

LECTURER: TAI LE QUY

INTRODUCTION TO COMPUTER SCIENCE

Basic Concepts of Data Processing

1

Information Representation

2

Algorithms and Data Structures

3

Propositional Logic, Boolean Algebra and Circuit Design

4

Hardware and Computer Architectures

5

Networks and the Internet

6

Software

7

Computer Science as a Discipline

8

UNIT 6

NETWORKS AND THE INTERNET



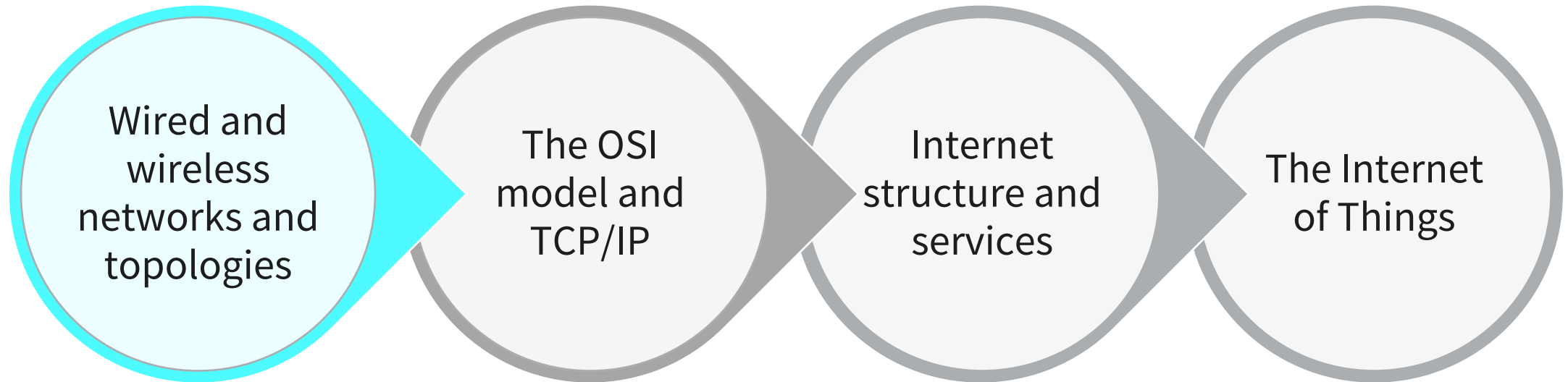
On completion of this unit, you will have learned ...

- ... about standard network topologies.
- ... about the hardware devices used in a network.
- ... how TCP/IP and the internet work.
- ... about wireless and wired network technologies.
- ... about the Internet of Things (IoT).



1. What is a switching network?
2. What is the difference between a switch and a router?
3. What is a URL?

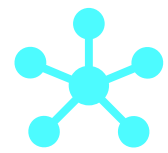
NETWORKS AND THE INTERNET



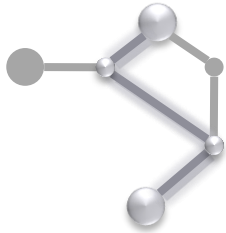
COMPUTER NETWORK TYPES

Criterion	Examples
Area Type	Personal area network (PAN), Local Area Network (LAN), Campus Area Network (CAN), Metropolitan Area Network (MAN), or Wide Area Network (WAN)
Media	Optical fiber, Ethernet, Wireless LAN, Power line communication
Connectivity	Client-server, Peer-to-peer
Topology	Bus, Star, Ring, Mesh, Tree
Technology	Modem, Wireless, Bluetooth, Parallel, Serial, Integrated Services Digital Network (ISDN), Digital Subscriber Line (DSL)

Area Types	Abbr.	Typical Distance	Example
Personal Area Network	PAN	1 - 10 m	Home net, Bluetooth
Local Area Network	LAN	1000 m	Company, Campus net
Metropolitan Area Network	MAN	20 km	Cable TV net
Wide Area Network	WAN	1000 km	Country-wide net
Internet	-	40,000 km	World-wide net

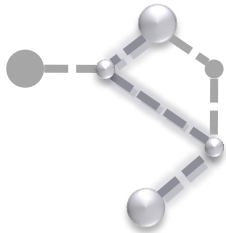


DESIGN ASPECTS



Circuit Switching

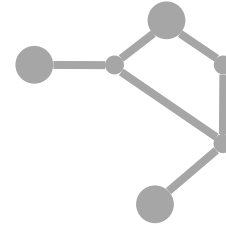
Sender and receiver are connected by dynamic nodes that are switched on demand.



Packet Switching

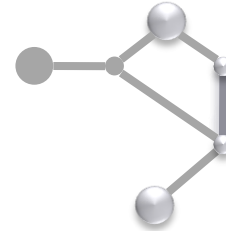
Data is dissected into packets and provided with a header including transport information.

Intelligent nodes read the header and decide for the route.



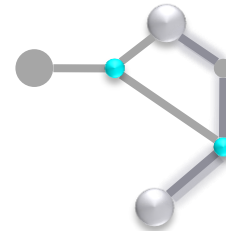
Topology

Layout and connection of components



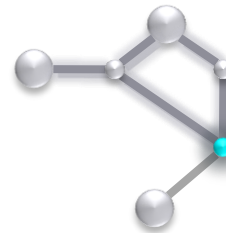
Switching

Transfer between adjacent nodes or components



Routing

Path from sender to receiver



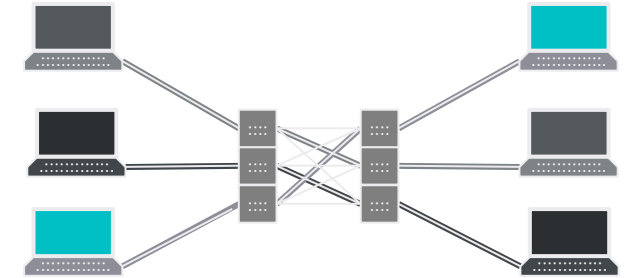
Flow Control

Handling congestion, loss or other exceptions

CIRCUIT VS. PACKET SWITCHING

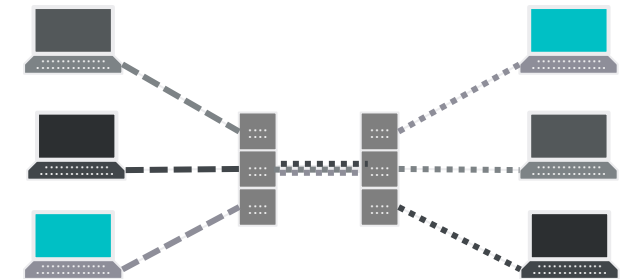
Circuit switching: Dedicated communication channel

- + Single overhead for setup and termination
- + No buffer required; full bandwidth
- Deadlock: line blocked even if unused
- No interleave possible



Packet switching: Dynamic communication channel

- + Resource is occupied only when needed
- + Alternative routing possible
- Buffer required; partial bandwidth
- Creation of packets required
- Flow control required
- Packet may be lost or delayed
- Depending on number of nodes



