How the OSI Model Enables Synchronous and Asynchronous Communication

RISD, Web Architecture Final Project

Cindy Gerhard, February 25, 2018
ampletableforeveryone.org

Using the OSI Model to Enable Synchronous and Asynchronous Communication through the Internet

- Ample Table for Everyone (ATE) has awarded grants to several organizations in NYC, resulting in a range of food support programs developed from their funding
- They also have a very active board with a wide network of contacts to reinforce and grow their influence in policy decisions affecting the lives of New Yorkers
- To enhance their effectiveness, they would like to have a vehicle for sharing the output of their grantees and enable more organizations to benefit from these programs
- To solve that problem, this project illustrates how the OSI model would facilitate communication among the grantees and other like-minded supporters

As a backdrop to delivering the new functionality, the OSI model makes it all work, connecting people in conversations and delivering requested content to their desktop

	Layer	Unit	Description of the Layer's role	How it supports ATE Functionality
7	Application	Data	High level APIs, HTTP, FTP, SMTP and other protocols	Leverages APIs to access New York City data for displaying charts, graphs, geo codes and other related content
6	Presentation	Data	Encryption/decryption compression Context for communication between layers	Takes the input from the application layer and converts into the language for onward communication through the other layers
5	Session	Data	Controls dialogue between computers Controls termination and restarts	Maintains the login session Supports a conversation by establishing a connection between two processes
4	Transport	Segments	Enables transfer of data TCP/UDP Ensures error-free delivery of messages End to end connections	Breaks up the message into smaller pieces for delivery through the network layer, adding headers to facilitate re-assembly at the receiving end of the transmission
3	Network	Packets	Connects hosts on different networks Routes messages among networks	Routes the message to the right location
2	Data Link	Frames	Provides error-free transfer of data frames Establishes logical links between two nodes	Links to the destination, with further connectivity, as needed, through a local network
1	Physical	Bits	Electrical and physical specifications for devices Cables and connectors; Data in 1's and 0's	Ultimate level of communication in binary data format

At the lower three layers, the protocol is between adjacent nodes

1. The Physical layer transmits the data bit streams over a physical medium, either electrical or optical, determines the signal state for “1”, and whether the encoded bits will be transmitted by digital or analog means, among other things
2. The Data Link layer provides error free transmission of frames over the physical layer by establishing logical links between nodes, controlling traffic speed and buffering, delimiting frames to set boundaries, and checking for transmission errors, recovery and retransmission, as needed
3. The Network layer handles routing through the physical network using IP addresses and eliminates the need for the upper layers to know anything about the transmission process and the switching technologies. The Network layer also determines the best path, taking into consideration other traffic on the network, as well as, the relationship between frame size and maximum transmission size to fragment frames into multiple pieces for reassembly

From the transport layer and above, the layers are true end to end layers, concerning themselves with the complete message, using message headers and controls.

