Distributed Systems

COMP90015 2018 Semester 1
Tutorial 07

Today’s Agenda

- Questions of Indirect Communication

Define indirect communication and its characteristics

Define indirect communication and its characteristics

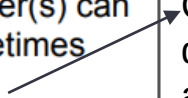
- *Indirect communication* is defined as communication between entities in a distributed system through an intermediary with no direct coupling between the sender and the receiver(s).

- Time uncoupling: a sender can send a message even if the receiver is still not available. The message is stored and picked up at a later moment.
  - Senders and receivers can have independent lifetimes

- Space uncoupling: a sender does not know, or need to know the receiver and vice versa.
  - No receiver, one receiver, or several receivers, a group
  - Participants can be replaced, updated, replicated, or migrated

Time and space coupling

	Time-coupled	Time-uncoupled
Space coupling	Communication directed to a given receiver(s) that must be available at the time *e.g. Messaging passing, RPC*	Sender(s) and receiver(s) can have independent lifetimes *e.g. Mailbox*
Space uncoupling	Sender does not need to know ID of receiver but they must exist at the same time *e.g. IP multicast*	Sender does not need to know ID of receiver; sender(s) and receiver(s) can have independent lifetimes *e.g. Message oriented*



Communication directed towards a given receiver or receivers

What are the advantages and disadvantages of indirect communication?

What are the advantages and disadvantages of indirect communication?

- It can handle scenarios where users connect and disconnect very often
  - Mobile environments, messaging services, forums
  - Runtime changes are anticipated
- Excel at event dissemination where receivers may be unknown and change often
  - RSS, events feeds in financial services
- Great scalability in handling a very large number of participants
  - Google Ads system, Spotify

What are the advantages and disadvantages of indirect communication?

- Performance overhead introduced by adding a level of indirection
  - Reliable message delivery, ordering
  - Dynamic changes are anticipated
- Hard to manage system behavior due to the lack of direct coupling
  - Hard to debug
- Difficult to achieve end-to-end properties
  - Real time behavior
  - Security

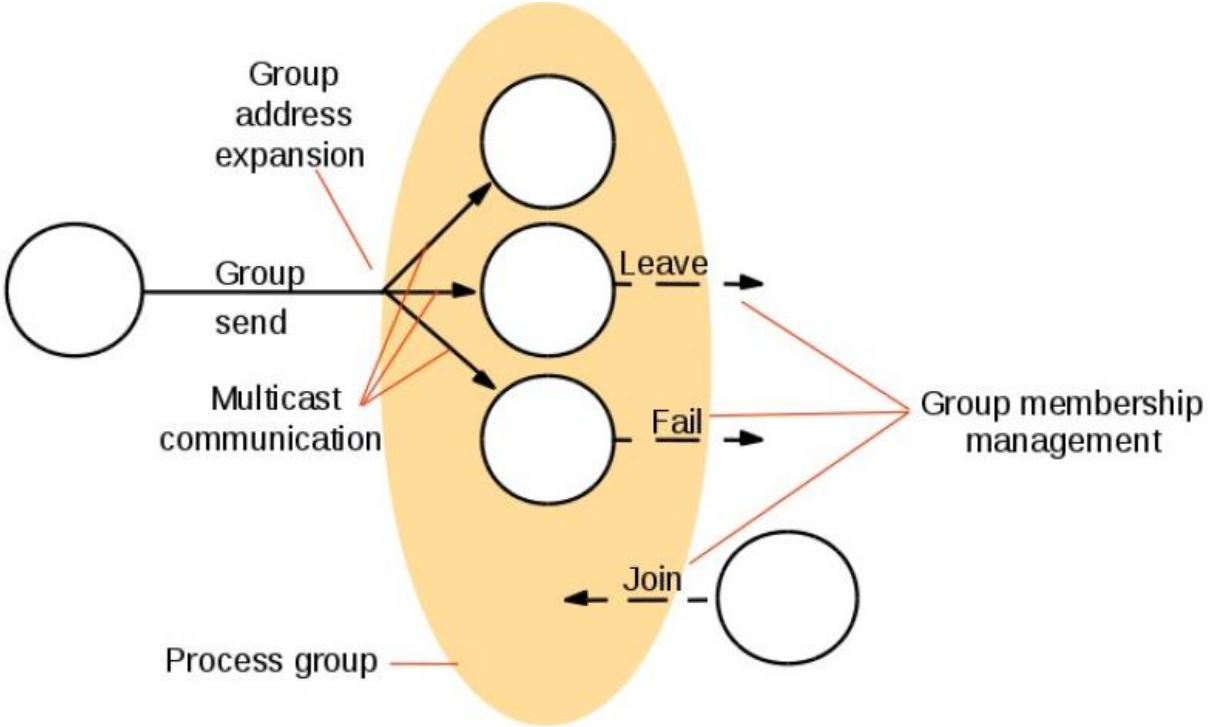
Describe the group communication paradigm and explain two of its defining characteristics

Describe the group communication paradigm and explain two of its defining characteristics

- Group communication offers a space uncoupled service whereby a message is sent to a group and then this message is delivered to all members of the group.