TOPOLOGIES

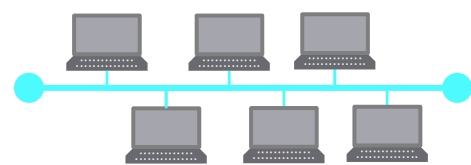
Point-to-Point



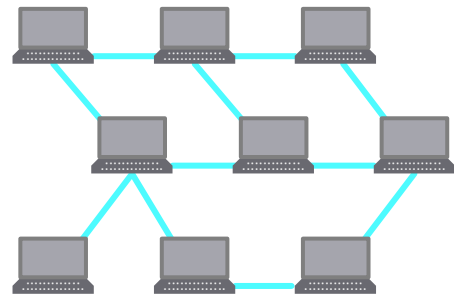
Virtual Point-to-Point



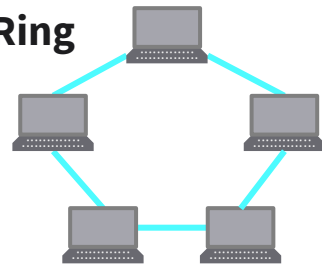
Bus



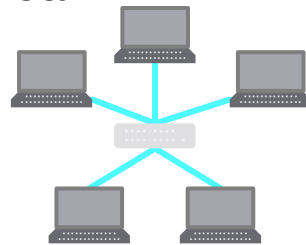
Partial Mesh



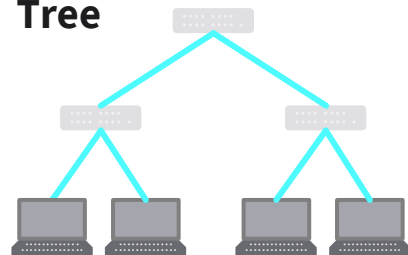
Ring



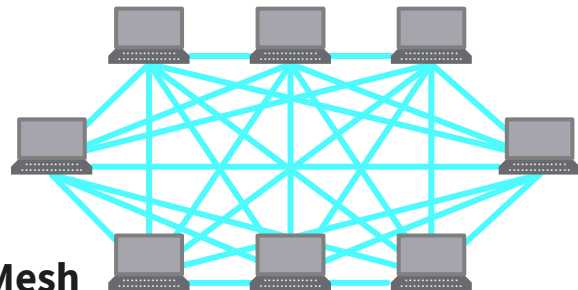
Star



Tree



Complete Mesh

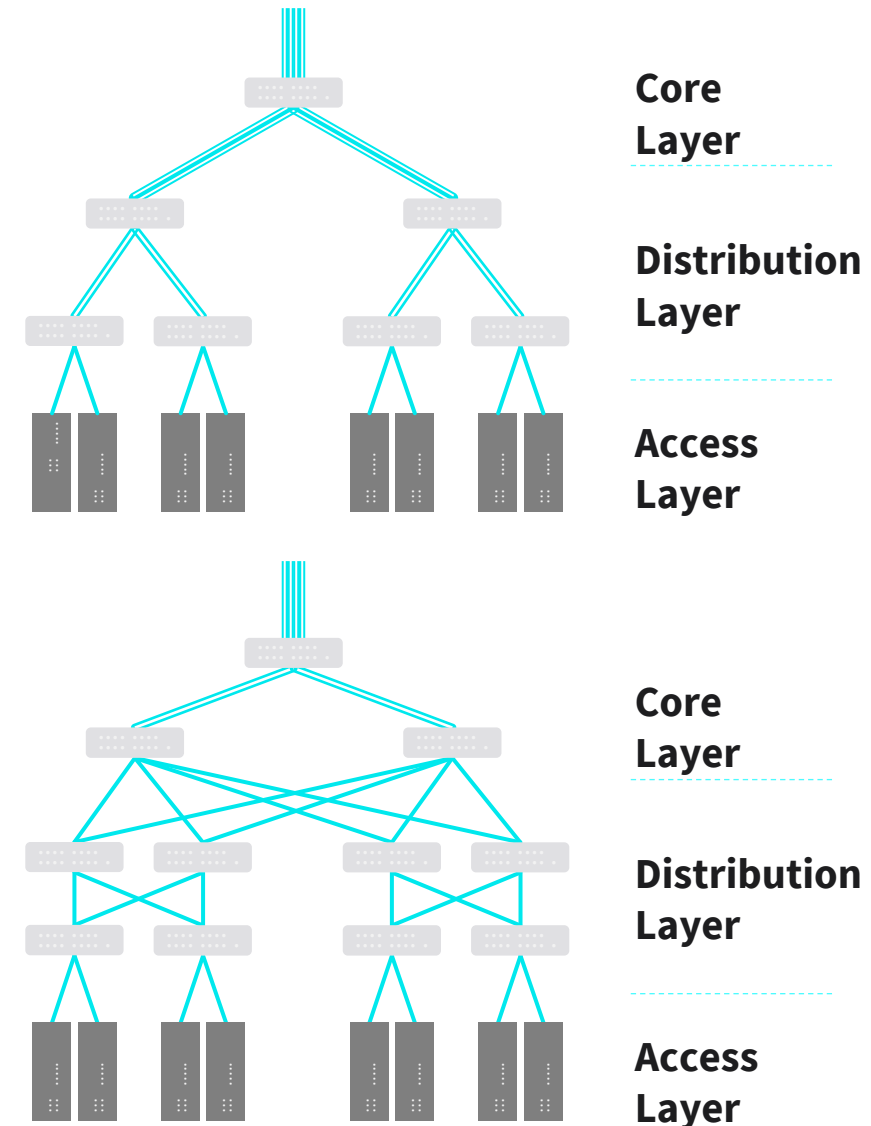


DATA CENTER TOPOLOGY



The main goal in a data center is to connect a large number of endpoints (processors or servers) by using switches that only have a limited number of ports.

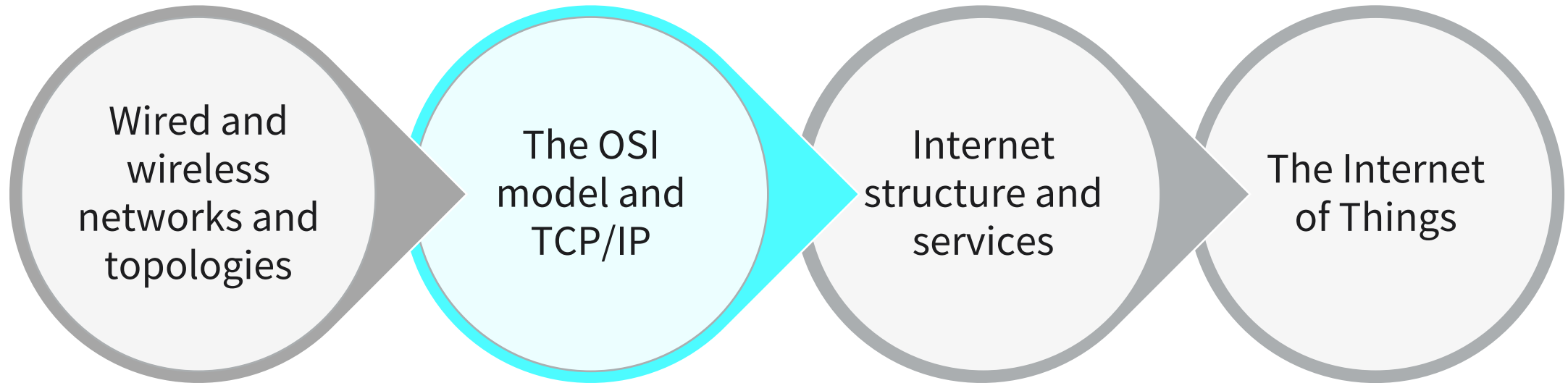
Fat-Tree networks consist of a tree in which any switch has the same number of connections in both directions.