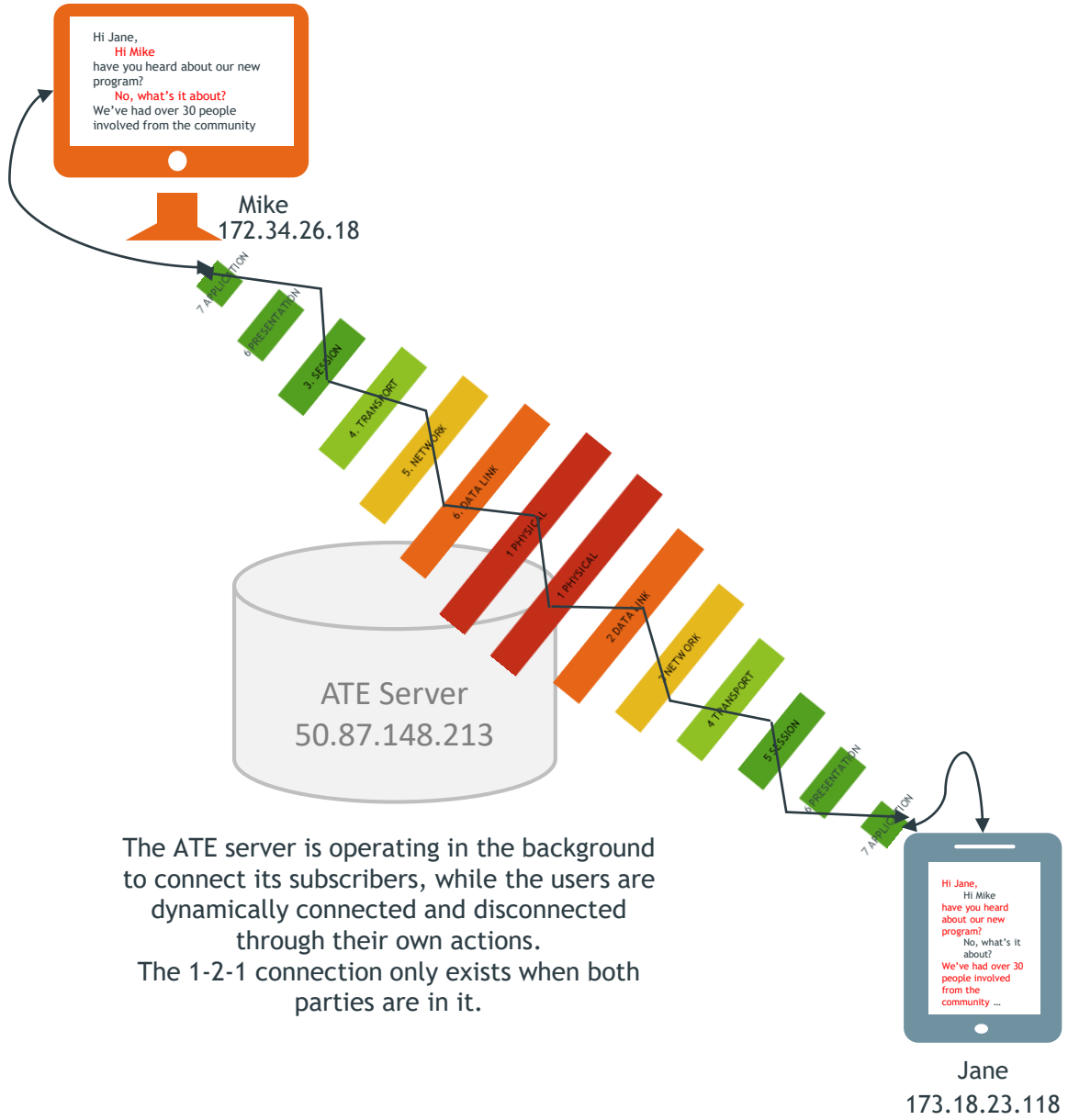
4. The Transport layer delivers messages error free, in sequence, without any loss or duplication by segmenting messages into frame sizes that can be handled by the network layer, applying headers and controlling the flow when no buffers are available in the network layer. The Transport layer provides control information for message start and end, adding headers to maintain sequence for correct reassembly. Multiplexing is also handled by the transport layer, creating efficiencies when the same message is to be sent to multiple recipients.
5. The Session layer provides continuity for two separate machines to establish, use and terminate a connection, called a session. It also manages security, name recognition and logging.
6. The Presentation layer formats the data to be presented to the application layer, performs data compression and encryption.
7. The Application layer is the entry point for users and processors to access network services, such as file transfer services, remote access for printers or other devices and email. There are also numerous data formats and protocols that get interpreted at the application layer, with one of the most frequently used formats being eXtensible markup language (XML).

Synchronous vs. Asynchronous Communication

- Similarities
  - Both methods allow two or more parties to engage in a conversation
- Differences
  - In synchronous communication, a transmission is completed before another one starts. The conversation is sequenced by one participant waiting for the other to finish before speaking - similar to a telephone call.
  - In asynchronous communication, a transmission is started without regard to whether another transmission has been completed. Any participant can contribute independently of whether the other participants have finished speaking (or typing) – similar to text messaging. A server is required to store incoming messages and relay them to all participants in the conversation. The message can be read at the convenience of the participant, in any order desired.

