Network Design Fundamentals

OSI Model

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Goals

- Understand the OSI Model
  - Purpose of the model
  - Technologies specified at each Layer
  - Relationship to (template for) network design
- Understand the NEN “Lego stack” in relation to the OSI Model

Agenda

- Overview
- Media Layers
  - facilities, encapsulation and switching
- Network Layers
  - addressing, subnet and routing
- Application Layers
  - Data (content), multicast, security, RT, NRT

OSI – Overview

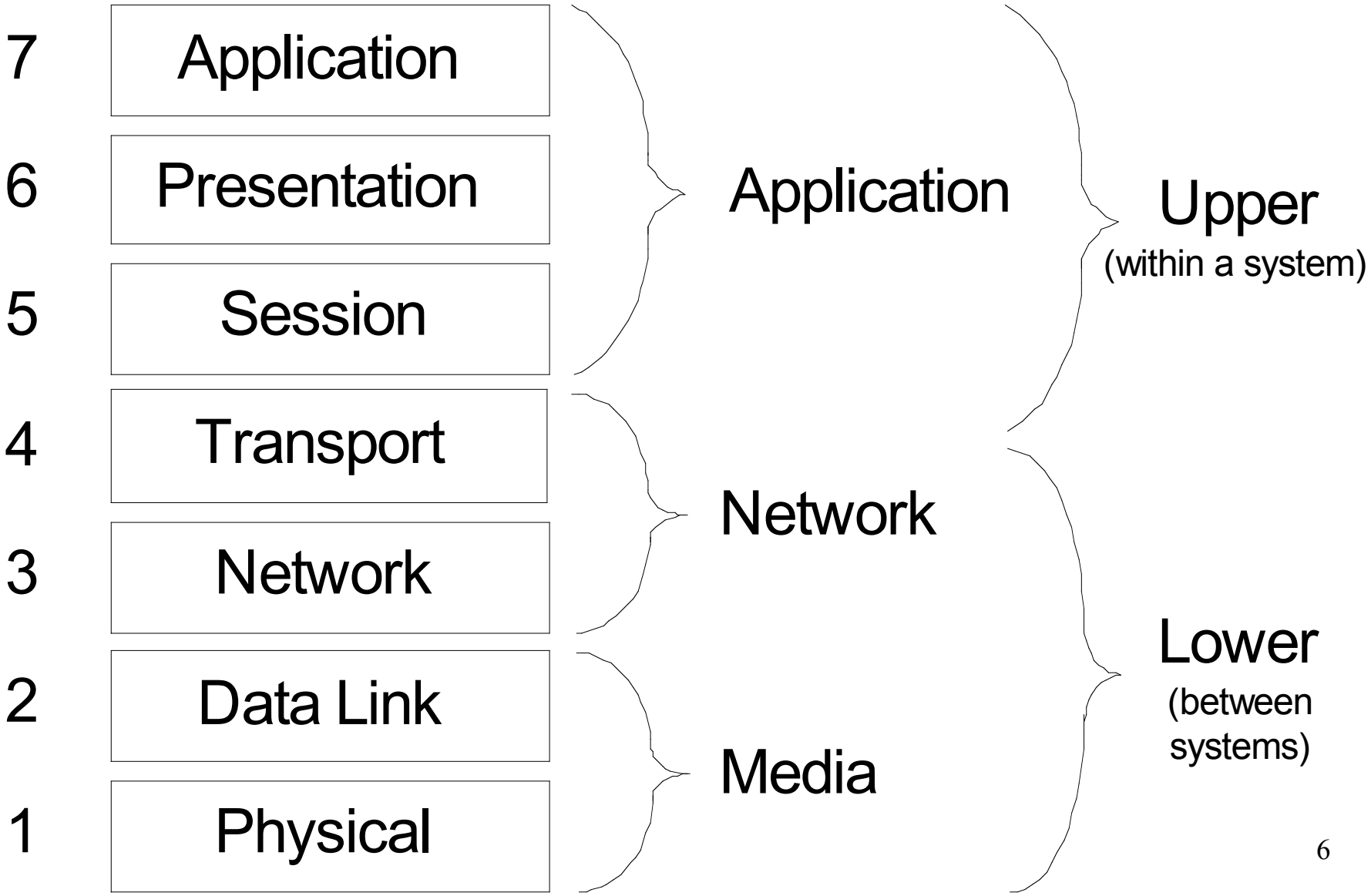
Why are we talking about OSI?

- Definition:
  - **O**pen **S**ystems **I**nterconnection
- Purpose:
  - Standards for inter and intra system communication
- Function:
  - **Source**: To build a data packet for transmission
  - **Destination**: To receive and interpret a data packet
- Utilization:
  - It's all 1's and 0's

OSI - Overview

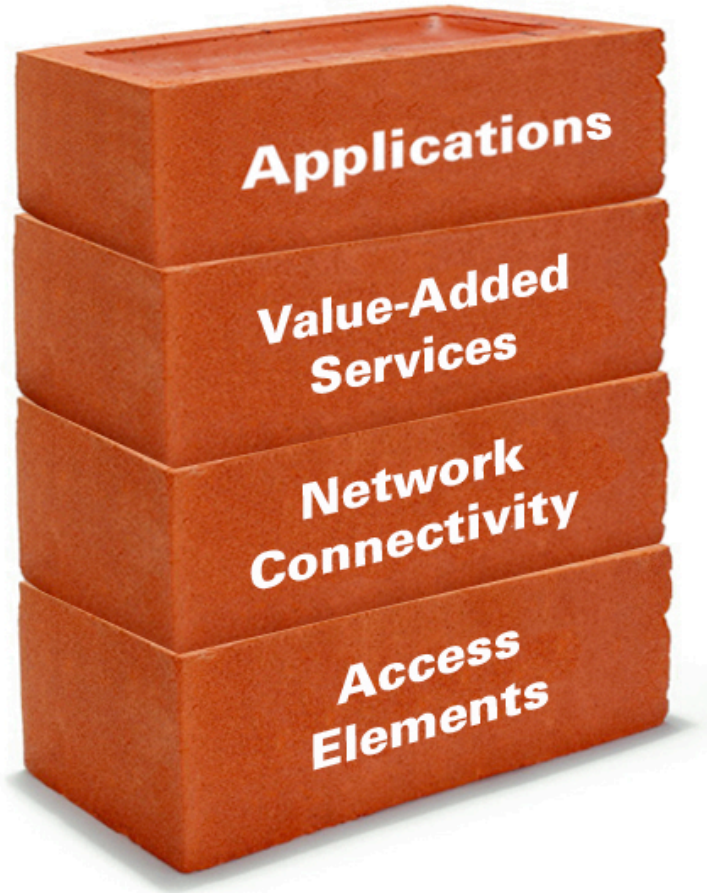
- Format: 7 layers.
  - Each layer provides a set of functions to the layer above
  - Each layer relies on the operation of the layer below.
- Sales & Marketing: where the layers get blurred
- Implementation: competing standards
- Interpretation: engineers disagree