- Characteristics
  - Sender is not aware of the identities of the receivers
  - Represents an abstraction over multicast communication

Describe the group communication paradigm and explain two of its defining characteristics

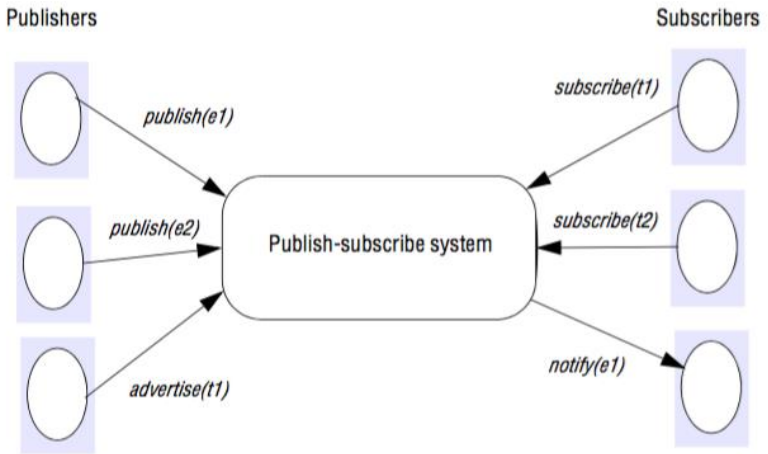


Describe the Publisher/Subscriber paradigm and explain two of its defining characteristics.

Describe the Publisher/Subscriber paradigm and explain two of its defining characteristics.

- A large number of producers (*publishers*) distribute information through *events* to consumers (*subscribers*)
- Publishers generate events containing information
- Subscribers express interest in one or more types of events and are notified when theses events occur
- Publishers and subscribers are loosely coupled

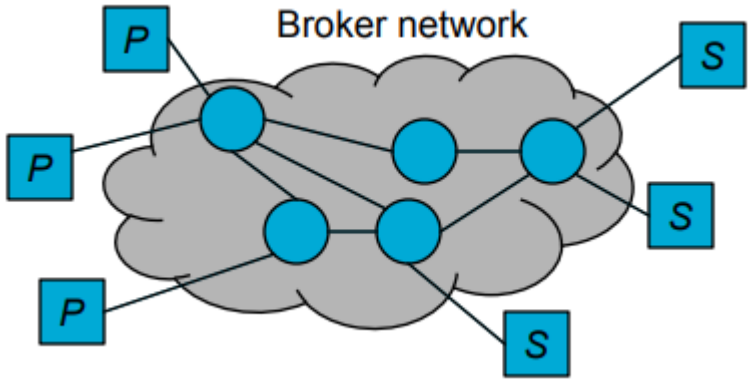
- Characteristics
  - Heterogeneity (heterogeneous components that were not designed to interoperate can work together)
  - Asynchronicity (Notifications are sent asynchronously)



What are the implementation variations of the Publish/Subscribe paradigm?

What are the implementation variations of the Publisher/Subscriber paradigm?

