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Her, Yong-Sork  
Kyushu University

Sakurai, Kouichi  
Kyushu University

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# The Secure Electronic Voting System for Absentee

Yong-Sork Her, Kouichi SAKURAI

Kyushu University

## Abstract

In this paper, we propose the absentee e-voting system based on security, completeness and verifiability. We use  $r$ -th residue cryptography for homomorphic encryption, ZKIP (Zero-Knowledge interactive proofs), RSA algorithm for the secure absentee e-voting.

## 1. Introduction

The absentee voting plays the important percentage in the existing voting system. But, the absentee vote can not look forward to the security because of transmit by mail. The absentee does not know whether one's voting is exactly counted or not.

## 2. The proposal e-voting system for absentee

Our proposal e-voting system for absentee consists of four parts. Fig.1 shows the structure of e-voting system. This system consists of five parts that is Absentee, Absentee system, Voting system, Bulletin Board and Election office.



<Fig.1> Overview of e-voting system

### 2.1 Absentee system

Absentee system has a list of legitimated absentee voters and plays the role of the determination whether the ballot is valid or not and can verify the unresuability. The roles of Absentee system are as follow.

- Decrypt the message of absentee voter
- Verify the absentee voter
- Cast a mark 'verified' on the bulletin board
- Received the notification of invalid vote from Election office
- Send the received results of absentee voting to VS

### 2.2 Voting system

Voting system verifies the received voting result from absentee system and announces the voting results.

## 3. Voting Procedure

Register an absentee  $V_i$  in Election office.

Receive the VS's public key  $\langle N_2, \gamma \rangle$

Receive the AS's public key  $\langle e_{ci}, N_1 \rangle$

Choose absentee  $V_i$  vote :  $m_i$ , 1 for yes-vote and 0 for no-vote

Encrypt  $m_i$  with the public key  $(N_2, \gamma)$  of VS

$$Z_i = \gamma^{m_i} x^r \text{ mod } N_2$$

Encrypt  $Z_i$  with the public key  $(e_{ci}, N_1)$  of AS

$$C_i = Z_i^{e_{ci}} \text{ mod } N_1$$

Make absentee voter's ID ( $ID_i$ ) and absentee voter's message ( $MSG_i$ ), containing absentee's name and date of voting

Sign with absentee's secret key.

Send  $ID_i, C_i (MSG_i)^{e_i} \text{ mod } N$  to AS

Decrypt  $ID_i, C_i (MSG_i)^{e_i} \text{ mod } N$  with absentee's public key

Decrypt  $C_i$  with AS's security key

Cast a mark 'Verified' on the bulletin board

Notify invalid vote (absentee died or lost the voting right) from Election office

Compute  $Z_c = Z_i - Z'_i$  ( $Z_i$  is valid ballot,  $Z'_i$  is invalid ballot)

( $1 \leq i \leq h$ , The valid ballots are  $1 \leq i \leq n$  and the invalid ballots are  $n+1 \leq i \leq h$ );  $Z_c = Z_i - Z'_i$

$$= \sum_{i=1}^n Z_i \text{ mod } N_2 - \sum_{i=n+1}^h Z'_i \text{ mod } N_2$$

Make  $ID_{ci}, Z_c (MSG_{ci})^{d_{ci}} \text{ mod } N_1$  using AS's secret key

Send  $ID_{ci}, Z_c (MSG_{ci})^{d_{ci}} \text{ mod } N_1$  to VS

Decrypt  $ID_{ci}, Z_c (MSG_{ci})^{d_{ci}} \text{ mod } N_1$  with AS's public key

Verify  $Z_c$  and determine the voting result

## 4. Conclusions

We proposed the absentee e-voting system and considered the absentee died or loss the right of casting the ballot in Election Day. Also, we kept the privacy, completeness, verifiability of absentee.

The election law is different by each country. So, it needs e-voting suitable to the election law in order to realize of e-voting.

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