Chp 15: Network Structures

Background:

* Topology
* Network Types
* Communication
* Communication Protocol
* Robustness
* Design Strategies

Motivation:

* Resource sharing:

  -- sharing and printing files at remote sites
  -- processing information in a distributed database
  -- using remote specialized hardware devices

* Computation speedup: load sharing

* Reliability: detect and recover from site failure, function transfer, reintegrate failed site

* Communication: message passing

Network-Operating Systems:

* Users are aware of multiplicity of machines.
  Access to resources of various machines is done
  explicitly by:

  -- Remote logging into the appropriate remote machine.

  -- Transferring data from remote machines to
     local machines, via the File Transfer Protocol (FTP)
     mechanism.

Distributed-Operating Systems:

* Users not aware of multiplicity of machines. Access to
  remote resources similar to access to local resources.

* Data Migration: transfer data by transferring entire
  file, or transferring only those portions of the file
  necessary for the immediate task.

* Computation Migration: transfer the computation,
  rather than the data, across the system.

Distributed-Operating Systems (Cont.):

* Process Migration: execute an entire process, or parts of it, at different sites.

  -- Load balancing: distribute processes across network to even the workload.

  -- Computation speedup: subprocesses can run concurrently on different sites.

  -- Hardware preference: process execution may require specialized processor.

  -- Software preference: required software may be available at only a particular site.

  -- Data access: run process remotely, rather than transfer all data locally.

Topology:

* Sites in the system can be physically connected in a variety of ways; they are compared with respect to the following criteria:

  -- Basic cost: How expensive is it to link the various sites in the system?

  -- Communication cost: How long does it take to send a message from site A to site B?

  -- Reliability: If a link or a site in the system fails, can the remaining sites still communicate with each other?

* The various topologies are depicted as graphs whose nodes correspond to sites. An edge from node A to node B corresponds to a direct connection between the two sites.

* The following six items depict various network topologies.

Network Types:

* Local-Area Network (LAN): designed to cover small geographical area.

  -- Multiaccess bus, ring, or star network.

  -- Speed H 10 megabits/ second, or higher.

  -- Broadcast is fast and cheap.

  -- Nodes:

    o usually workstations and/or personal computers

    o a few (usually one or two) mainframes.

Network Types (Cont.):

* Wide-Area Network (WAN) links geographically separated sites.

  -- Point-to-point connections over long- haul lines (often leased from a phone company).

  -- Speed about 100 kilobits/second.

  -- Broadcast usually requires multiple messages.

  -- Nodes:

     o usually a high percentage of mainframes

Communication:

The design of a communication network must address four basi issues:

* Naming and name resolution : How do two processes locate each other to communicate?

* Routing strategies . How are messages sent through the network?

* Connection strategies . How do two processes send a sequence of messages?

* Contention: The network is a shared resource, so how do we resolve conflicting demands for its use?

Naming and Name Resolution:

* Name systems in the network

* Address messages with the process- id.

* Identify processes on remote systems by

    <host-name, identifier> pair.

* Domain name service (DNS) specifies the naming structure of the hosts, as well as name to address resolution (Internet).

Routing Strategies:

* Fixed routing: A path from A to B is specified in advance; path changes only if a hardware failure disables it.

  -- Since the shortest path is usually chosen, communication costs are minimized.

  -- Fixed routing cannot adapt to load changes.

  -- Ensures that messages will be delivered in the order in which they were sent.

* Virtual circuit: A path from A to B is fixed for the duration of one session. Different sessions involving messages from A to B may have different paths.

  -- Partial remedy to adapting to load changes.

  -- Ensures that messages will be delivered in the order in which they were sent.

Routing Strategies (Cont.):

* Dynamic routing: The path used to send a message form site A to site B is chosen only when a message is sent.

  -- Usually a site sends a message to another site on the link least used at that particular time.

  -- Adapts to load changes by avoiding routing messages on heavily used path.

  -- Messages may arrive out of order. This problem can be remedied by appending a sequence number to each message.