# Design of PSIP converter for data broadcasting service in the interoperable network of terrestrial and cable

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**Abstract:** In this paper, we propose a method for constructing terrestrial/cable PSIP converting system, so-called a PSIP converter, which is converting terrestrial PSIP into cable PSIP for a data broadcasting service in the interoperable network of terrestrial and cable, and define an interface between the PSIP converter and the OOB SI generator by using PMCP messages compliant to ATSC T3/S1. The exiting PSIP converter just converts terrestrial PSIP into cable PSIP compliant to ATSC and OCAP standard and transmits by a MPEG-2 TS format. That is to say, it is not for the digital data broadcasting but for the digital broadcasting.

Say in other word, the proposed PSIP converter is designed to convert and transmit PSIP including DET information which is necessary data event information for data broadcasting service. In addition, the PSIP converter can support various types of PSIP information to the OOB SI generator by using PMCP messages defined by a hierarchical structure as per each channel, audio/video event, data event and so on.

PSIP, PSI, PMCP, ATSC, OCAP, Data broadcasting, DET.

## 1. INTRODUCTION

With the emerging of the interoperable network era of terrestrial and cable, a terrestrial/cable convergence data broadcasting service based on the ATSC (Advanced Television Systems Committee) data broadcasting middleware standard, so it called the ACAP (Advanced Common Application Platform), has become to play an important role as a rich media to provide viewer with various information[1][2].

Now, in Korean digital broadcasting environment, a digital terrestrial broadcasting system is based on the ACAP standard and a digital cable broadcasting system is based on the OCAP (OpenCable Common Application Platform) standard. And some channels in the digital broadcasting law (must-carry)[3][8].

However, to provide various data broadcasting service based on the interoperable network era of terrestrial and cable, there are so many considering problems such as a compatibility of data broadcasting contents between ACAP and OCAP, a method of retransmission, a retransmission service scenario, an EPG (Electronic Program Guide) information reuse, and so on. One of important problems is a reuse method of EPG information on terrestrial/cable retransmission system for digital cable data broadcasting service.

In this paper, we describe the structure and the operation method of a retransmission system, so it called a PSIP converter, which is supporting the terrestrial/cable convergence data broadcasting service compliant with ACAP and OCAP standard.

To do this, we propose the method for converting and managing PSIP information for terrestrial/cable convergence data broadcasting service. Also, we propose an interface and an operation method between the PSIP converter and the OOB SI (Out Of Band - Service Information) generator by using PMCP (Programming Metadata Control Protocol) messages.

PMCP standard mentioned in this paper defines a method for communicating metadata related to PSIP, including duplicate data that needs to be entered in other locations in the transport stream[4]. A communication is based on a protocol utilizing XML (eXtensible Markup Language) message documents generated in accordance with a PMCP XML schema. PMCP messages are capable of an extension to incorporate additional metadata and transactions not directly related to PSIP[5][6]. PMCP communications are intended to apply to systems and equipments that affect production of PSIP tables and the digital television transport stream in studio and network centers and associated remote program planning and listing services[4].