- Connections closer to the root switch have a higher bandwidth.
- Higher redundancy: multiple paths are possible to connect between servers.
- Power consumption is lower compared to other topologies.



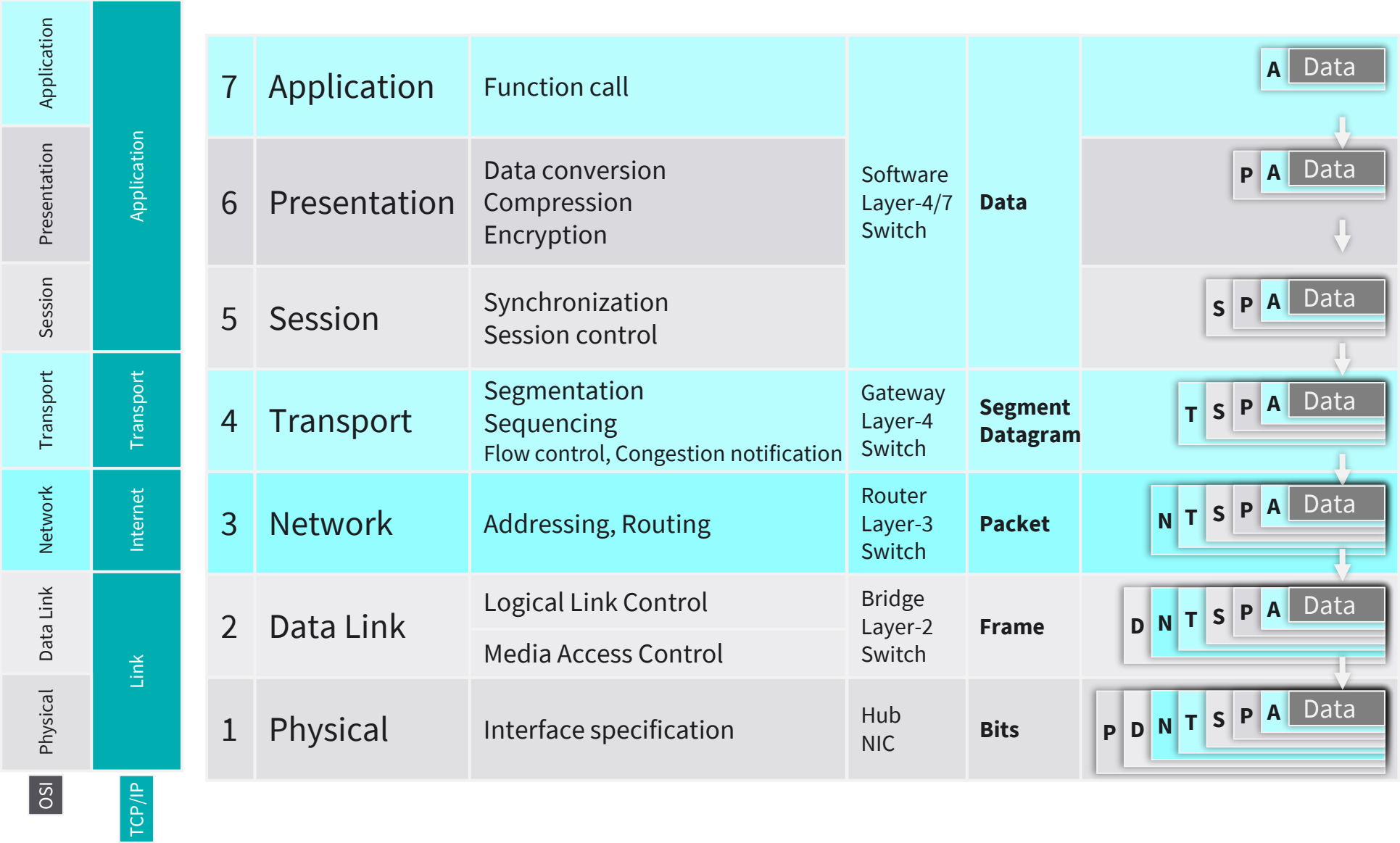
WIRED VERSUS WIRELESS

Wired network		Wireless network	
Devices physically limited by cable		Devices can move more freely within range	
Easier to troubleshoot		Can be difficult to troubleshoot	
Fastest data speeds		Medium data speeds	
Much more secure		Easy to intercept signal	
Must purchase cabling		Only wireless access point must be purchased	