OSI Model – Layers

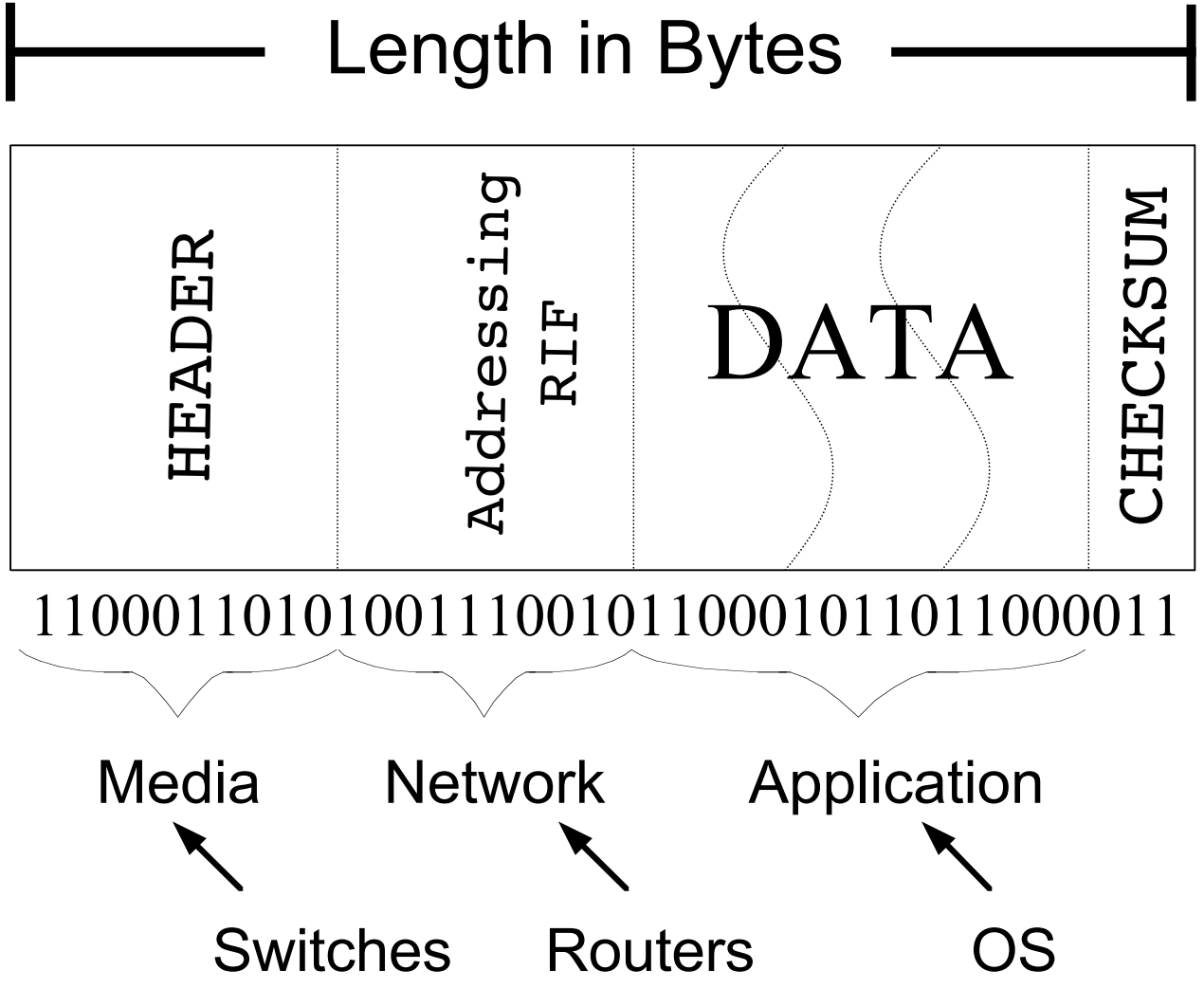


New Edge Networks Product Model

The “Lego Stack”