The remainder of this paper is organized as follows: Sect. 2 presents the structure and the data flow of the proposed PSIP converter and related works. the proposed method of interface with PMCP standard is presented in Sect. 3. Finally, Sect. 4 concludes this paper.
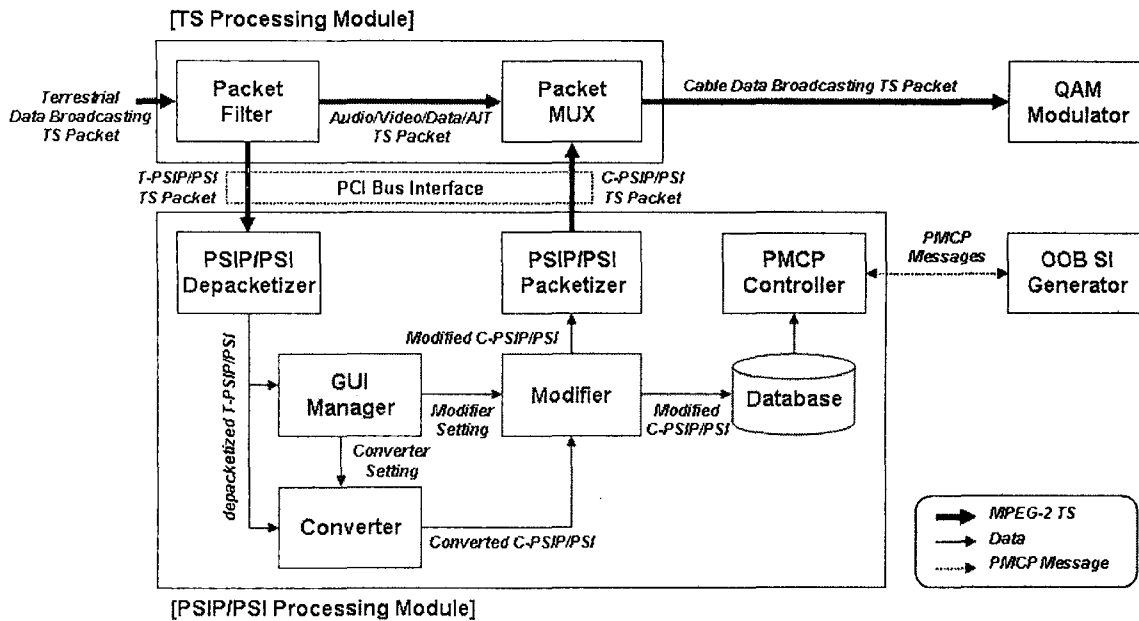
**[TS Processing Module]**

**[PSIP/PSI Processing Module]**

Fig. 1 The structure of Proposed PSIP converter

## 2. THE STRUCTURE OF PROPOSED PSIP CONVERTER

In this section, we present the structure and the data flow of our proposed PSIP converter for the data broadcasting service in the interoperable network of terrestrial and cable.
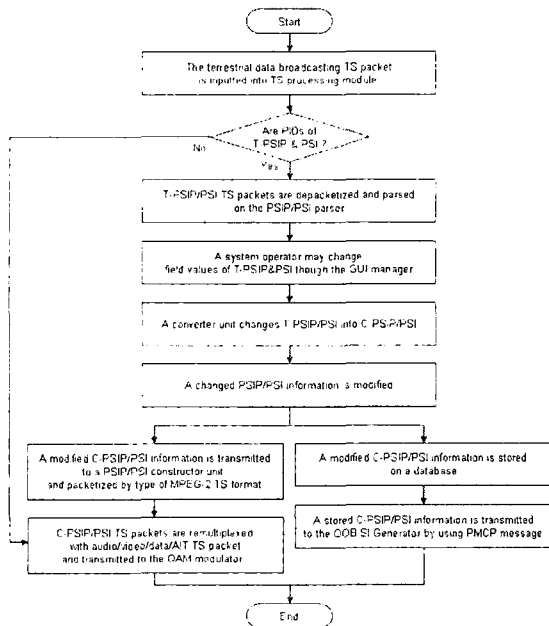


Fig. 2 Flow chart of the proposed PSIP converter

In Fig. 1, the existing the PSIP converter[3] is consisted of a TS Processing Module except a PMCP Controller and a Database of a PSIP/PSI Processing Module, and just has a function to convert PSI and PSIP

for the digital terrestrial broadcasting into PSI and PSIP for the digital cable broadcasting. So the main function of the exiting PSIP converter briefly is shown as Fig. 2.

First of all, TS (Transport Stream) processing module, which is implemented as hardware on PCI type interface card, analyzes TS received form the 8 VSB demodulator by looking up the fields of header part in TS that consists of header part and payload part, then it abstracts PSIP/PSI as the result of the analysis. The PSIP/PSI TS and the contents (that is, audio, video, data and AIT) TS is distinguished by checking up the PID (Packet Identification) values in TS header. The abstracted PSIP/PSI TS is sent to PSIP/PSI processing module through PCI BUS interface. This module also multiplexes the PSIP/PSI TS that is reconstructed form PSIP/PSI processing module and the bypassed audio and video TS, PCR (Program Clock Reference) jitter might occur in the process of multiplexing two kinds of TSs. Therefore, the TS processing module has a function of correcting PCR values to remove this PCR jitter[3][5-7].