Synchronous Model Illustration

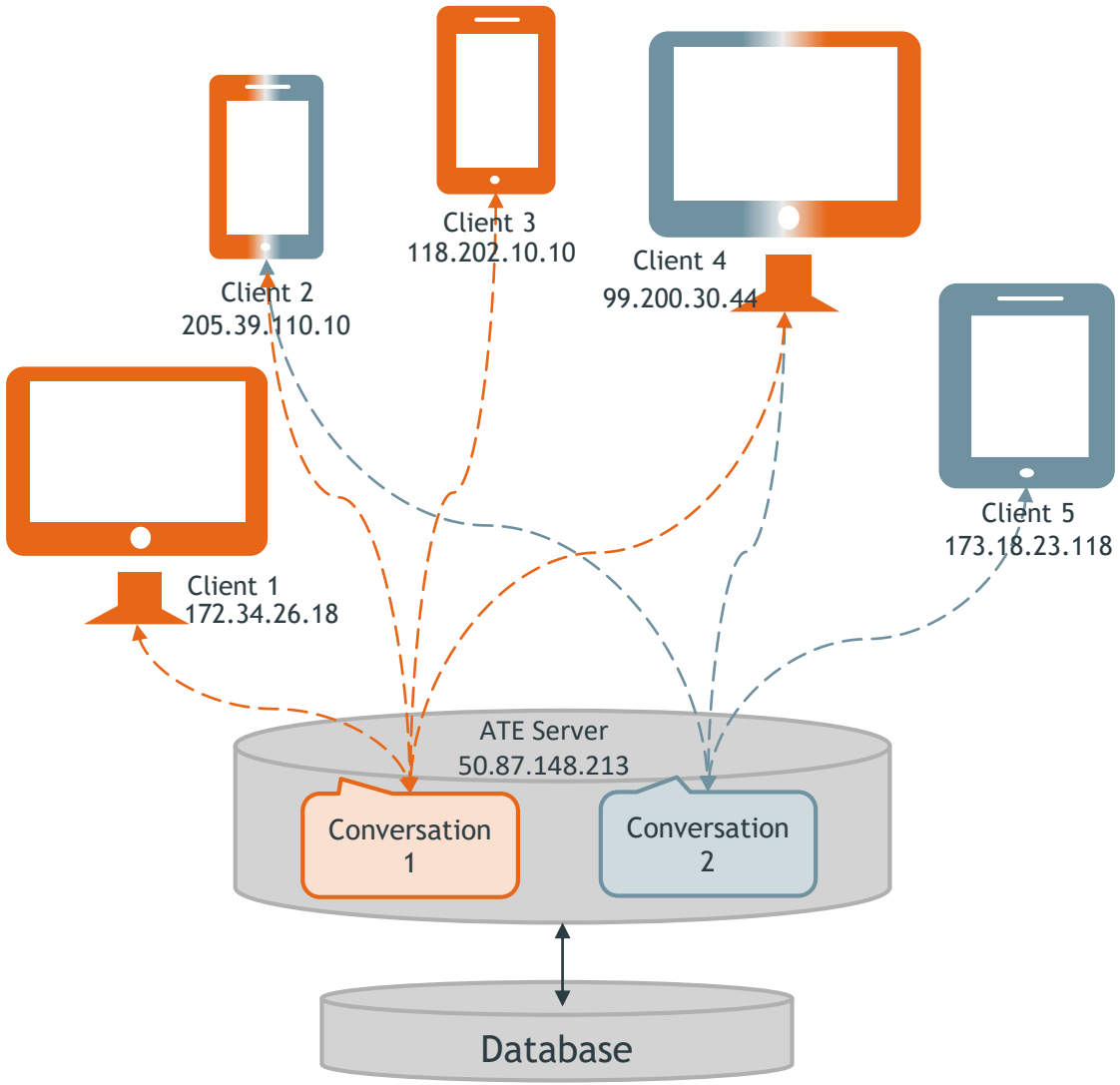
- Users connect dynamically with each other in the synchronous model.
- While the server is not a requirement, in this instance, it limits the connections to ATE subscribers and supports the login security and real-time session while in operation.
- When one of the parties disconnects, the conversation is over.



The ATE server is operating in the background to connect its subscribers, while the users are dynamically connected and disconnected through their own actions.
The 1-2-1 connection only exists when both parties are in it.

Asynchronous Model Illustration

- The server manages users' entry and exit into on-going conversations, while storing the content for access independently.
- Each layer in the OSI model plays a role for enabling users to selectively send and receive messages, starting with the creation of the message, through the layers to encode, route and be received by the ATE server.

