Networks, Security, and Privacy

158.235

Al Massey Uni rd

(Today covers chapter 1 in the textbook)

Housekeeping

- **Textbook**
  - **J. FitzGerald and A. Dennis, "*Business Data Communications & Networking*", 12th edition. Wiley, 2012.**

- **Delivery**
  - **One Lecture (2-hour) per week, wk1 – wk12 (12 weeks)**
  - **One lab (1-hour) per week, wk2 – 11 (10 weeks)**

Housekeeping

- **Assessments**
  - **Internal Assessments (40%)**
    - **May have 2-3 assignments throughout the semester**
  - **Final exam (60%)**

- **Software**
  - **Wireshark (w**
    - **network traffic capture & analy**
  - **Packet tracer (https://www.netacad tworking-academy/packet-tracer/)**
    - **Network simulation**

Introduction

Our goal:

- get "feel" and terminology
- more depth, detail *later* course
- approach:
  - use Internet as example

***overview*:**

- Network components
- types of network
- protocol layers
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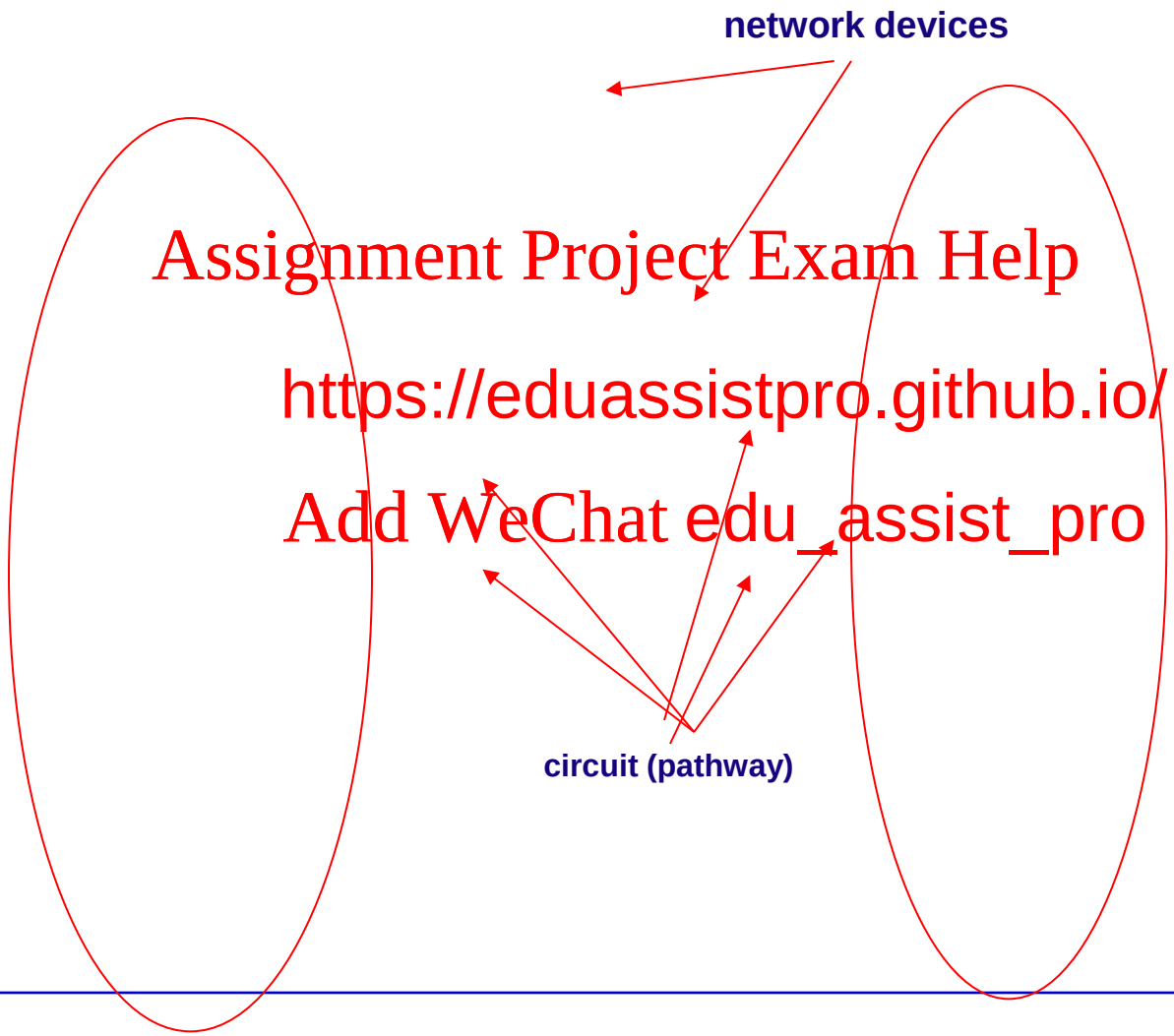
t 5 layer
-
- andards

