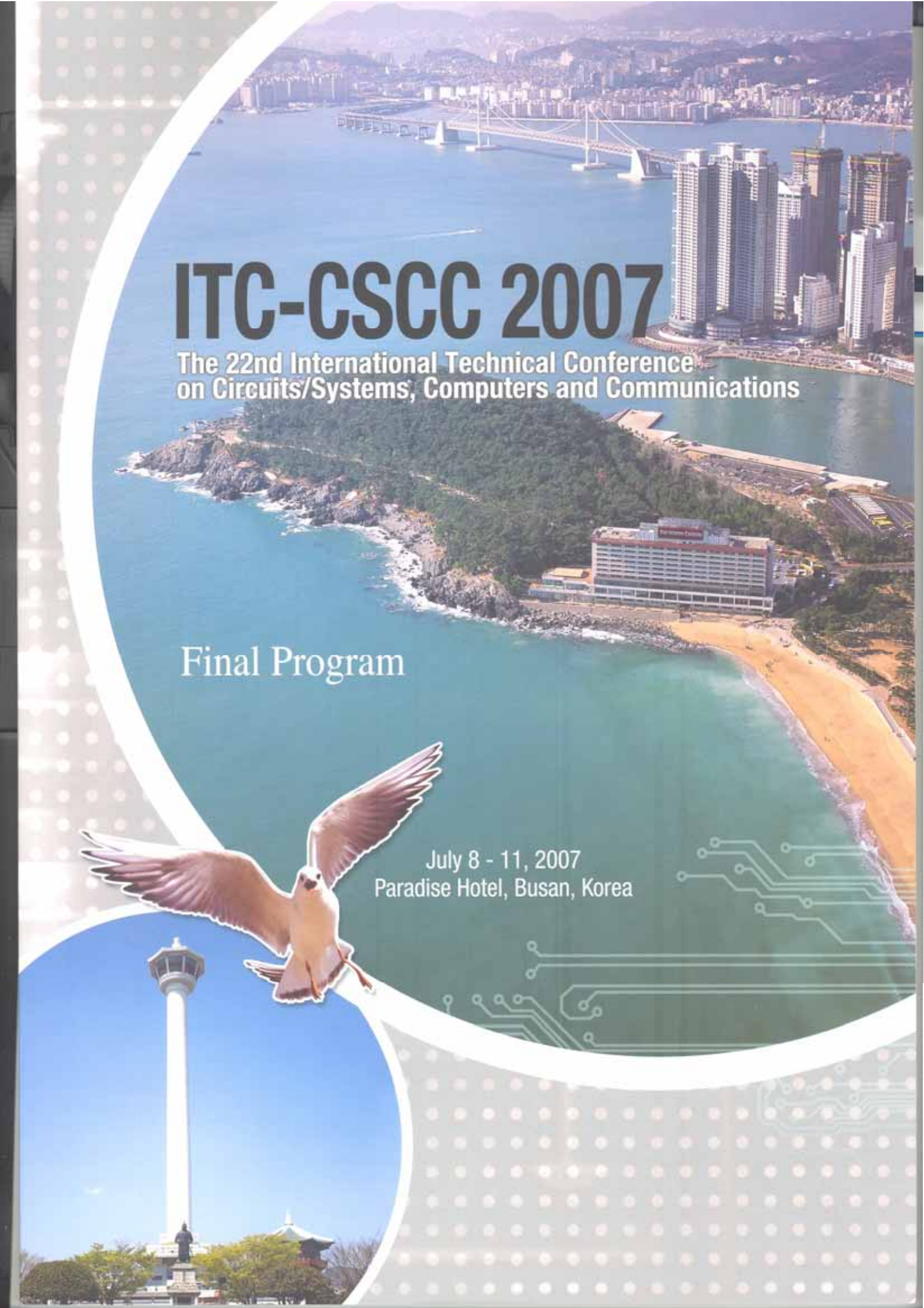

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MMCP: A Control Protocol for IP Multicasting in Mobile Networks

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Abstract: This paper proposes a control protocol for IP multicasting in mobile networks, named Mobile Multicast Control Protocol (MMCP). The MMCP is designed to support one-to-many real-time multicast applications running over multicast-capable mobile/wireless networks. This paper dscribes the protocol model, protocol operations and implementation structures of the MMCP.