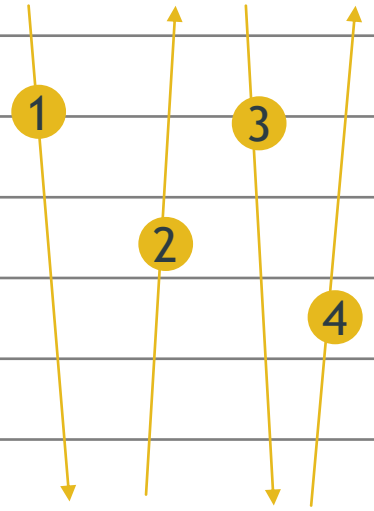


Asynchronous Model from the Perspective of 1 Participant

OSI Layers | **Entering the Conversation**

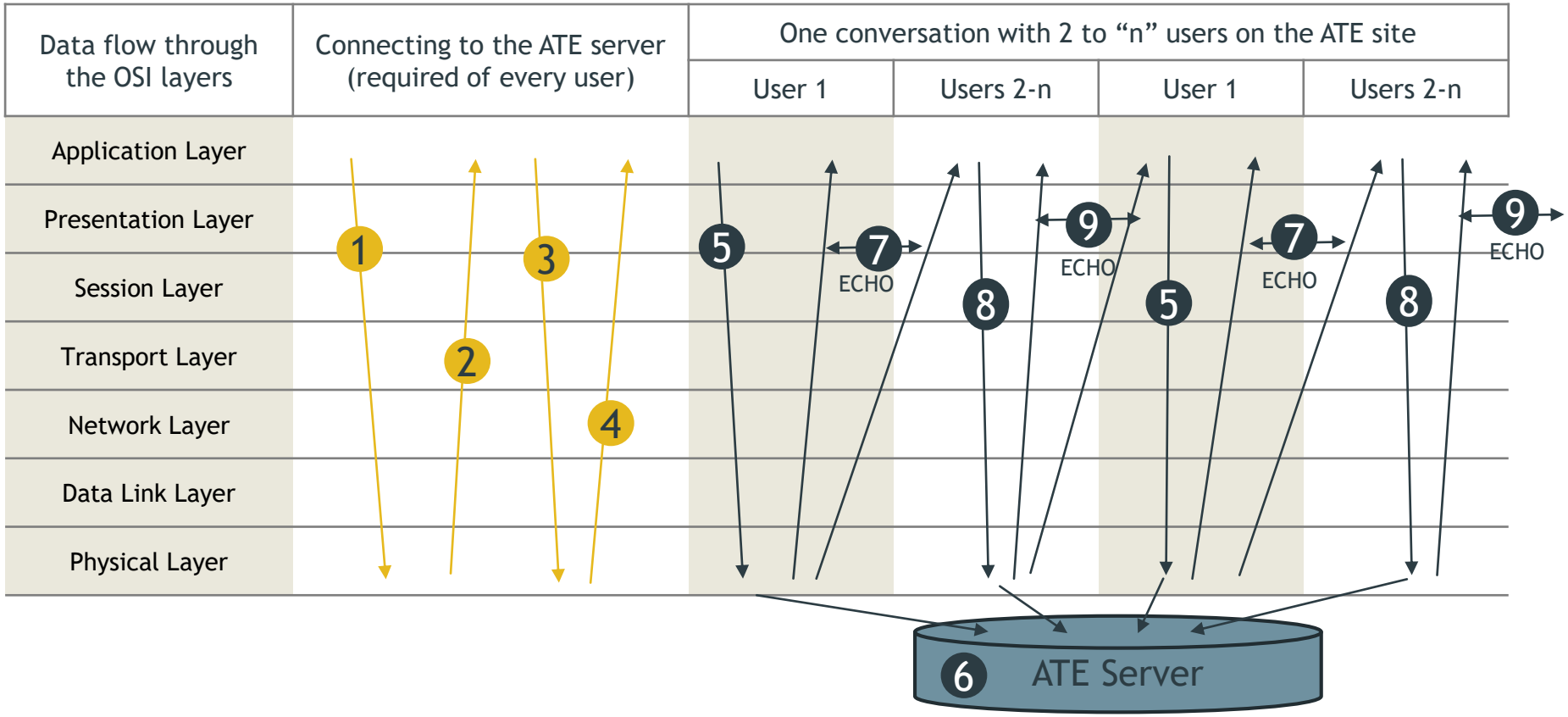
Interplay through the OSI layers

1. Client requests information on open conversations
2. ATE responds with information
3. Client confirms their selection or chooses to start a new thread and connects to the ATE server
4. Session is confirmed

Data flow through the OSI layers	Connecting to the ATE server (required of every user)
Application Layer	
Presentation Layer	
Session Layer	
Transport Layer	
Network Layer	
Data Link Layer	
Physical Layer	

