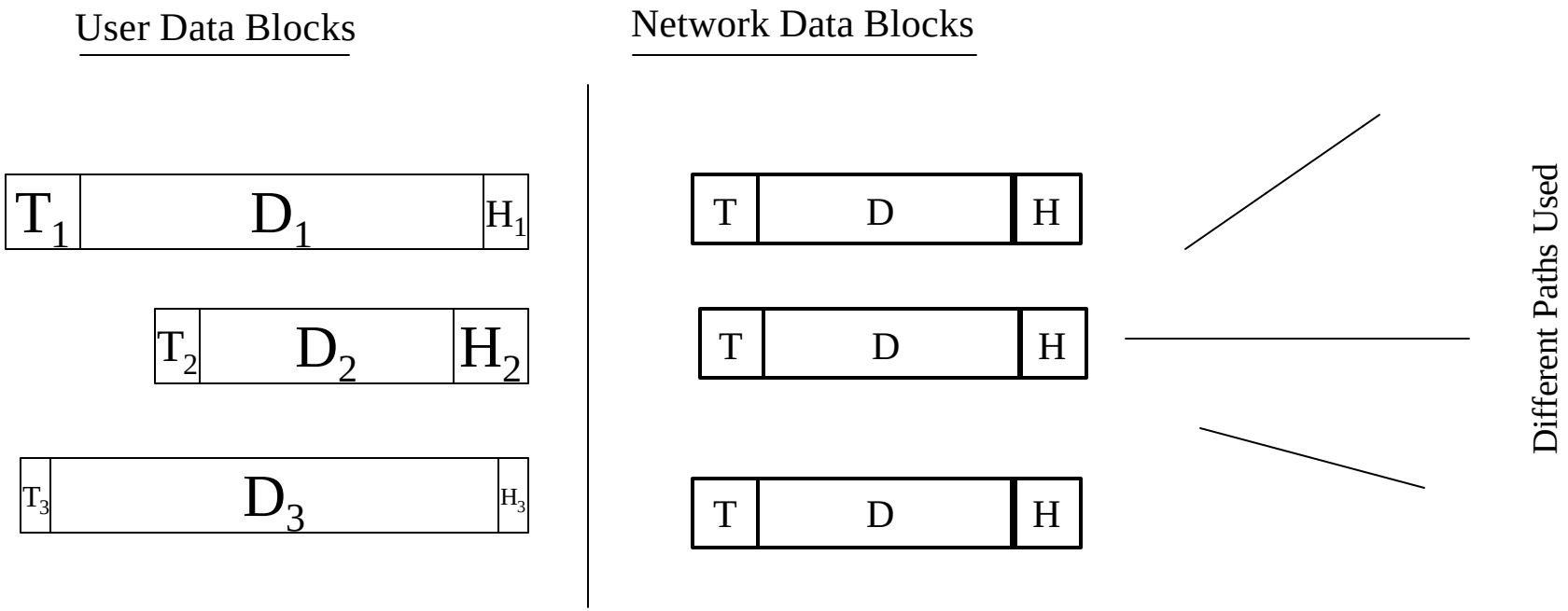
PROTOCOL FUNCTIONS

- Segmentation & Re-assembly
- Encapsulation
- Connection Control
- Flow Control
- Error Control
- Synchronization
- Sequencing
- Addressing
- Multiplexing
- Transmission Services

