

An aerial photograph of the Dalhousie University campus in Halifax, Nova Scotia. The image shows a mix of modern and traditional architecture. In the foreground, a large, multi-story brick building with a central clock tower and a dome is prominent. To its right is a large green soccer field with white markings. In the background, there are several modern, multi-story buildings with glass facades. The campus is surrounded by trees and greenery.

CSCI 3171 - Network Computing Protocol Layers and Service Models

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Goal and Roadmap

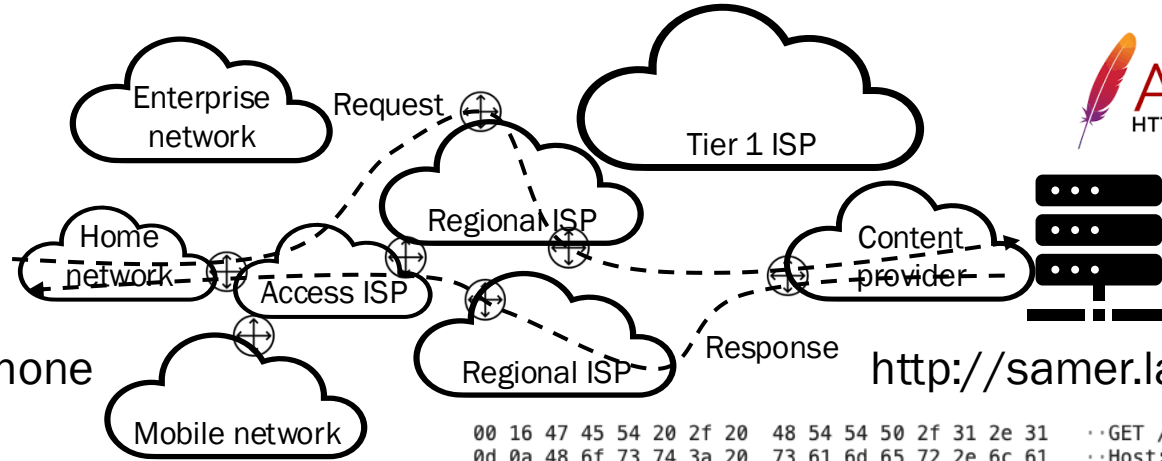
- Goal:
 - *Big picture* of the Internet
 - Introduction to terminology
- Overview and roadmap
 - What is the Internet? What is a protocol?
 - Network edge: hosts, access network, physical media
 - Network core: packet switching
 - Performance: loss, delay, throughput
 - Packet and circuit switching
 - Protocol layers, service models
 - Internet structure and challenges



