Script **generated by TTT**

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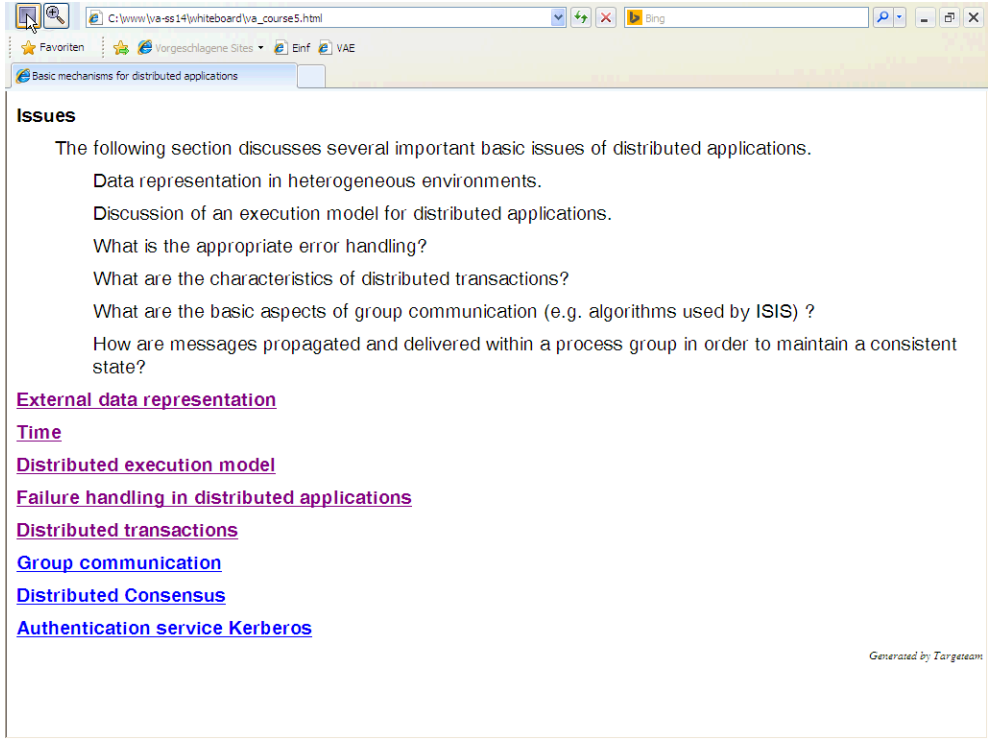

Group communication

Introduction

Group communication facilitates the interaction between groups of processes.

- Motivation
- Important issues
- Conventional approaches

Groups of components

Management of groups

Message dissemination

Message delivery

Taxonomy of multicast

Group communication in ISIS

JGroups

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Motivation

Many application areas such as CSCW profit immensely if primitives for a group communication are supported properly.

typical application for group communication

- fault tolerance using replicated services, e.g. a fault-tolerant file service.
- object localization in distributed systems; request to a group of potential object servers.
- conferencing systems and groupware.

functional components (e.g. processes) are composed to a group; a group is considered as a single abstraction.

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Important issues

Important issues of group communication are the following:

Group membership : the structural characteristics of the group; composition and management of the group.

Support of group communication : the support refers to group member addressing, error handling for members which are unreachable, and the message delivery sequence.

Communication within the group

unicasting, broadcasting, multicasting

Multicast messages are a useful tool for constructing distributed systems with the following characteristics

fault tolerance based on replicated services.

locating objects in distributed services.

multiple update of distributed, replicated data.

Synchronization

the sequence of actions performed by each group member must be consistent.

Conventional approaches

Group addressing

Central approach: There is a central group server which knows the current state of the group composition.

Decentralized approach: Each group member is aware of the group structure and its members.

Communication services

This issue refers to the technology used for the communication between group members.

Datagrams (for example UDP).

reliable data stream (for example TCP).

In order to get a consistent global group behavior, even in case of errors, a special group communication support is needed, for example ISIS (and the succeeding project Horus) by Cornell University.

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Message dissemination

For message dissemination to the group members the following mechanisms are possible options:

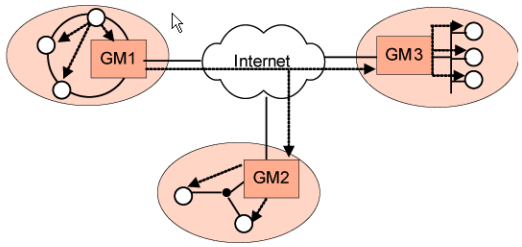
Unicast: send and receive messages addressed to individual group members.

Group multicast: send and receive messages addressed to the group as a whole.

Inter-group multicast: send and receive messages addressed to several groups.

Broadcast: send and receive messages addressed to all components (requires filtering).

Hybrid approach for wide-area networks



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Atomicity

Atomicity specifies ***who*** receives a message.

in the absence of errors, we have the "exactly-once" semantics, i.e. messages to the group are delivered exactly once to all group members.

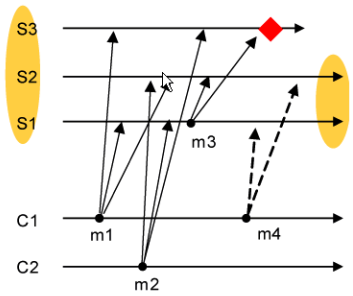
"all-or-nothing" semantics for messages to the group ("atomic broadcast"), i.e. a message is either delivered ***to all group members or to none*** .

atomicity facilitates distributed application programming.

Sequence of message delivery

It is desired to deliver all messages sent to the group G to all group members of G in the ***same sequence*** , because otherwise we might get non-deterministic system behavior.

Example for group reconfiguration



m4 is sent by C1 before the group composition is modified. However, in order to guarantee atomicity, m4 should not be delivered to S1 and S2 (since, due to the crash, it is no longer possible to deliver m4 to S3).

Message delivery

Message delivery is an important issue of group communication; two aspects are relevant:

a) ***who*** gets the message, and

b) ***when*** is the message delivered.

Atomicity

Sequence of message delivery

Ordering for message delivery