UNIVERSITÀ DEGLI STUDI DI TERAMO

ICT for Organizations

Internet

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Internet

Statistics

» More than half of the world's population has access to the internet
  - overall penetration of 51%,
  - up two points compared to 2017
  - more than doubled in the last 10 years
» The geography of connections suffers from deep economic and social inequalities globally
  - A large part of the digital population comes from Asia (51%)
  - North America, despite representing only 9% of the total market, guarantees internet coverage to 89% of the population
  - in Africa, it is stuck at 32%

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

Trends

» For the first time in history, it surpasses the medium of television in terms of time of use

» Growth trend is steadily slowing down.

- It is increasingly difficult to find new users and expand the penetration rate on the territory
- the idea of a transnational digital agenda and a welfare system based on Internet infrastructures is becoming more central

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

Trends

» Tra le prime 10 compagnie al mondo per capitalizzazione, appena 3 non fanno della tecnologia il proprio core business – Berkshire Hathaway, Visa e Johnson & Johnson –
  - le altre 7 hanno una capitalizzazione di mercato dal 46% al 266% più alta rispetto a tre anni fa

» Tra le prime 25 aziende tecnologiche degli Stati Uniti
  - il 60% è stato fondato da immigrati di prima o seconda generazione, che nel solo 2018 hanno dato lavoro a 1,9 milioni persone

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

Internet trends in 2023

Now let's look at a few of these numbers today, that we've verified on our own. Here's what we can tell you about the internet in 2023. Next, you can drill into our roundups of cybersecurity trends and IT/tech spending trends.

	2018-2019	2022-2023
Global internet users	3.18 billion global users (51% of world population)	5.16 billion global users (Nearly 65% of world population)
Most valuable companies by market cap	7 tech companies 3 non-tech companies	9 tech companies, including Tesla & Taiwan Semiconductor Manufacturnig 1 "non-tech" company: Berkshire Hathaway
Time Americans spend online, per person	6.3 hours a day online	6.59 hours a day*
Encrypted web traffic	87%	90-95%
Spending on internet ads	~$90 billion	~$209.7 billion (Up almost 11% YoY)

https://www.splunk.com/en_us/blog/learn/internet-trends.html

How we use Internet

» A significant part of the content exchanged online is made up of images, of which users are both users and creators
  - Twitter now has more than 50% of visual content among its impressions

» Instagram, in 2018 grows more than anyone else, increases its daily users by 6% and slightly ahead of YouTube which increases its audience by 5%

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

How we use Internet

» The number of users of short videos has doubled – Instagram Stories, Facebook Stories, WhatsApp Status

» The number of podcast listeners is increasing significantly, reaching 70 million every month

» There are almost 2.5 billion users of gaming and electronic sports, 6% more than in 2017

- Interactive and multiplayer gaming experiences are becoming real social networks for young people
- Also used to establish online relationships (in 44% of cases)
- Twitch, the video streaming platform dedicated mainly to electronic games, has more than doubled its viewership and hours of content produced in two years

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

How we use Internet

» The e-commerce sector continues to grow steadily
  - increase of 12.4% compared to +2% recorded by physical stores
  - It now accounts for 15% of total retail sales in the U.S.
  - 59% of daily transactions are now made via digital payment

Despite platforms' efforts to simplify the buying and selling experience and investment in advertising, consumers' reasons for subscribing to online shopping services are still purely personal, with 23% of users being convinced by word of mouth.

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

The challenges of the future

- Privacy and potentially problematic content
  - Widespread need for privacy
  - Published content will become less and less manageable, thanks to the acceleration of the phenomena of virality and the difficulty in its removal
  - 42% of American teens have experienced online abuse, 32% have come into contact with defamatory rumors, and 16% have experienced physical threats.

https://www.wired.it/internet/web/2019/06/14/internet-trends-2019-rapporto-mary-meeker/
https://youtu.be/G_dwZB5h56E

Internet: what it is not

» It is not a single network, but a collection of networks that spans the globe

» It is not governed by a group or an entity or a single company

» It is not centrally managed because all the individual networks that make up the Internet are self-managed

» And above all: It's not synonymous with the World Wide Web

WHO RUNS THE INTERNET?

NO ONE PERSON, COMPANY, ORGANIZATION OR GOVERNMENT RUNS THE INTERNET.

The Internet itself is a globally distributed computer network comprised of many voluntarily interconnected autonomous networks. Similarly, its governance is conducted by a decentralized and international multi-stakeholder network of interconnected autonomous groups drawing from civil society, the private sector, governments, the academic and research communities, and national and international organizations. They work cooperatively from their respective roles to create shared policies and standards that maintain the Internet's global interoperability for the public good.

WHO IS INVOLVED:

IAB A C P S R
INTERNET ARCHITECTURE BOARD
Oversees the technical and engineering development of the IETF and IRTF.
www.iab.org

ICANN C O P V
INTERNET CORPORATION FOR ASSIGNED NAMES AND NUMBERS
Coordinates the Internet's systems of unique identifiers: IP addresses, protocol parameter registries, top-level domain space (DNS root zone).
www.icann.org

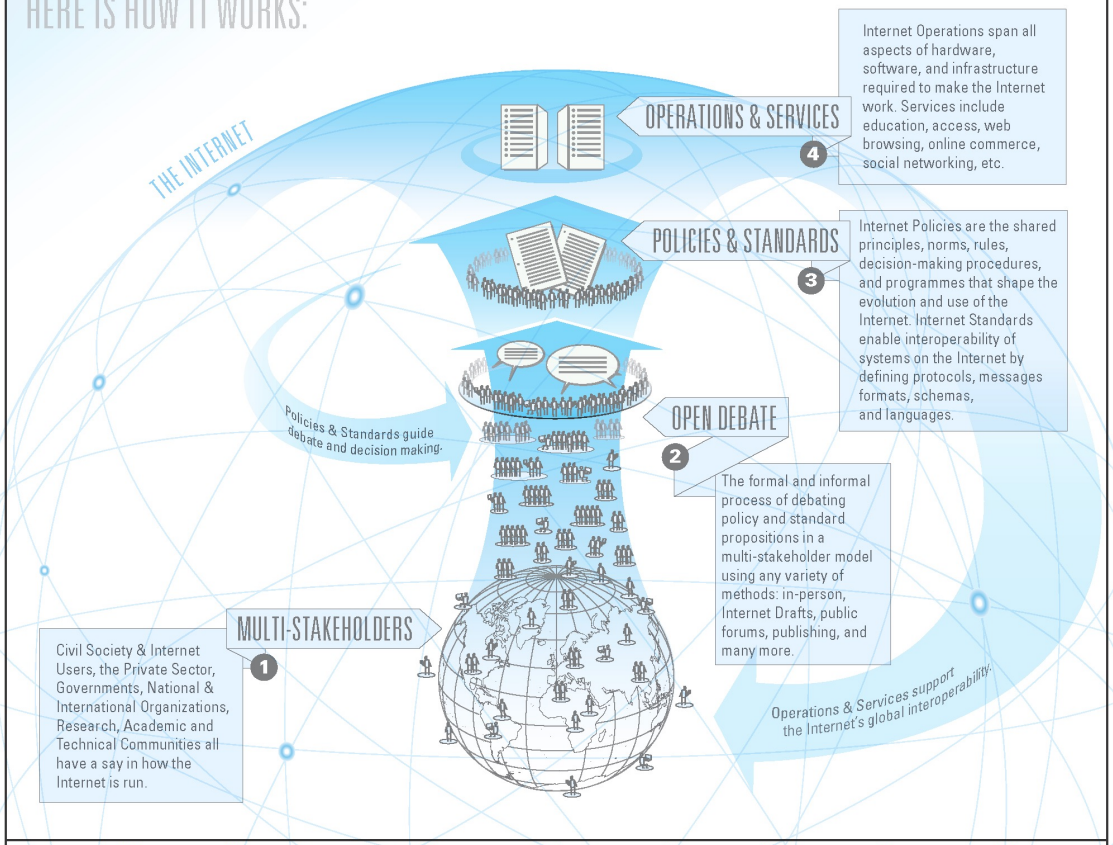
IETF C P S
INTERNET ENGINEERING TASK FORCE
Develops and promotes a wide range of Internet standards dealing in particular with standards of the Internet protocol suite. Their technical documents influence the way people design, use, and manage the Internet.
www.ietf.org

IGF A C P
INTERNET GOVERNANCE FORUM
A multi-stakeholder open forum for debate on issues related to Internet governance.
www.intgovforum.org

IRTF R
INTERNET RESEARCH TASK FORCE
Promotes research of the evolution of the Internet by creating focused, long-term research groups working on topics related to Internet protocols, applications, architecture and technology.
www.irtf.org

GOVERNMENTS AND INTER-GOVERNMENTAL ORGANIZATIONS C P
Develop laws, regulations and policies applicable to the Internet within their jurisdictions; participants in multilateral and multi-stakeholder regional and international fora on Internet governance.

HERE IS HOW IT WORKS:



WHO IS INVOLVED:

ISO 3166 MA S
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION, MAINTENANCE AGENCY
Defines names and postal codes of countries, dependent territories, special areas of geographic significance.
www.iso.org/iso/country_codes.htm

ISOC C E P V
INTERNET SOCIETY
Assure the open development, evolution and use of the Internet for the benefit of all people throughout the world. Currently ISOC has over 90 chapters in around 80 countries.
www.internetsociety.org

RIRs O P V
5 REGIONAL INTERNET REGISTRIES
Manage the allocation and registration of Internet number resources, such as IP addresses, within geographic regions of the world.

www.afrinic.net	Africa
www.apnic.net	Asia Pacific
www.arin.net	Canada & United States
www.lacnic.net	Latin America & Caribbean
www.ripe.net	Europe, the Middle East & parts of Central Asia

W3C S
WORLD WIDE WEB CONSORTIUM
Create standards for the world wide web that enable an Open Web Platform, for example, by focusing on issues of accessibility, internationalization, and mobile web solutions.
www.w3.org

INTERNET NETWORK OPERATORS' GROUPS A O V
Discuss and influence matters related to Internet operations and regulation within informal fora made up of Internet Service Providers (ISPs), Internet Exchange Points (IXPs), and others.