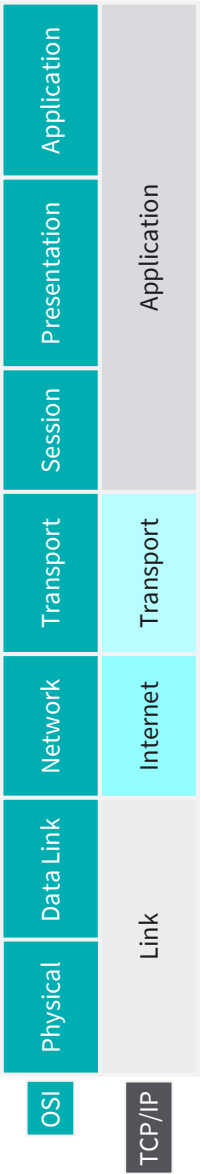




CONCEPTUAL OSI MODEL

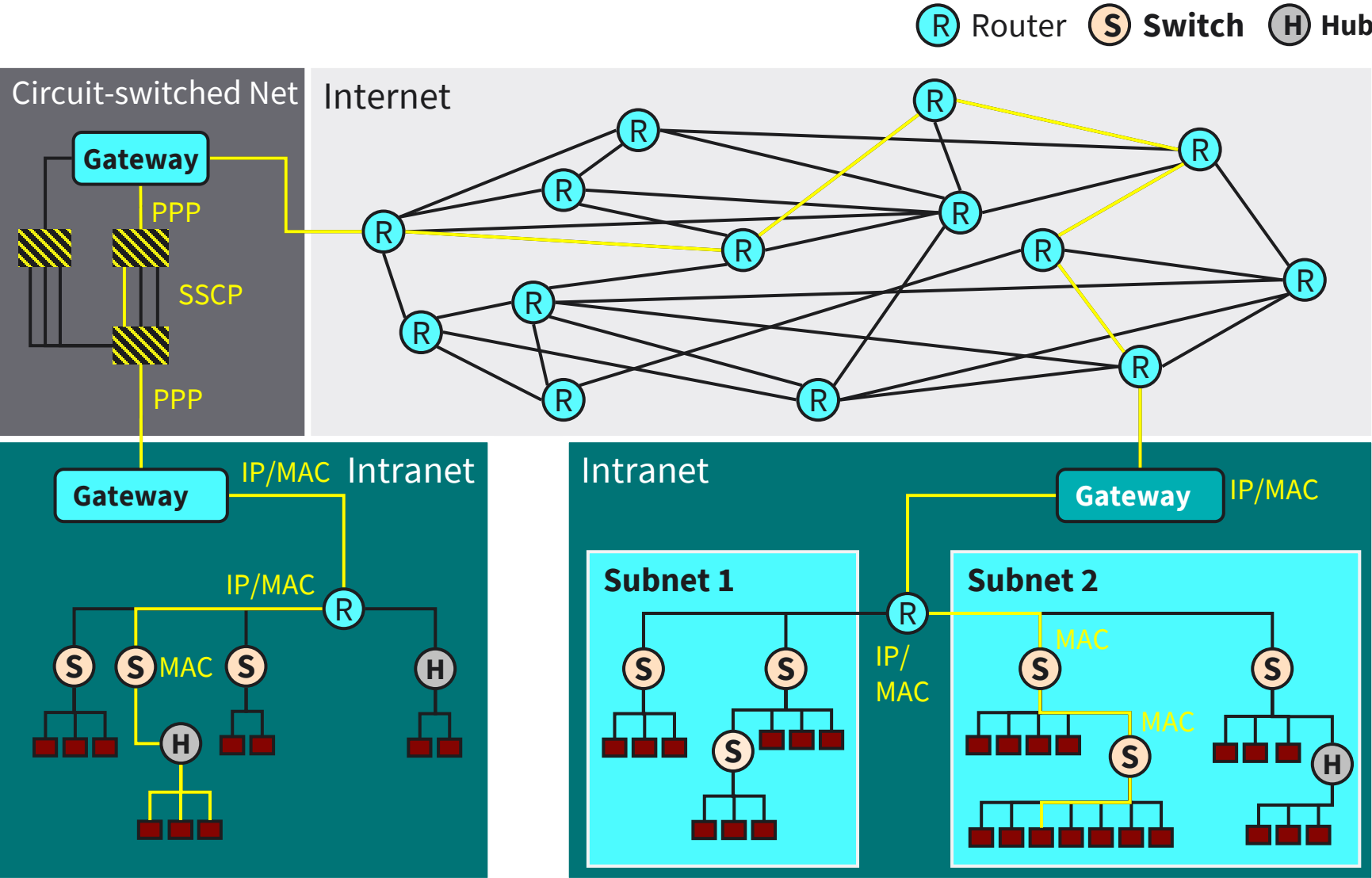


INTERNET PROTOCOL SUITE



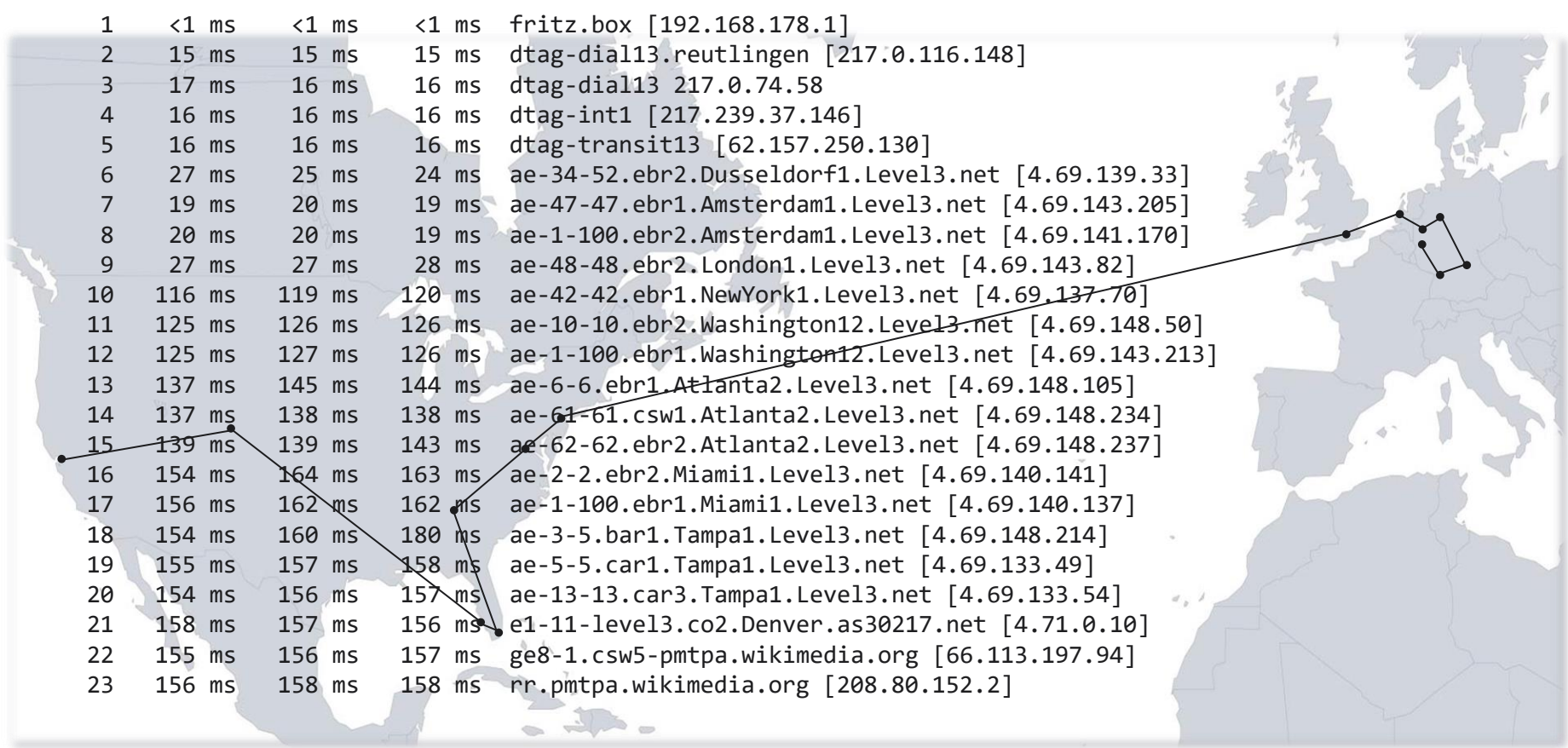
TCP/IP Layer	Typical Services	Typical Protocols
Application	Name and Directory Services Transmission Communication Encryption	DHCP, DNS, LDAP FTP, HTTP, HTTPS IRC, POP, IMAP, SMTP SSH TLS/SSL
Transport	Flow control Error control Port addressing	TCP, UDP DCCP, SCTP
Internet	Logical addressing	IPv4, IPv6, ICMP, ICMPv6, IPsec
Link	Physical addressing Interfaces Topology	ARP, NDP, OSPF, Tunnels, L2TP, PTPP, MAC (Ethernet, DSL, ISDN)