And then The PSIP/PSI processing module, which is implemented as software, converts the PSIP/PSI TS abstracted form TS processing module to the PSIP/PSI TS for digital cable broadcasting. PSIP/PSI processing module also modifies the converted PSIP/PSI TS in consideration of the data fed by a system operator through GUI (Graphic User Interface) Manager. The data fed by a system operator contains system information of programs received through different channels for remultiplexing[3].

Finally, The GUI Manager offers a GUI to make a

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system operator key-in data for modification of PSIP/PSI TS and control of the PSIP/PSI processing module. The protocol data group contains the various data fields received form the GUI Manager and data files for creating PSI tables and PSIP tables in each table manger. PSI table manager and PSIP table manager analyze the PSIP/PSI tables for digital cable broadcasting. A sequence of all process is carried out in real-time[3].

on the other hand, the proposed PSIP converter has all functions of the exiting PSIP converter as well as is able to support data broadcasting service applying DET (Data Event Table) parsing and modifying function. In addition, the proposed PSIP converter can support various types of PSIP information to the OOB SI generator by using PMCP messages because PMCP messages can be defined by a hierarchical structure as per each channel, data event and so on.

## 3. THE PROPOSED METHOD OF INTERFACE WITH PMCP STANDARD

In this section, we present how to define an interface between the proposed PSIP converter and an OOB SI generator. In order to present better, we show an additional PMCP schema for data broadcasting service, the method of connection and transmission between PSIP Converter and OOB SI Generator by using examples of PMCP message.

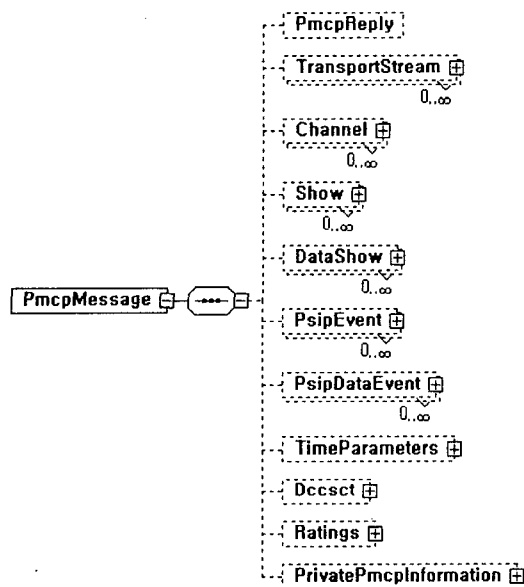**The extended PMCP XML schema**



**Fig. 3 The extended PMCP schema for data broadcasting service**

As shown in Fig. 3 and Table 1, the original PMCP schema defined by ATSC T3/S1 has 11 elements;

PmcpReply, TransportStream, Channel, Show, PsipEvent, TimeParameters, PrivatePmcpInformation, Dccsct, and Ratings. For data broadcasting service, 2 elements are added, which are a "DataShow" element and a "PsipDataEvent" element on an original PMCP schema defined by ATSC T3/S1. a DataShow element and a PsipDataEvent element are defined by being equal to a Show element and a PsipEvent element of the original PMCP schema[2].

**Table 1 The extended PMCP XML Schema Description**

| Elements | Description |
|---|---|
| PmcpReply | This element, required when the PMCP message is a reply, references the request and communicates its status |
| TransportStream | Declaration of the transport streams managed by the system and definition of their global parameters. |
| Channel | Declaration of the "virtual channels" managed by the system and definition of their branding and tuning parameters. |
| Show | List of shows used in the program guides. Has no PSIP equivalent. |
| PsipEvent | Program guide information for regular TV and radio services. |
| TimeParameters | Parameters used to compute the System Time Table (A/65B 6.1), with the exception of the time itself, which is communicated using other protocols than PMCP. |
| Dccsct | Definition of the DCCSCT table (A/65B 6.8), which is global to the system. |
| Ratings | Definition of the parental rating system for multiple regions as carried in the RRT (A/65B 6.4) |
| PrivatePmcpInformation | System-level PMCP-private information |
| DataShow (added) | List of data shows used in the program guides. Has no PSIP equivalent. |
| PsipDataEvent (added) | Program guide information for data services. |

**PMCP Message Flow**

A PMCP message is either of type "information"(default), "request", or "reply". An information message may be sent to communication some set of metadata information. A request message may be sent to communicate or request some information. Zero, one or two reply messages may be sent to acknowledge a specific information message. One or two reply messages shall be sent to acknowledge a specific request message. No reply message shall be sent otherwise. A reply message shall

contain the "PmcpReply" element. No "PmcpReply" element shall be present in an information or request message[2].