This graphic is a living document, designed to provide a high level view of how the Internet is run. It is not intended to be a definitive guide. Please provide feedback at www.xplanations.com/whorunstheinternet

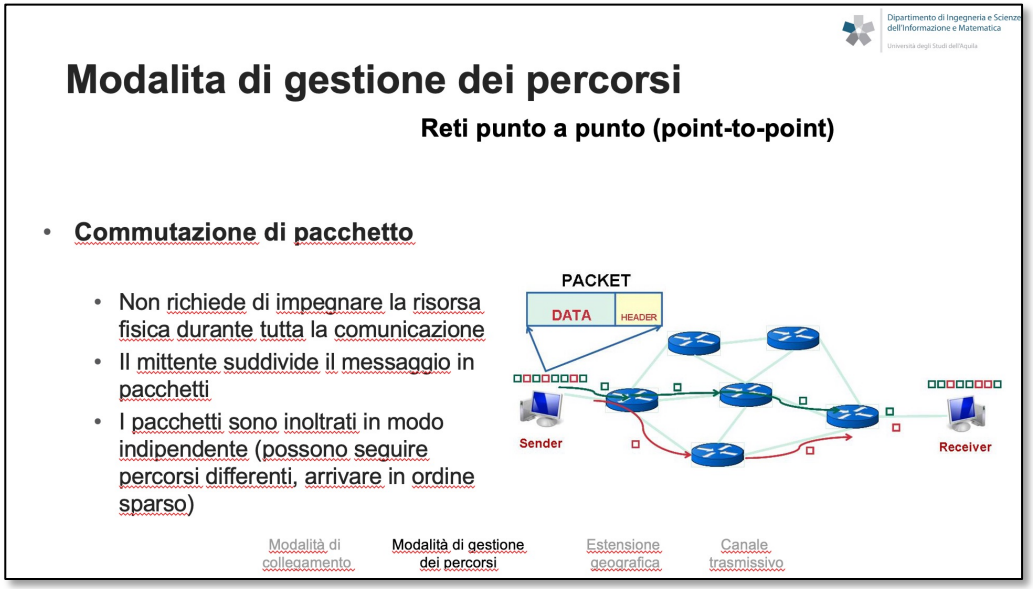
https://upload.wikimedia.org/wikipedia/commons/e/ed/Who-Runs-the-Internet-graphic.png

Internet: what it is

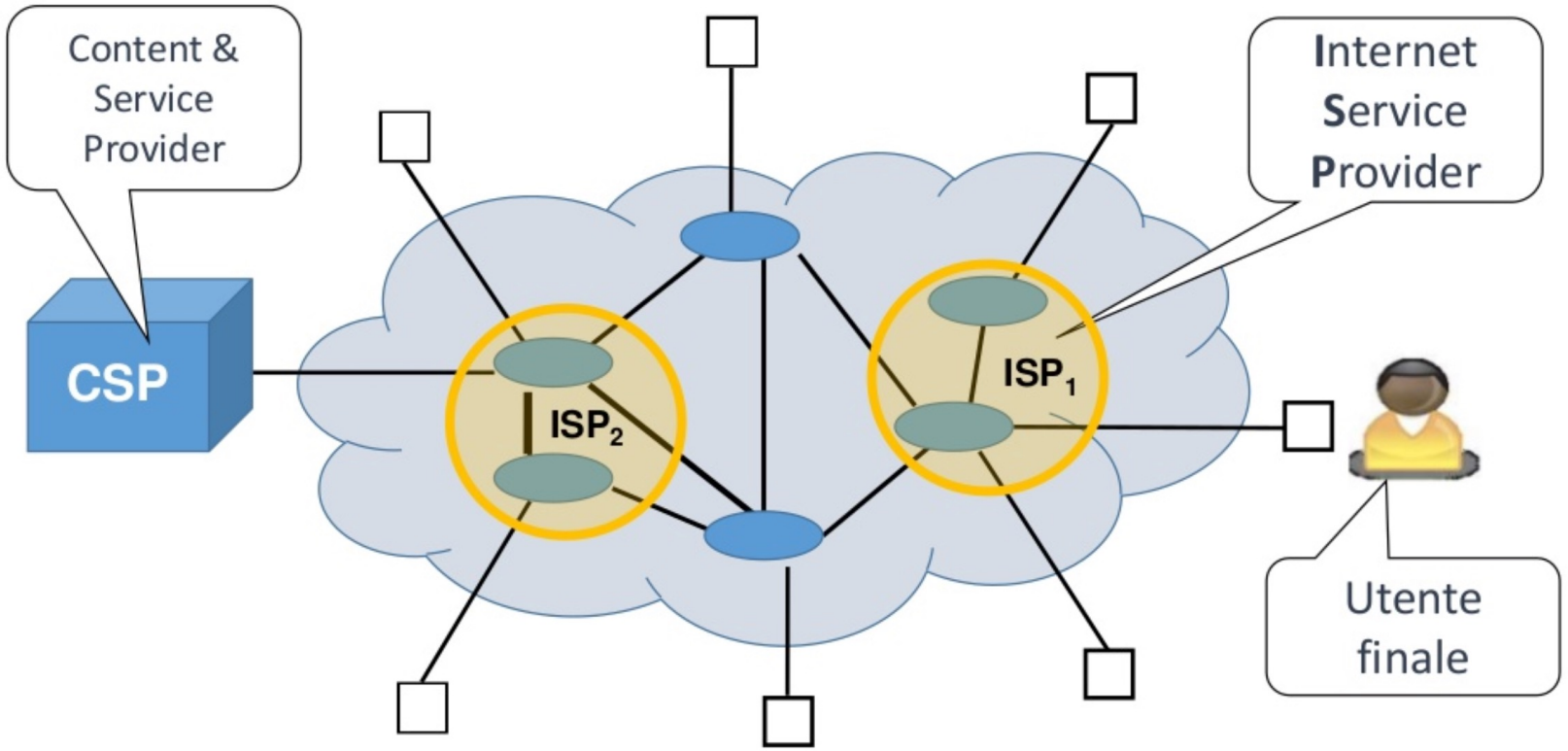
» Network network, packet-switched

» It uses a set of protocols organized in a stack, a layered structure

» The network is "stupid": application intelligence is outside the network, or at the edge of the network if we think that the terminals are part of the network



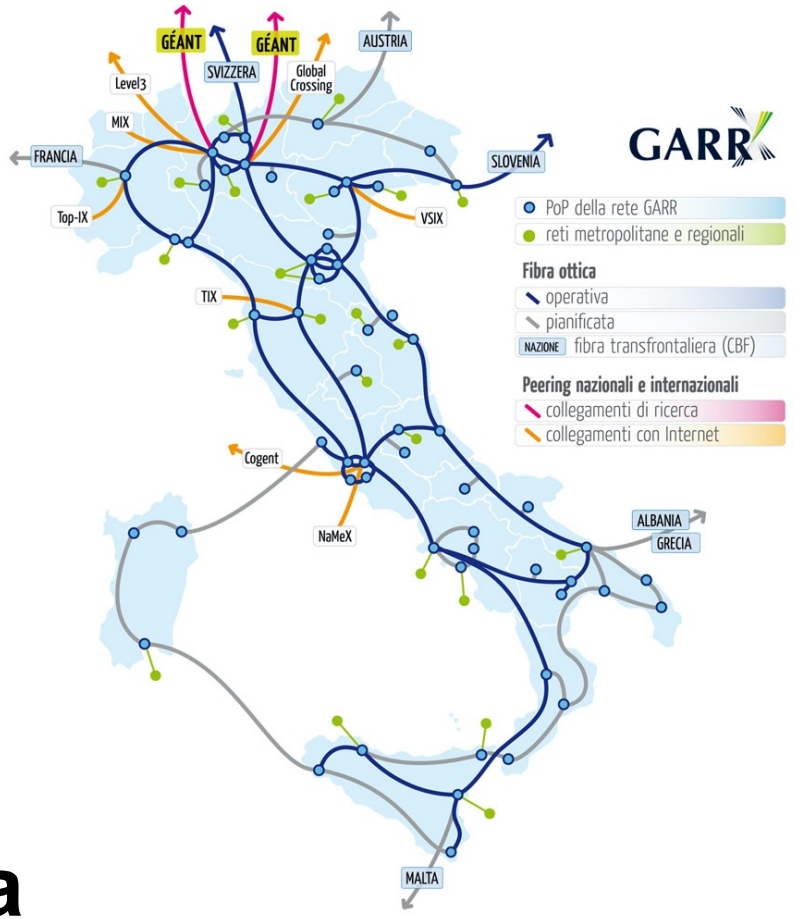
Who provides Internet access?



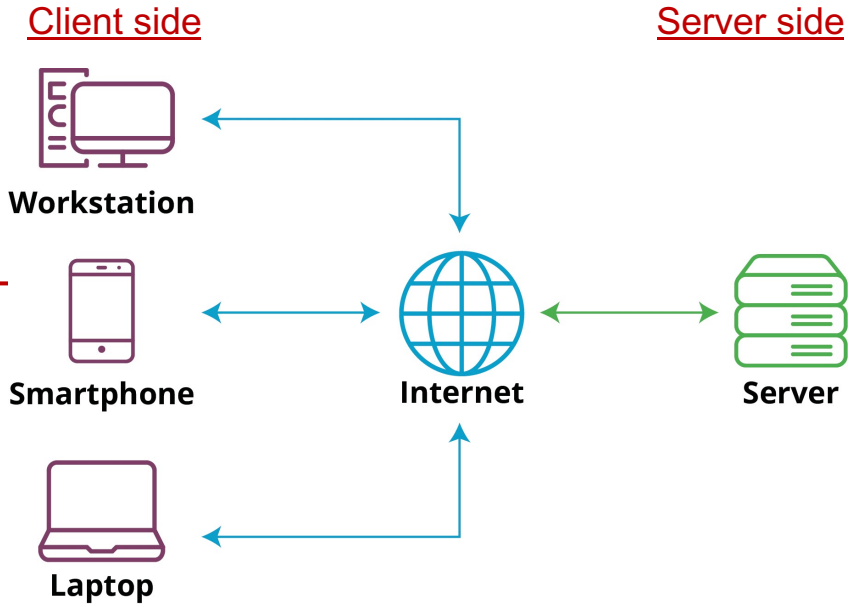
Internet Service Provider (ISP): an example