ROUTING

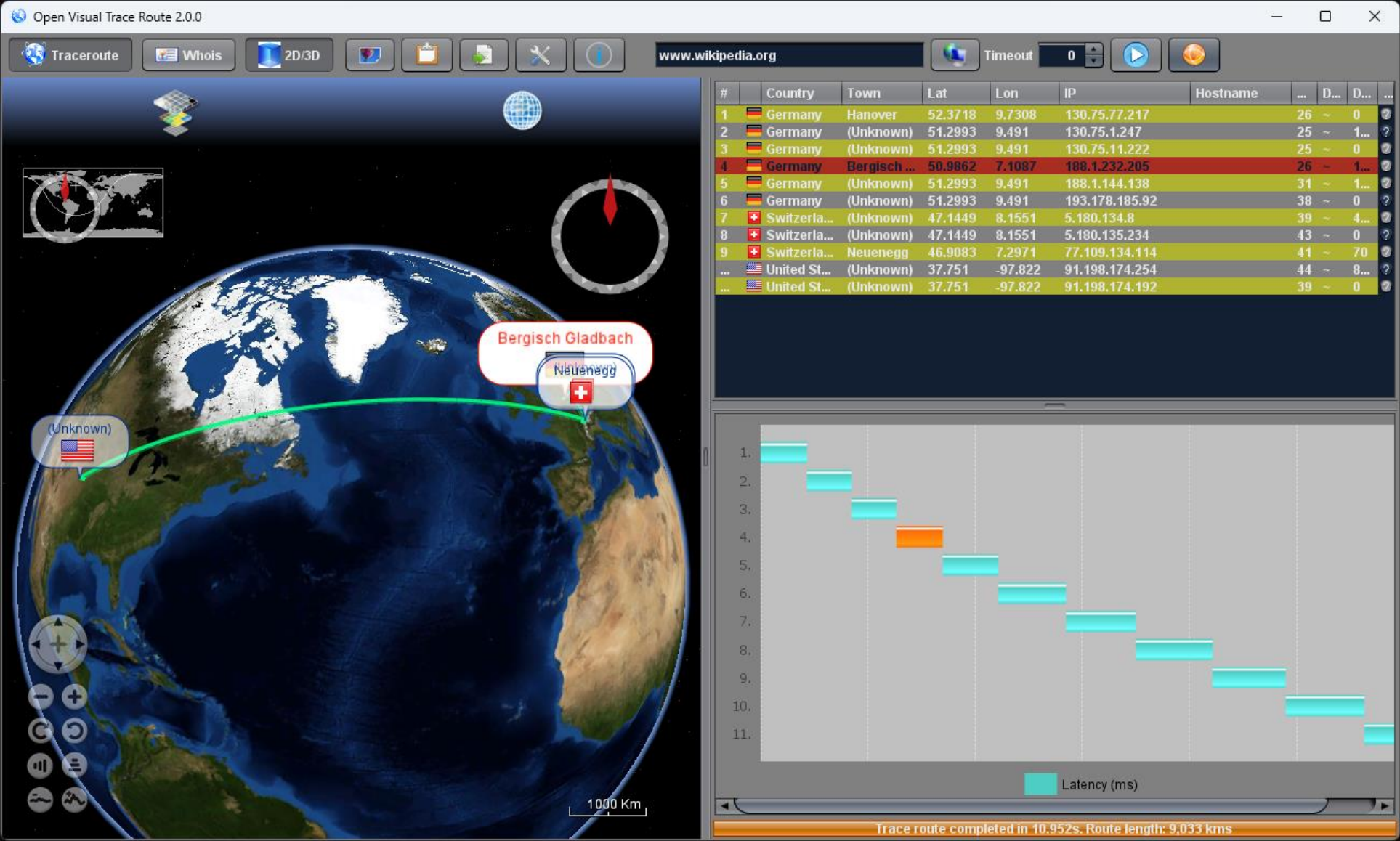


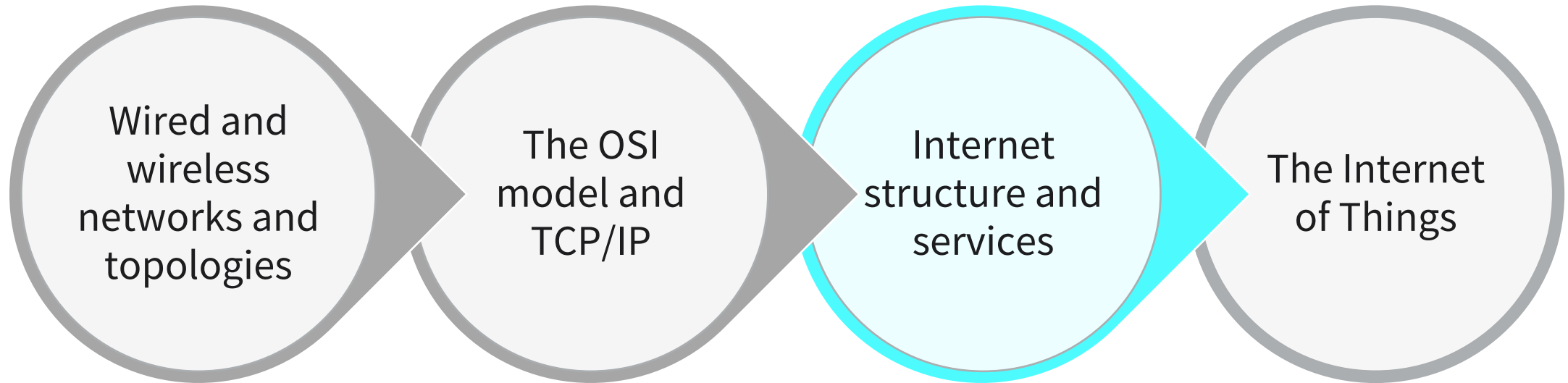
ROUTE TRACING

The software `tracert.exe` (trace route) can be used to identify the nodes that are used to connect to the target computer.



VISUAL TRACEROUTE





INTERNET

- Is defined as an information super-highway to access information.
- Internet is a global system of interconnected computer networks.
- Internet uses the standard Internet Protocol **(TCP/IP)**.
- Every computer is identified by a unique IP address IPv4 or IPv6.
- IP Address is a unique set of numbers (such as 110.22.33.114) which identifies a computer location.
- A special computer DNS **(Domain Name Server)** is used to give name to the IP Address so that user can locate a computer by a name.
 - For example, a **DNS server** will resolve a name <http://www.tutorialspoint.com> to a particular IP address to uniquely identify the computer on which this website is hosted.
- Internet is accessible to every user all over the world.



INTERCONTINENTAL INTERNET

The internet's undersea world

The vast majority of the world's communications are not carried by satellites but an altogether older technology: cables under the earth's oceans. As a ship accidentally wipes out Asia's net access, this map shows how we rely on collections of wires of less than 10cm diameter to link us all together

