Unit-4

COMMUNICATION

Communication

1. Foundation
2. Remote procedural call
3. Message-oriented Communication
4. Multicast Communication

Introduction

The most important difference between a distributed system and uniprocessor system is the inter-process communication.

Interprocess communication is a set of programming interfaces that allows a programmer to coordinate activities among different program process that can run concurrently in an operating system.

In a uniprocessor system, inter-process communication assumes the existence of shared memory whereas in a distributed system, there is no shared memory, so the entire nature of inter-process communication must be completely reframed from scratch. All communication in distributes system is based on message passing.

Introduction

Interprocess communication is at the heart of all distributed systems. It makes no sense to study distributed systems without carefully examining the ways that processes on different machines can exchange information. Communication in distributed systems is always based on low-level message passing as offered by the underlying network. Expressing communication through message passing is harder than using primitives based on shared memory, as available for no distributed platforms. Modern distributed systems often consist of thousands or even millions of processes scattered across a network with unreliable communication such as the Internet. Unless the primitive communication facilities of computer networks are replaced by something else, development of large-scale distributed applications is extremely difficult.

Three popular models of communication

- Remote Procedure Call (RPC)
- Message-Oriented Middleware (MOM)
- data streaming

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Three popular models of communication

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Fundamentals

Before we start our discussion on communication in distributed systems, we first recapitulate some of the fundamental issues related to communication. In the next section we briefly discuss network communication protocols, as these form the basis for any distributed system. After that, we take a different approach by classifying the different types of communication that occurs in distributed systems.

Layered Protocols

Because there is no shared memory in distributed systems, communication relies on sending and receiving low-level messages. When process A wants to talk to process B, it first creates a message in its own memory. Then, it makes a system call to send the message over the network to B. While this idea seems simple, A and B must agree on what the message means to avoid confusion. For example, if A sends a French novel encoded in IBM's EBCDIC, but B expects an English inventory list in ASCII, the communication will not work well.

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- International Standards Organization (ISO) reference mode:Open Systems Interconnection (OSI) Reference Model (Day and Zimmerman, 1983).
- Protocols that were developed as part of the OSI model were never widely used.
- Underlying model useful for understanding computer networks.
- OSI model is designed to allow open systems to communicate.
- An open system is one that is prepared to communicate with any other open system by using standard rules that govern the format, contents, and meaning of the messages sent and received.
- Rules are formalized into protocols.
- Groups of computers communicate over a network by agreeing on the protocols to be used.

Cont..

- Two general types of protocols:

1. **Connection oriented protocols**

- Before exchanging data the sender and receiver first explicitly establish a connection, and possibly negotiate the protocol to use.
- When done communicating, the connection is terminated.
- e.g. telephone is a connection-oriented communication system.

2. **Connectionless protocols**

- No advance setup.
- The sender transmits the first message when it is ready.
- e.g. Dropping a letter in a mailbox is an example of connectionless communication.

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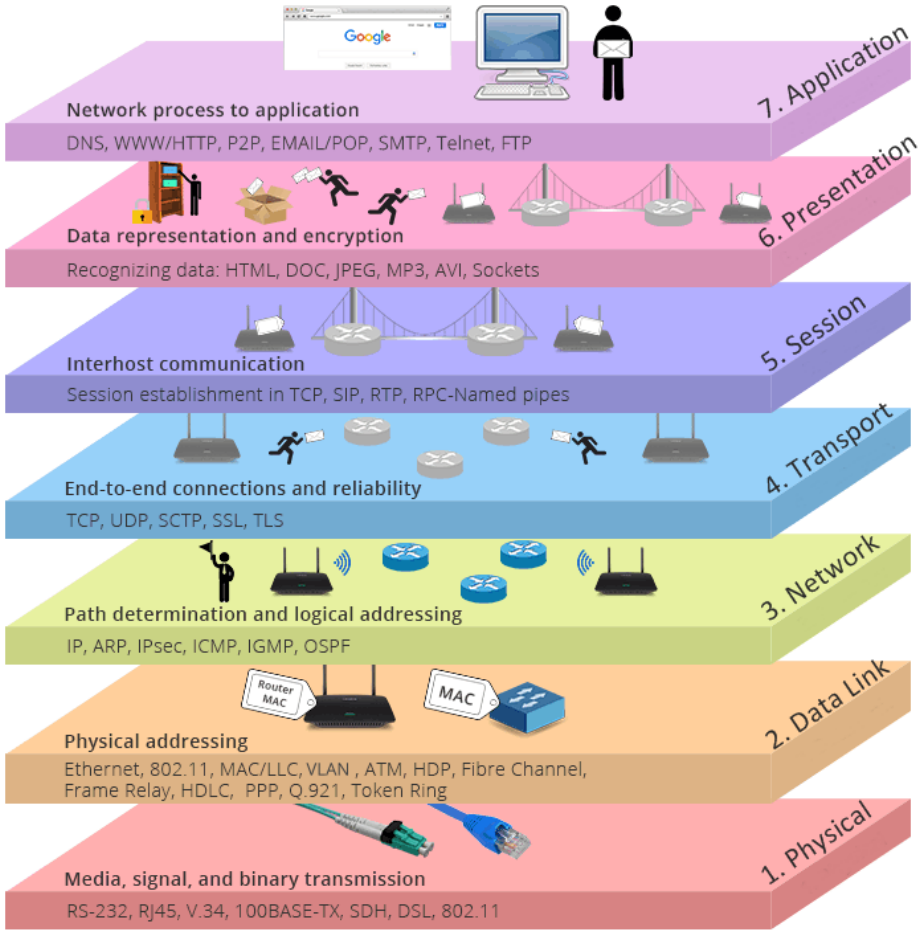
- **The OSI MODEL**
  - Communication is divided up into seven levels or layers.
  - Each layer deals with one specific aspect of the communication.
  - Each layer provides an interface to the one above it.
  - The interface consists of a set of operations that together define the service the layer is prepared to offer its users.