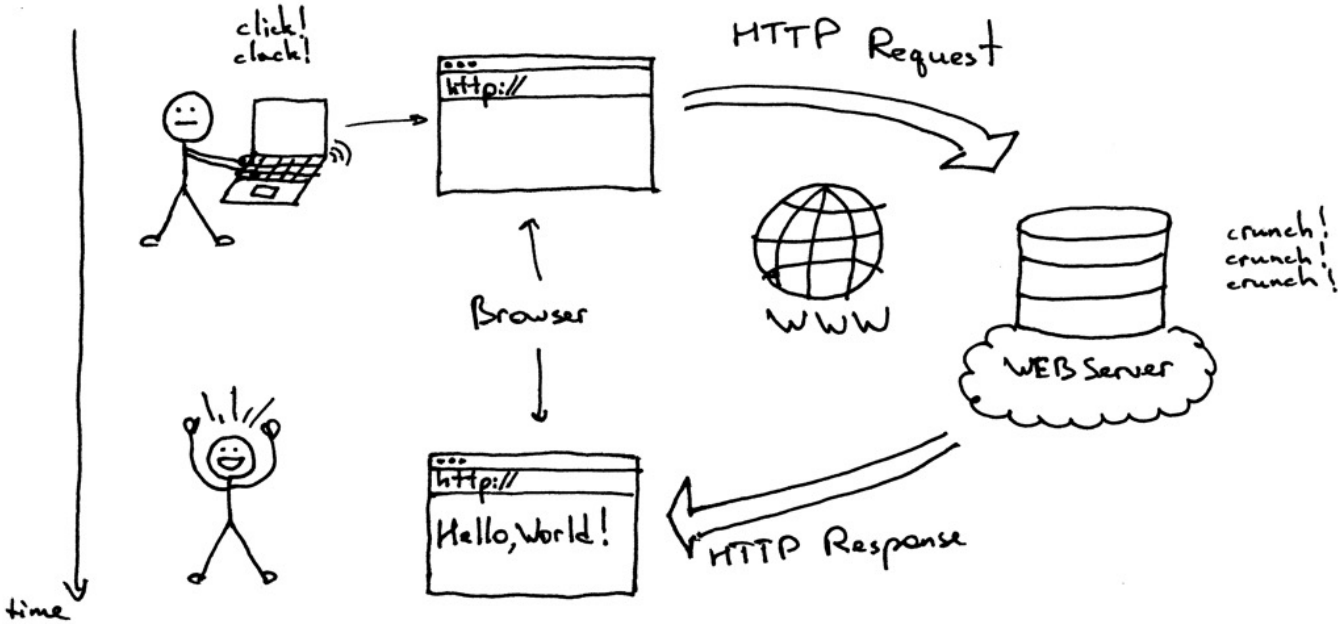
Consortium GARR

La Rete Italiana dell'Istruzione e della Ricerca



Client-Server architecture





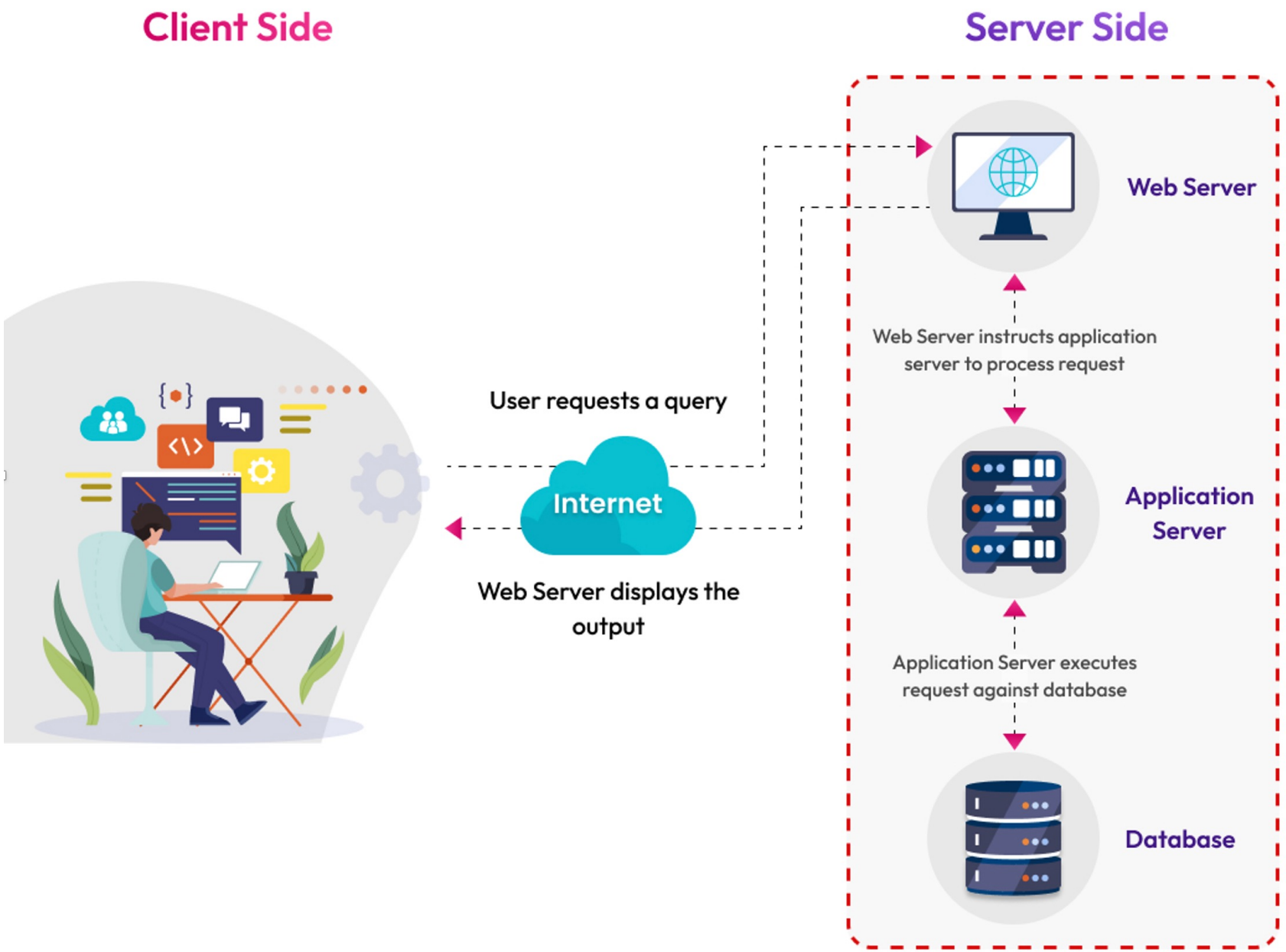
Client-Server application

» The term "client/server application" refers to a distributed application in which it is possible to distinguish two types of components: Client and Server

» Clients and servers play different roles

- The server has a passive role and exports a specific set of services
- The client uses these services by acting as an active component that initiates communication

» In general, clients and servers reside on separate processing units connected by a communication network

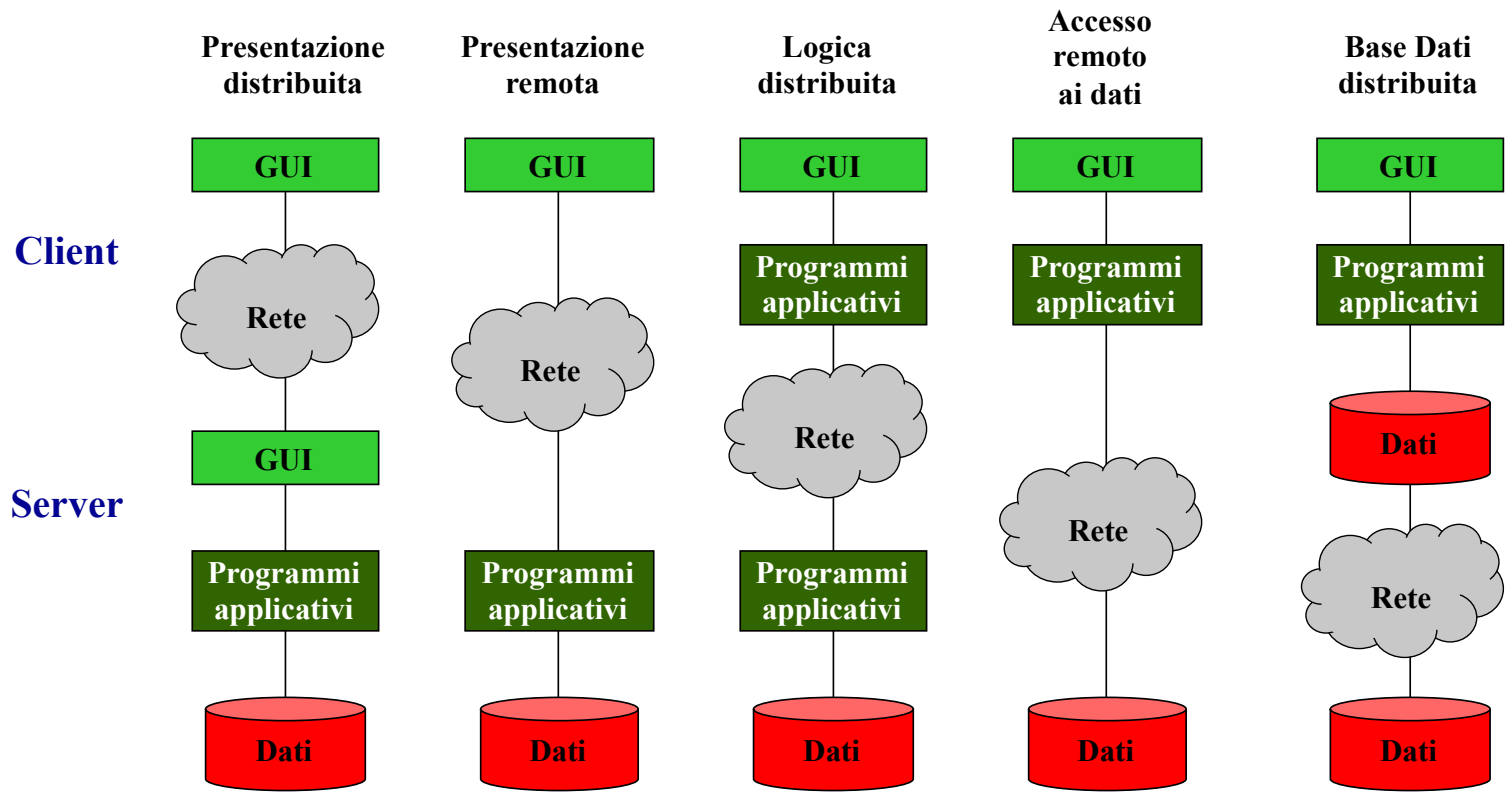

Client Side
Server Side
Web Server
Web Server instructs application server to process request
User requests a query
Internet
Application Server
Application Server executes request against database
Web Server displays the output
Database

Logical decomposition of an application

» The functionalities offered by an application can be generically broken down into three sets
  - User Interface Features
  - Processing Capabilities
  - Persistent data management capabilities

» In Client/Server applications, depending on how these functionalities are allocated to distinct processes, we distinguish between:
  - *Two-tiered architectures*
  - *Three-tiered architectures*