Segmentation & Re-Assembly



H = Header
D = User Data
T = Trailer

Encapsulation

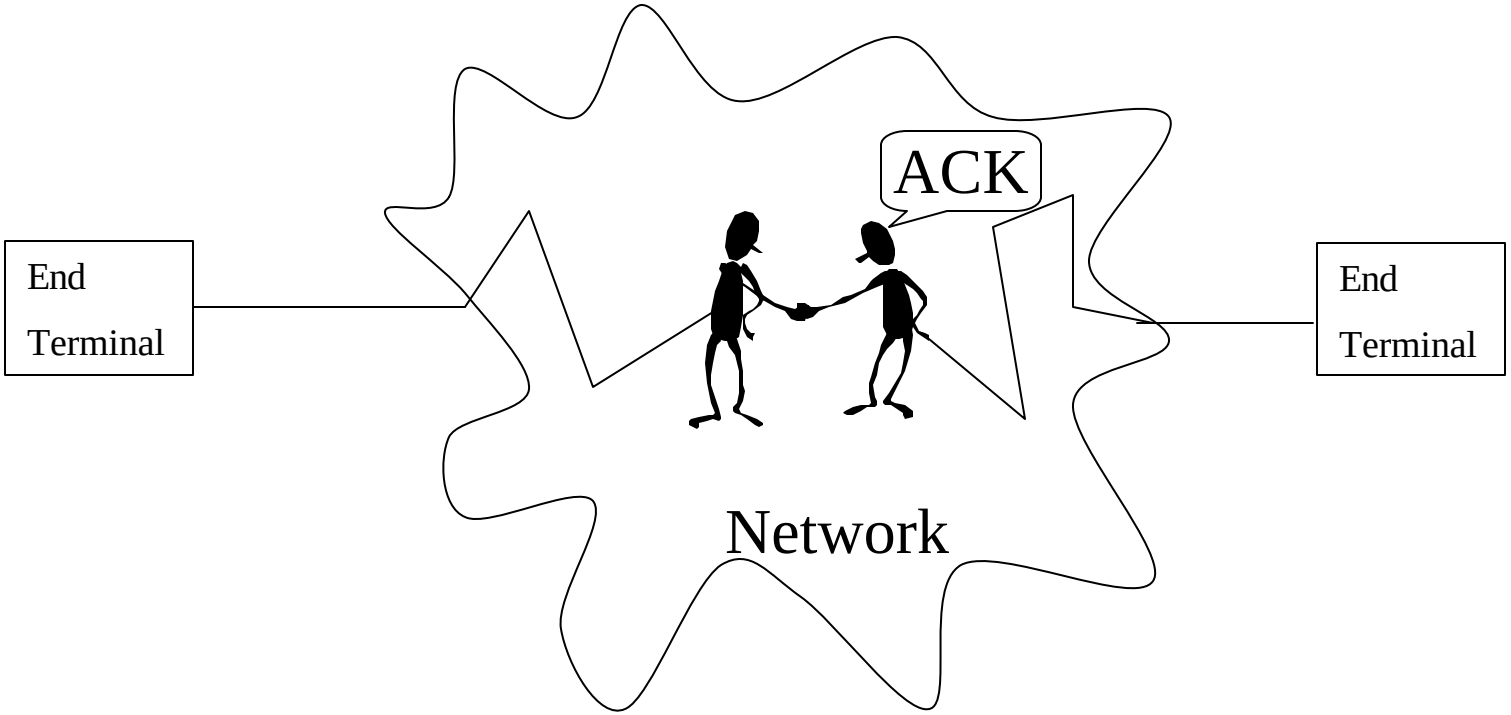
T+	D	H+

Protocol Data Unit

Connection Control

Flow Control

Error Control