Components of a Network



Network Types (based on Scale)

Network Types (based on Scale)

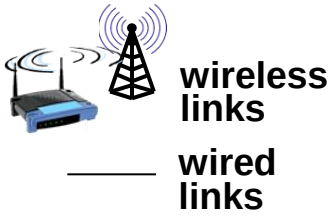
- **Local Area Networks (LAN) - room, building**
  - **a group of PCs that share a circuit (~100Mbps)**
- **Backbone Networks (BN) - less than few kms**
  - **a high speed backbone linking together organizational LANs at various l)**
- **Metropolit AN) - (more than a few kms)**
  - **connects LANs and BNs acr t locations**
  - **Often uses leased lines or other services used to transmit data (expensive, high transfer rate; ISP alternative)**
- **Wide Area Networks (WANs) - (far greater than 10 kms)**
  - **Same as MAN except wider scale**

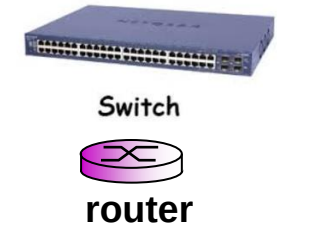
Network: nuts and bolts

- millions of connected computing devices:
  - *hosts* = *end systems*
  - running *network apps*

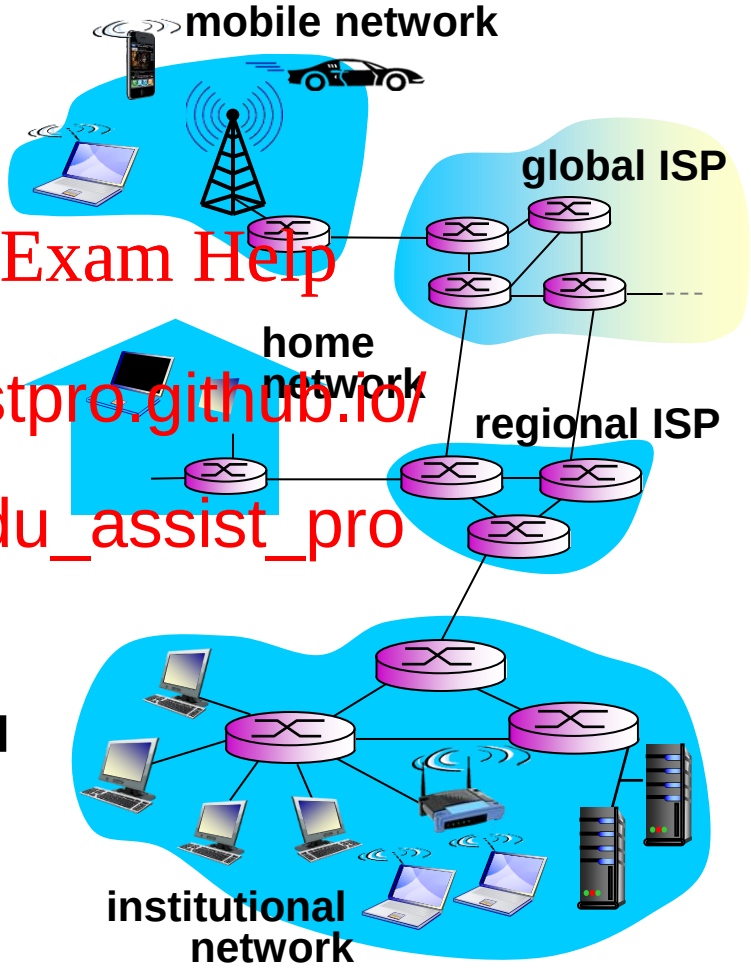
❖ *commu*

- fib
  satellite
- transmission rate: *bandwidth*



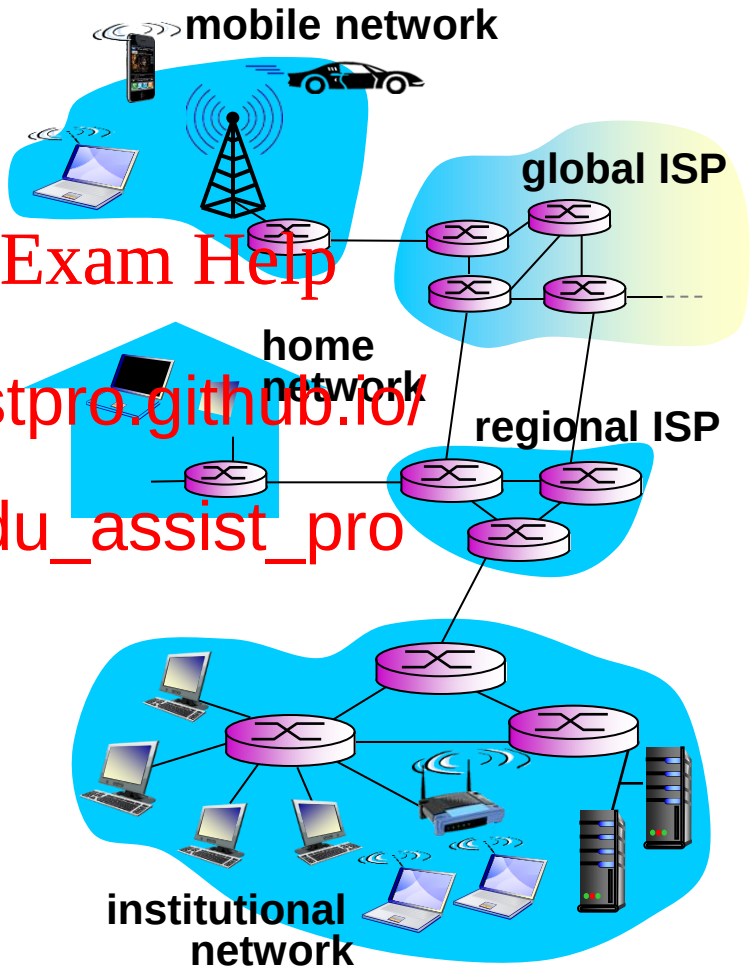


❖ Network devices: forward packets (chunks of data)
- *routers* and *switches*



Network: nuts and bolts

- *Internet:* "network of networks"
  - Interconnected ISPs
- *protocols* con
  receiving of
  - e.g., TCP, IP, HTTP, Skype, 802.11
- *Internet standards*
  - RFC: Request for comments
  - IETF: Internet Engineering Task Force



What is a protocol?

human protocols:

- "what's the time?"
- "I have a question"
- introductions

… specific msgs sent

… specific actions taken when msgs received, or other events

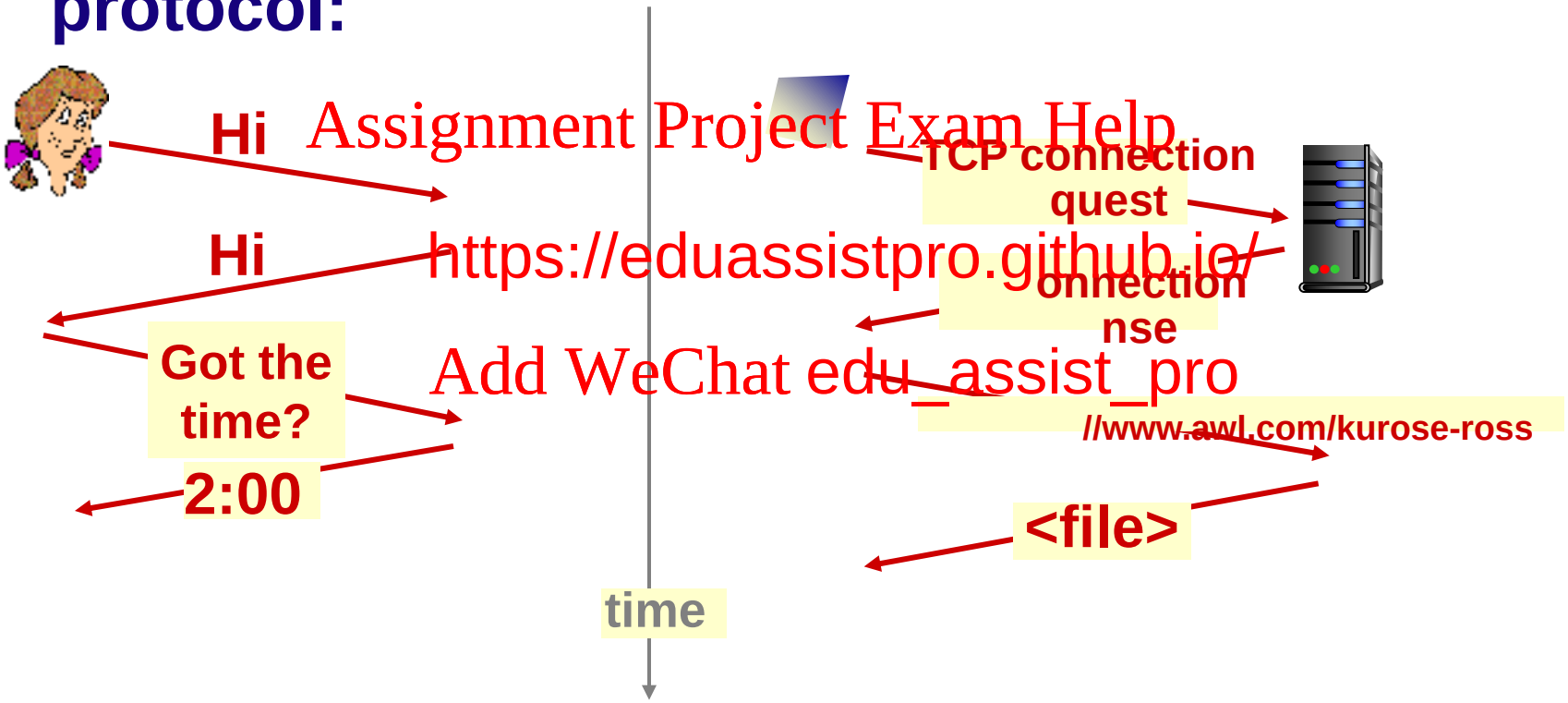
network protocols:

- machines rather than humans
- unication
- Internet
- d by pr

pr *ne format, order of msgs sent and received among network entities, and actions taken on msg transmission, receipt*

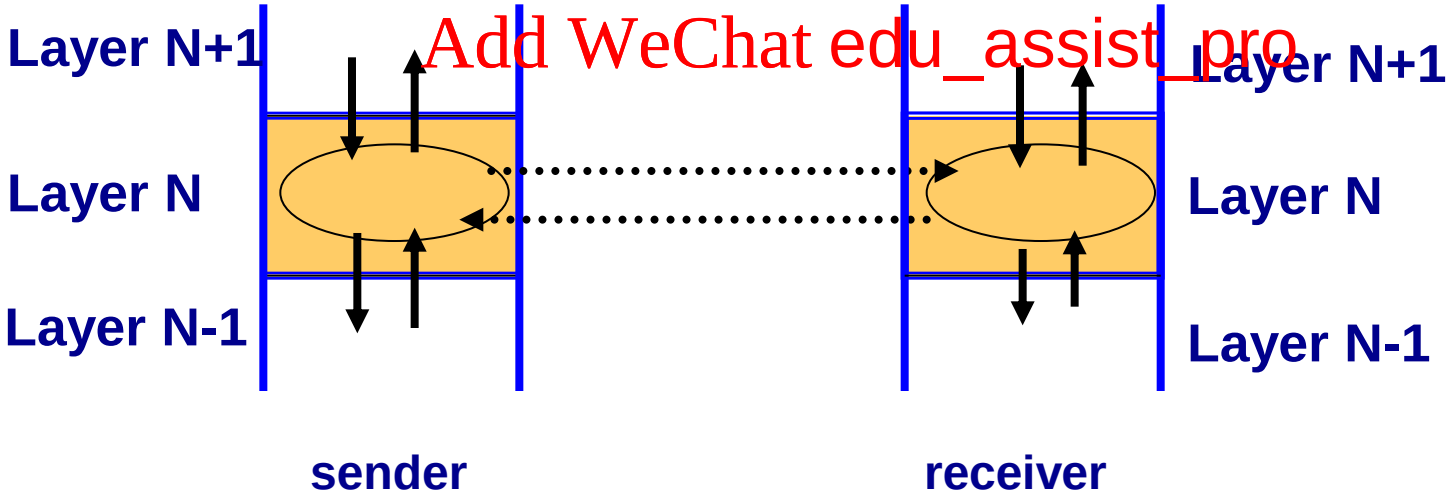
What is a protocol?