Two-tiered architecture



Two-tiered architecture

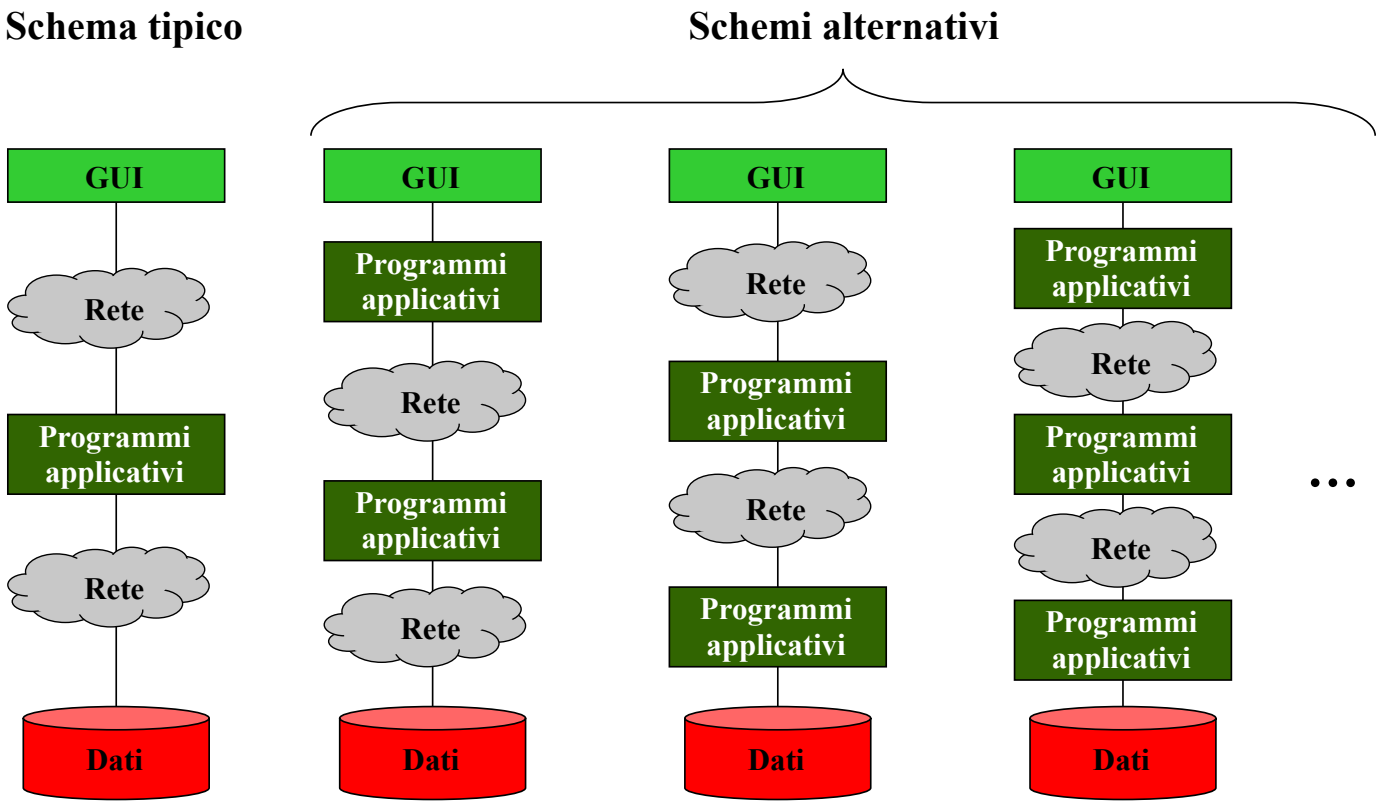
- **Distributed presentation**: all the intelligence is in the server, the client only takes care of interacting with the server which entrusts it with specific presentation tasks
  - e.g. a pure HTML form presents the user with a data entry mask, but is not able to perform any checks on the validity of the data entered
- **Remote Presentation:** The entire presentation portion is the responsibility of the client.
- **Distributed logic:** Application logic is split between client and server

Two-tiered architecture

» **Remote data access:** the presentation and logic are in the client that approaches the server to access the data, typically through a SQL interface

» **Distributed database:** data management functions are partly on the client and partly on the server (e.g. IBM's Distributed Relational Database Architecture)

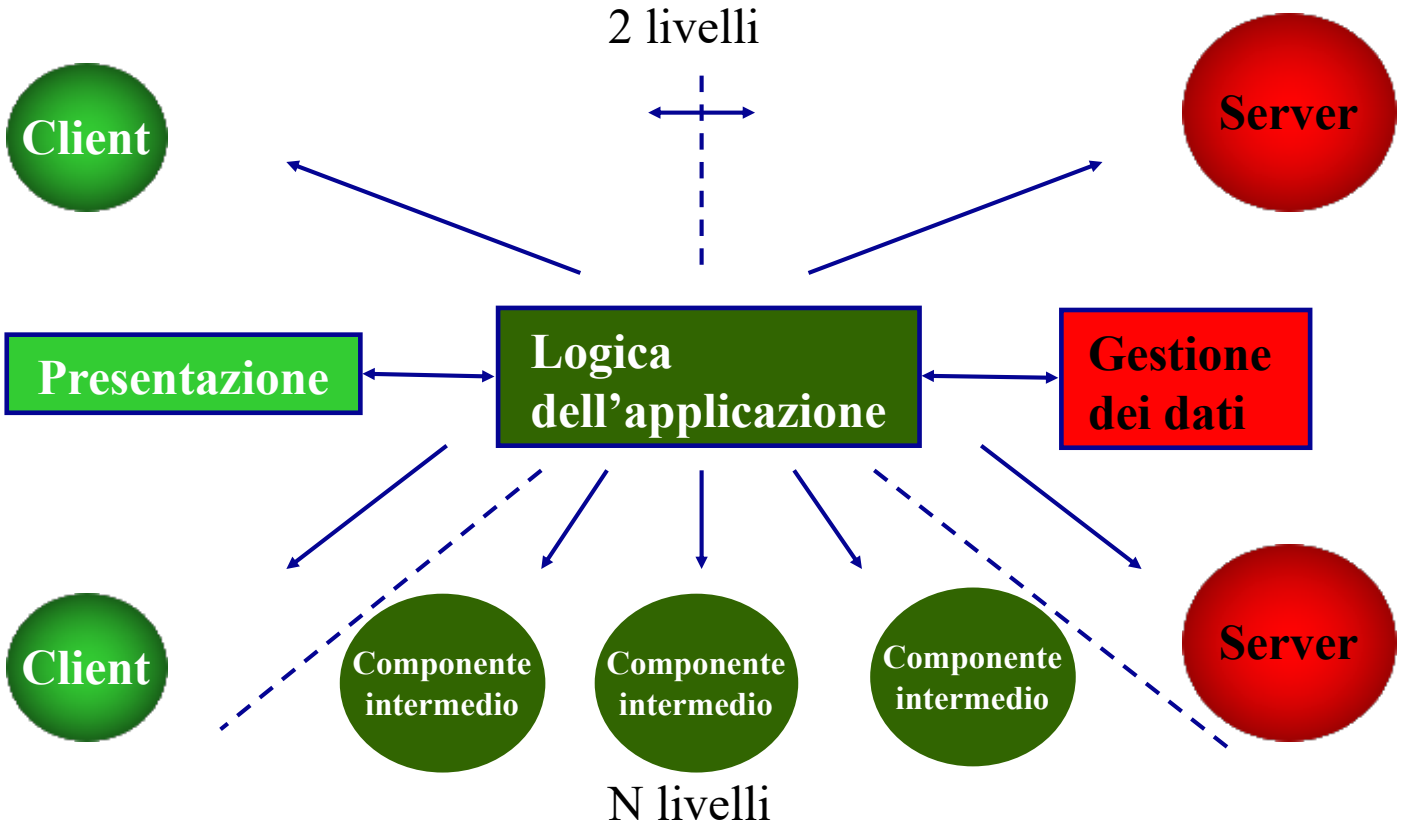
Three-tiered architecture



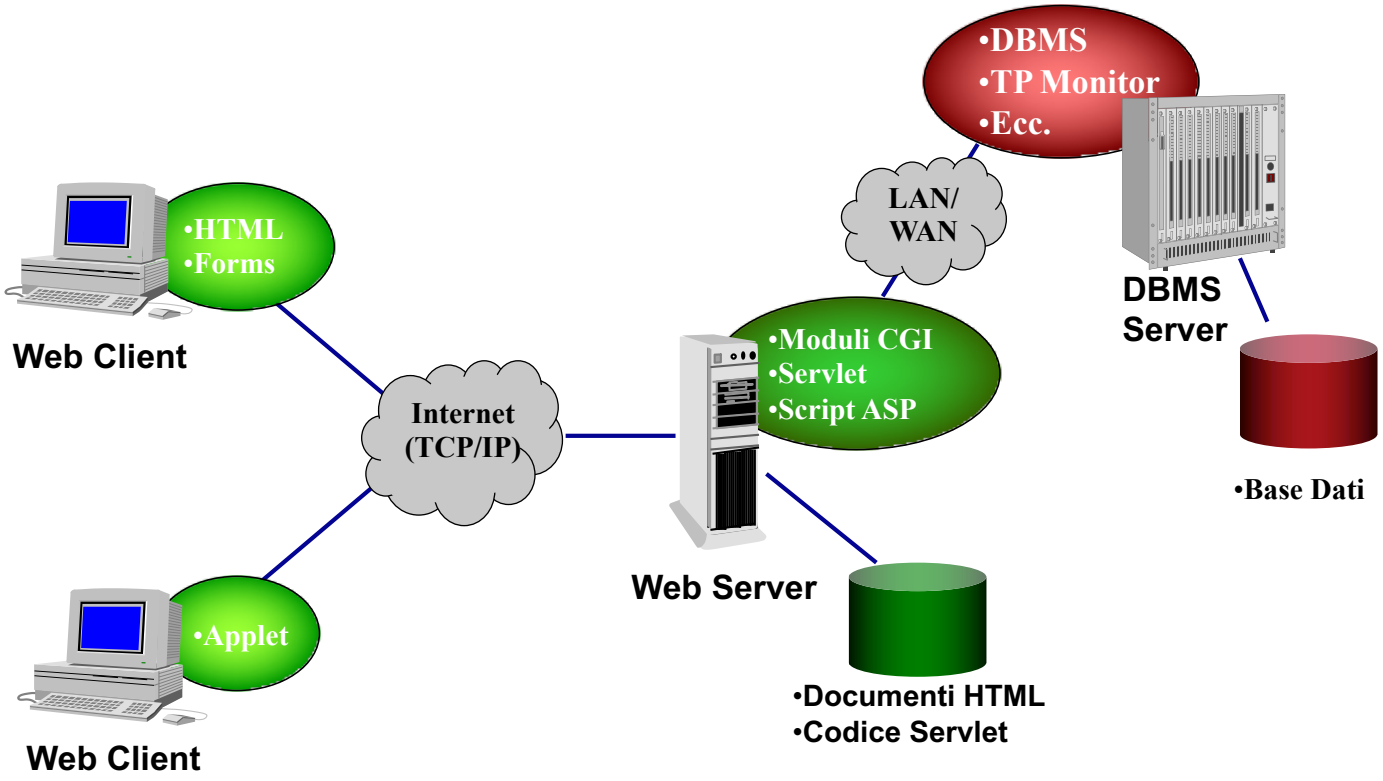
Three-tiered architecture

- In the typical schema, the intermediate component contains all the application logic.
  - In real-world cases, parts of the logic are handled by the client and the server
- Advantage: Decoupling logic and data and logic and presentation
  - There can be several distributed data sources
  - There can be different types of clients

