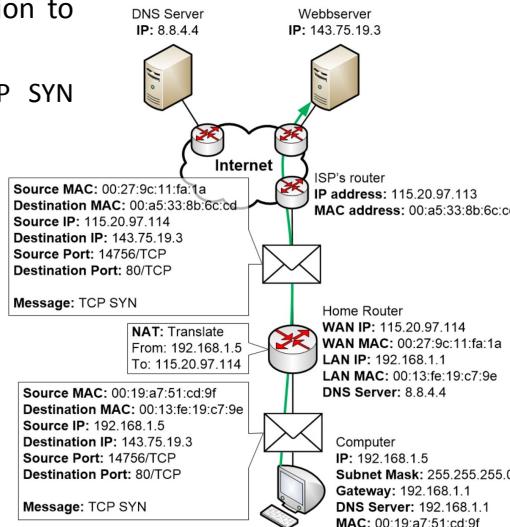


46

How does Internet work?

3. Computer sets up a session to www.iis.se

- a. Computer sends a TCP SYN message

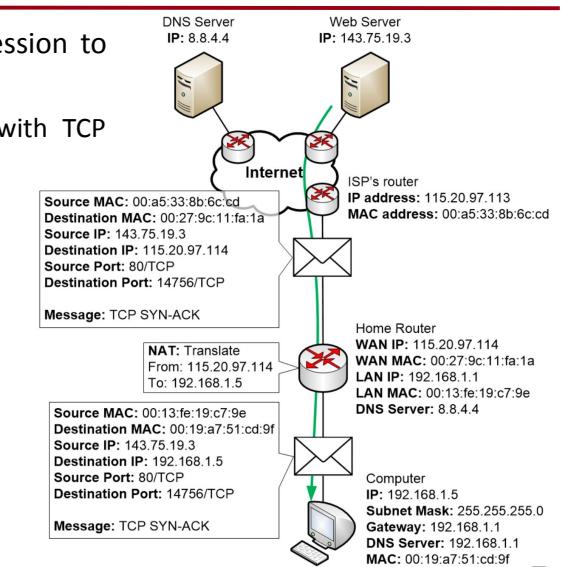


48

How does Internet work?

3. Computer sets up a session to www.iis.se

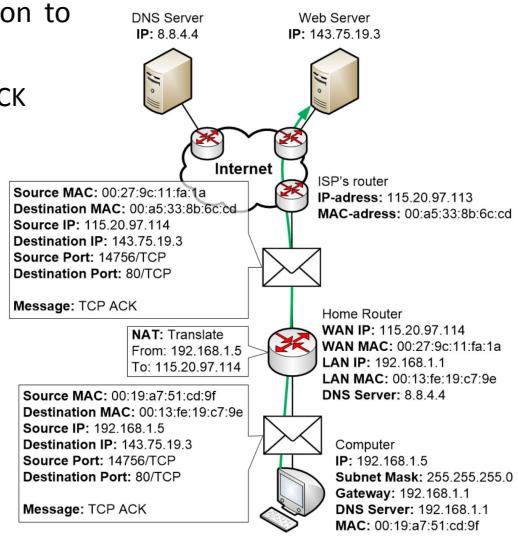
- Initialize TCP 3-way Handshake



49

How does Internet work?

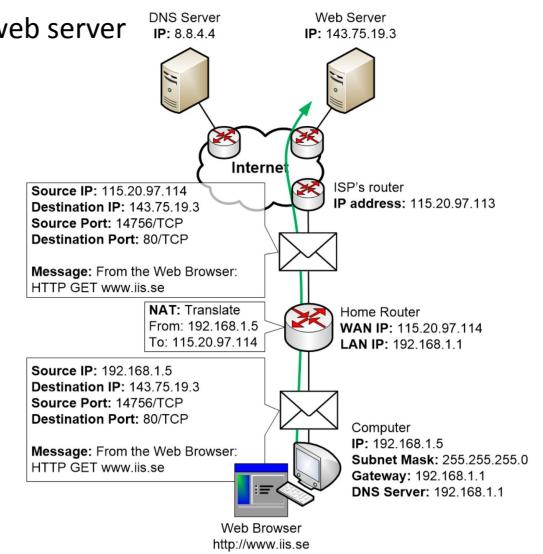
- 3. Computer sets up a session to www.iis.se
- c. Computer sends a TCP ACK



50

How does Internet work?

- 4. Web browser talks with web server



51

Summary and conclusions

- Growth/innovation vs create/exacerbate tensions
 - Does Internet design prevent misuse?
 - Which of following is true
 - (A) When connecting to network, individual endpoints can only use addresses given to them
 - (B) Individual endpoints can "spoof" any IP address

By IP spoofing

Summary and conclusions

- Growth/innovation vs create/exacerbate tensions
 - Central authority IANA assigns unique IP address blocks to networks
 - Which of following is true
 - (A) Networks can only announce assigned addresses
 - (B) Networks can spoof any address → using malicious behaviour explained in previous question they can, but it is a malicious behaviour

→ see they have to use it from the block assigned to them by IANA. To ensure each block of IP address is globally unique and prevents conflicts.

Summary and conclusions

- Growth/innovation vs create/exacerbate tensions
 - Does Internet provide reliable packet delivery?
 - Which of following is true
 - (A) Yes, it's necessary for protocols like HTTP that require in-order streams
 - (B) No, packets can be arbitrarily dropped or reordered

Thank you!

DHCP (Dynamic Host Configuration Protocol) : DHCP is a network management protocol used to automatically assign IP addresses to the devices on the network. When a device connects to the internet it requests an IP address from the DHCP server. The server assigns the IP address from the predefined range along with the network configuration details like subnet mask, default gateway, and DNS servers.

APIPA (Automatic Private IP Addressing) : It is a feature in windows and some other operating systems that automatically assigns an IP address to the device if it cannot obtain one from a DHCP server. The device also checks if the IP address it selects is not in use by some other device on the network.

Ex. Scenario by Ankit sir, 3 computers connected to the same network via switch or directly and don't have. DHCP server present. So each computer will use APIPA to assign itself an IP address. So as they are on the same network they can share files without DHCP using APIPA.

DNS server : translates domain names to IP addresses.

ARP (Address Resolution Protocol) : Its a network protocol used to map or translate an IP address (a logical address) to a MAC address (a physical address) on LAN.

54

55

Sub-domain is a file/folder ideally, but it can also be a computer.

WORKING OF INTERNET :

1. Computer Wants to Send Traffic

When you enter a URL into your web browser or request any data from the Internet, your computer prepares to send traffic (data packets) to a specific destination, such as a website.

2. DNS (Domain Name System)