Protocol Layers and References Models



My smartphone



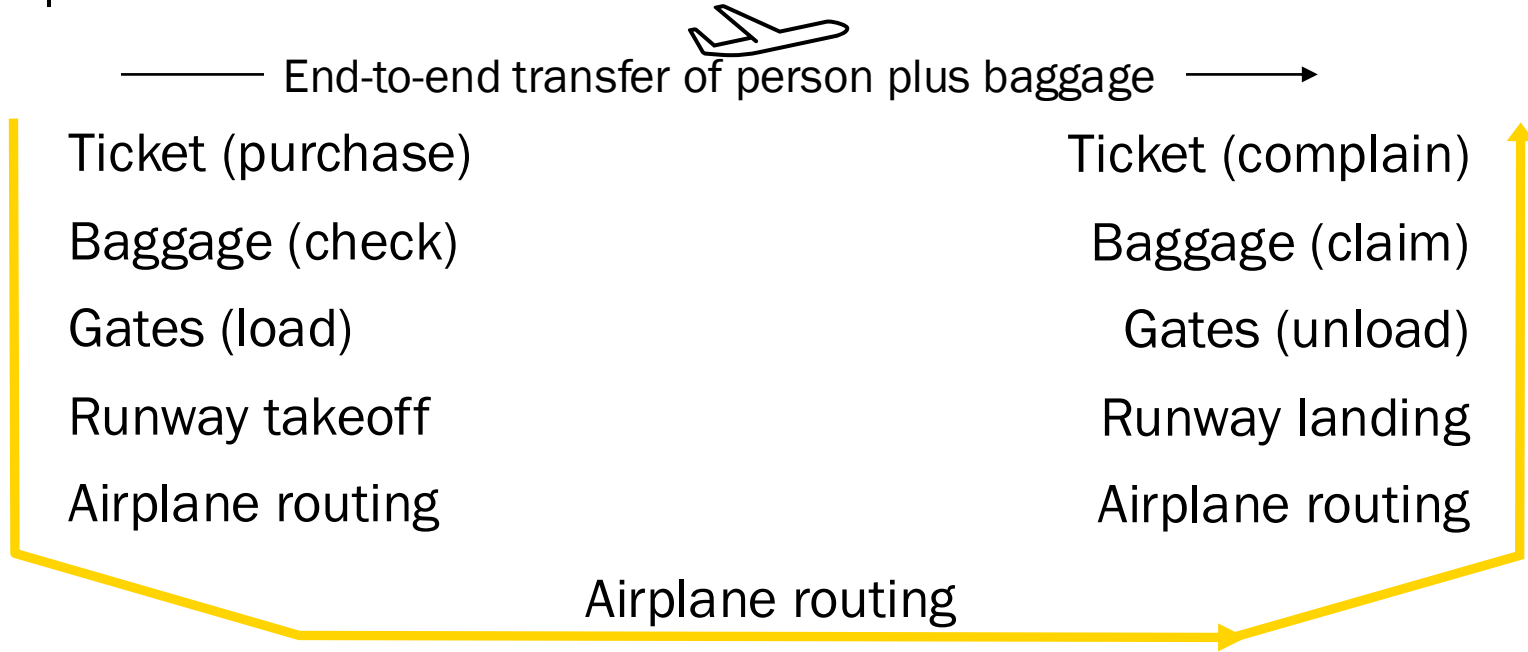
<http://samer.lahoud.fr>

```
00 16 47 45 54 20 2f 20 48 54 54 50 2f 31 2e 31 ..GET / HTTP/1.1
0d 0a 48 6f 73 74 3a 20 73 61 6d 65 72 2e 6c 61 ..Host: samer.la
68 6f 75 64 2e 66 72 0d 0a 55 70 67 72 61 64 65 houd.fr
2d 49 6e 73 65 63 75 72 65 2d 52 65 71 75 65 73 -Upgrade
74 73 3a 20 31 0d 0a 41 63 63 65 70 74 3a 20 74 -Insecure-Request
65 78 74 2f 68 74 6d 6c 2c 61 70 70 6c 69 63 61 ts: 1
74 69 6f 6e 2f 78 68 74 6d 6c 2b 78 6d 6c 2c 61 ..Accept: text/html,application/xhtml+xml,a
```

- Networks are complex: Devices, services, applications, protocols, packet switches, links
- Is there any structure of networks and how to organize our discussion of networks?



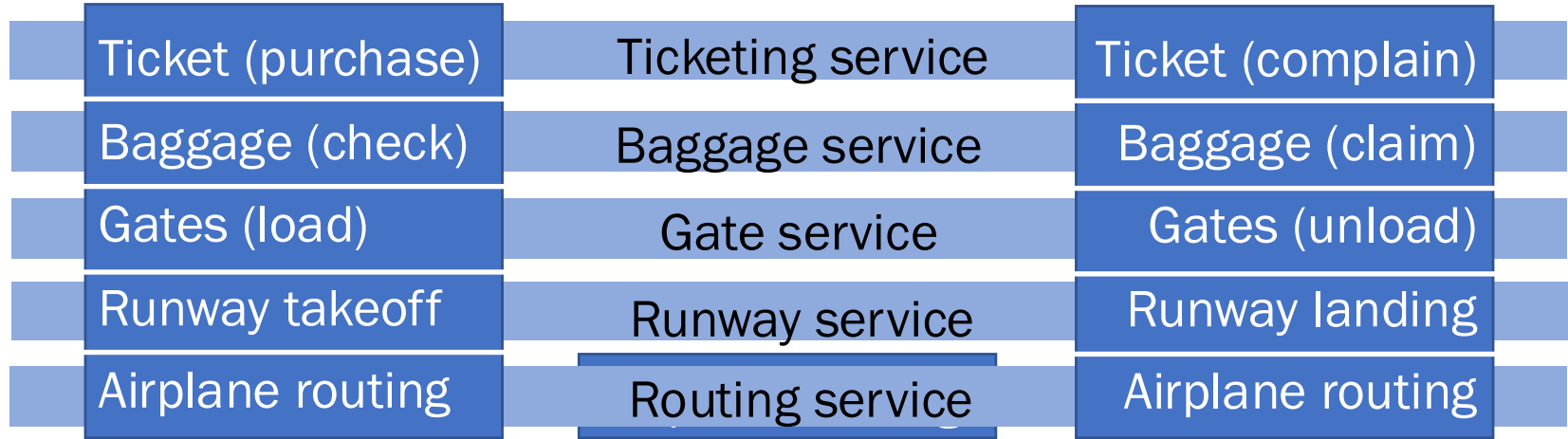
Example: Organization of Air Travel



- How would you define and discuss the system of airline travel?
 - A series of steps, involving many services



Example: Organization of Air Travel



- Layers: each layer implements a service
 - Via its own internal-layer actions
 - Relying on services provided by layer below



What Is a Layer?

