

Smart Agricultural Framework over RCAS in CATV network

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Abstract— This paper proposed smart agricultural framework over RCAS in CATV network. The proposed framework adopts RCAS, which is a security system which is dedicated to cable television system, as a data protection system, and cable two-way broadband network as a communication channels among smart agricultural service participants.

Keywords— Smart agricultural framework, RCAS, CATV network

I. INTRODUCTION

Smart agricultural is a convergence technology applying ICT to agricultural production, distribution, sales, and consuming for improving productivity, food safety, quality, and economic feasibility. Smart agricultural framework consists of the four players, who are agricultural producer, distributor, service provider, and consumer, and they have own roles in the cycle of smart agricultural.

Broadband communication network is essential to smart agricultural framework since many smart agricultural relevant data should be delivered among the participants of smart agricultural services. From this sense, cable broadband network could be a great candidate as a communication network for a smart agricultural framework. Furthermore, cable television network probably has more benefits compared to other communication networks since it can provide not only broadband communication network, but also broadcasting network.

One issue that should be seriously considered is security issue of data when they are delivered through the cable network. Smart agricultural framework delivers many private data such as video surveillance information, purchase information, plant growth environment information, and processed plant growth information, etc. This information should be protected using a proper method.

Conditional access system (CAS) [1] could be one of solutions for protecting private data in smart agricultural framework, but it is not good choice since CAS is a much closed proprietary system as well as utilizing CAS to another purpose could cause unexpected security vulnerability.

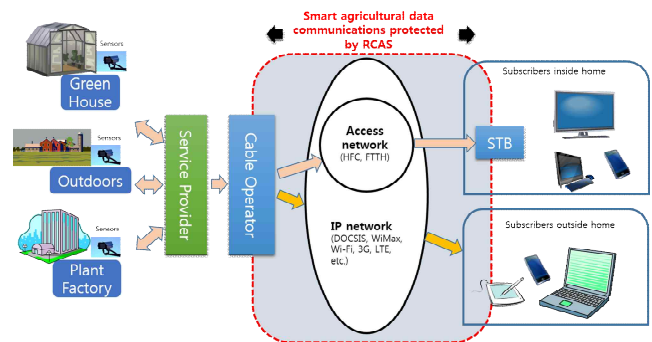


Figure 1. Architecture of smart agricultural framework over RCAS in CATV network

Another option for protecting communication data in smart agricultural framework is utilizing renewable conditional access system (RCAS) [2-4] as shown in Figure 1. RCAS is very open and standardized security system in ITU-T SG9. ITU-T SG9 has been developing the family Recommendations concerning RCAS since 2009. The Recommendation numbers for them are J.1001 [2], J.1002 [3], and J.1003 [4]. J.1001 is a Recommendation for the requirements of RCAS. It contains architectural, functional, and security requirement of RCAS. J.1002 is a Recommendation for the RCAS pairing specification, and J.1003, which would be J.1003, is a Recommendation for the RCAS network specification.

RCAS is briefly introduced in section II, and the proposed smart agricultural framework over RCAS in CATV network is in section III. Finally, the conclusion is followed.

II. RENEWABLE CONDITIONAL ACCESS SYSTEM

The RCAS is a new paradigm technology for renewing conditional access (CA) client software by securely downloading the new version of software through the digital cable two-way environment. The benefit of RCAS is that no additional budget is required for issuing a new security hardware module when the multiple systems operator (MSO) wants to upgrade the old CA client software to a new one.

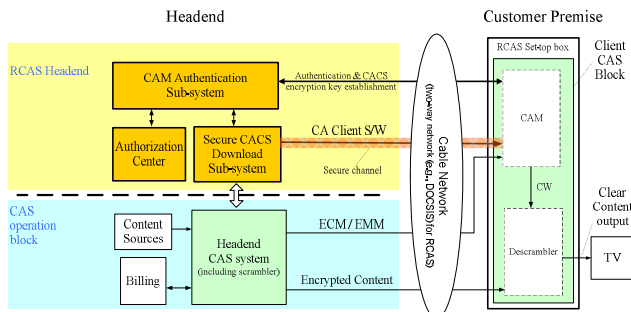


Figure 2. Reference architecture of RCAS

As shown in Figure 2, the RCAS consists of RCAS headend, and RCAS STB at the customer premises. The authorization center (AC) issues identification information to the CAM and descrambler and authenticates them. The MSO headend establishes a CACS encryption key with the CAM and sends encrypted CACS to the CAM. Finally, the RCAS STB, which is a two-way (e.g., DOCSIS [5]) digital cable set-top box, downloads the CACS in the memory of the CAM, and descrambles the encrypted video streams at the descrambler. Here, 'CAM' has a role to request CACS to a head-end, and update the old conditional access client software into a new one.