1. Introduction

The Mobile Multicast Control Protocol (MMCP) is based on the Mobile Multicast Communications Framework (MMCF) [1]. MMCP designed to support one-to-many multicast applications running over multicast-capable networks. MMCP operates over IPv4/IPv6 networks that have the IP multicast forwarding capability with the help of IGMP and IP multicast routing protocols. We will describe the design and implementation for MMCP [2]. The MMCP protocol will be used to support mobile IPTV applications. Some related works can be seen in the 3GPP/MBMS [3] and 3GPP2/BCMCS [4].

This paper is organized as follows. In Section 2, the protocol overview of the MMCP is presented. Section 3 describes the implementation details of MMCP. Finally, Section 4 concludes this paper.

2. Protocol Overview

2.1 Protocol Model

Figure 1 shows the protocol model of MMCP.

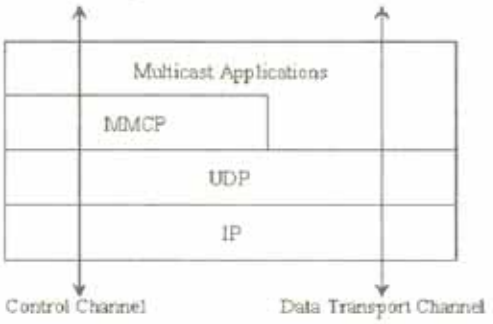

Figure 1. MMCP Protocol Model

The MMCP is a control protocol that can be used with the existing multicast applications. Multicast application will run over UDP/IP multicasting, whereas the MMCP control channel uses UDP/IP unicasting and provides APIs for multicast applications.

Figure 2 shows the entities associated with control functionality of MMCP. In the figure, it is assumed that a Multicast Contents Server (MCS) transmits multicast data to many Mobile Nodes (MNs) using the legacy UDP/IP multicasting. For the control purpose of the multicast data transport, a MMCP session is established between a Session Manager (SM) and MNs, possibly with one or more Local Mobility Controllers (LMCs) between SM and MNs. The SM is used to perform the overall control operations for the MMCP session, and it shall be interworking with MCS. The LMC is used to locally control a part of MNs participating in the session, which is for scalability enhancement of the MMCP operations. Each MN represents a receiving user for mobile multicast applications.

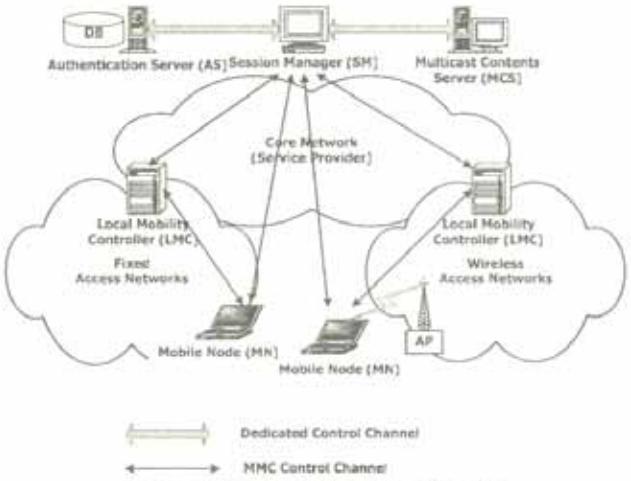

Figure 2. Functional Entities of MMCP

2.2 Protocol Operations

The MMCP operations are divided into the three phases: Session Management, Status Monitoring, and Handover Support Management.

1) Session Management
   A MN will join the session by contacting with the SM and LMC. For this purpose, a certain Authentication Server (AS) may be used to authenticate and authorize the users and services. The MCS will start the multicast data transmission toward the MNs who have joined the MMCP session. The MN will leave the session by contacting with the LMC.
2) Status Monitoring
   The SM will gather the information on active membership and Quality of Services (QoS) of MNs who are participating in the MMCP session. For this purpose, two operations are performed: status report and status probe. In the status report operation, a set of periodic messages on status information will be exchanged between SM and MNs. To alleviate the processing overhead of the SM, one or more LMCs may be used, which will locally control a part of MNs in the MMCP session. The LMCs deliver aggregated information of MNs to SM. If the status report is not working appropriately, the status probe operations will be performed. When an MN leave the session, an LMC will report information of the leaving MN to SM.
3) Handover Support Operation

When a MN moves into a new network region during the session, the handover support operations are performed between LMC and MNs in the horizontal handover and between SM and MNs in the vertical handover to support the seamless handover for the multicast session.