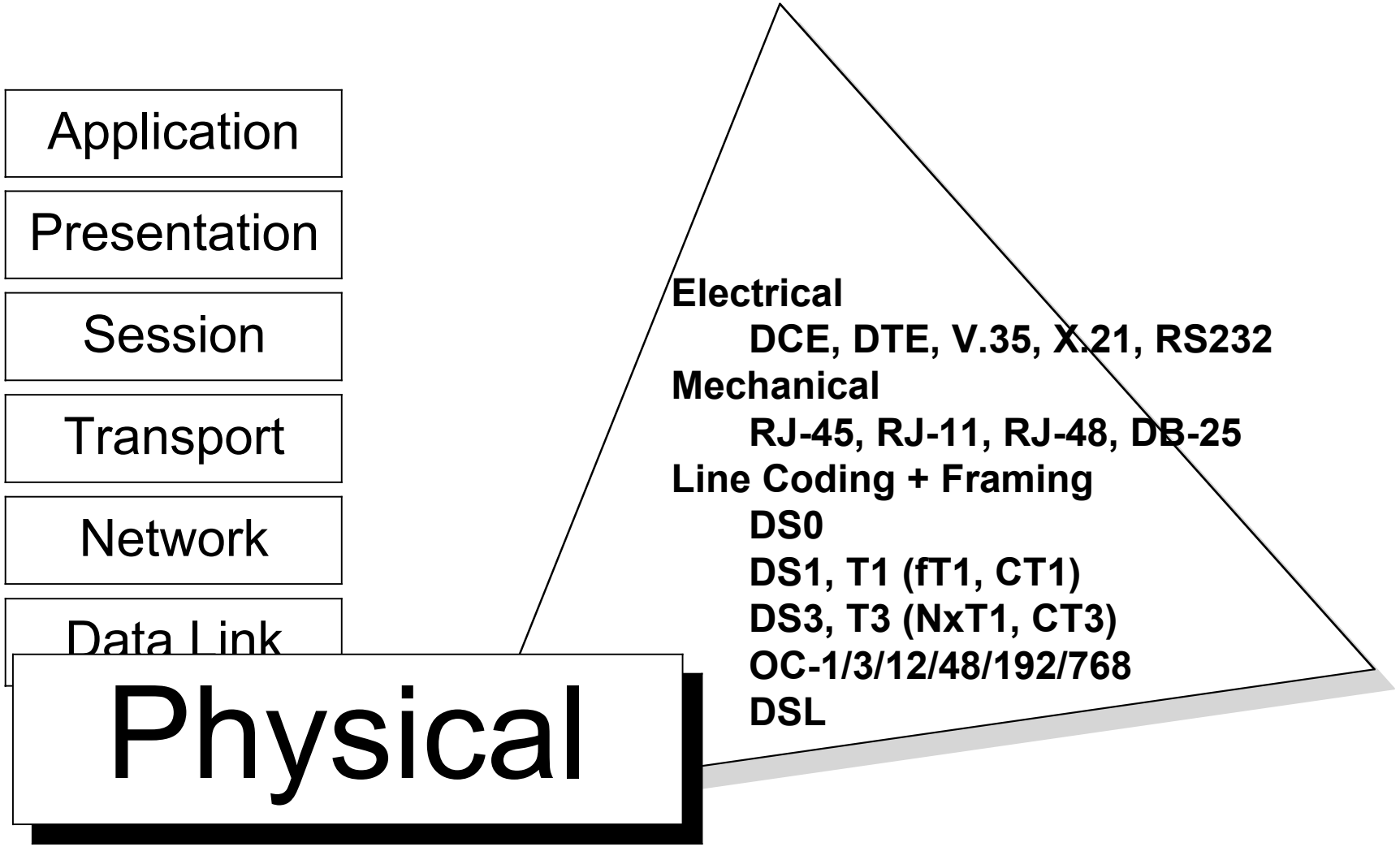
Packet Drawing



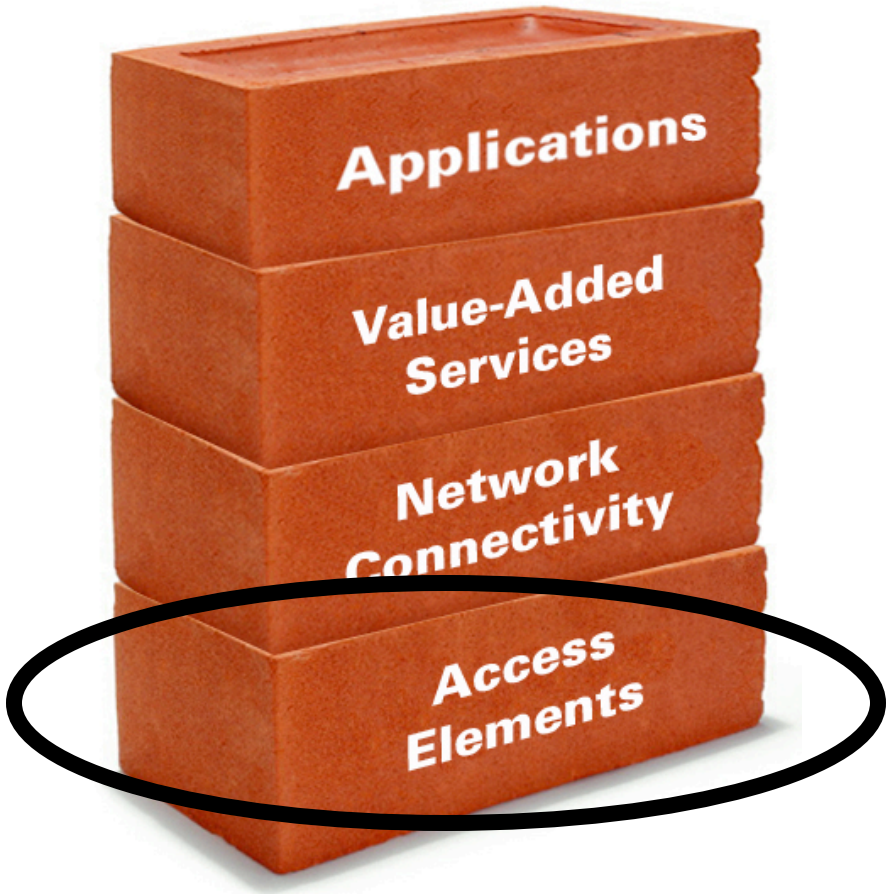
Layer 1 – Physical

- Defines electrical, photonic and mechanical characteristics of a network.
- Interface between network medium and network devices.
- Responsible for:
  - Preparation of a packet for transmission
  - Reception of packet for communication to upper levels
- Interworking between media types

Layer 1


Application
Presentation
Session
Transport
Network
Data Link
Physical
Electrical
DCE, DTE, V.35, X.21, RS232
Mechanical
RJ-45, RJ-11, RJ-48, DB-25
Line Coding + Framing
DS0
DS1, T1 (fT1, CT1)
DS3, T3 (NxT1, CT3)
OC-1/3/12/48/192/768
DSL