OSI cont..


Google
Network process to application
DNS, WWW/HTTP, P2P, EMAIL/POP, SMTP, Telnet, FTP
7. Application
Data representation and encryption
Recognizing data: HTML, DOC, JPEG, MP3, AVI, Sockets
6. Presentation
Interhost communication
Session establishment in TCP, SIP, RTP, RPC-Named pipes
5. Session
End-to-end connections and reliability
TCP, UDP, SCTP, SSL, TLS
4. Transport
Path determination and logical addressing
IP, ARP, IPsec, ICMP, IGMP, OSPF
3. Network
Router MAC
MAC
Physical addressing
Ethernet, 802.11, MAC/LLC, VLAN , ATM, HDP, Fibre Channel,
Frame Relay, HDLC, PPP, Q.921, Token Ring
2. Data Link
Media, signal, and binary transmission
RS-232, RJ45, V.34, 100BASE-TX, SDH, DSL, 802.11
1. Physical

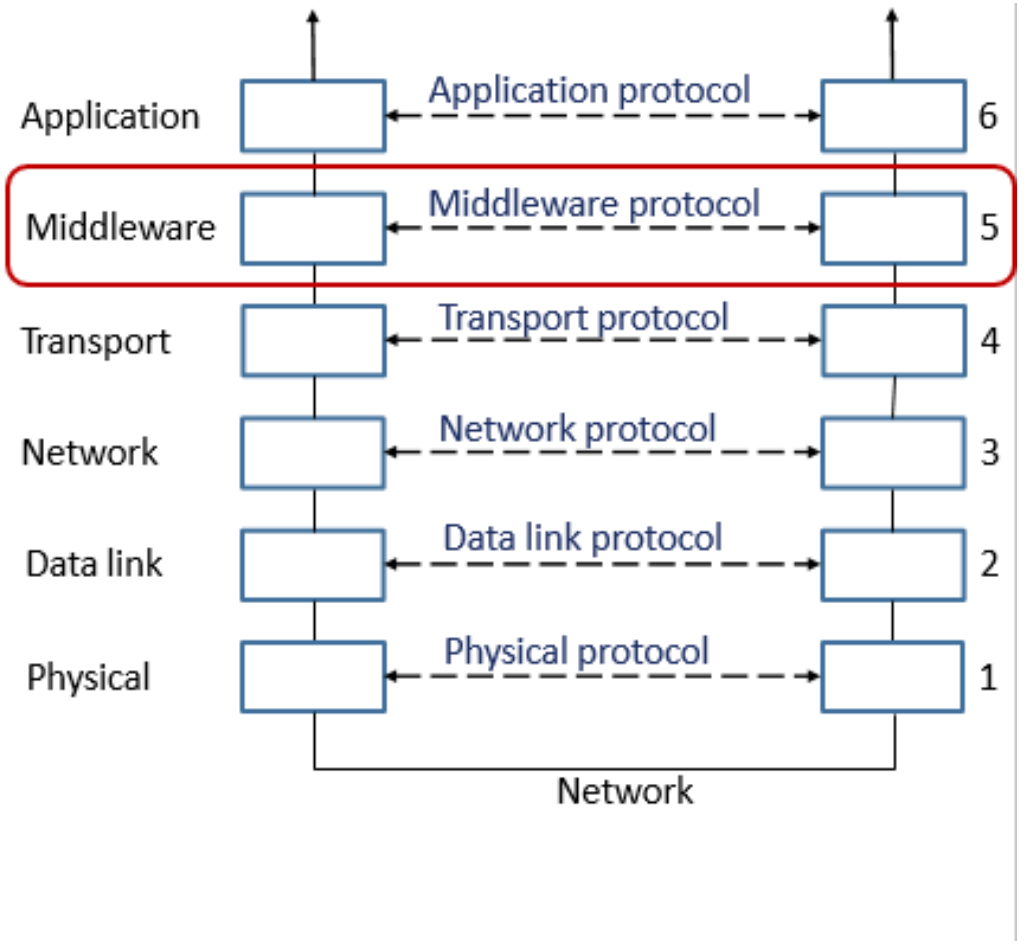
OSI cont..