a human protocol and a computer network protocol:



Network Protocols

- Used by network model layers
- Sets of standardized rules to define how to communicate at each layer and how to interface



Protocol “layers”

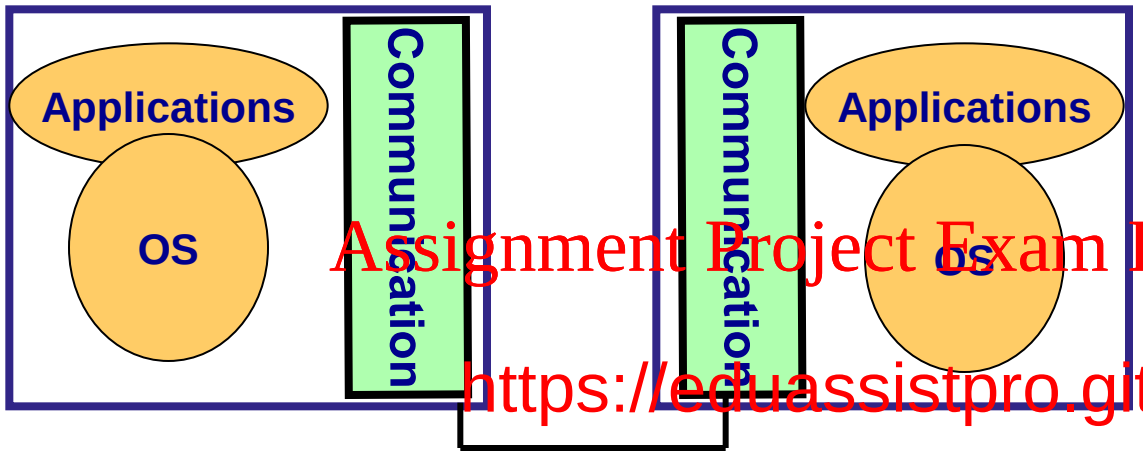
Networks are complex, with many “pieces”:

- **hosts**
- **Routers/switches**
- **links of vari media**
- **protocols**
- **applications**
- **hardware, software**

Question:

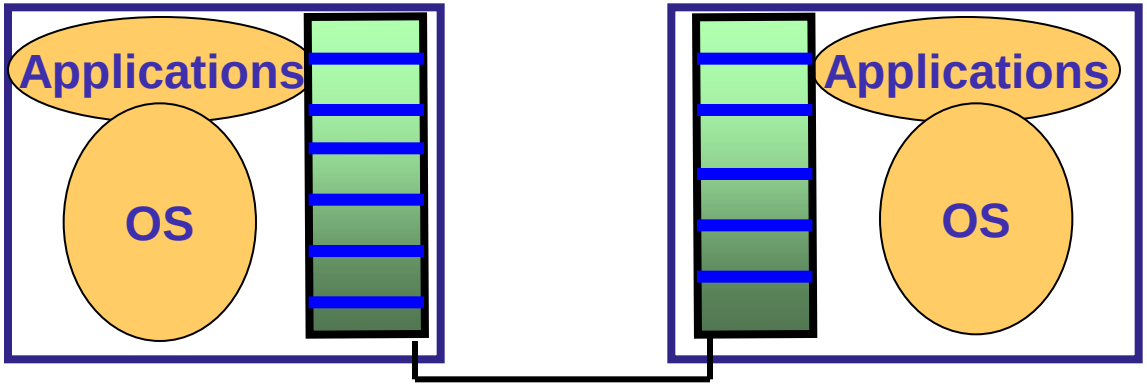
any hope of *izing* structure etwork?