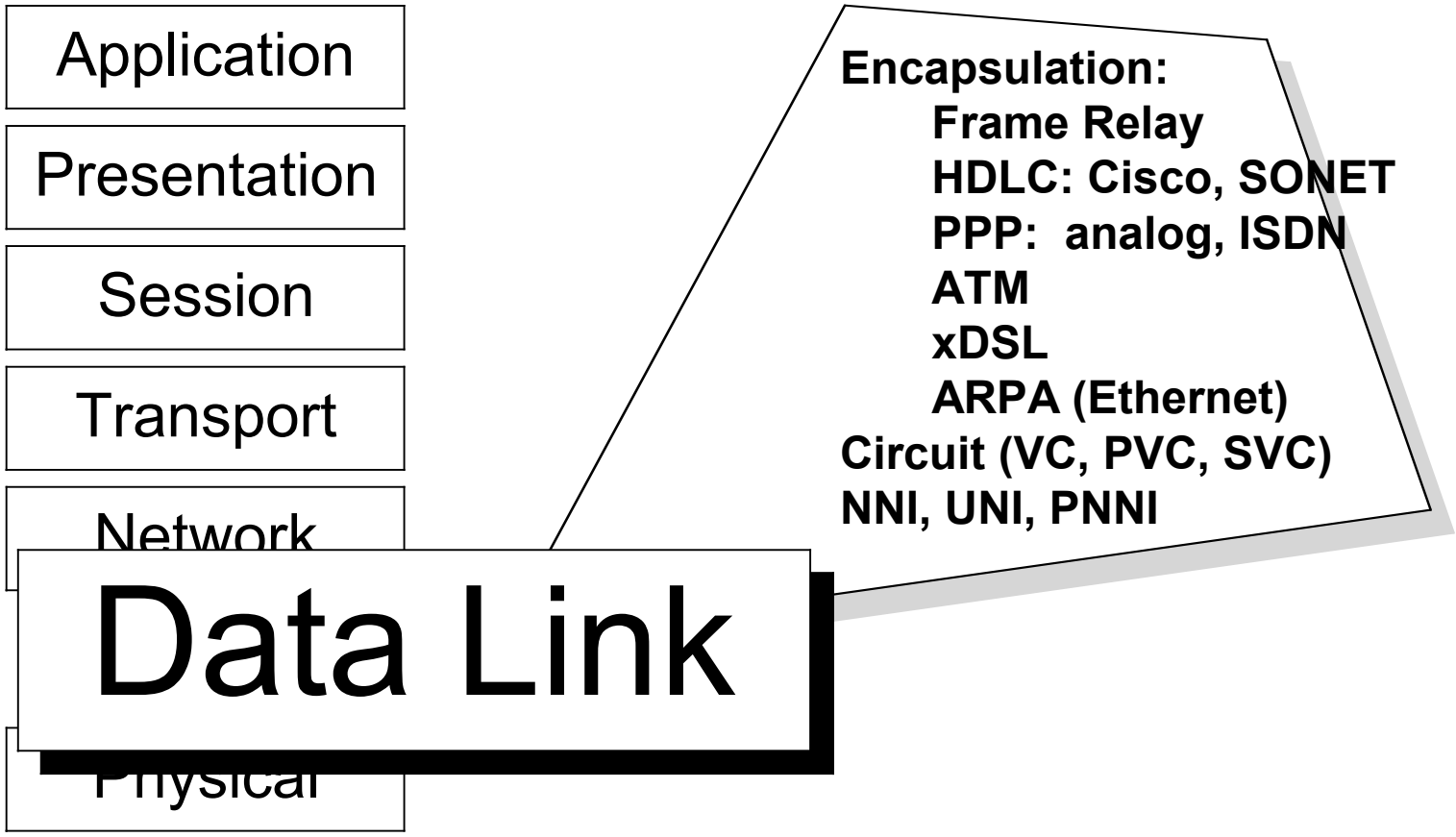
NEN Product Model



Layer 2 – Switching

- Encapsulates packet for
  - Communication between Layer 2 devices.
- Defines Layer 2 Virtual Circuits (P or S - VC)
  - Addressing: MAC, DLCI, VPI/VCI
  - End-points: Layer 3 devices (routers)
- Interworking (bridging):
  - between media devices (i.e. FDDI, Ethernet, ATM and Frame Relay)
- Security:
  - Virtual Private Network (VPN)

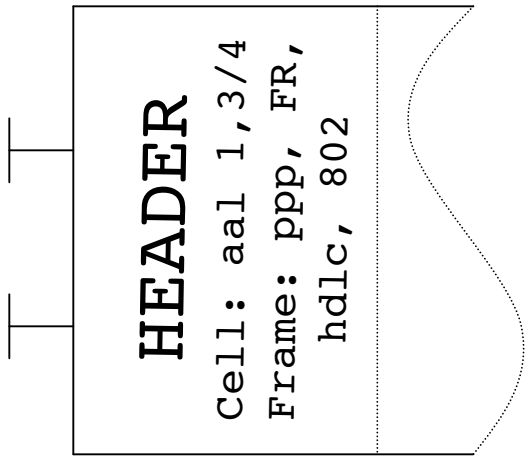
Layer 2


Application
Presentation
Session
Transport
Network
Data Link
Physical
Encapsulation:
Frame Relay
HDLC: Cisco, SONET
PPP: analog, ISDN
ATM
xDSL
ARPA (Ethernet)
Circuit (VC, PVC, SVC)
NNI, UNI, PNNI