Layers and activities

OSI Layers	Activities
Application	To allow access to network resources.
Presentation	To translate, compress, and encrypt/decrypt data.
Session	To establish, manage, and terminate session.
Transport	To provide reliable process-to-process message delivery and error recovery.
Network	To move packets from source to destination; To provide internetworking.
Data Link	To organize bits into frames; To provide hop-to-hop delivery.
Physical	To transmit bits over a medium; To provide mechanical and electrical specifications.

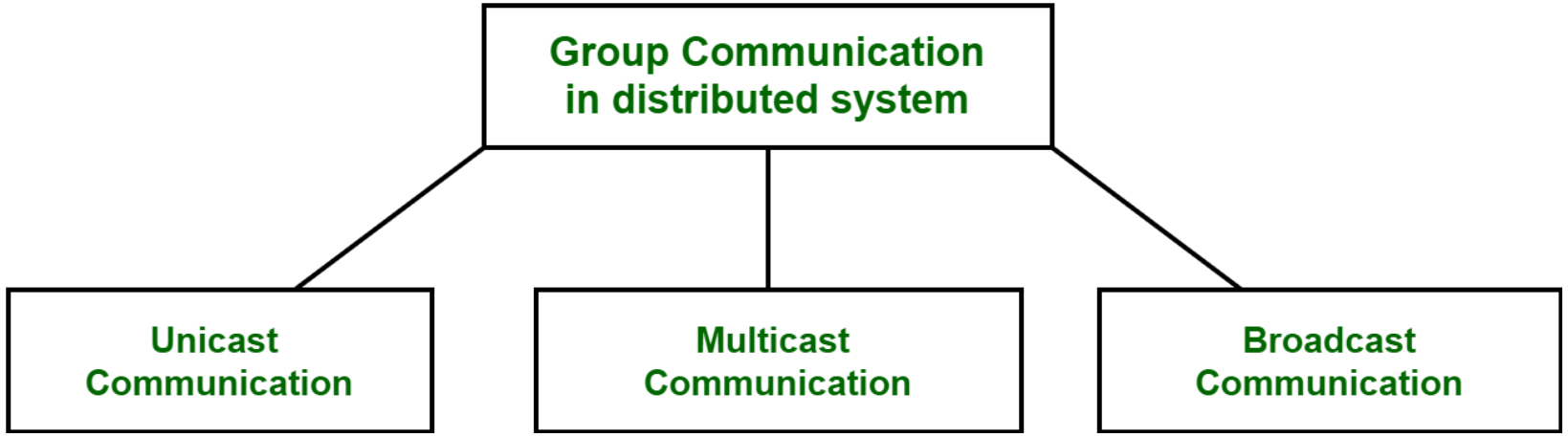
Middleware

- Middleware is an application that logically lives (mostly) in the application layer, but contains many general-purpose protocols that warrant their own layers, independent of other, more specific applications.
- Middleware provides common services and protocols that can be used by many different applications
  - High-level communication services, e.g., RPC, multicasting
  - Security protocols, e.g., authentication protocols, authorization protocols
  - Distributed locking protocols for mutual exclusion
  - Distributed commit protocols



Group Communication in Distributed system

Communication between two processes in a distributed system is required to exchange various data, such as code or a file, between the processes. When one source process tries to communicate with multiple processes at once, it is called **Group Communication**. A group is a collection of interconnected processes with abstraction. This abstraction is to hide the message passing so that the communication looks like a normal procedure call. Group communication also helps the processes from different hosts to work together and perform operations in a synchronized manner, therefore increasing the overall performance of the system.