Layered Implementation



Single layer implementation

-Networking with large components is complex to understand and implement



Multi layer implementation

-Breaking down into smaller components

-Easier to implement

Multi-layer Network Models

- **The two most important such network models: OSI and Internet**
- **Open Systems Interconnection Model (OSI)**
  - **Created by International Standards Organization (ISO) as a frame standards in 1984**
  - **Based on 7**
- **Internet Model (also calle odel)**
  - **Created by DARPA originall 70's**
  - **Developed to solve the problem of internetworking**
  - **Based on 5 layers**
  - **Based on Transmission Control Protocol/ Internet Protocol (TCP/IP) suite**

7-Layer Model of OSI

Physical	DataLink	Network	Transport	Session	Presentation	Application

"Please Do Not Touch Steve's Pet Alligators"

- **Application Layer**
  - **set of utiliti grams**
- **Presentatio**
  - **formats data for presentati**
  - **provides data interfaces, data compression and translation between different data formats**
- **Session Layer**
  - **initiates, maintains and terminates each logical session between sender and receiver**

7-Layer Model of OSI

- **Transport Layer**
  - **deals with end-to-end issues such as segmenting the message for network transport, and maintaining the logical connections between sender and receiver**
- **Network Lay**
  - **responsibl ions from source to destination**
- **Data Link Layer**
  - **Responsible for moving messages from one device to another reliably**
- **Physical Layer**
  - **defines how individual bits are formatted to be transmitted through the network**

Internet's 5-Layer Model

"Please Do Not Touch Alligators"

- **Application Layer –**
  - **Combines Application, Presentation, session layer of OSI model**
- **Transport L ort layer of OSI model**
- **Network Layer – Same as OSI model**
- **Data Link Layer – Same as OSI model**
- **Physical Layer – Same as OSI model**