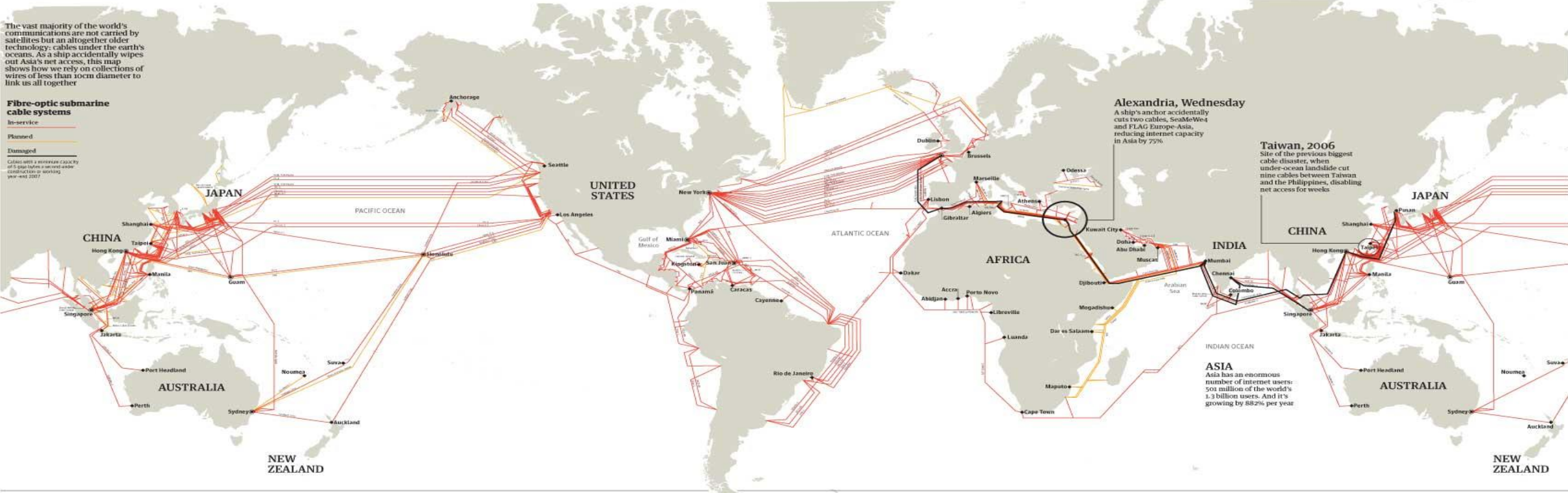
Fibre-optic submarine cable systems

In-service

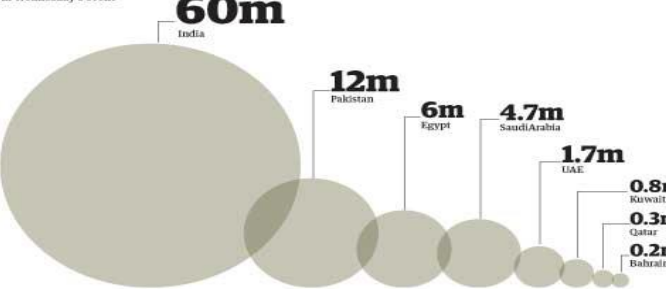
Planned

Damaged

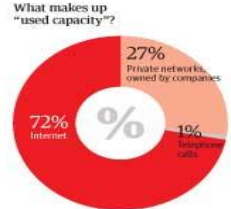
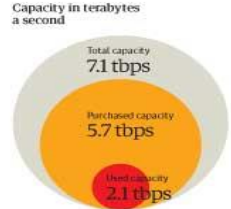
Cables with a minimum capacity of 100,000 km are not under construction in working year-end 2007



Internet users affected by the Alexandria accident
The main countries affected in Wednesday's event



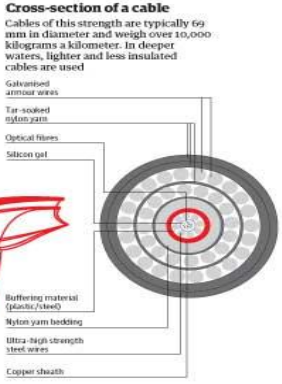
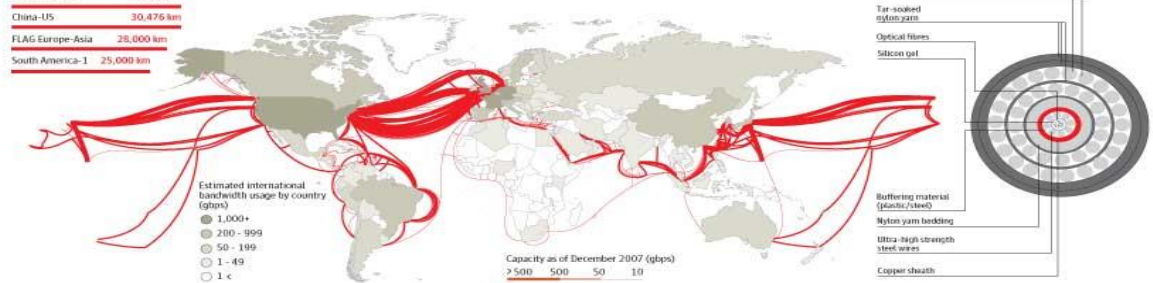
World cable capacity
Submarine cable operators light (turn on) capacity on their systems to sell bandwidth to other carriers. Carriers buy extra capacity, mainly to hold in reserve. On the trans-Atlantic route 80% of the bandwidth is purchased, but only 29% is used



The longest submarine cables
The SeaMeWe-3 system from Norden in Germany to Keelung, South Korea connects 32 different countries with 39 landing points

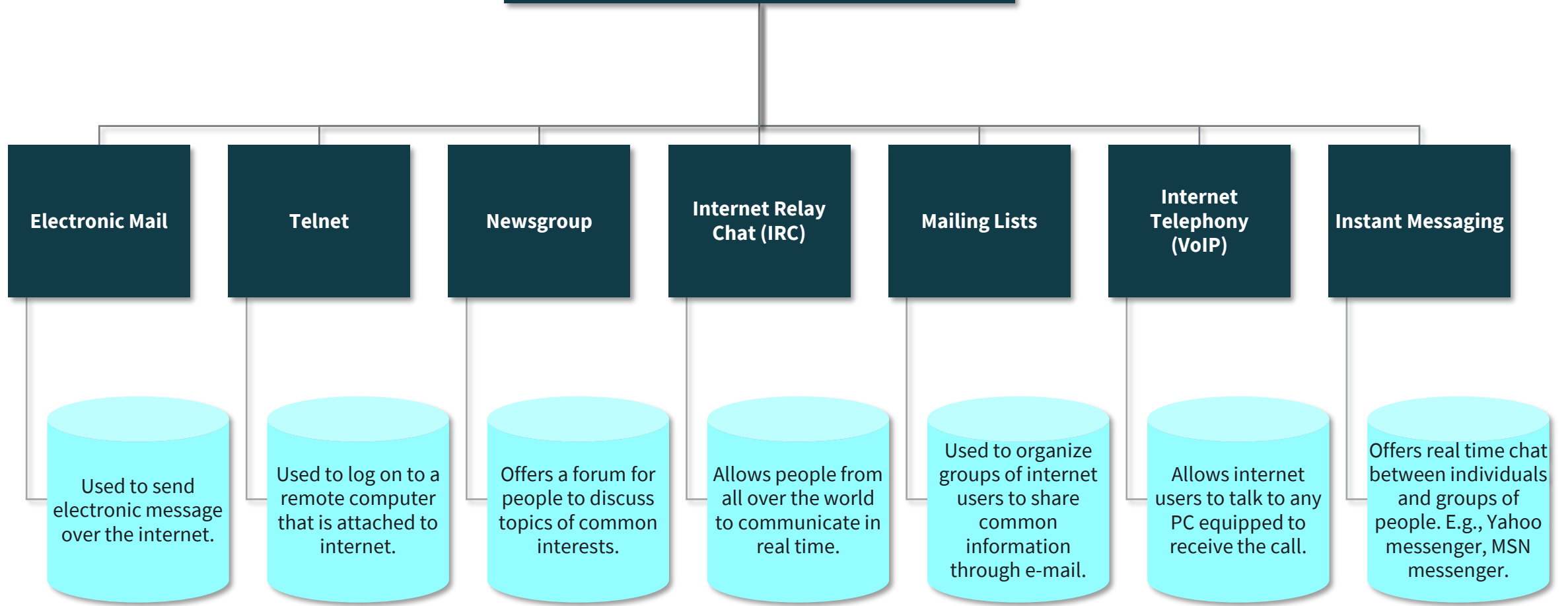
SeaMeWe-3	39,000 km
Southern Cross	30,500 km
China-US	30,476 km
FLAG Europe-Asia	28,000 km
South America-1	25,000 km