RCAS headend could be categorized into three parts such as 'CAM Authentication Sub-system', 'Secure CACS Download Sub-system', and 'Authorization Center'. The 'CAM Authentication Sub-system' issues unique identification information to each CAMs, and authenticates a CAM if it requests a new conditional access client software. The 'Secure CACS Download Sub-system' establishes secure channel between itself and CAM. Then it downloads conditional access software to CAM after 'CAM Authentication Sub-system' authenticates the CAM.

III. PROPOSED SMART AGRICULTURAL FRAMEWORK OVER RCAS IN CATV NETWORK

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A. Conceptual Relationship among the Participants of Smart Agricultural framework

Figure 3 shows a proposed high-level ubiquitous plant farming model. It consist of four players, which are agricultural producer, distributor, service provider, and consumer. Each players, which could be considered as Actors, contains relevant Roles as listed:

Agricultural producer: Outdoors producer, Green-house producer, Plant-factory operator

Distributor: Direct seller, Wholesale/retail distributor, On-line seller

Service Provider: Network business operator, Service business operator, Content business operator

Consumer: General consumer, Business consumer, Group consumer

Especially three players, which are agricultural producer, distributor, and consumer, have cyclic procedures while

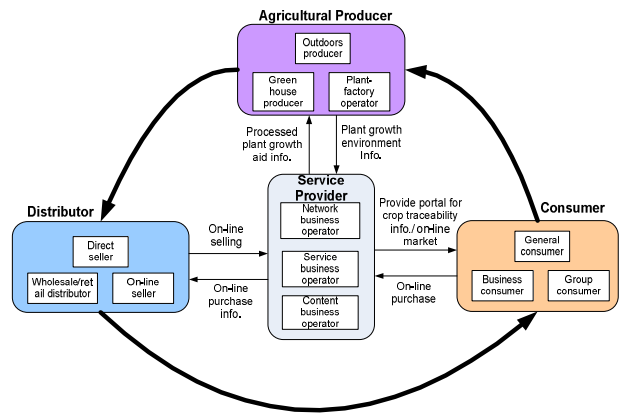


Figure 3. Conceptual relationship among the four player of smart agricultural

service provider has relationships with each of the three players. The inter-actions between three players and service provider are listed as follows:

Agricultural producer and Service provider

- Agricultural producer provides 'plant growth environment information' to service provider
- Service provider offers 'processed plant growth aid information' to agricultural producer. This information is generated based on the 'plant growth environment information' from agricultural producer.

Distributor and Service provider

- Distributer provides agricultural products to service provider. These agricultural products will be sold to consumers through a portal.
- Service providers relays on-line purchase information originated from consumers via service provider.

Consumer and Service provider

- Service provider offers portal site that provides crop traceability information or agriculture on-line trade market.

B. Service Scenarios

Service Scenario 1

- Prerequisite: Plant growth environmental information is gathered from sensors which are installed in a green house, outdoors, or plant-factory.
- ① A farmer or a ubiquitous plant farming service provider can check the gathered information using a smartphone
- ② A farmer or a ubiquitous plant farming service provider can manually control the plant growth environment of a green house, outdoors, or plant-factory in remote site as well as automatically control them according to the gathered information.

Service Scenario 2

- Prerequisite: Video data of plant as well as plant growth environmental information are gathered from sensors which are installed in a green house, outdoors, or plant-factory.
- ① An agriculture consultant, who is one of ubiquitous plant farming service providers, can monitor the gathered data, and provide the processed plant growth aid information with taking into account the list as follows:
 - Configuration information for environmental control
 - Time for water supply
 - Time for spraying agricultural chemicals
 - Crops growth information from weather information, amount of light, and temperature change
 - Etc.
- ② A farmer can receive the processed plant growth aid information from an agriculture consultant in real-time through the various ways such as PC, smartphone, tablet, etc.
- ③ A farmer can raise agricultural productivity by efficiently utilizing the received information.

Service Scenario 3

- Prerequisite: Ubiquitous plant farming service distributor provides on-line agricultural product distributing market.
- ① A house wife, who is one of ubiquitous plant farming service consumers, can check the quality of agricultural product which she want to buy with video data or environment information from ubiquitous plant farming service distributor.
- ② A house wife can purchase good quality agricultural product at low price through on-line agriculture market using smartphone.

Service Scenario 4

- Prerequisite: Ubiquitous plant farming service distributor provides on-line agricultural product distributing market.
- ① A house wife, who is one of ubiquitous plant farming service consumers, can purchase good quality agricultural product at low price through direct dealing by utilizing a social network service or IPTV.
- ② A house wife also can receive agricultural product history record information through a social network service or IPTV.