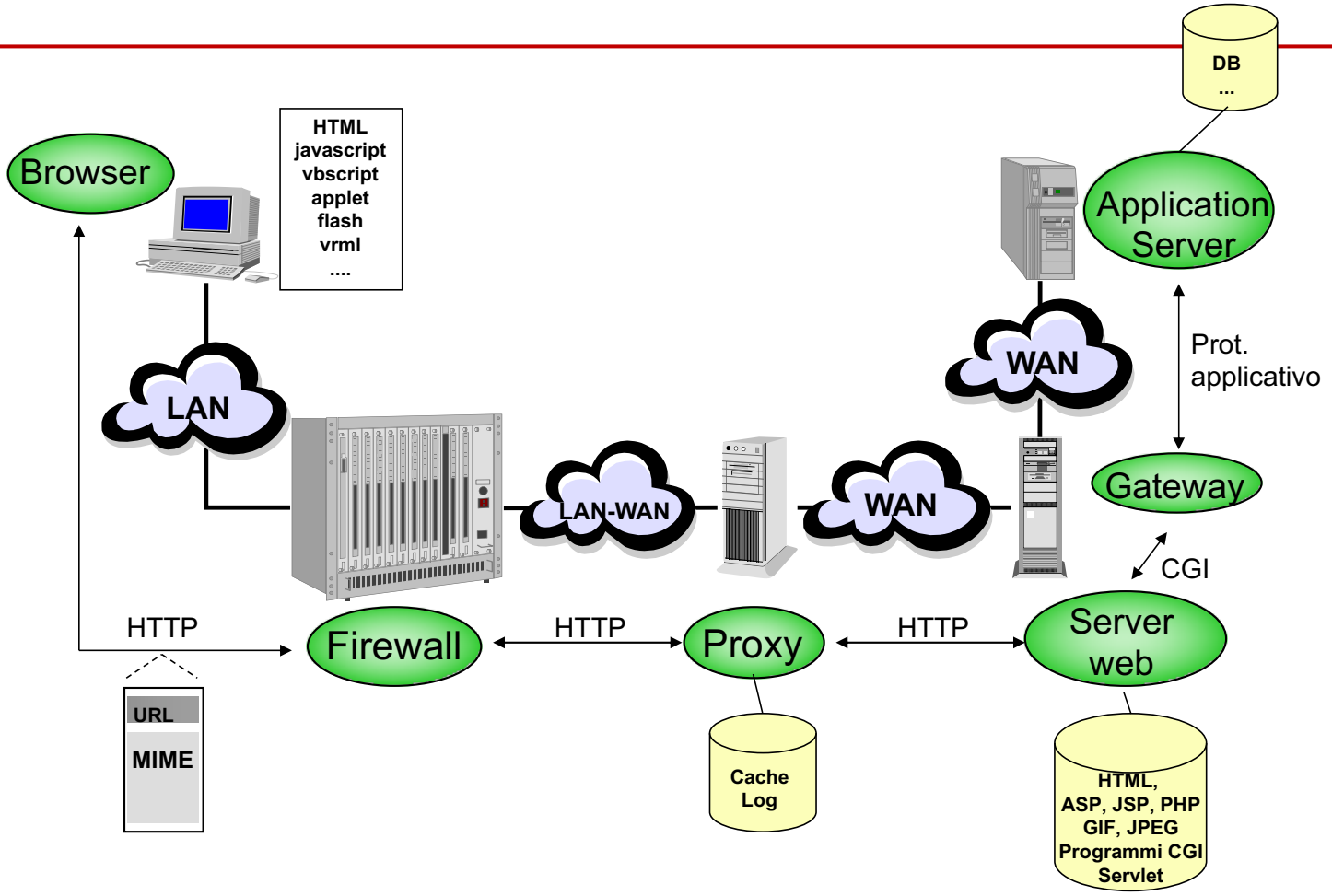
Three-tiered architecture



Three-tiered architecture: Web example



Web architecture in detail



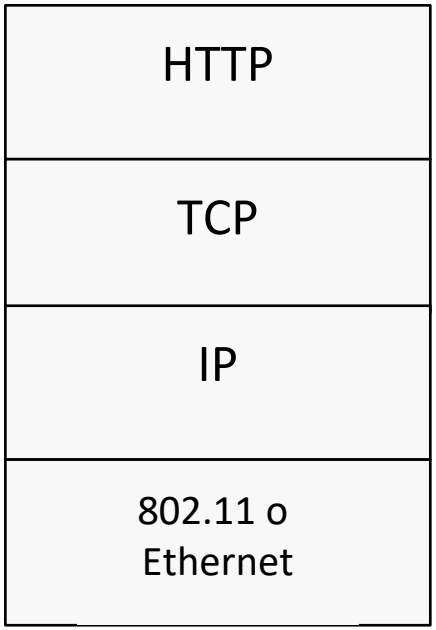
HTTP

» The protocol for communication between browser and server

» Leverage a TCP connection

» Use URLs as a Addressing Mechanism

» Use the MIME protocol to define the type of data being transported



Browser

» Play the role of the client
  - Manages user interaction

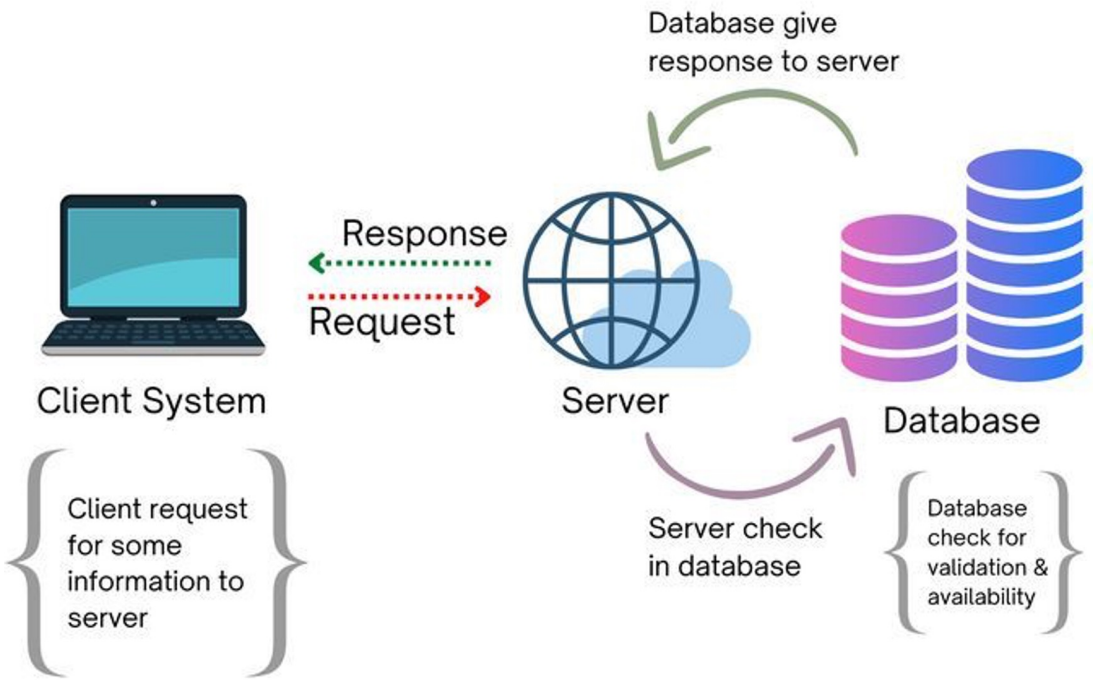
» Interprets html language and presents data on screen

» Examples: Safari, Chrome, Firefox, Opera, Internet Explorer,...

Web Server

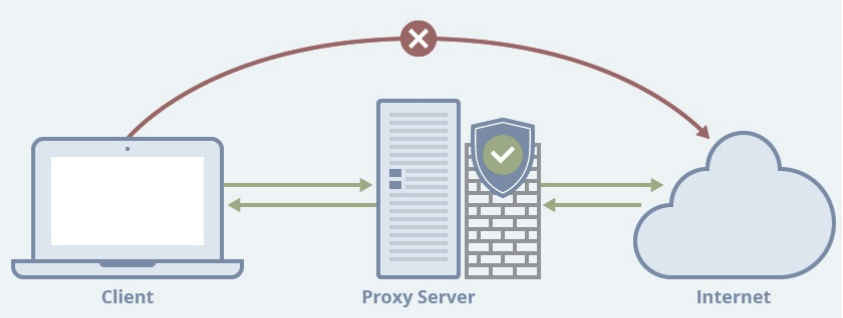
» Responds to browser requests
  - Transmitting the required data (html files, images, ...)

» Examples: MS Internet Information Server, Netscape Server, Apache



Proxy and Firewall

- Proxy
  - Acts as an intermediary between client and server
  - It caches web pages in order to improve the performance perceived by the user...
  - Reducing network traffic



- Firewall
  - Filter communications to increase security
  - Based on protocol and/or source and destination addresses
  - Generally:
    - block all communication from the outside...
    - ... let communications from within

How nodes are identified

» Nodes in the network are identified by an IP address of 32 bits (IPv4), then 128 bits (IPv6)

» Addresses are assigned to nodes so that

- Static manual, for particular networks, e.g. University network
- Automatically and dynamically by DHCP servers, which maintain a table of locally available addresses
- Try: https://whatismyipaddress.com/

IP address

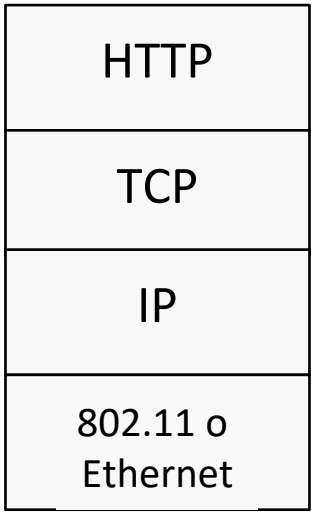
» To provide a universal communication service (i.e., to be able to make each node in the network communicate with each other node) you need a method that allows each node to be uniquely identified

» TELEPHONY: (status prefix) (area code) (number)

E.g., 0039 0862 2056233

» INTERNET: A binary number of 32 bits, or 4 bytes, each separated by a period

E.g., 00101011.10100101.11100011.00110011



IP address

» The IP address is divided into 4 fields, each of which consists of 8 bits, separated by a period n.n.n.n where 0≤n≤255.