3. Protocol Implementations

3.1 Implementation Structures

Figure 3 shows an abstract overview of the MMCP implementation structure.

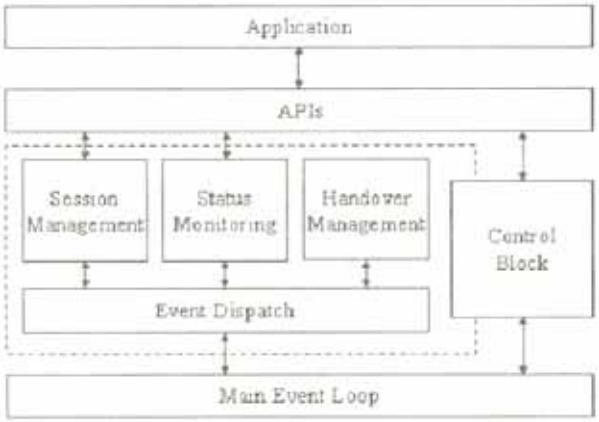

Figure 3. Implementation Structure of MMCP

The MMCP implementation includes the four sub-modules:

1) MMCP APIs,
   This module is used by the upper layer applications.
2) Event Loop (handler),
   This module is used to process the protocol events.
3) MMCP Protocol Core,
   This module is further classified into session management, status monitoring, handover support management and event dispatch. The management part is used for the MMCP operations. The event dispatch part is used for event processing between management part and event handler.
4) Control Block.
   This module is used to handle the internal protocol information and timers.

3.2 Internal Functions

- mmcp_join_confirm,
- mmcp_local_join_request,
- mmcp_local_join_confirm,
- mmcp_leave_confirm,
- mmcp_status_report,
- mmcp_status_probe,
- mmcp_handover_request,
- mmcp_handover_transfer,
- mmcp_handover_confirm.

The internal join functions are used to join session. The internal local join funtions are used to join the processing between MN and LMC. The internal leave function is used to leave session. The internal status functions are used for status monitoring. The internal handover functions are used for handover operations.

3.3 APIs Functions

- mmcp_socket,
- mmcp_create,
- mmcp_join_request,
- mmcp_leave_request,
- mmcp_status_monitor,
- mmcp_setsockopt,
- mmcp_getsockopt.

When an MMCP session starts, the entities use the mmcp_socket function. The *mmcp_create* function creates protocol control block and *inits* parameter. When a MN will join a session, the MN uses the *mmcp_join_request* function. The *mmcp_leave_requst* function is used for session leave. When a SM looks at status information, the SM uses the *mmcp_status_monitor* function. The *mmcp_setsockopt* function sets optional variables of MMCP. The *mmcp_getsockopt* function gets optional variables of MMCP.

3.4 Packets

Each MMCP packet contains a 12-byte common header and the message body parts. For MMCP, the following 15 packets are used.

Table 1. Packets used in the MMCP

Full Name	Acronym	Encoding Value	From	TO
Session Join Request	SJR	0000 0001	MN	SM
Session Join Confrim	SJC	0000 0010	SM	MN
Local Join Request	LJR	0000 0011	MN	LMC
Local Join Confirm	LJC	0000 0100	LMC	MN
User Leave Request	ULR	0000 0101	MN	LMC
User Leave Confirm	ULC	0000 0110	LMC	MN
User Status Report	USR	0000 0111	MN	LMC or SM
Aggregation Status Report	ASR	0000 1000	LMC	SM
Status Report ACK	SRA	0000 1001	LMC	MN
			SM	LMC or MN
User Status Probe	USP	0000 1010	LMC	MN
			SM	LMC or MN
Handover Initiation Request	HIR	0000 1011	MN	LMC or SM
Handover Initiation Progress	HIP	0000 1100	LMC	MN
Handover Context Transfer	HCT	0000 1101	Old LMC	New LMC
Handover Transfer ACK	HTA	0000 1110	New LMC	Old LMC
Handover Initiation Confirm	HIC	0000 1111	LMC or SM	MN

4. Conclusion

This paper describes the design and implementation of the MMCP. It discusses the issues on implementation over Linux environment. The MMCP is designed such that it can easily be integrated with legacy multicast applications through separation the MMCP control channel from the multicast data channel. It is expected that the MMCP protocol can be used for supporting real-time mobile multicast applications. In the future, some more implementation and experimental test works wil be done based on the design and implementation of the MMCP describe in this paper.

Acknowledgement

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