LAN, BB, WAN, and Internet

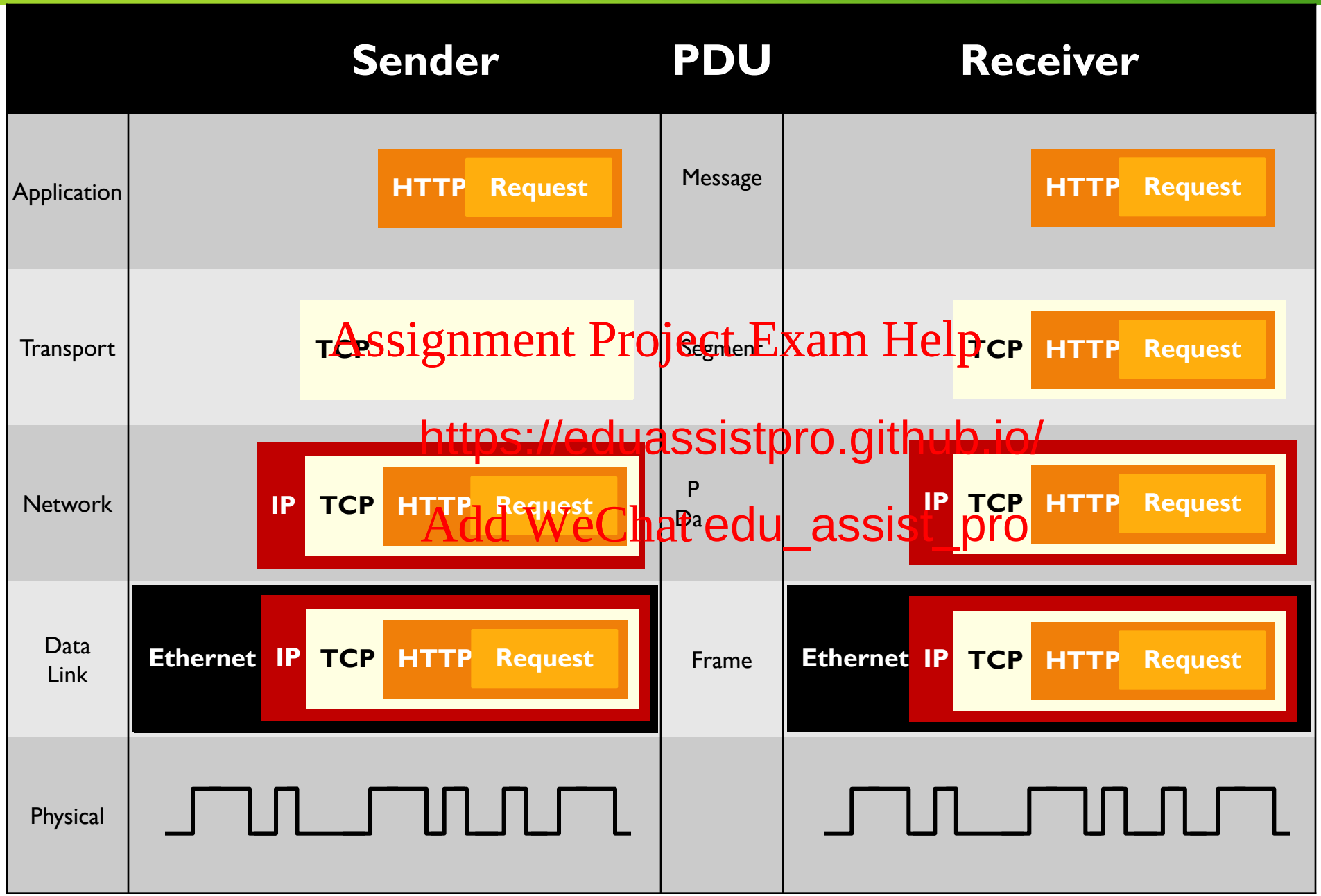
Comparison of Network Models

Network models

- **Protocol** defines the language of transmission
  - It specifies the rules, functionality, and messages for communication at the layer
- **Protocol Dat** aver-specific information n ge to be transmitted through a netw
  - Each layer adds a PDU
  - PDUs act like nested envelopes
  - Encapsulation occurs when a higher level PDU is placed inside of a lower level PDU

Network Models

Layer	Purpose	Example Protocols / Standards	PDU
5. Application	User's access to network, software to perform work	HTTP, SMTP, DNS, FTP, DHCP, IMAP, POP, SSL	Packet (or Data)
4. Transport	End-to-End Man 1.Link application 2.Segmenting an 3.Flow control	P	Segment
3. Network	Deciding where the message goes 1.Addressing 2.Routing		Packet
2. Data Link	Move a message from one device to the next 1.Controls hardware 2.Formats the message 3.Error checking	Ethernet	Frame
1. Physical	Transmits the message	100BASE-T, 802.11n	



Points about Network Layer View

- Layers allow simplicity of networking in some ways
  - Easy to develop new software that fits each layer
  - Relatively simple to change the software at any level
- Matching la ween different computers a s
  - Accomplis ll agree on
  - e.g., Physical layer at the s puter must match up with the same lay eiving computer
- Somewhat inefficient
  - Involves many software packages and packets
  - Packet overhead (slower transmission, processing time)
  - Interoperability achieved at the expense of perfectly streamlined communication

Network Standards

- **Why?**
  - **Provide a "fixed" way for hardware and/or software systems (different companies) to communicate**
  - **Help promote competition and decrease the price**
- **Types of Sta**
  - **Formal standards**
    - **Developed by an industr ment standards-making body**
  - **De-facto standards**
    - **Emerge in the marketplace and widely used**
    - **Lack official backing by a standards-making body**

Major Standards Bodies

- **ISO (International Organization for Standardization)**
- **ITU-T (International Telecommunications Union – Telecom Group**
- **ANSI (Ameri Institute)**
- **IEEE (Institute of Electric tronic Engineers)**
- **IETF (Internet Engineering Task Force)**