» Since binary notation is not easily used, dotted decimal notation is preferred.

» Example IP address: 130.192.5.189

» In the current version of the IP protocol, there are about 4 billion IP addresses available

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Why do the numbers go from 0 to 255?

IP address

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Why do the numbers go from 0 to 255?

Numero binario	1	1	1	1	1	1	1	1
Pesi	$2^7 = 128$	$2^6 = 64$	$2^5 = 32$	$2^4 = 16$	$2^3 = 8$	$2^2 = 4$	$2^1 = 2$	$2^0 = 1$

$128+64+32+16+8+4+2+1 = 255$

$255 = 2^8-1 = 256-1$

Besides IP: *Hostname*

https://193.206.27.39/ **Website University of Teramo**

» Given the user-facing purpose of Internet services, choosing the IP address in decimal format also does not seem to be the most suitable

» How to assign mnemonic values to networked hosts?

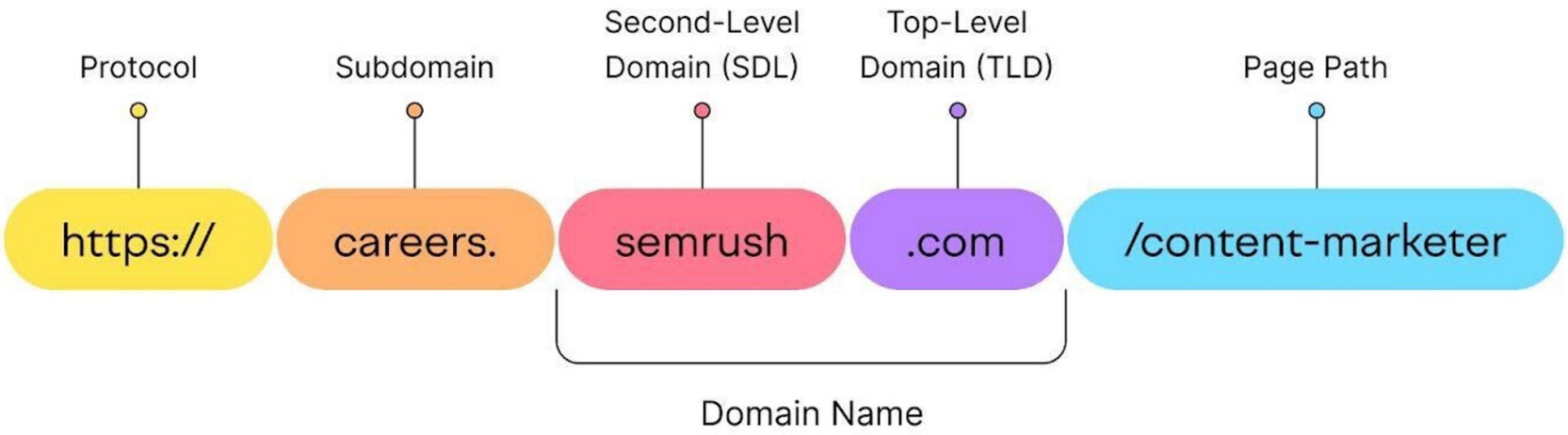
Use the hostname:

- **Computer name**
- **Domain of Origin**

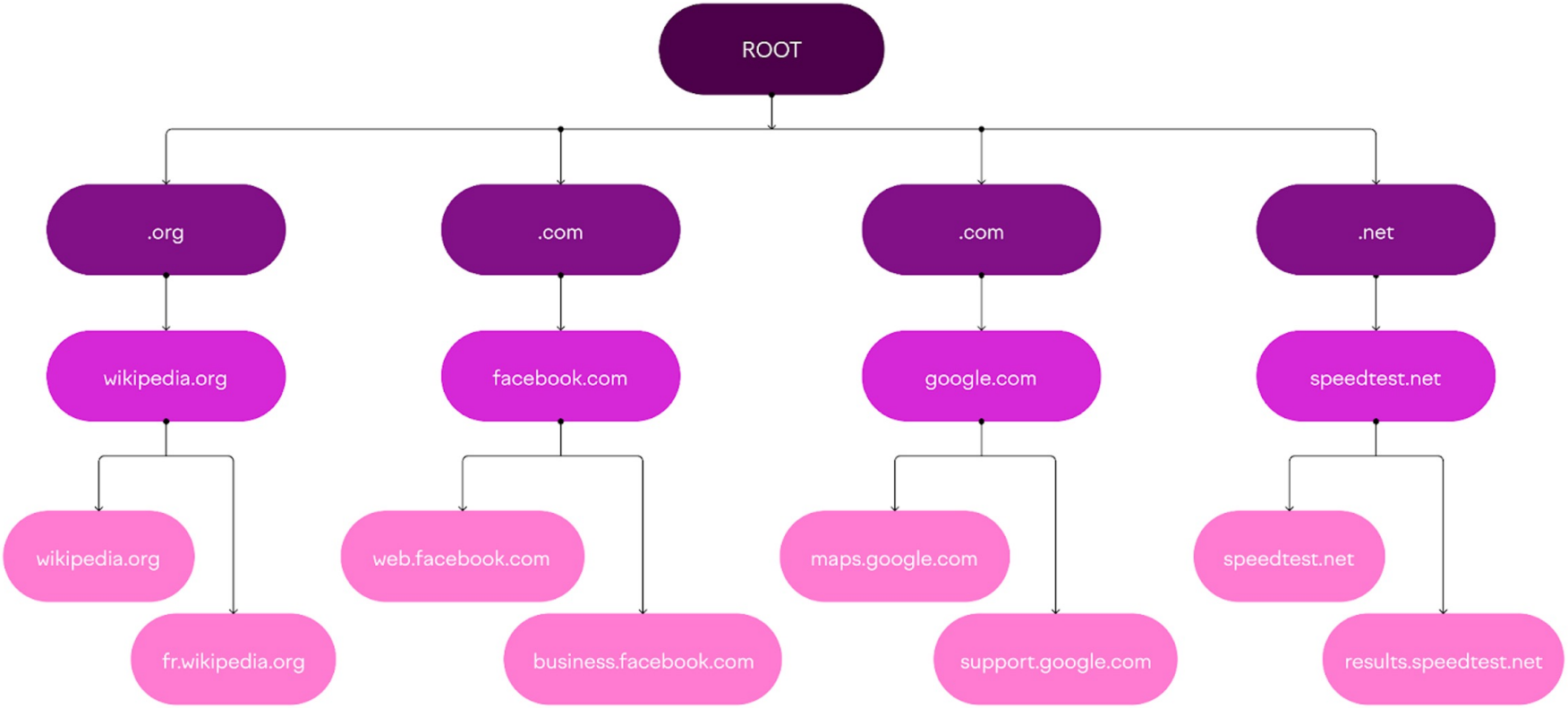
https://www.unite.it/ **Website University of Teramo**

Besides IP: *Hostname*

Parts of a URL (Unified Resource Locator)



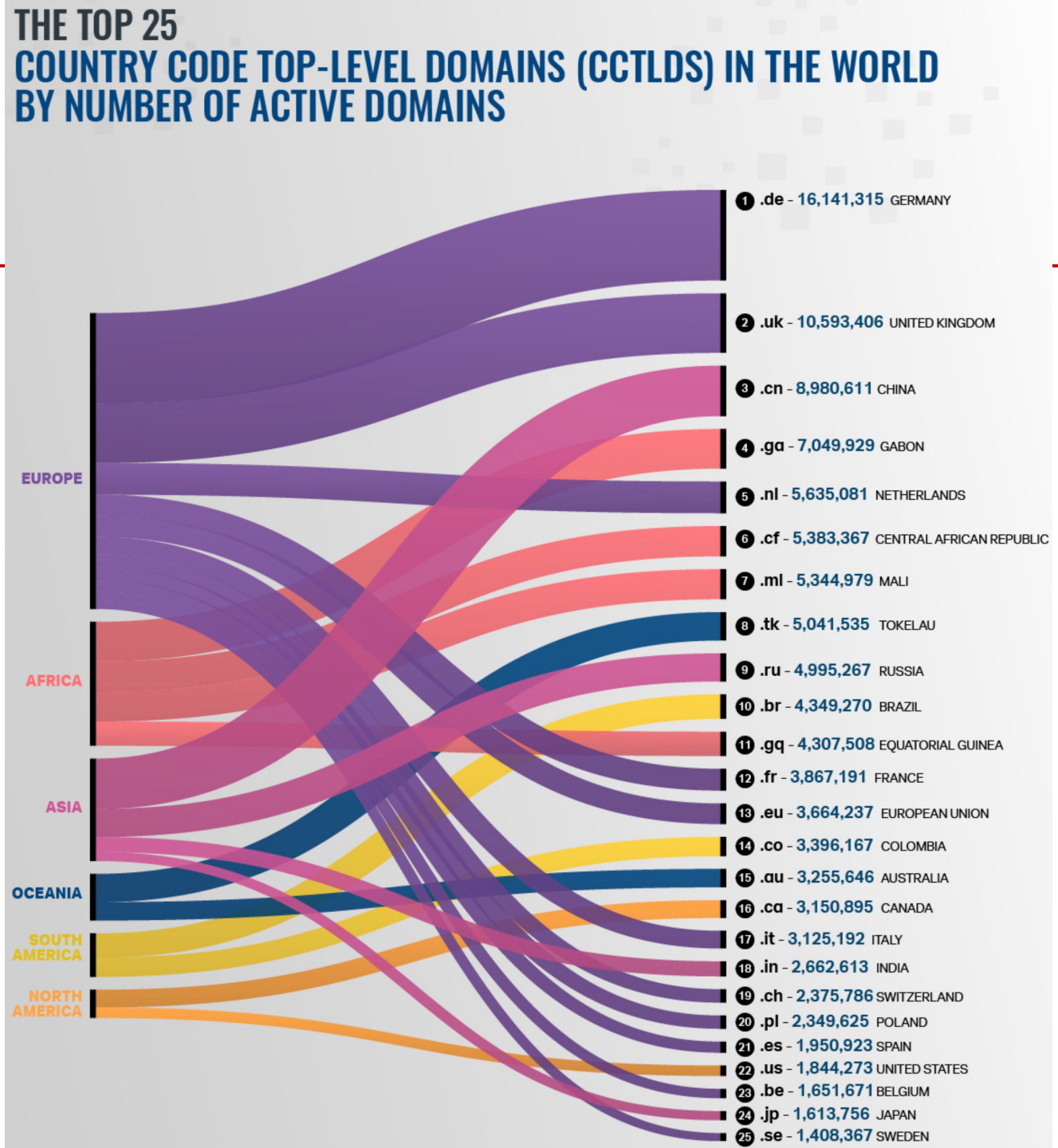
Hierarchy of *domains*



TLD - TOP LEVEL DOMAIN

DOMAIN NAME	TLD	PURPOSE
Constellix	.com	commercial
USA	.gov	government
Bethesda	.net	network
Harvard	.edu	education
Conservation	.org	organization
Army	.mil	U.S. military
CBC	.ca	origin, country
Muenchen	.de	origin, country