Synchronization

Sequencing

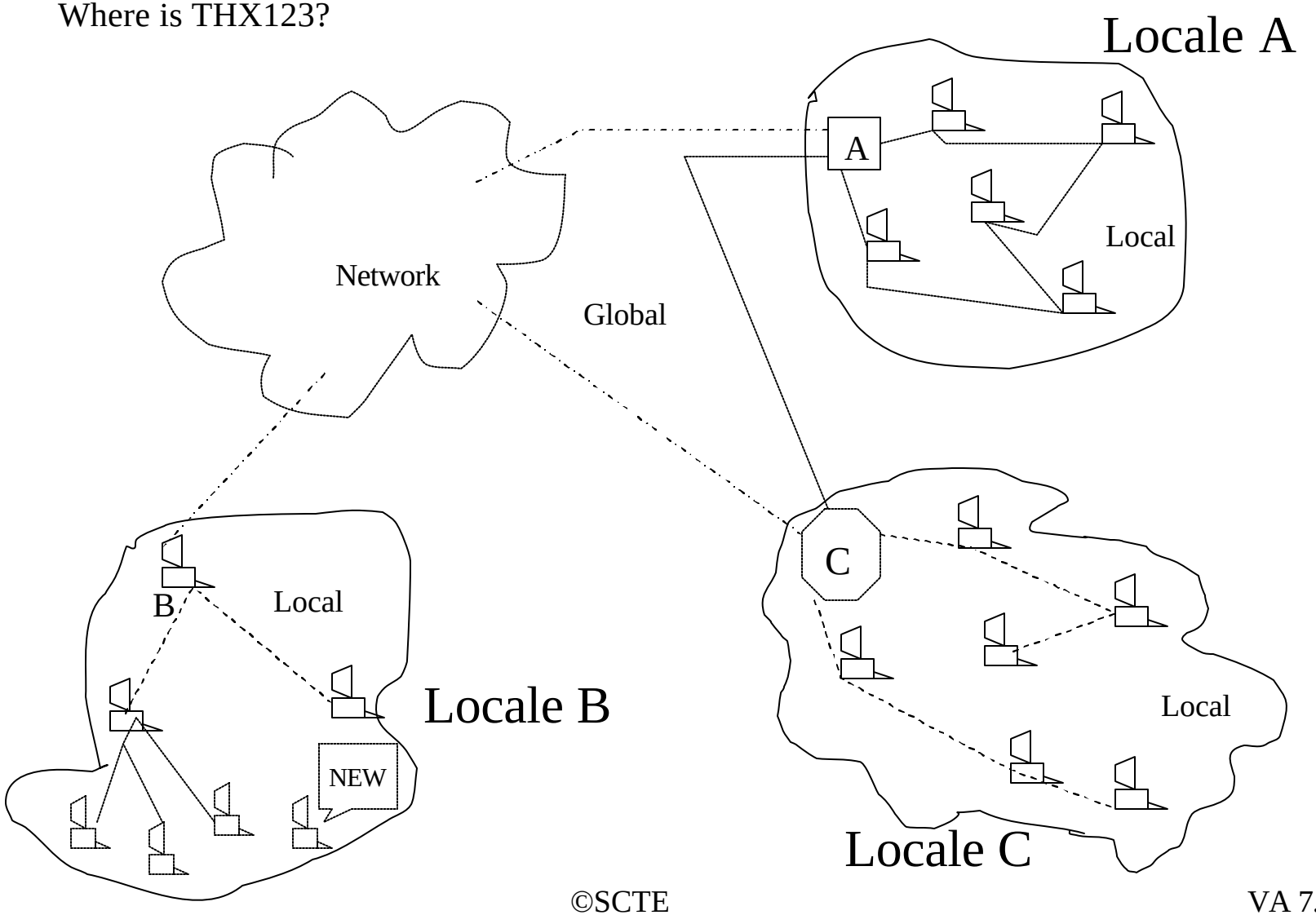
For example:

1st - Establish the connection
2nd - Acknowledge data receipt
3rd - Terminate connection

Put the data back together
in the correct order.