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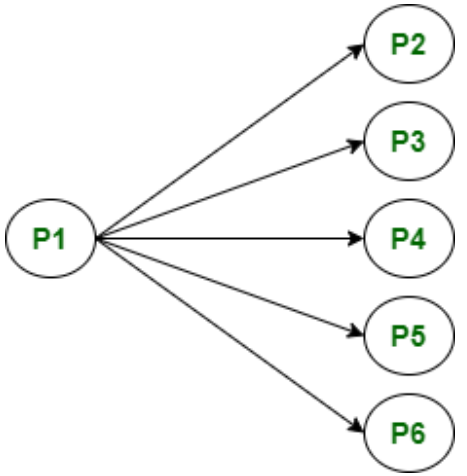
Types of Group Communication in a Distributed System:

Broadcast Communication : When the host process tries to communicate with every process in a distributed system at same time. Broadcast communication comes in handy when a common stream of information is to be delivered to each and every process in most efficient manner possible. Since it does not require any processing whatsoever, communication is very fast in comparison to other modes of communication. However, it does not support a large number of processes and cannot treat a specific process individually.



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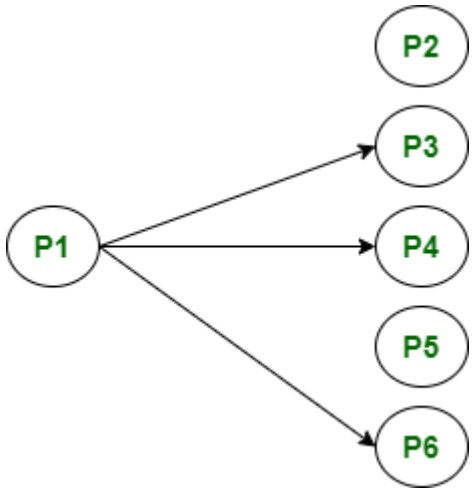
Multicast Communication : When the host process tries to communicate with a designated group of processes in a distributed system at the same time. This technique is mainly used to find a way to address problem of a high workload on host system and redundant information from process in system. Multitasking can significantly decrease time taken for message handling.



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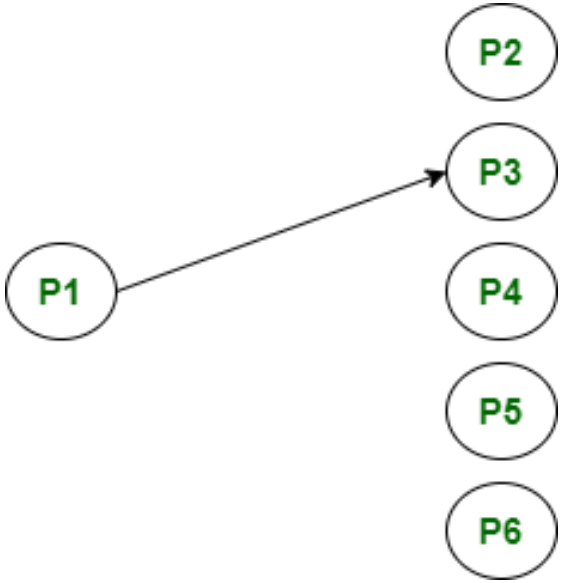
Unicast Communication : When the host process tries to communicate with a single process in a distributed system at the same time. Although, same information may be passed to multiple processes. This works best for two processes communicating as only it has to treat a specific process only. However, it leads to overheads as it has to find exact process and then exchange information/data.



Remote Procedure Call

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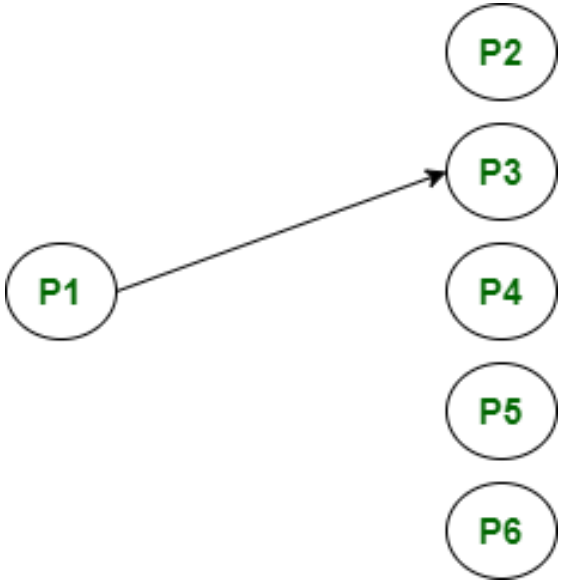

Types of Communication