THE TOP 25
COUNTRY CODE TOP-LEVEL DOMAINS (CCTLDS) IN THE WORLD BY NUMBER OF ACTIVE DOMAINS

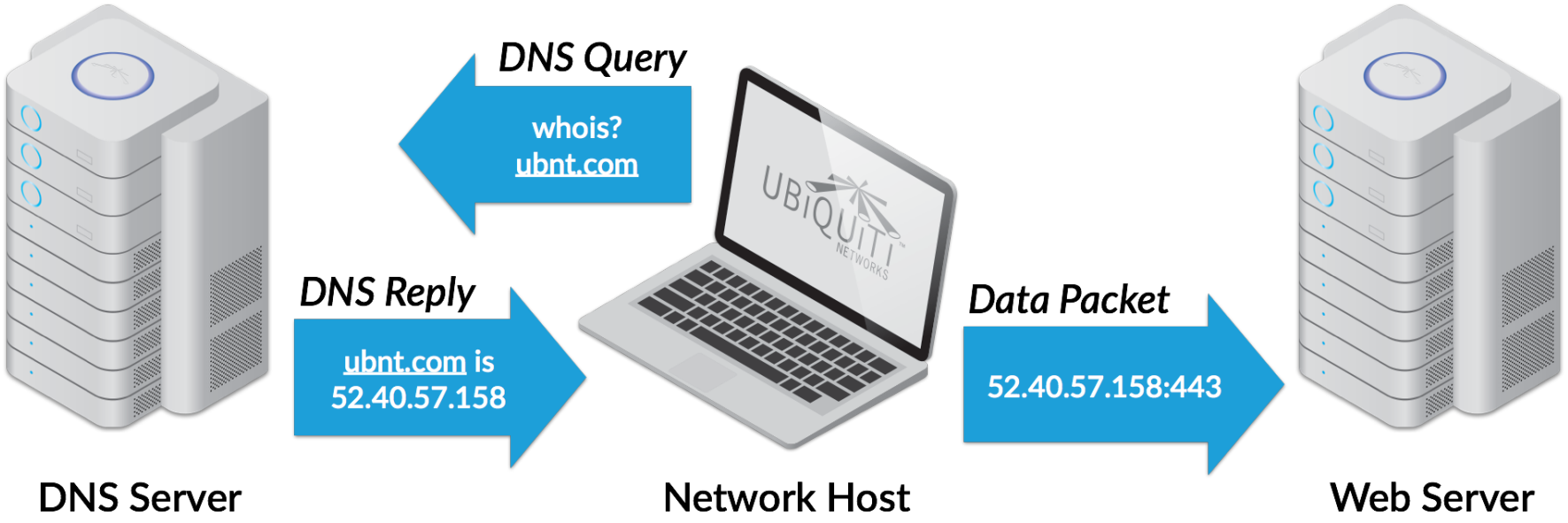


Domain Name System (DNS)

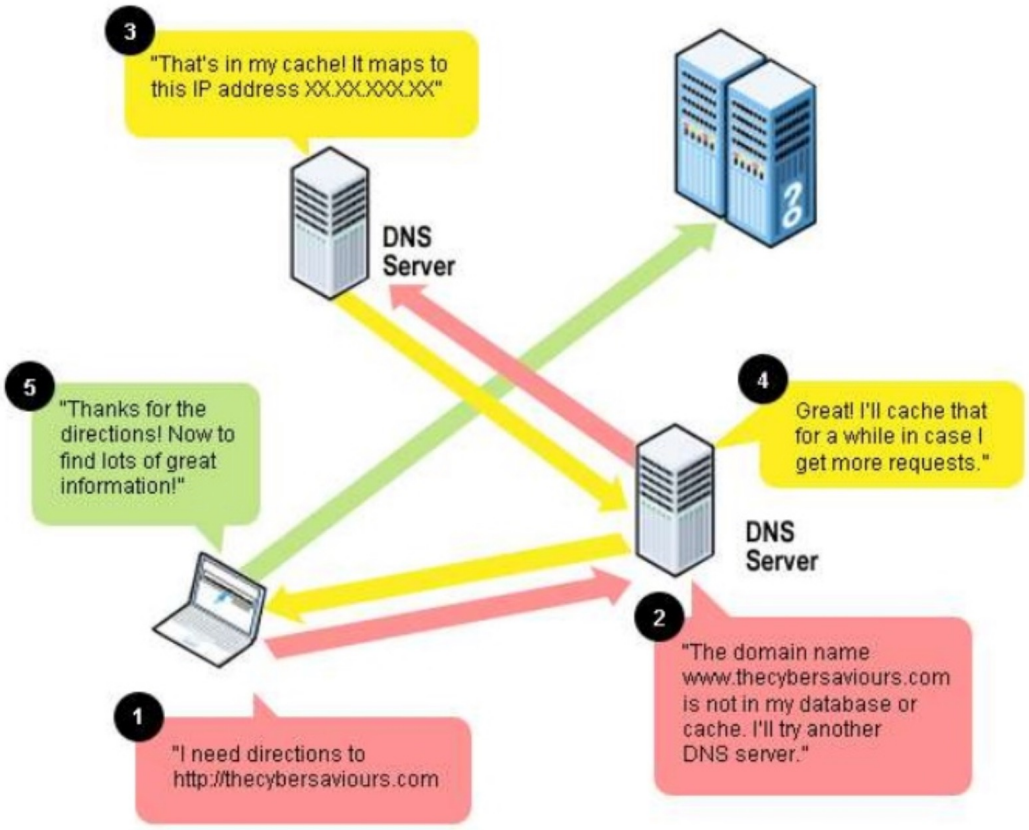
» It creates a hierarchical namespace and allows the translation of a host's mnemonic name into an IP address and vice versa. E.g.

» Implement an efficient mechanism (through multiple name servers), distributed on a geographical scale, to "resolve" a hostname to an IP address and vice versa

Domain Name System (DNS)



Domain Name System (DNS)



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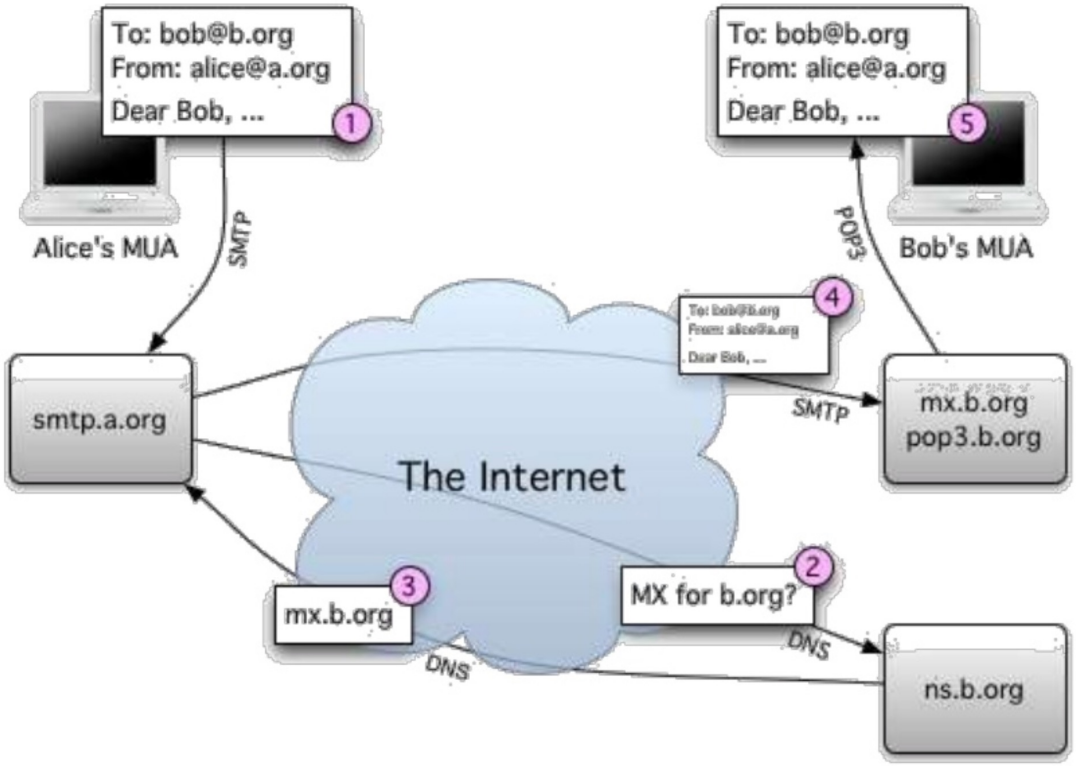
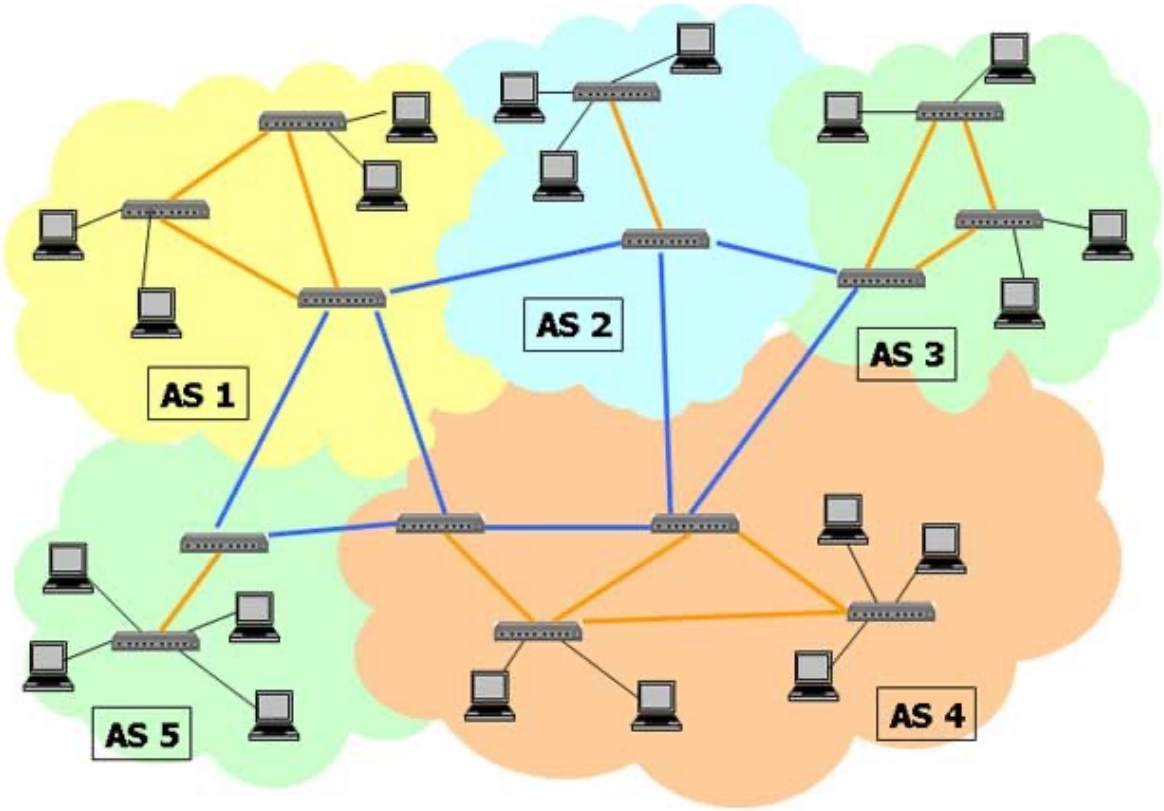


What is Internet?