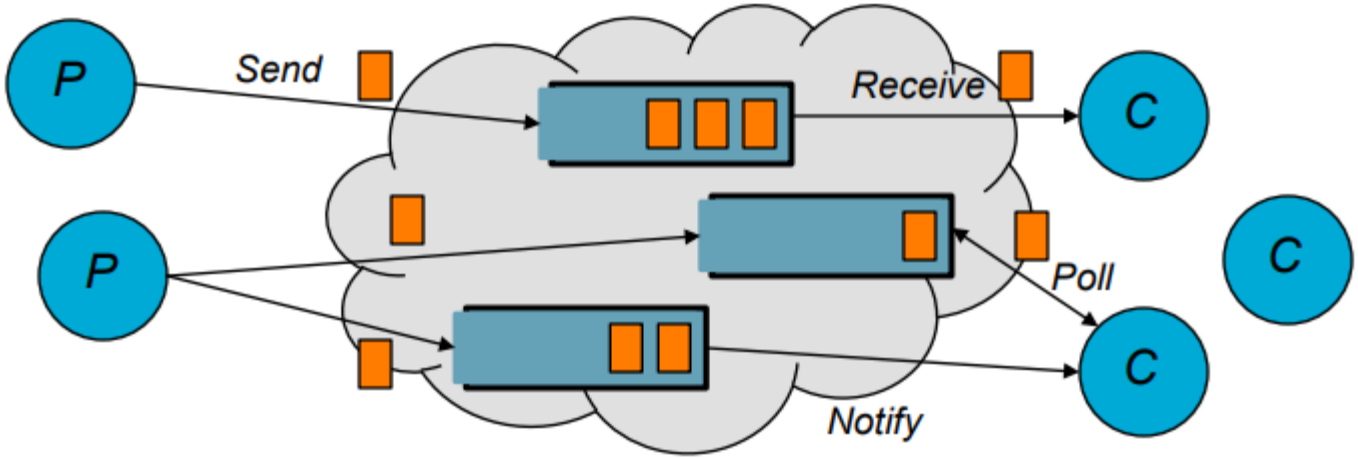
- Channel Based
- Type Based
- Topic Based
- Content Based
- Centralized/distributed
  - Centralized event broker
  - Network of brokers
  - Full P2P – not distinction between publishers and subscribers, i.e., everyone is a broker



Define distributed message queues and explain its receive styles

Define distributed message queues and explain its receive styles

- Point-to-point comm. through an intermediary queue
  - Senders place msgs into a queue, receivers removed them
  - Queues correspond to buffers at communication servers
  - E.g., IBM WebSphere MQ, Java Messaging Service, Oracle's Stream Advanced Queuing



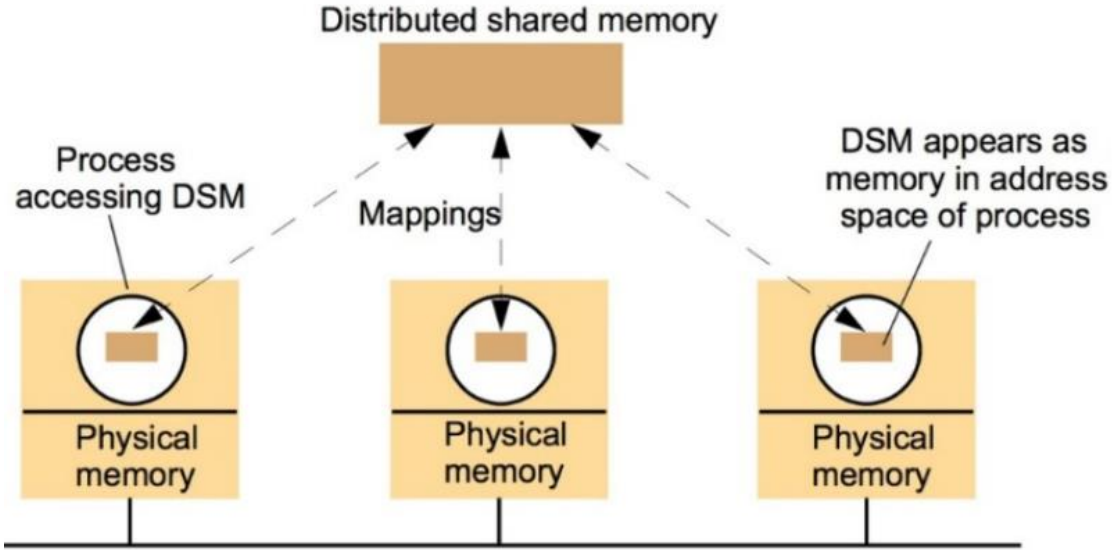
Define distributed message queues and explain its receive styles

- Blocking
  - A consumer waits for at least one message on a queue then returns
  - Block until an appropriate message is available
- Non-blocking
  - or poll, a consumer will check and get a message if there, otherwise it returns without a message
- Notify
  - an event is generated at the receiver when a message is available

Define shared memory and describe its architecture

Define shared memory and describe its architecture

- Distributed shared memory is an abstraction for sharing data between computers that do not share physical memory. Processes access DSM by reads and updates to what appears to be ordinary memory within their address space.



Summary

- The power of indirection in communication – communication through an intermediary
  - Uncoupling in space and/or time

	Group	Pub/sub	MQ	DSM	Tuples
Space uncoupled	Yes	Yes	Yes	Yes	Yes
Time uncoupled	Possible	Possible	Yes	Yes	Yes
Style	Comm	Comm	Comm	State	State
Comm pattern	1-m	1-m	1-1	1-m	1-1/1-m
Scalability	Limited	Possible	Possible	Limited	Limited
Associative	No	Content-based only	No	No	Yes