Layer 2 - Data Link

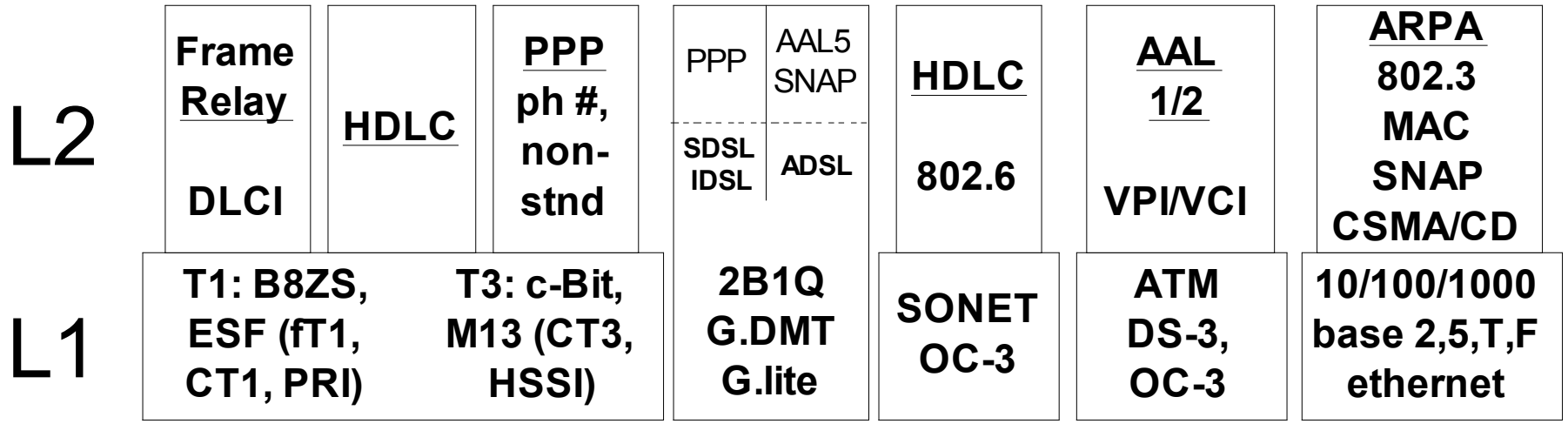
Layer 1 - Physical

Media Layer

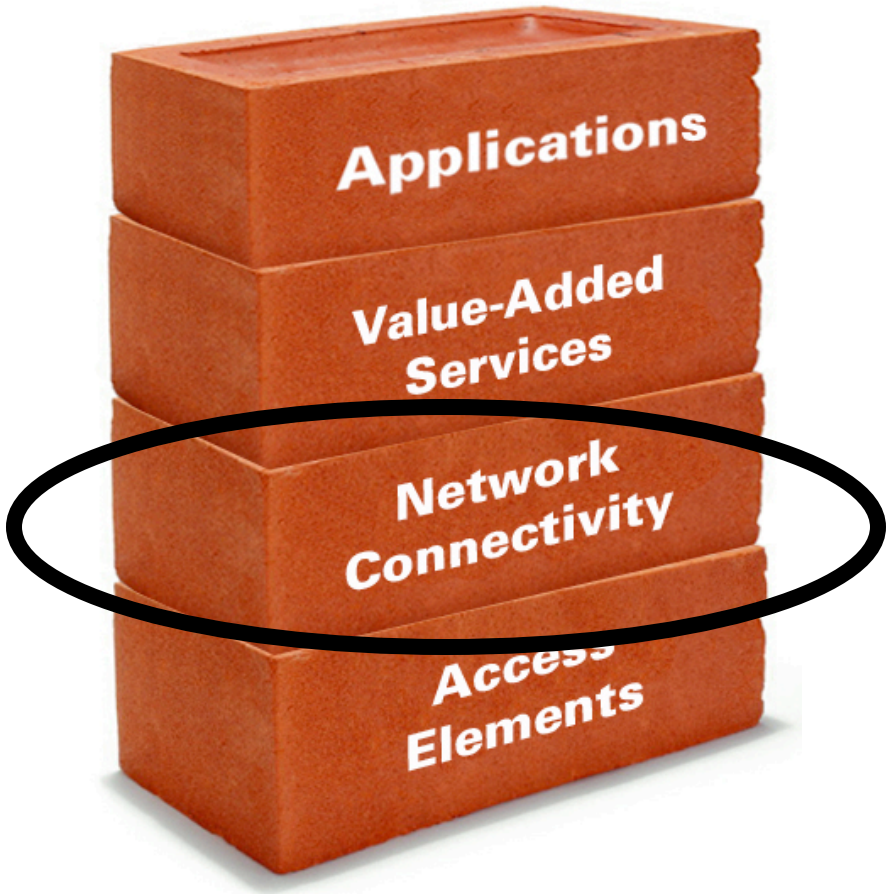


- **Purpose**:
  - Encapsulation
  - Interworking (a.k.a. bridging)
  - Compression
  - Encryption
- **Definitions**:
  - LAN, WAN, MAN, access, TLS
- **Considerations**:
  - Sub-layer 1: facilities equipment and right-of-ways
  - Sub-layer 2: NNI (interconnect with other xLECs)
  - Voice and Data competition

L1/L2 dependencies



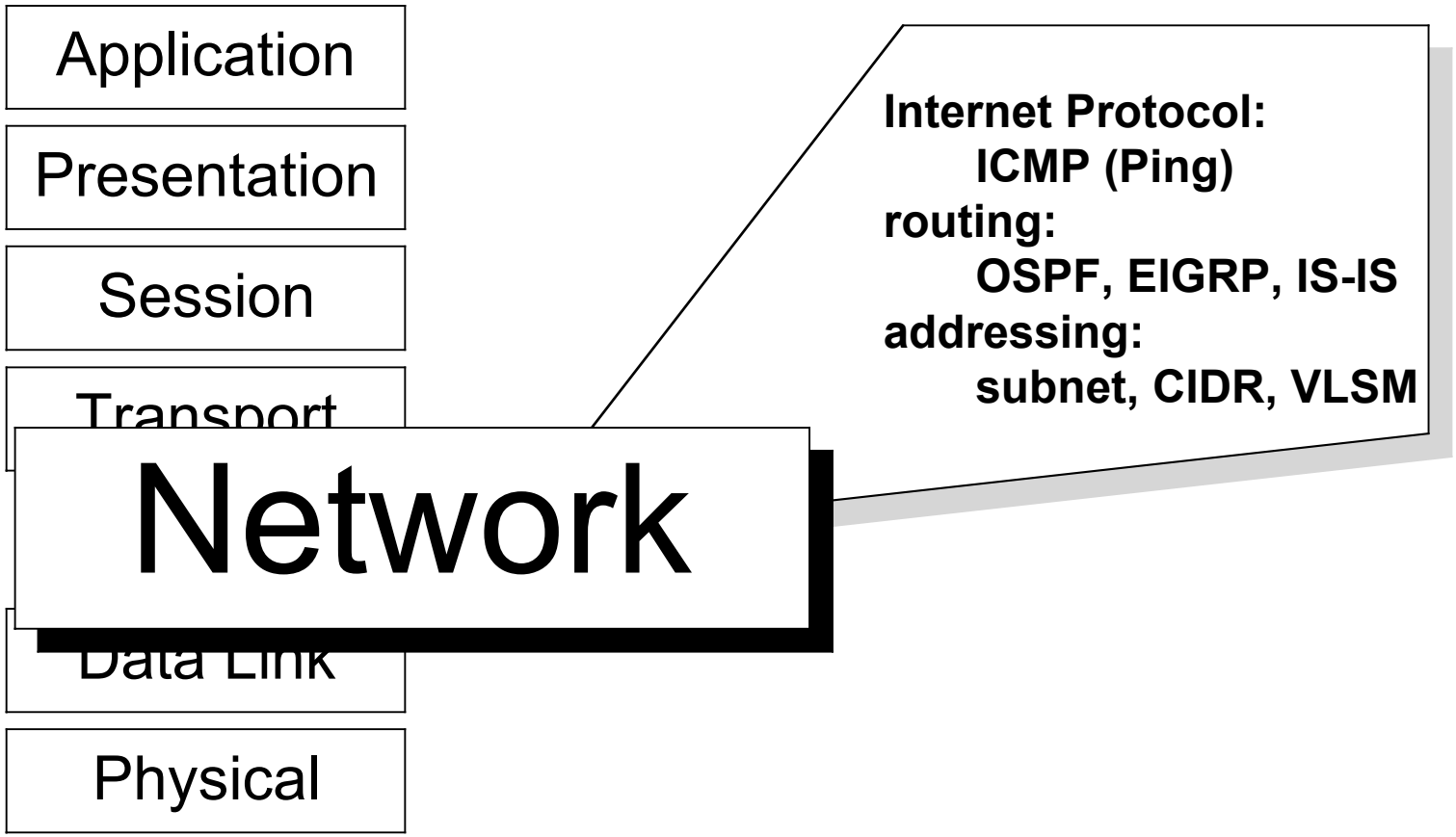
NEN Product Model



Layer 3 – Routing & Addressing

- Defines the protocol (logical) address for a device
- Used for
  - Inter-communication of routing protocols
  - Control & Messaging
- Security: Layer 3 VPN
  - Packet Encryption
  - Packet Interrogation (Access Control Lists)
  - Tunneling (packet-in-packet or end-to-end)
  - NAT (Network Address Translation)
- Services
  - DHCP, NAT

Layer 3


Application
Presentation
Session
Transport
Network
Data Link
Physical
Internet Protocol:
ICMP (Ping)
routing:
OSPF, EIGRP, IS-IS
addressing:
subnet, CIDR, VLSM

Layer 4 - Caching

- Traffic types:
  - Guaranteed delivery
  - Best-effort delivery
- Security: Data Encryption (SSL/TLS)
- QoS (Quality of Service)

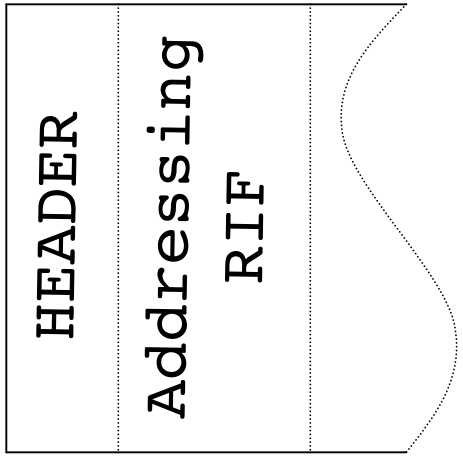
- Information in this layer is used to determine if data traffic is inbound or outbound from the host system

