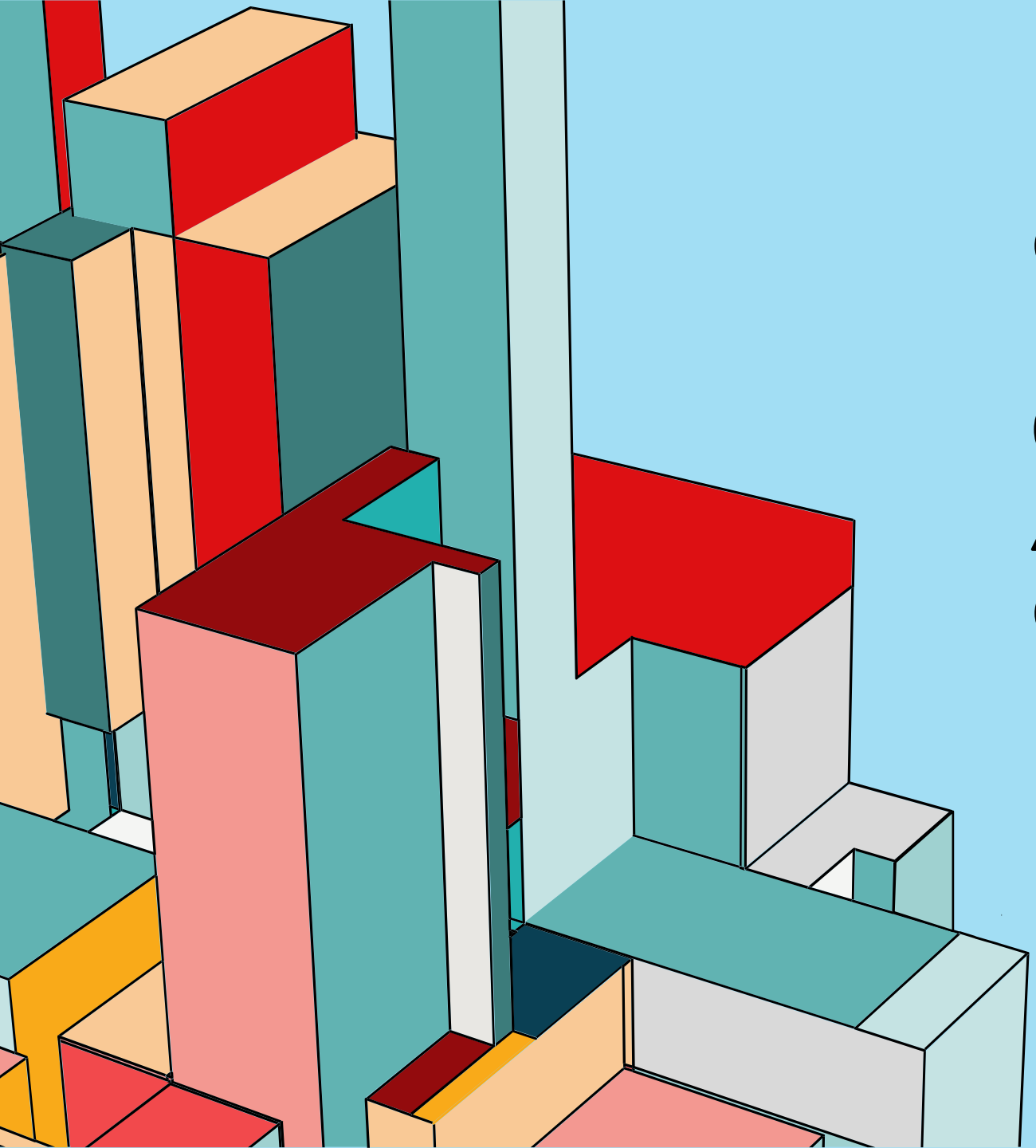

CYBER SECURITY

02
ARCHITECTURE OF CYBERSPACE

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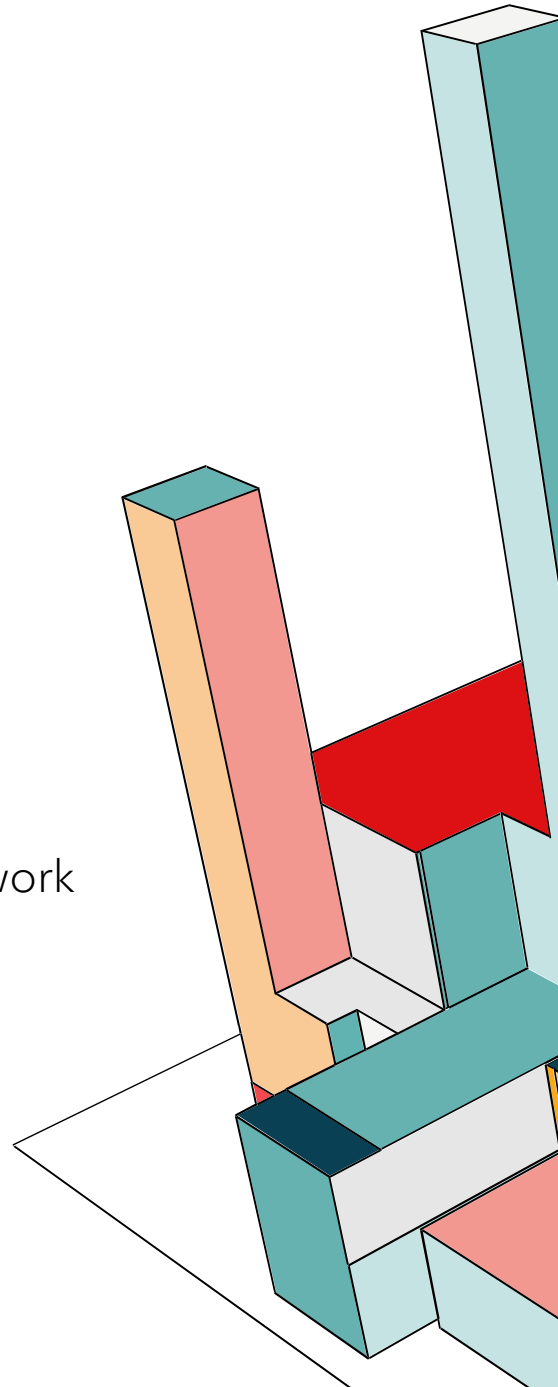
AGENDA

- Overview of Cyberspace Architecture
- Physical Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Application Layer
- OSI Functions
- Key Components of Cyberspace
- Protocols Governing Data Transfer
- Concept of Routing & Switching
- Internet Backbone
- Internet Protocol Suite
- Role of ISPs in Cyberspace
- Data Communication & Computer Network



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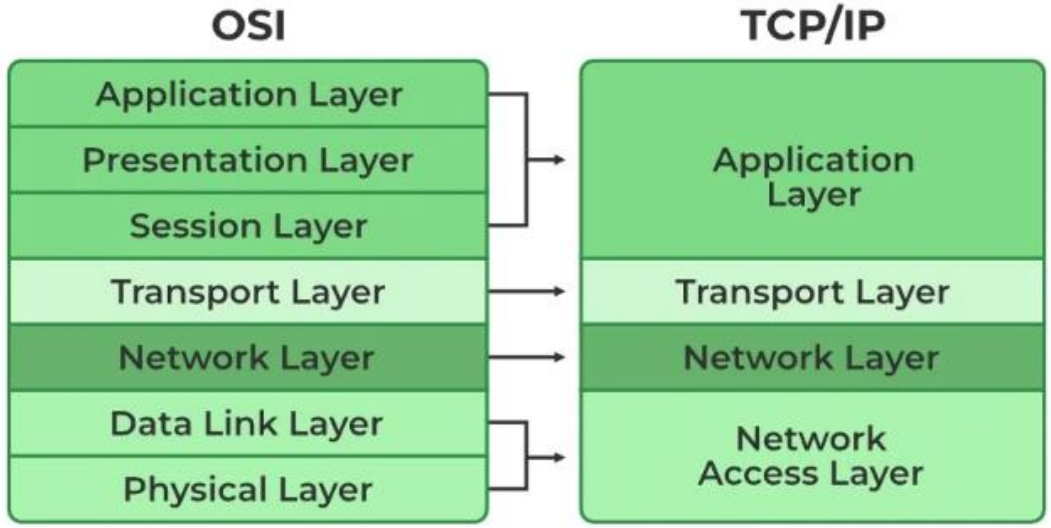
OVERVIEW OF CYBERSPACE ARCHITECTURE

- Cyberspace is structured in multiple layers, each serving a specific function.
- Layers include the
  - Physical Layer
  - Data Link Layer
  - Network Layer
  - Transport Layer
  - Application Layer



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PHYSICAL LAYER

- The Physical Layer is responsible for the transmission of raw data bits over a physical medium.
- The physical layer is the first and lowest layer of the Open Systems Interconnection (OSI) communications model. The physical layer's function is to transport data using electrical, mechanical or procedural interfaces. OSI is a reference model used to show how applications communicate over a network
- Examples include cables, fiber optics, and wireless transmission.
- https://www.tutorialspoint.com/data_communication_computer_network/physical_layer_introduction.htm

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DATA LINK LAYER

- The Data Link Layer provides node-to-node data transfer and error detection/correction.
- Data link layer is responsible for converting data stream to signals bit by bit and to send that over the underlying hardware. At the receiving end, Data link layer picks up data from hardware which are in the form of electrical signals, assembles them in a recognizable frame format, and hands over to upper layer.
- Common protocols: Ethernet, PPP.
- https://www.tutorialspoint.com/data_communication_computer_network/data_link_layer_introduction.htm

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NETWORK LAYER

- The Network Layer is responsible for data transfer between different networks. It handles routing of data packets using IP addresses.
- Load balancing and link management
- Security
- L3 VPN and tunnels can be used to provide end to end dedicated connectivity.
- Key protocol: Internet Protocol (IP).
- It comes in two flavors. IPv4 & TPv6
- https://www.tutorialspoint.com/data_communication_computer_network/network_layer_introduction.htm