The world's cables in bandwidth
The first intercontinental telephony submarine cable system, TAT-1, connected North America to Europe in 1958 and had an initial capacity of 640,000 bytes per second. Since then, total trans-Atlantic cable capacity has soared to over 7 trillion bps



INTERNET SERVICES

COMMUNICATION SERVICES



INFORMATION RETRIEVAL SERVICES

```
graph TD; A[INFORMATION RETRIEVAL SERVICES] --> B[File Transfer Protocol (FTP)]; A --> C[Archie]; A --> D[Gopher]; A --> E[Very Easy Rodent Oriented Netwide Index to Computer Achieved (VERONICA)];
```

File Transfer Protocol (FTP)

Enables users to transfer files.

Archie

Updated database of public FTP sites and their content. It helps to search a file by its name.

Gopher

Used to search, retrieve, and display documents on remote sites.

Very Easy Rodent Oriented Netwide Index to Computer Achieved (VERONICA)

VERONICA is a gopher-based resource. It allows access to the information resource stored on gopher's servers.

INTERNET SERVICES

Web Services

Web services allow exchange of information between applications on the web.

Using web services, applications can easily interact with each other.

World Wide Web (WWW)

WWW is also known as W3.

It offers a way to access documents spread over the several servers over the internet.

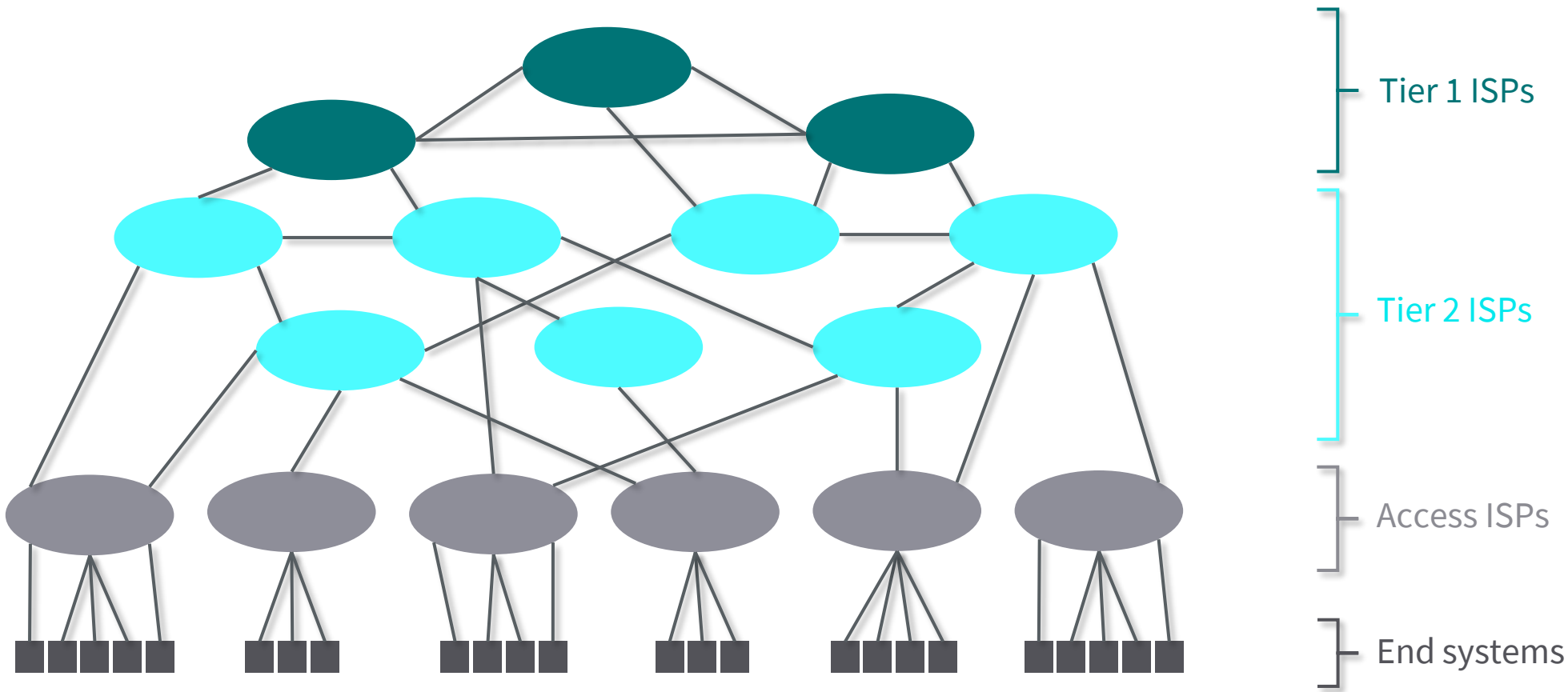
These documents may contain texts, graphics, audio, video, hyperlinks.

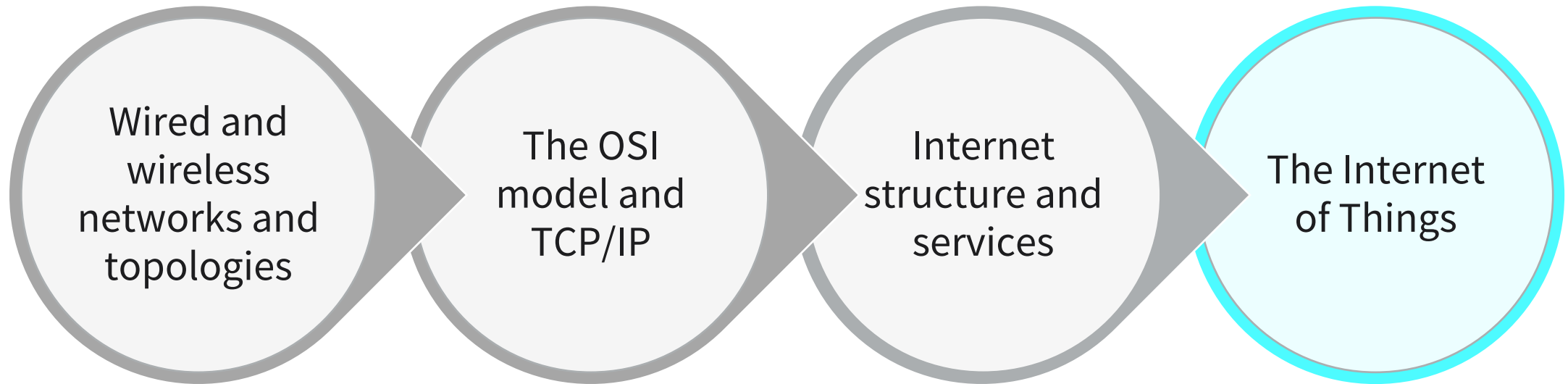
The hyperlinks allow users to navigate between the documents.