Asynchronous Model from the Perspective of 1 Participant

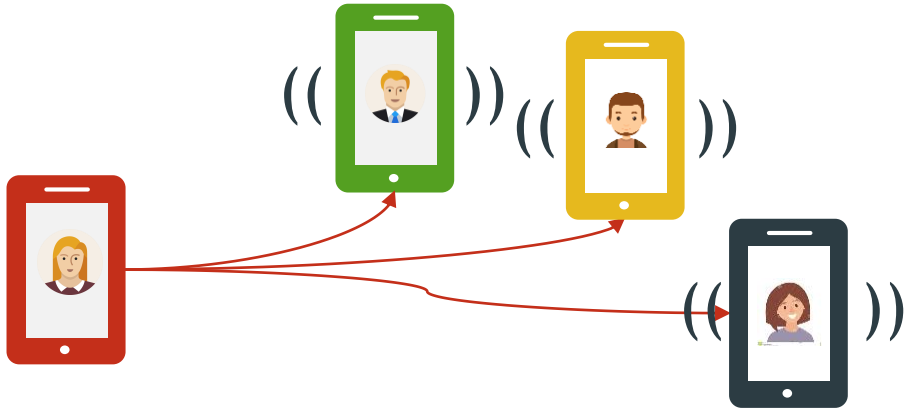
OSI Layers	Entering the Conversation	Participating in the Conversation
Interplay through the OSI layers	1. Client requests information on open conversations 2. ATE responds with information 3. Client confirms their selection or chooses to start a new thread and connects to the ATE server 4. Session is confirmed	5. Client begins communicating and sends a message 6. The server stores the message 7. The sender receives confirmation and the message is echoed to the other participants, multiplex may be used for efficiency 8. Another user initiates a message 9. The sender receives confirmation and the message is echoed to the other participants, multiplex may be used for efficiency, and the process continues…



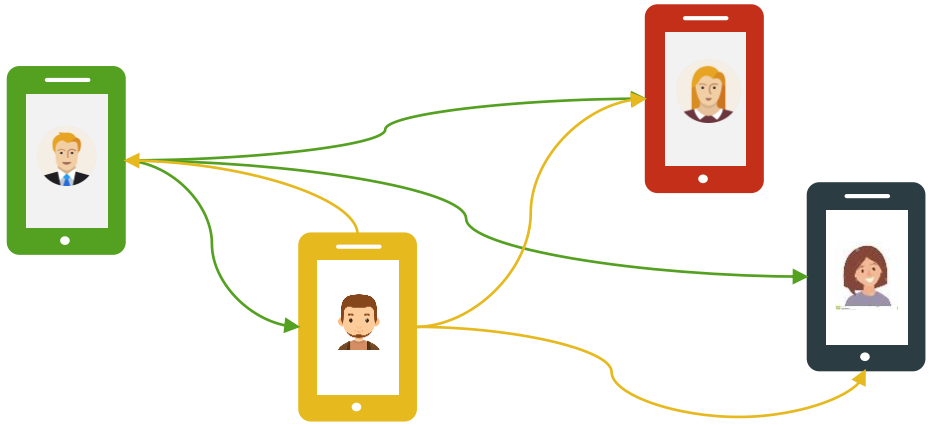
What It Feels Like to Be in an Asynchronous Conversation

Four Friends in a Text Group

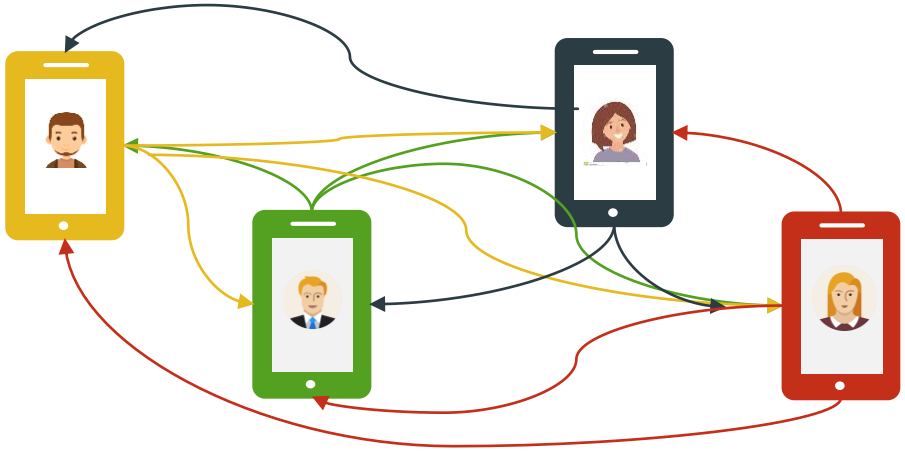
1. The conversation starts …



2. Then 2 people respond …



3. Then they all answer each other; messages are jumbling onto the phones …



4. Then it goes quiet while they wait for all the messages to land, understand how they relate to each other, and continue …

Closing Observations

- Similar to the view of communication through the web, the OSI model would facilitate other beneficial functions to enhance the ATE website

Secure Login

XML Data