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TRANSPORT LAYER

- The Transport Layer ensures complete data transfer. It provides end-to-end communication control and error handling.
- Transport layer takes data from upper layer (i.e. Application layer) and then breaks it into smaller size segments, numbers each byte, and hands over to lower layer (Network Layer) for delivery.
- This layer ensures that data must be received in the same sequence in which it was sent.
- Common protocols: TCP (Transmission Control Protocol), UDP (User Datagram Protocol).
- https://www.tutorialspoint.com/data_communication_computer_network/transport_layer_introduction.htm

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APPLICATION LAYER

- The Application Layer provides network services directly to applications. It includes protocols for web browsing, email, file transfer, and more.
- Security: It is responsible for the execution of the security tests at the user entity points.
- File Transfer, E-mail, Database Access
- Common protocols: HTTP, HTTPS, FTP, SMTP.
- https://www.tutorialspoint.com/data_communication_computer_network/application_layer_introduction.htm

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OSI FUNCTIONS

Data Format	Layer	Function
Data	Application Layer	Applications access network services
Data	Presentation Layer	Encryption and Compression of data
Data	Session Layer	Connection management b/w nodes
Segment	Transport Layer	Maintains data flow during transmission
Packet	Network Layer	Determine the path for data transfer
Frame	Data Link Layer	Connect physical nodes for transfer
Bit	Physical Layer	Transfer raw bits using physical mode

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KEY COMPONENTS OF CYBERSPACE

- Servers: Store and manage data, applications, and websites.
- Clients: Devices used to access servers (e.g., computers, smartphones).
- Routers: Direct data packets between networks.
- Switches: Connect devices within a single network.

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PROTOCOLS GOVERNING DATA TRANSFER

- TCP/IP: Fundamental protocol suite for internet communication.
- HTTP/HTTPS: Protocols for web communication.
- FTP: Protocol for file transfers.
- SMTP: Protocol for email transmission.

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TYPES OF NETWORKS

- LAN (Local Area Network): Connects devices within a small geographic area.
- WAN (Wide Area Network): Connects devices over large distances.
- MAN (Metropolitan Area Network): Spans a city or campus.
- Wireless Networks: Use radio waves to connect devices.

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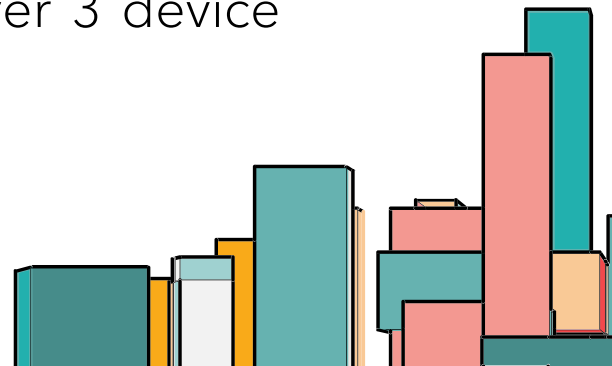
CONCEPT OF ROUTING & SWITCHING

- Routing determines the path data packets take from source to destination.
- Routers use routing tables and algorithms to find the best path.

- Switching connects devices within a network and directs data to its destination.
- Types: Circuit switching, packet switching.

- The process of sending packets from one host to another within a LAN is called switching. The process of doing that between two or more LANs is called routing. A switch is a Layer 2 device (Data-Link Layer), while a router is a Layer 3 device (Network Layer)



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INTERNET BACKBONE

- The internet backbone is a collection of high-capacity data routes and networks.
- It interconnects different networks and handles large-scale data transfer.
- Internet backbones are high-performance network core areas that serve to connect the subnetworks below them. Smaller subnetworks of different providers converge at the backbones to enable global data exchange on the Internet. Data is usually transmitted via optical fiber, but satellite links are also used.

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INTERNET PROTOCOL SUITE

- IPv4: Fourth version of the Internet Protocol, widely used.
- IPv6: Sixth version, designed to replace IPv4 and handle more IP addresses.

IPv4	IPv6
Deployed 1981	Deployed 1998
32-bit IP address	128-bit IP address
4.3 billion addresses Addresses must be reused and masked	7.9×10^{28} addresses Every device can have a unique address
Numeric dot-decimal notation 192.168.5.18	Alphanumeric hexadecimal notation 50b2:6400:0000:0000:6c3a:b17d:0000:10a9 (Simplified - 50b2:6400::6c3a:b17d:0:10a9)
DHCP or manual configuration	Supports autoconfiguration

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ROLE OF ISPS IN CYBERSPACE

- ISPs provide access to the internet and manage network traffic.
- They offer various services including broadband, fiber-optic, and wireless connections.
- ISPs make it possible for their customers to surf the web, shop online, conduct business, and connect with family and friends—all for a fee. ISPs may also provide other services, including email services, domain registration, web hosting, and browser packages

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DATA COMMUNICATION & COMPUTER NETWORK

- https://www.tutorialspoint.com/data_communication_computer_network/index.htm

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THANK YOU