- Layer = a part of a system with well-defined interfaces to other parts
- Two layers interact only through the interface between them
- One layer interacts only with layer above and layer below



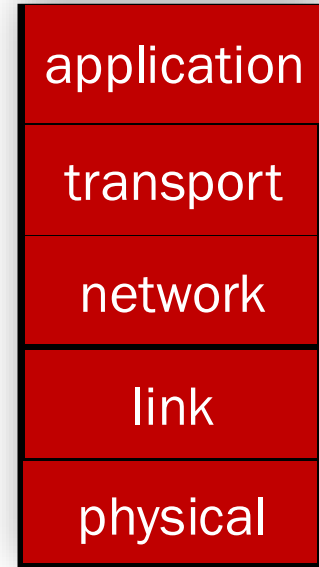
Why Layering?

- Approach to designing/discussing complex systems
- Explicit structure allows identification, relationship of system's pieces
 - Layered reference model for discussion
- Modularization eases maintenance, updating of system
 - Change in layer's service implementation: transparent to rest of system
 - e.g., change in gate procedure does not affect rest of system



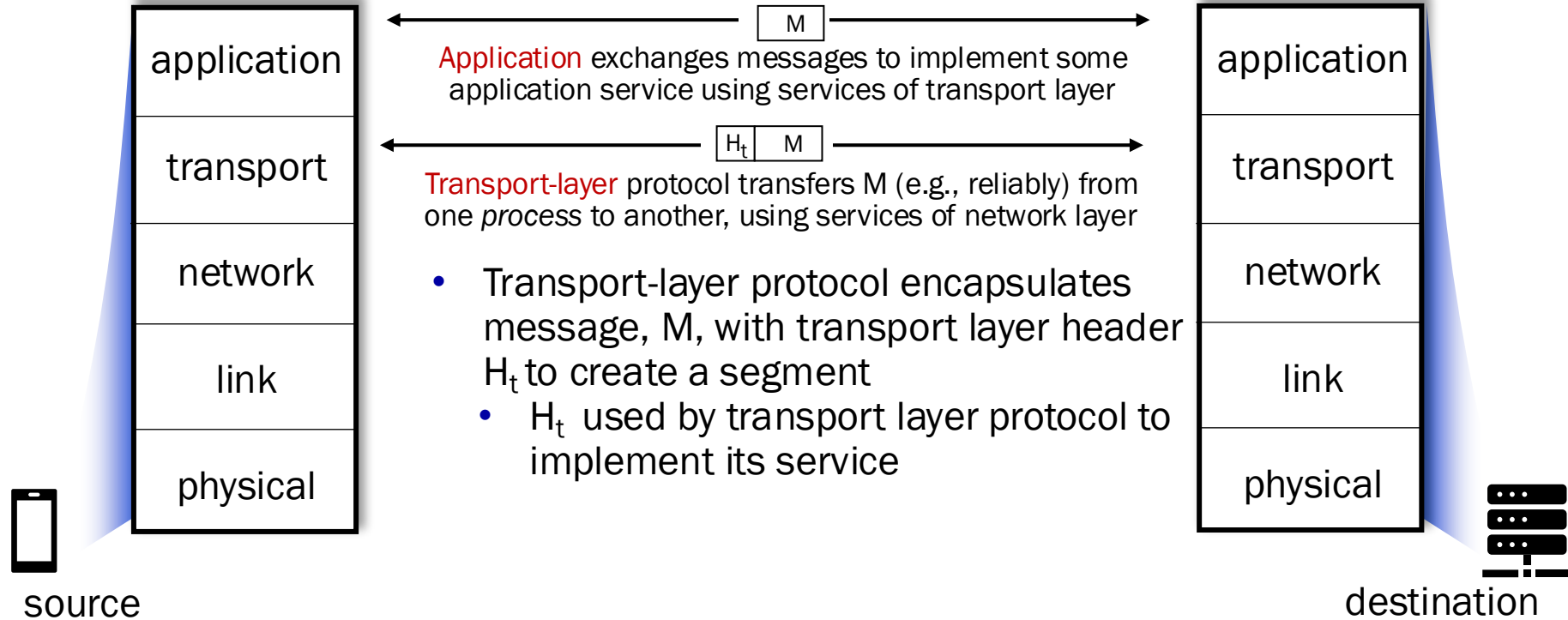
Layered Internet Protocol Stack

- Application: supporting network applications
 - HTTP, IMAP, SMTP, DNS
- Transport: process to process data transfer
 - TCP, UDP
- Network: routing of datagrams from source to destination
 - IP, routing protocols
- Link: data transfer between neighboring network elements
 - Ethernet, WiFi
- Physical: bits *on the wire*