Layer 4 - Transport

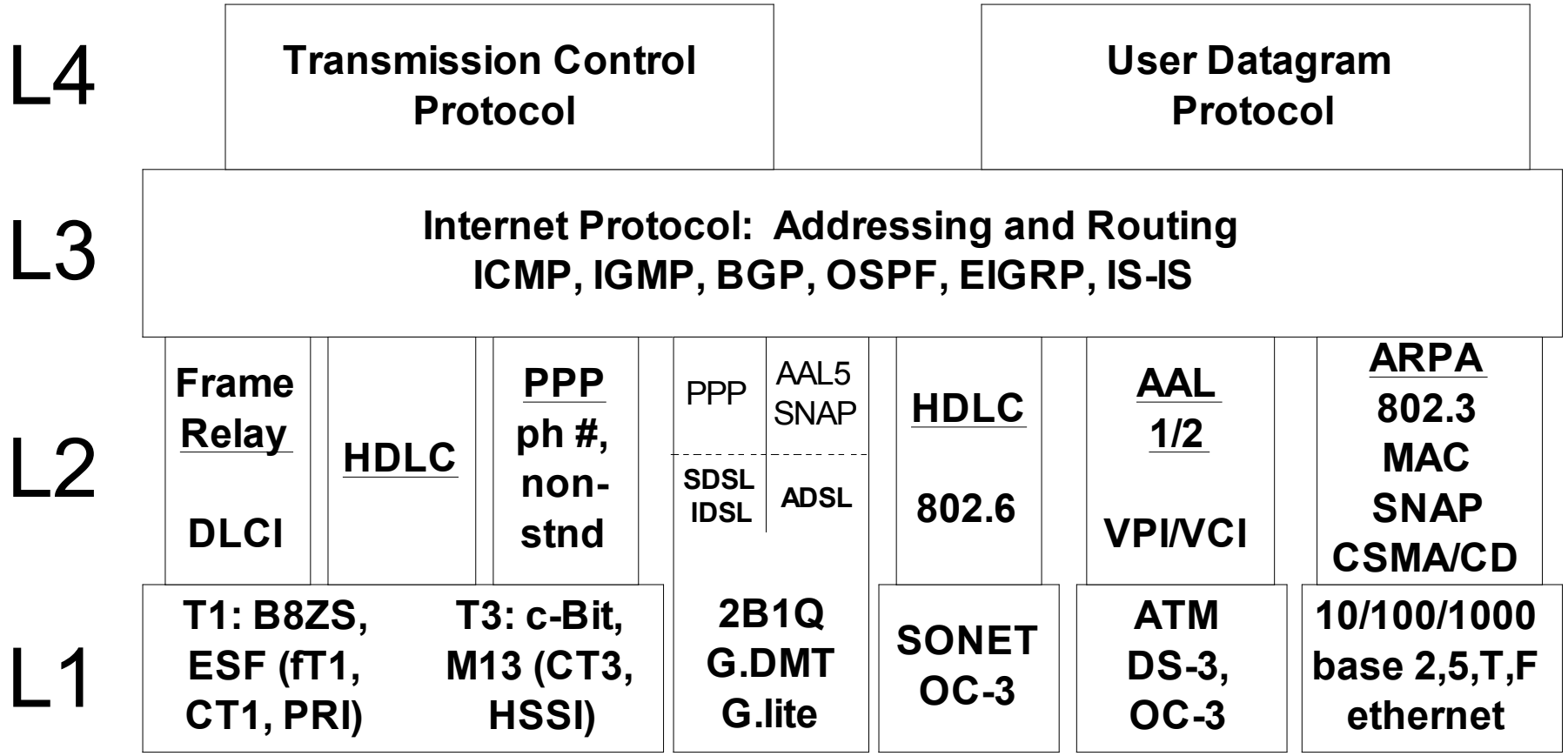
Layer 3 - Network

Network Layer

- **Purpose**:
  - addressing
  - routing
  - Inbound or Outbound traffic
  - compression
- **Definitions**:
  - Routing domain, Autonomous System
- **Considerations**:
  - Security: VPN
  - QoS
  - IPv6



L1, L2, L3, L4 dependencies



Layer 5-7 - Application

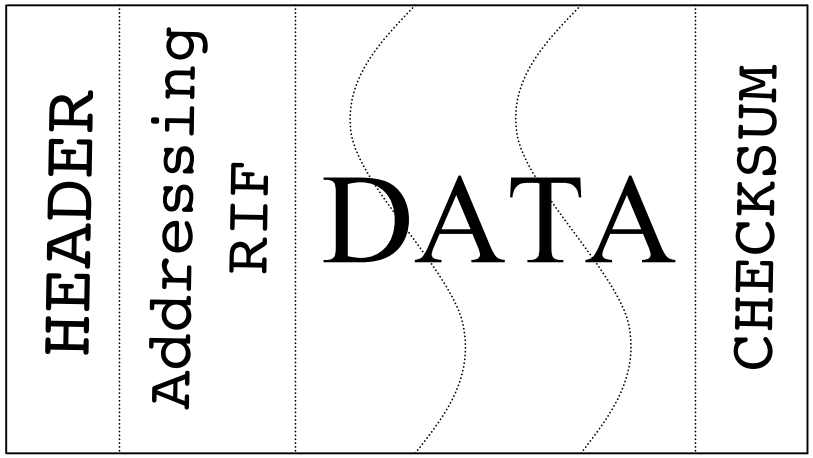
- Provides services to application processes (such as e-mail, file transfer, and terminal emulation) that are outside of the OSI model.
- Identifies and establishes the availability of intended communication partners and the resources required to connect with them.
- Synchronizes cooperating applications, and establishes agreement on procedures for error recovery and control of data integrity