FROM AN ORGANIZATIONAL POINT OF VIEW:

A set of about 30000 Autonomous Systems (AS), some on a national scale, others on a continental and intercontinental scale

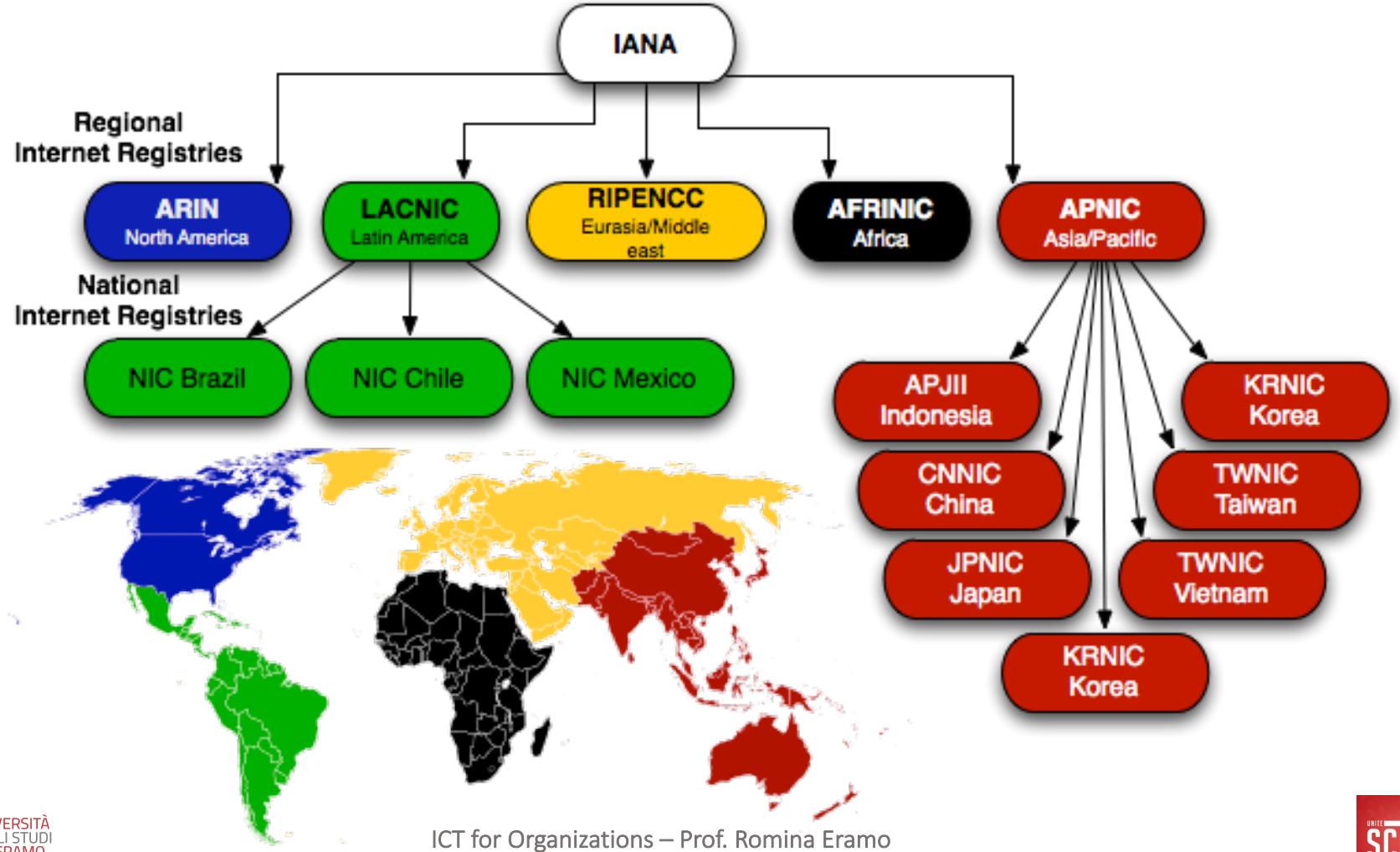


Autonomous system (Internet)

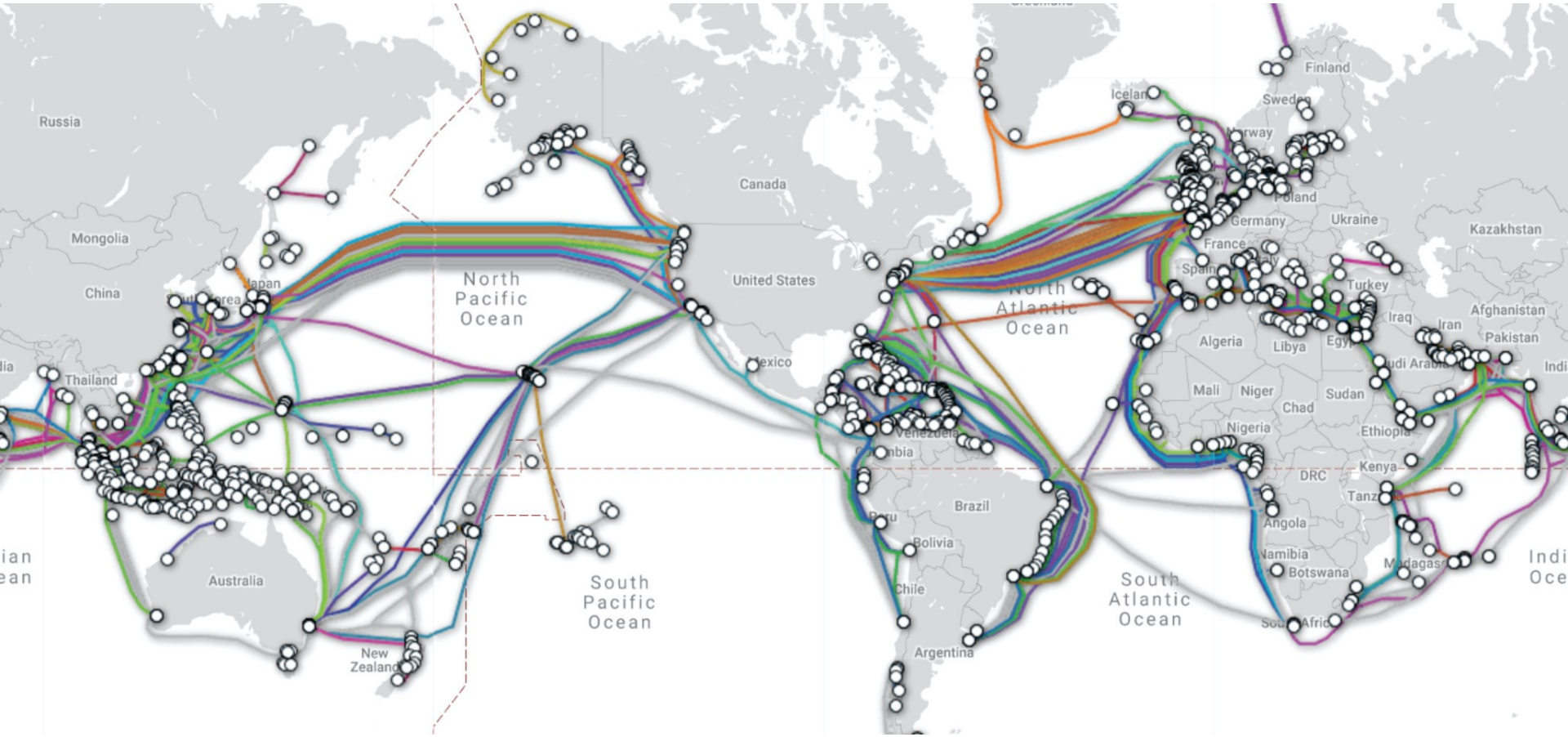
- An Autonomous System Network, in reference to routing protocols, is a group of routers and networks under the control of a single, well-defined administrative authority.
- An administrative authority is distinguished both on the basis of technical-IT elements (specific routing policies) and for administrative reasons.
- Each AS using the public network must be registered with the respective Regional Internet Registry (RIR)
- Each AS is also identified by a unique 16-bit or 32-bit number.
- Each AS is assigned a number of public IP addresses, which can be distributed.

https://it.wikipedia.org/wiki/Sistema_autonomo

Internet Assigned Numbers Authority (IANA)



Submarine cables for Internet



Submarine cables for Internet

To know more…

» IP address: https://it.wikipedia.org/wiki/Indirizzo_IP

» TCP/IP: https://it.wikipedia.org/wiki/Suite_di_protocolli_Internet

» DNS: https://it.wikipedia.org/wiki/Domain_Name_System

To know more…

» What is net neutrality? Who are the conflicting stakeholders?
  - https://en.wikipedia.org/wiki/Net_neutrality

» What is Google fiber? Why would anyone give connectivity as a gift?
  - https://fiber.google.com/

» Why isn't it necessarily a good idea to connect to open Wi-Fi? What is a sniffer?
  - https://en.wikipedia.org/wiki/Packet_analyzer

Takeaways

» We know what the internet is and what it isn't

» We know how a machine can locate the receiver of the message

» We know how we communicate with other continents

Textbooks and references

» Fluency, Conoscere e usare l'informatica, Lawrence Snyder, Alessandro Amoroso, Paerson (6/ed. or 7/ed.)
  - Capitoli: Definire l'Information Techology, Il funzionamento delle reti