C. Actors and Roles for Smart Agricultural Service

Agricultural producer

Actors	Roles
Outdoors producer	- Farmer who grows crops in outdoors on his own.
Green house producer	- Farmer who grows crops in green house on his own.

Plant-factory operator	- Farmer who operates plant-factory and grow crops in it.
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Distributor

Actors	Roles
Direct seller	- Farmer who grows and sell crops on his own
Wholesale/retail distributor	- Business operator who sells crops in wholesale/retail. - Business operator who gathers/selects/packages/processes agricultural products
On-line seller	

Service provider

Actors	Roles
Network business operator	- Business operator who makes a profit by providing network to service business operator for agricultural products information delivery
Service business operator	- Business operator who makes a profit by providing portal to consumers through the network
Content business operator	- Information provider, e.g., agriculture consultant, who makes a profit by providing plant growth aid information based on the data, gathered from sensors and videos in green house or plant-factory

Consumer

Actors	Roles
General consumer	- Consumer who lives in general home and buys agricultural products.
General consumer	- Consumer who buys agricultural products for business purposes such as restaurants, hotels, etc.
General consumer	- Consumer who buys agricultural products for inter group members' feeding.

D. Reference model for Smart Agricultural Framework over RCAS in CATV network

Figure 4 shows a reference model for smart agricultural framework over RCAS in CATV network. This model consist of Cable headend, Consumer, Distributer, Service Provide, and Producer. The Cable headend has a central role of managing a smart agricultural framework in CATV network, and it includes RCAS Management System (RMS), Smart agricultural Framework Management System (SFMS), Tranceiver Management System (TMS), and Subscriber Management System (SMS). Each of other components,

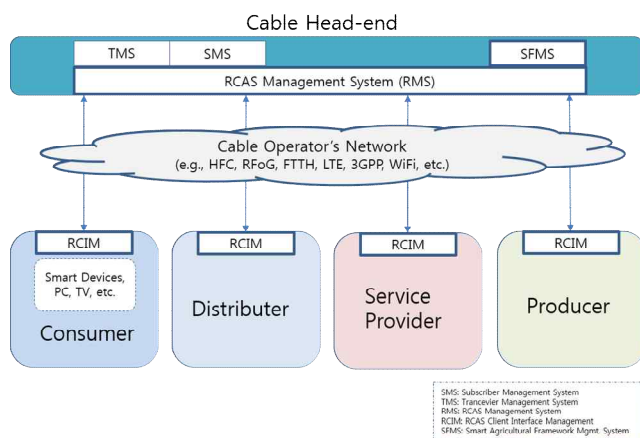


Figure 4. System model for smart agricultural framework for RCAS in CATV network

which are Consumer, Distributer, Service Provider, and Producer, equipped with RCAS Client Interface Management (RCIM) module. The definitions of the management modules are as follows:

RMS: Modified RCAS to be able to provide data protection function for smart agricultural control and metadata.

SFMS: Classify data with conventional cable data and smart agricultural related data, and routing them to TMS and SMS based on the type of smart agricultural services.

RCIM: The counterpart of RMS in Cable headend, and it has a main role of processing security relevant function of RCAS. It also performs data processing for the interface between Cable headend and smart agricultural components.

TMS: Transmit and receive data to/from Cable operator's network. For example, DOCSIS system [6] could be used for HFC network.

SMS: Manage subscribers who involved in smart agricultural service. For example, accounting information could be used for providing pay services along with Service Provider.

Each components of smart agricultural framework over RCAS in CATV network could include the following functions.

Distributer

- Distribution data management
- Safety certification management
- Agricultural product traceability management

Service Provider

- Big data management
- User profile management
- Service database management

Producer

- Environment and energy management
- Crop growth data management
- Remote monitoring & action to disaster management
- Sensor data interface management

IV. CONCLUSIONS

The conceptual relationship among the participants of smart agricultural, service scenarios, actors and roles, and reference model are proposed for smart agricultural framework over RCAS in Cable headend. Especially the modules, i.e., RMS, SFMS, and RCIM, are defined which play distinguished functions in CATV network perspectives.

ACKNOWLEDGMENT

This work was supported by ICT R&D program of MSIP/IITP. [R0166-15-1025, Development of Service Framework and Crop Meta data Standards for Smart Agriculture]

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Han-Seung Koo received his Ph.D degrees in Chungnam National University, Korea in 2008. Since 2001, he has been with ETRI, Daejeon, Korea, where he has been working on digital broadcasting system, ICT convergence technologies, and their standardization. Currently, he serves as a rapporteur for ITU-T interest includes renewable conditional access system and smart agricultural technologies.



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