Layer 7 - Application

Layer 6 - Presentation

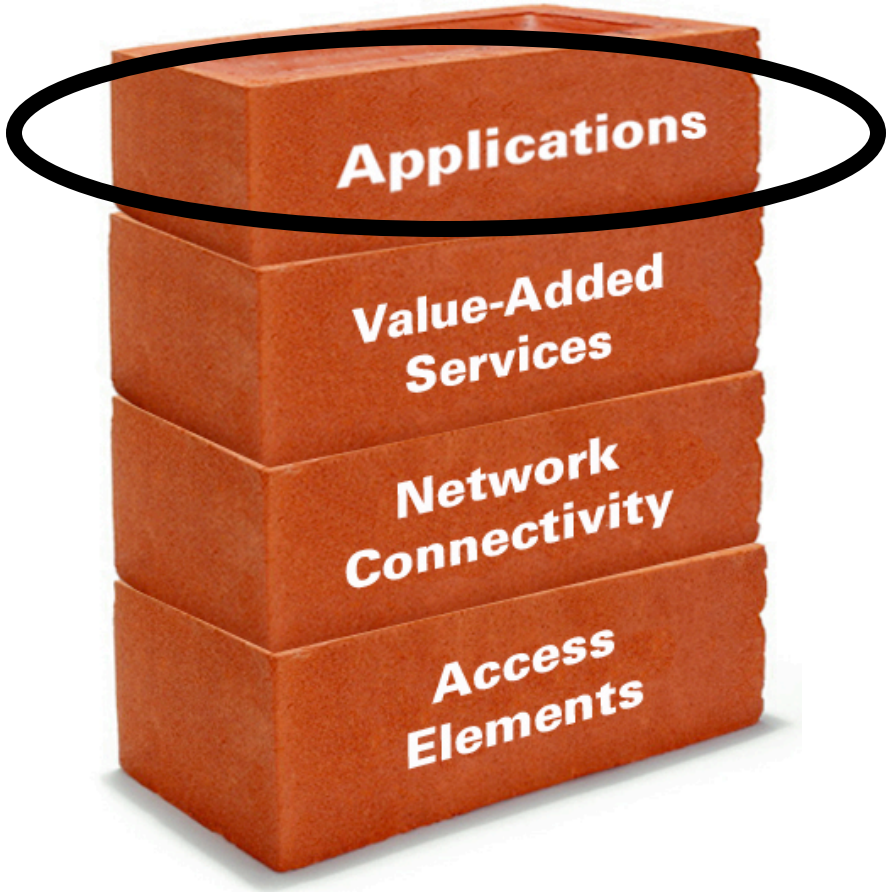
Layer 5 - Session

Application Layer



- Purpose:
  - packet-ize application output
- Definitions:
  - Real-Time, Non-Real-Time
- Concerns:
  - security, compression, RT, NRT
- Examples:
  - Layer 7: Eudora, X, rsh, ssh, SSL
  - Layer 6: ASCII, BinHex, Mime
  - Layer 5: SMTP, HTTP, Telnet