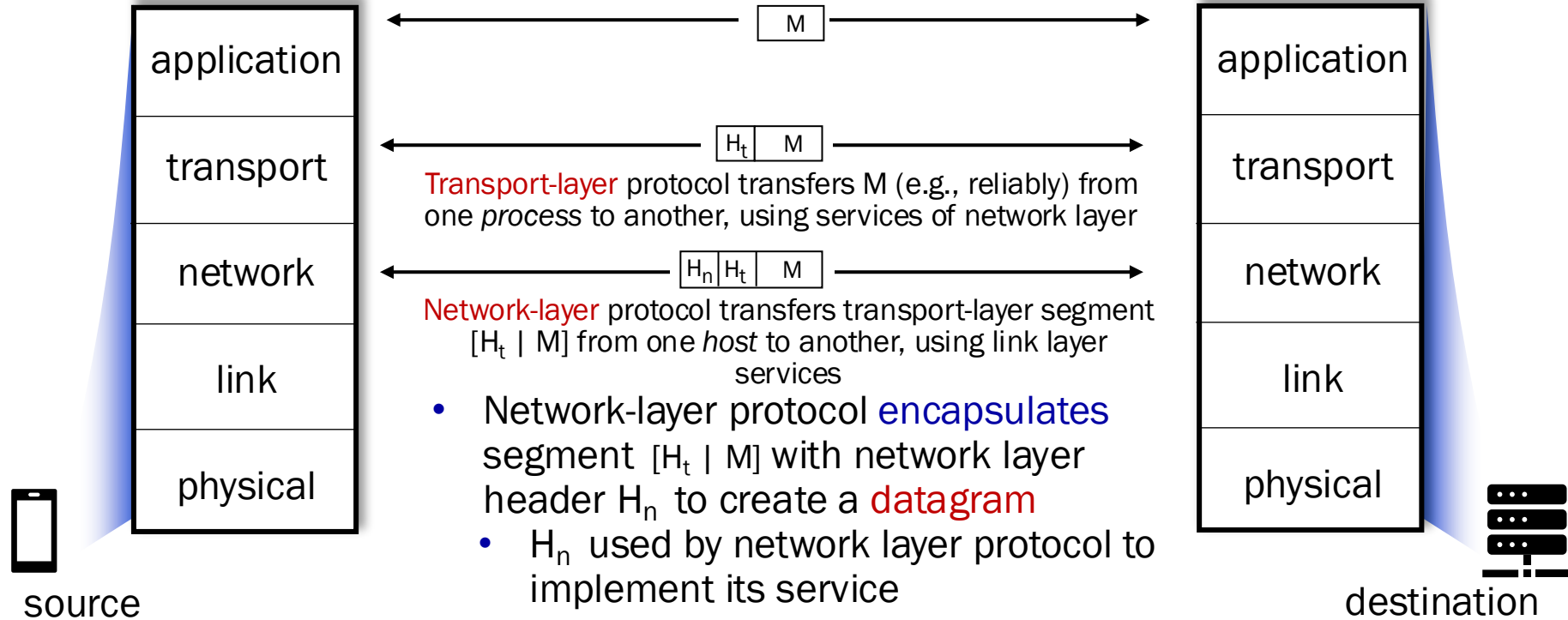


Services, Layering and Encapsulation



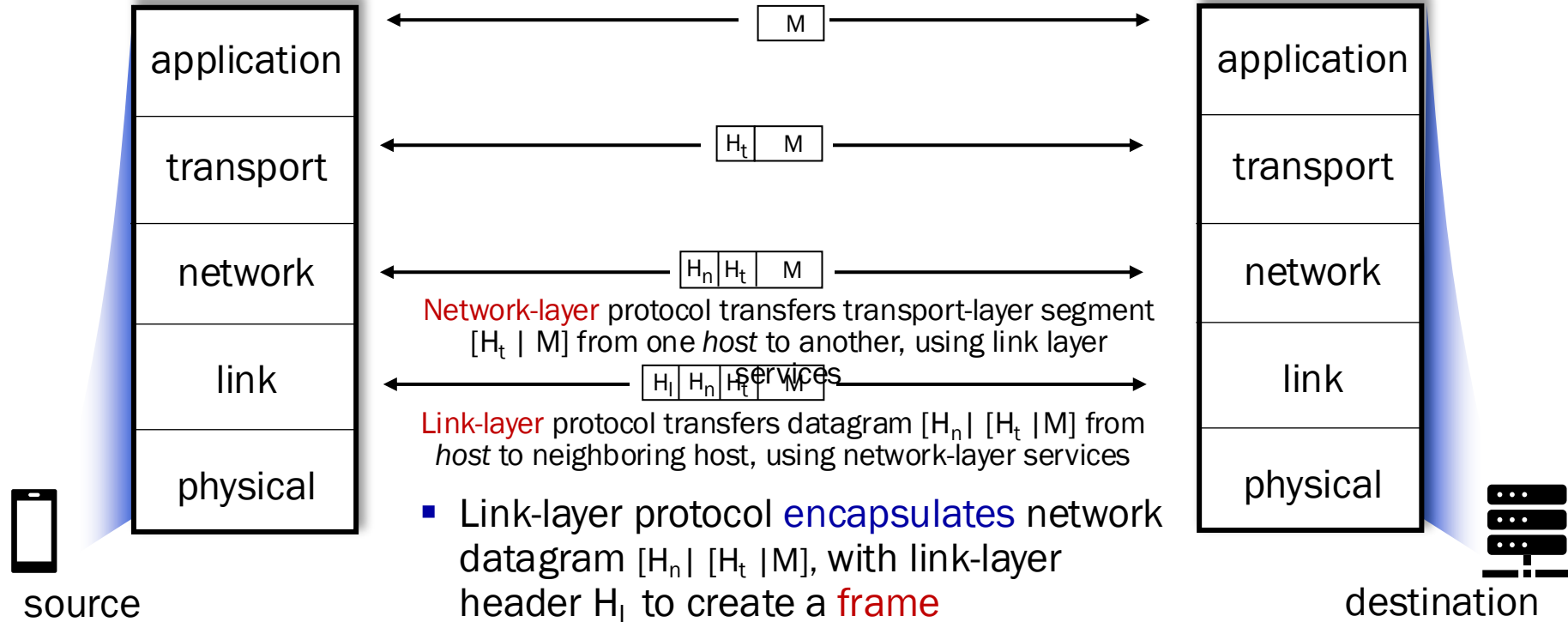


Services, Layering and Encapsulation





Services, Layering and Encapsulation





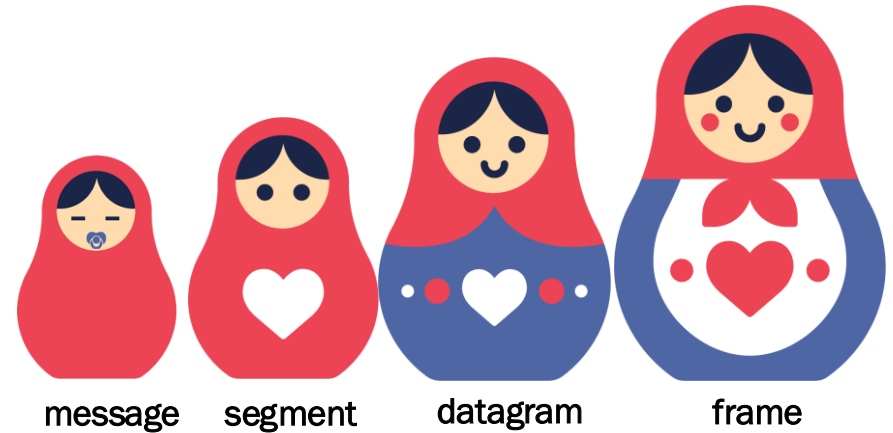
Layers and Encapsulation

- Each layer manipulates only the header of the same layer
- Encapsulation = adding a new header
- Decapsulation = remove a header



Encapsulation

- Matryoshka dolls (stacking dolls)





Services, Layering and Encapsulation