Video Conferencing

Video conferencing or video teleconferencing is a method of communicating by two-way video and audio transmission with help of telecommunication technologies.

INTERNET COMPOSITION





INTERNET OF THINGS

IoT

edureka!



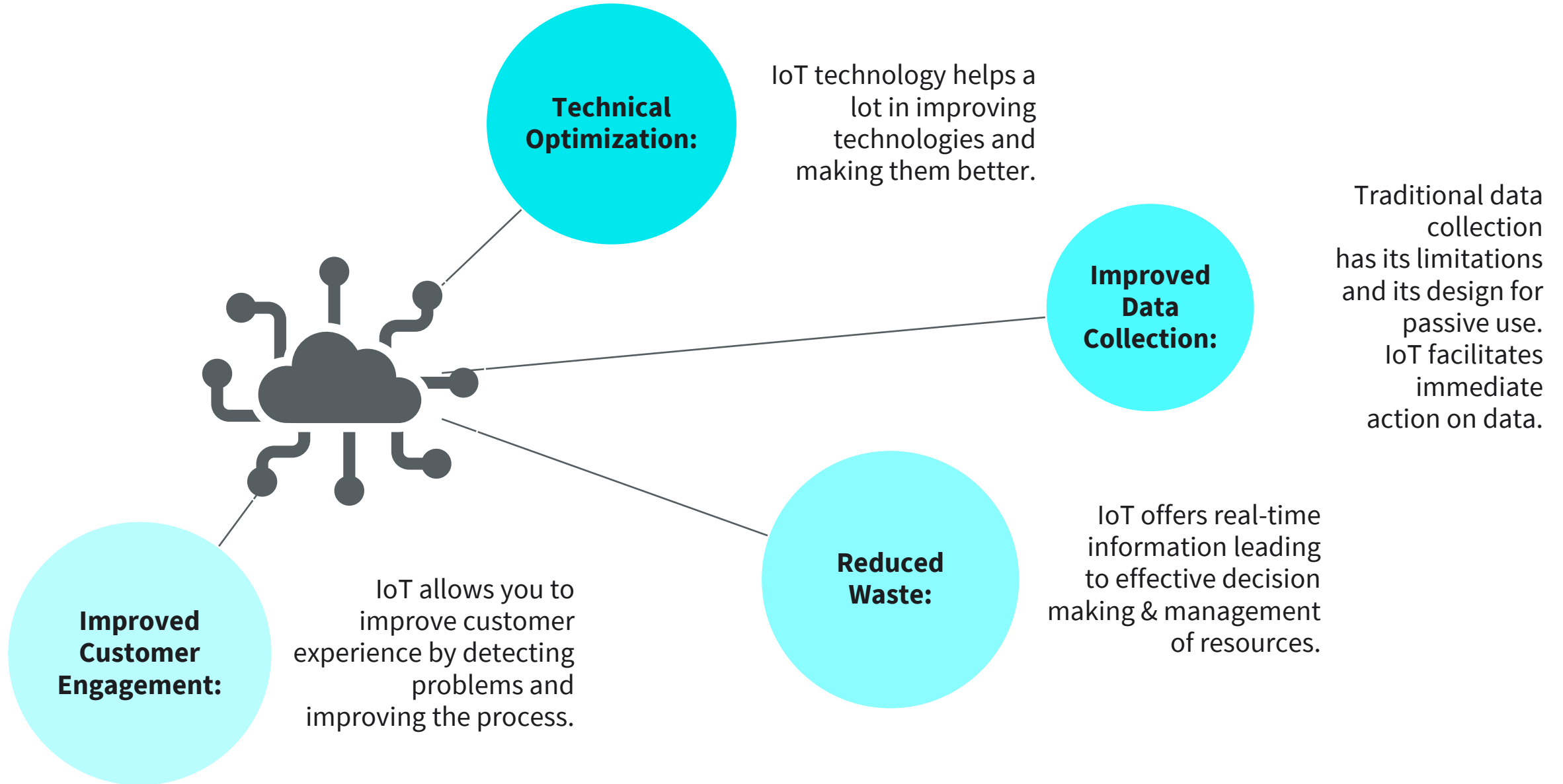
INTERNET OF THINGS (IOT)

IoT is a **network of** physical objects or people called “**things**” that are embedded with software, electronics, network, and sensors that allow these objects to collect and exchange data.

The goal of IoT is to extend to internet connectivity **from standard devices** like computer, mobile or tablet **to relatively dumb devices** like a toaster.



ADVANTAGES OF IOT



DISADVANTAGES IOT



SECURITY

IoT technology creates an ecosystem of connected devices. However, during this process, the system may offer little authentication control despite sufficient security measures.



PRIVACY

The use of IoT exposes a substantial amount of personal data in extreme detail without the user's active participation. This creates lots of privacy issues.



FLEXIBILITY

There is a huge concern regarding the flexibility of an IoT system. It is mainly regarding integrating with another system as there are many diverse systems involved in the process.



COMPLEXITY

The design of the IoT system is also quite complicated. Moreover, its deployment and maintenance are not very easy.



COMPLIANCE

IoT has its own set of rules and regulations. However, because of its complexity, the task of compliance is quite challenging.

CHALLENGES OF INTERNET OF THINGS (IOT)

At present IoT is faced with many challenges, such as:

- insufficient testing and updating
- concerns regarding data security and privacy
- software complexity
- data volumes and interpretation
- integration with AI and automation
- devices require a constant power supply which is difficult
- interaction and short-range communication





You have learned ...

- ... about standard network topologies.
- ... about the hardware devices used in a network.
- ... how TCP/IP and the internet work.
- ... about wireless and wired network technologies.
- ... about the Internet of Things (IoT).

SESSION 4

TRANSFER TASK



Dial-In via Internet Service Provider

You are at home and your local IP address is 192.168.178.0. You want to reach Wikipedia from your browser. You have the following network components available:

- Internet
- Homenet
- Home PC
- Your ISP (Internet service provider) (IP 80.45.4.9)
- Routers
- Gateways
- Wikipedia.org Server
- DSL connection Switches
- Hubs

Draw a schema of the network by using the above components to reach Wikipedia form your Home PC.

TRANSFER TASK
PRESENTATION OF THE RESULTS

Please present your
results.

The results will be
discussed in
plenary.





1. Which of these is found at the data link layer of the OSI model?
 - a) packets
 - b) Ethernet
 - c) encoding
 - d) routing



2. Which of these devices does not filter network traffic?

- a) switch
- b) router
- c) hub
- d) firewall



3. Which layer of the OSI model is responsible for encryption?
- a) application
 - b) session
 - c) transport
 - d) presentation



4. IoT stands for:?

- a) Interweb owner Transfer
- b) Internet of Things
- c) Intelligent on Throughput
- d) Interleaving of Technology



5. A router is used as part of what network topology?
- a) hub
 - b) star
 - c) ring
 - d) bus

LIST OF SOURCES

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