Addressing

Where is THX123?



Multiplexing

Downward

ONE Upper level protocol uses MANY lower level connections

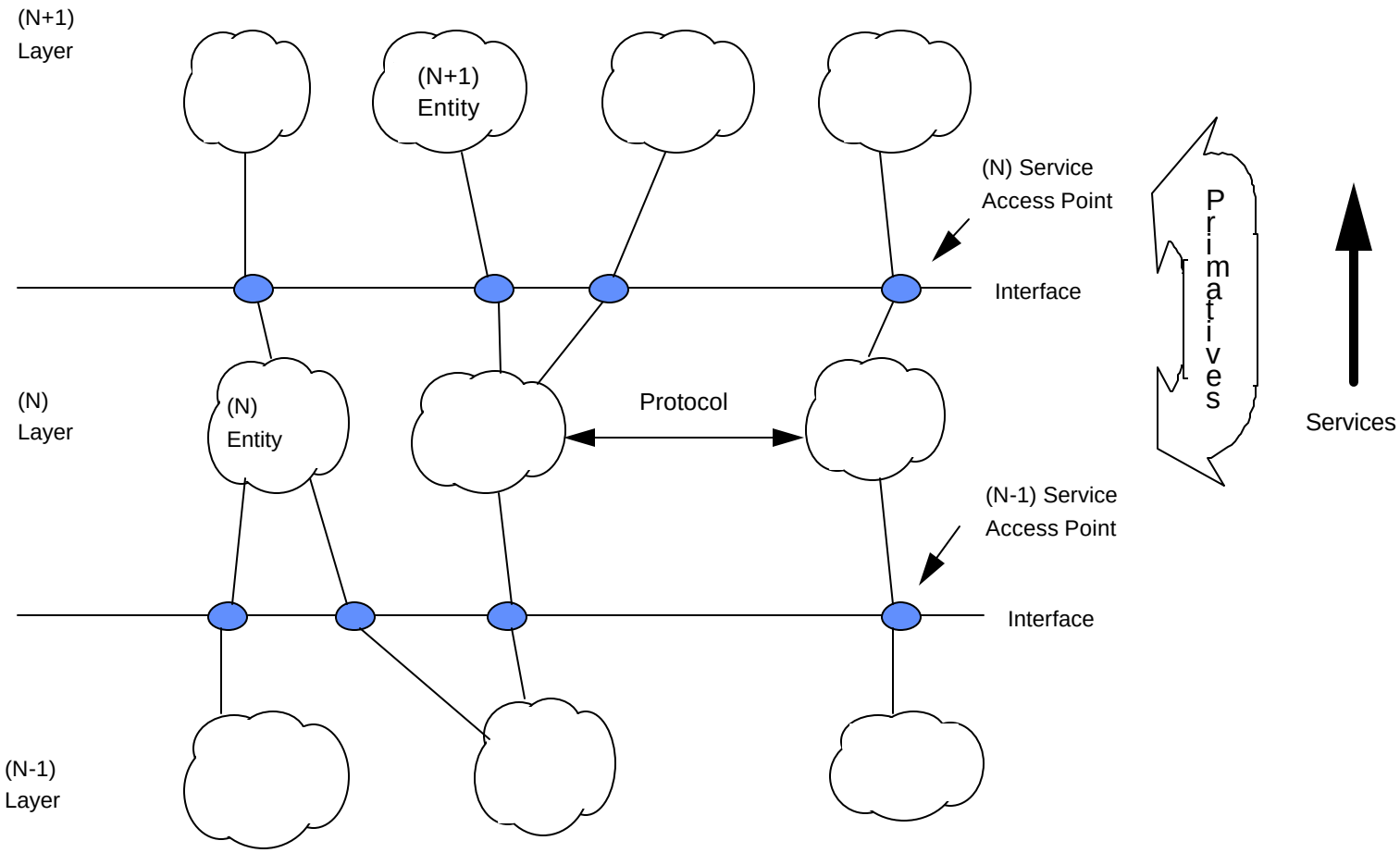
- Route diversity
- Improved reliability