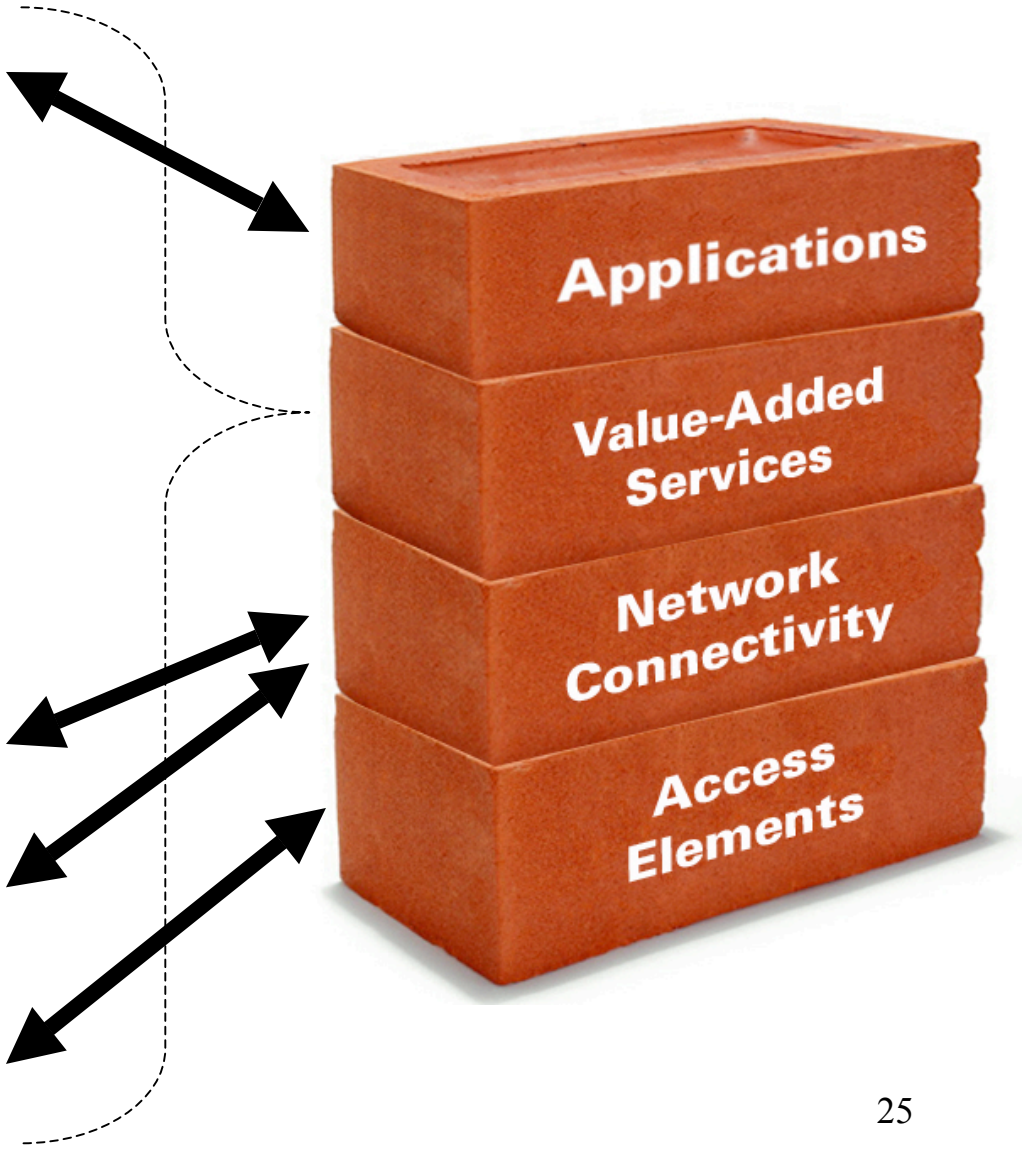
NEN Product Model

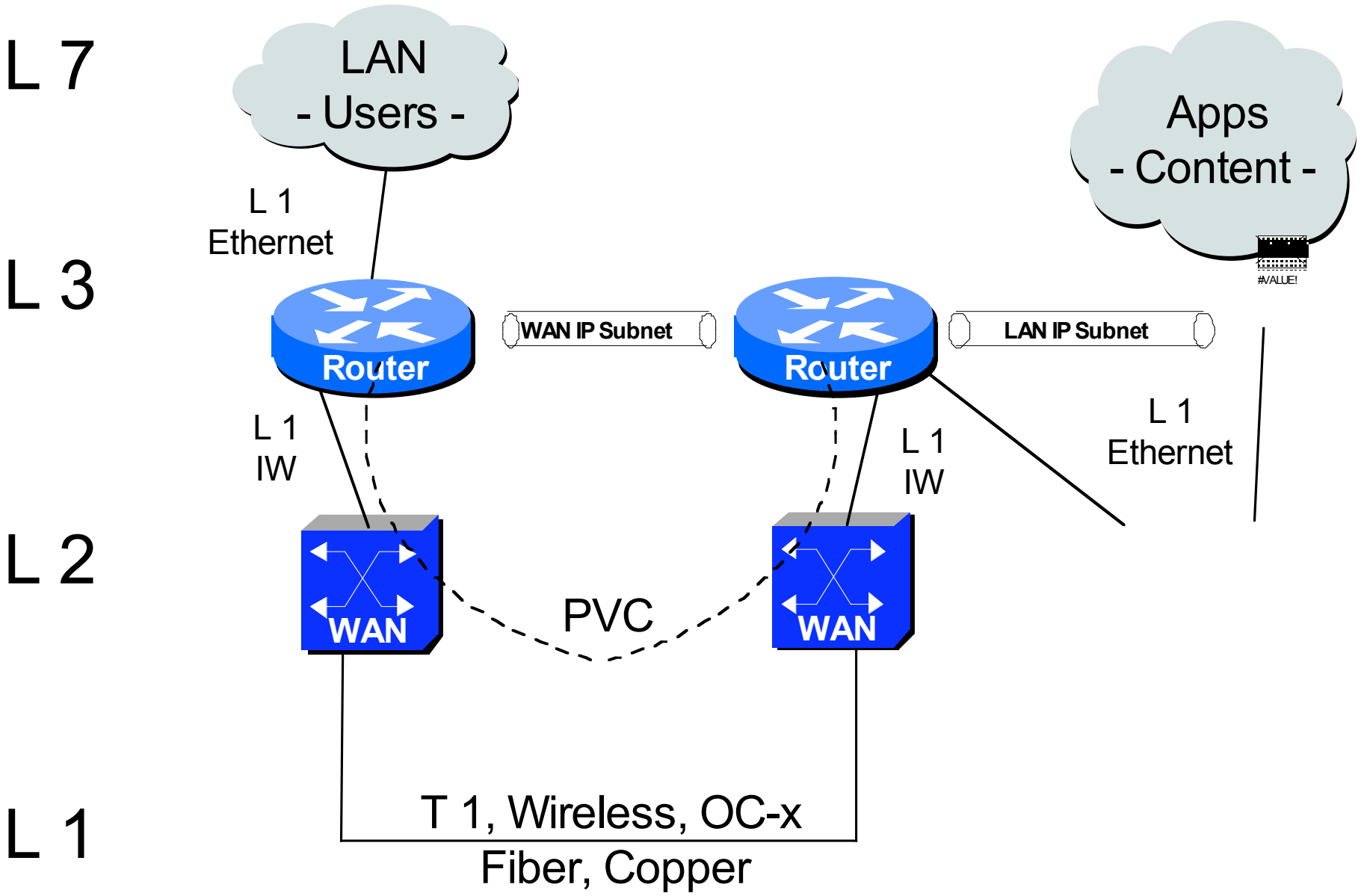


OSI Model

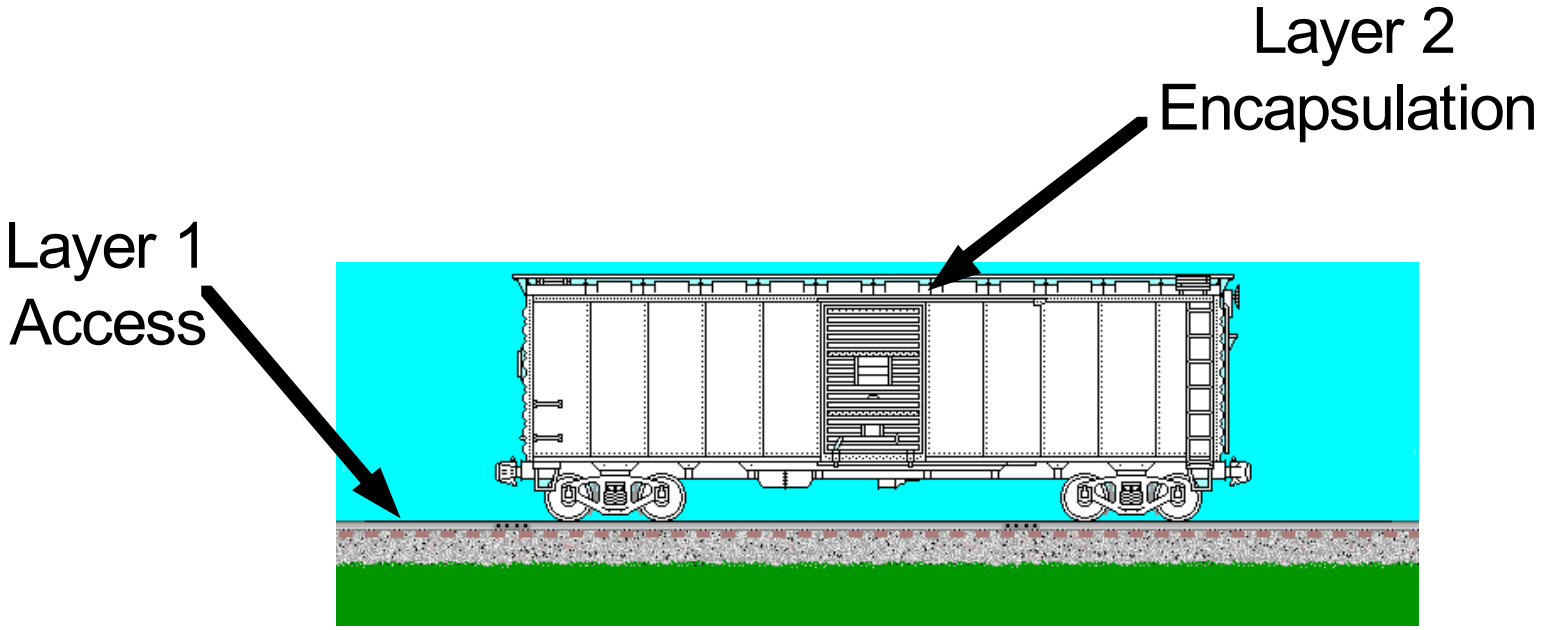
7	Application
6	Presentation
5	Session
4	Transport
3	Network
2	Data Link
1	Physical

NEN "bricks"




L 7
L 3
L 2
L 1
LAN
- Users -
Apps
- Content -
L 1
Ethernet
Router
WAN IP Subnet
Router
LAN IP Subnet
L 1
IW
L 1
IW
L 1
Ethernet
WAN
PVC
WAN
T 1, Wireless, OC-x
Fiber, Copper

Security: Layer 2 VPN



Layer 3 (shipping crates inside)

Layer 4 (packages inside shipping crates)

Layer 5,6,7 (content inside packages)

Reference

- www.cisco.com
  - /cpress/cc/td/doc/cisintwk/ita/index.htm
  - /univercd/cc/td/doc/cisintwk/ito_doc/introint.htm
  - /cpress/cc/td/cpress/fund/ith/ith01gb.htm
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