Group Communication

- Point-to-point *vs.* one-to-many
- Multicast communication
- Atomic multicast
- Virtual synchrony
- Group management
- ISIS

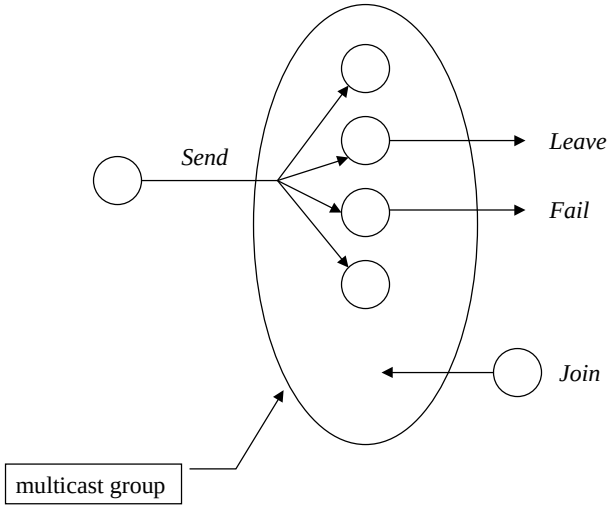
Reading:

- *Coulouris: Distributed Systems, Addison Wesley, Chapter 4.4, Chapter 11*

Group Communication: Introduction

- One-to-many communication
- Dynamic membership
- Groups can have various communication patterns
  - peer group
  - server group
  - client-server group
  - subscription (diffusion) group
  - hierarchical groups

Group Membership Management



Multicast Communication

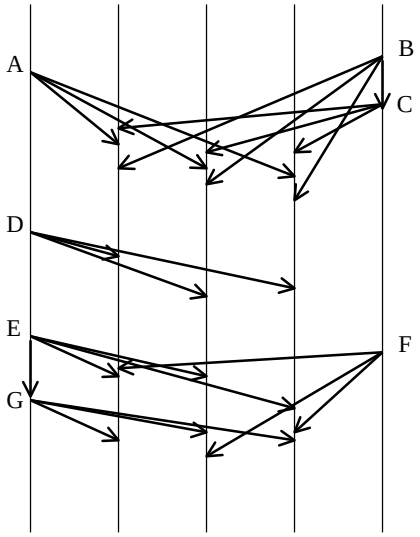
- Reliablity guarantees:
  - *Unreliable* multicast: Attempt is made to transmit the message to all members without acknowledgement.
  - (*Reliable* multicast: Message may be delivered to some but not all group members.)
  - *Atomic* multicast: All members of the group receive message, or none of them do.

- Message **reception**: message has been received and buffered in the receiver machine. Not yet delivered to the application.
- Message **delivery**: The previously received message is delivered to the application.

Multicast Communication: Message Ordering

- *Globally (chronologically) ordered* multicast: All members are delivered messages in order they were sent.
- *Totally (consistently) ordered* multicast: Either m_1 is delivered before m_2 to all members, or m_2 is delivered before m_1 to all members.
- *Causally ordered* multicast: If the multicast of m_1 *happened-before* the multicast of m_2, then m_1 is delivered before m_2 to all members.
- *Sync-ordered* multicast: If m_1 is sent with sync-ordered multicast primitive, and m_2 is sent with *any ordered* multicast primitive, then either m_1 is delivered before m_2 at all members, or m_2 is delivered before m_1 at all members.
- *Unordered* multicast: no particular order is required on how messages are delivered.

Message Ordering: Examples



Atomic Multicast

- Simple multicast algorithm: Send a message to every process in the multicast group, using reliable message passing mechanism (e.g. TCP).
  - Is not atomic: does not handle processor failures.
- "Fix" to simple multicast algorithm: Use 2-phase-commit (2PC) technique and treat multicast as transaction.
  - Works, but correctness guarantees stronger than necessary
  - 1. If sending process *s* fails to obtain ack from process *p*, *s* must abort delivery of message.
  - 2. If *s* fails after delivering *m* to all processors, but before sending "commit" message, delivery of *m* is blocked until *s* recovers.
- 2PC protocol does more work than is really necessary.

2-Phase-Commit Protocol

- Protocol for atomic commit.