Upward

MANY Upper level protocols use ONE lower level connections

- Only one lower level path available
- Maximizes usage of a lower level connection

The Layer Concept

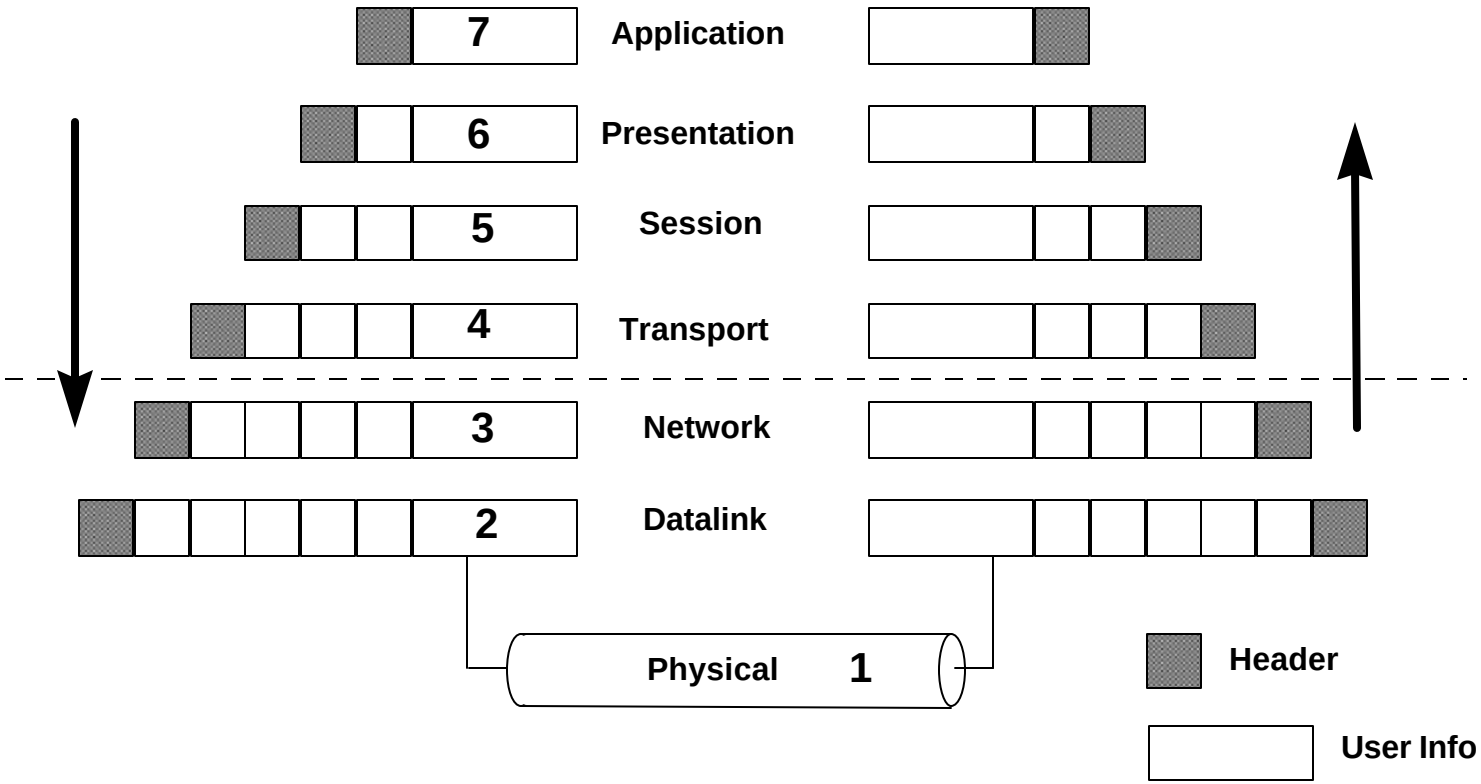


Layered Protocols

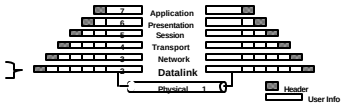
- OSI is the standard reference
- Set of rules for data flows
  - –Intra-Layer
  - –Inter-Layer
- Find multiple protocols in a complete data system
- Layers provide
  - –Specialization
  - –Segmentation
  - –Separation
  - –Functional symmetry
  - –Layers can be worked on independently

The OSI Model

Set of Rules

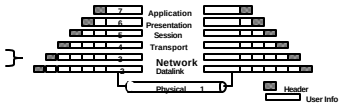


Datalink Layer



- Governs flow of data
- Provides
  - High Throughput
  - Fast Response
  - Data Integrity
- Functionality
  - Synchronization
  - Flow Control
  - Error Detection
  - Identification of entities
  - Identification of information

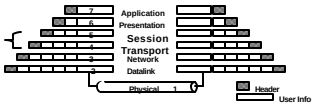
Network Layer



- Governs communications of a *group* of networks
- Provides resolution for issues involving:

  –PDUs of different sizes/formats
  –Different timers/timeouts
  –Various quality of services
  –Different addressing techniques
  –Different performance levels
  –Different routing methods
  –Different user interfaces
  –Different security levels
  –Different troubleshooting, diagnostic, and maintenance methods
  –Cost and billing determination

Transport Layer & Session Layer



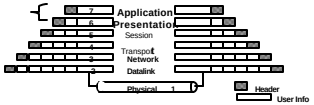
Transport Layer

- End to end data integrity
- Manages interface between upper & lower layers
- Connection and termination of session
- Detection of lost, duplicate, or out of sequence data
- Control data flow

Session Layer

- Coordinates data exchange between applications
- Synchronization checkpoints
- Structures user application interactions
- Provides rules for users exchanging data
- Prevents lost data by closing dialogs properly

Presentation Layer & Application Layer



Presentation Layer

- Allows end users to operate with different syntax
- Translates User 1's syntax so User 2 can read

Application Layer

- Direct interface with the end user applications
- Application Service Elements key
  - ASCE - Regulates user requests
  - RTSE - Notifies sender of successes/failures
  - ROSE - Allows interactive communications
  - CCR - Manages database interactions

TCP/IP Protocol

<table>
<tr><th colspan="2">OSI Model</th><th>DOD Standards</th><th>DOD Model</th></tr>
<tr><td>7</td><td>Application</td><td>FTP; SMTP</td><td rowspan="3">Process/ Application</td></tr>
<tr><td>6</td><td>Presentation</td><td>TELNET</td></tr>
<tr><td>5</td><td>Session</td><td rowspan="2">TCP</td></tr>
<tr><td>4</td><td>Transport</td><td rowspan="2">Host to Host</td></tr>
<tr><td>3</td><td>Network</td><td rowspan="2">IP</td><td>Internet</td></tr>
<tr><td>2</td><td>Data Link</td><td rowspan="2"></td><td rowspan="2">Network Access</td></tr>
<tr><td>1</td><td>Physical</td></tr>
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