Section 2: Week 3: Communication Mechanisms

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**Communication Mechanisms**

Distributed systems are composed of systems that need to participate in conversations across the network. The requirements of these conversations will as the participants optimize network overhead, service response time, higher hit ratios, and scalability considerations (Chen & Sung, 2016). Due to applications having different constraints, there is an assortment of protocols that make trade-offs in terms of scale or performance. Chen and Sung, provide the example of Microsoft’s Universal Plug and Play (UPnP), which can easily share services on a local network but cannot scale to an enormous enterprise environment. This naturally leds to systems designers needing to be cognisent of the target audience when selecting a network protocol.

# Common Protocols in Networked Applications

The Open Systems Interconnection (OSI) model represents network communication as a series of layers (Zimmermann, 1980). Implementation of each layer can focus on the immediate task at hand, as there are clear sepearation of duties with other aspects of the system.

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| OSI Level | Purpose | Examples |
| Application  (Layer 7) | Provides the interface between the software running on the device and the network protocol | Secure Shell (SSH): Remote Administration  File Transfer Protocol (FTP): File Administration  Domain Name Services (DNS): A protocol for translating network names into IP addresses.  Bonjour: Protocol for name translation on OSX |
| Presentation  (Layer 6) | Responsible for packet forwarding and routing through intermediate routers | HyperText Transport (HTTP): Stateless protocol for request/response traffic  Simple Network Management Protocol (SNMP): Stateless protocol for communicating with switches |
| Session  (Layer 5) | Provides process communications between two or more networked devices | Remote Procedure Calls (RPC): Share application state across disjoined systems  Named Pipes: An Inter-Process Communication (IPC) mechanism  Server Message Block (SMB): Windows-to-Windows protocol of choice for administration scenarios. |
| Transport  (Layer 4) | Transfers data between various systems and hosts | Transmission Control Protocol (TCP): Mechanism for ensuring delivery and resending packets within a stream  User Datagram Protocol (UDP): A lightweight system for best effort delivery and multi-casting scenarios  Border Gateway Protocol (BGP): Defines network edge to edge routes. |
| Network Link (Layer 3) | Provides switching and routing functionality between connected devices | Internet Protocol (IP): A route addressing solution for getting packets across the Internet.  Virtual Private Network (VPN): Encapsulates traffic and then routes it to a different network. |
| Data Link  (Layer 2) | A link between two directly connected nodes. Detects and corrects errors transmitted from the physical layer | Ethernet: A technology for detecting and correcting failures on the wire.  Address Resolution Protocol (ARP): Translates IP-to-MAC addresses between switches. |
| Physical Layer (Layer 1) | Defines the connection between the physical device and its connection mechanism | CAT-5: An encoding scheme for reading the electrical signal.  Universal Serial Bus (USB): Connects devices through a generic interface.  802.11 (Wi-Fi): Radio communication frequently used in offices, coffee shops, and other wireless scenarios. |