Many elements in a PMCP message may have an "action" attribute. The allowed values are "read", "add", "update", and "remove". Only a request message may contain "action" attributes with the value "read". A reply message shall not contain may "action" attribute[2].

In an initiation step of Fig. 4, a heartbeat message is used to confirm activation status of the PSIP converter and the OOB SI generator. The acknowledgement to the heartbeat request shall be initiated no later than 100ms after the receipt of the heartbeat request message. And a heartbeat request message is sent using the root PmcpMessage alone. All other information, request and reply messages comprise the root element and one or more child elements and their attributes as defined in the PMCP schema[2].
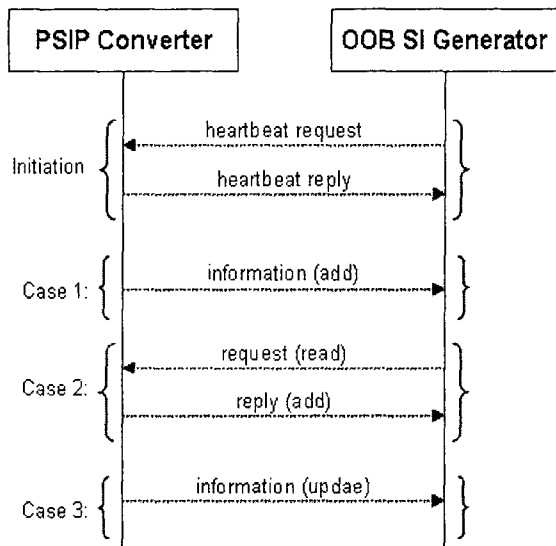
```
<?xml version="1.0" encoding=" UTF-8"?>
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/1.1"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="PMCP1.1.xsd"
id="17365" origin="psip_converter"
originType="Table_Extractor" destination="si_generator"
dateTime="2003-12-16T09:30:48-05:00" type="reply">
    <PmcpReply id="12345" origin="si_generator"
destination="psip_converter"
dateTime="2003-12-16T09:30:47-05:00" status="OK"/>
</PmcpMessage>
```

**Fig. 6 An example of PMCP heartbeat reply message**

Fig. 7 is an example PMCP message of case 1 as shown in Fig. 4. In this example PMCP message includes two events of audio and video divided by "eventide" element[2].



**Fig. 4 A PMCP message flow between a PSIP converter and OOB SI generator**

Fig. 5 and 6 show examples of heartbeat request and reply message in case of initiation in Fig. 4. And a message id of heartbeat request and reply message must be equal[2].

```
<?xml version="1.0" encoding=" UTF-8"?>
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/1.1"
id="12345" origin="si_generator "
originType="Table_Gernator" destination="psip_converter"
dateTime="2003-12-16T09:30:47-05:00"
```

**Fig. 5 An example of PMCP heartbeat request message**

```
<?xml version="1.0" encoding="UTF-8"?>
<!--Sample PMCP file showing an initial schedule
download-->
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/1.1"
id="4294967295" origin="psip_converter"
originType="Table_Extractor"
dateTime="2000-12-16T09:30:47-05:00"
destination="si_generator">
    <PsipEvent action="add" duration="PT30M">
        <EventId channelNumber="57-2">
            <InitialSchedule
startTime="2000-12-16T10:00:00-05:00"/>
        </EventId>
        <ShowData>
            <Name lang="eng">Barney &amp;
Friends</Name>
            <Description
lang="eng">Exercise/Dance</Description>
            <ParentalRating region="1"
dimension="Children" value="TV-Y"/>
            <Ac3Audio audioId="1" lang="eng"/>
            <Caption lang="eng"/>
        </ShowData>
    </PsipEvent>
    <PsipEvent action="add" duration="PT30M">
        <EventId channelNumber="57-2">
            <InitialSchedule
startTime="2000-12-16T10:30:00-05:00"/>
        </EventId>
        <ShowData>
            <Name lang="eng">Dragon Tales</Name>
            <Description lang="eng">Crash Landings/The
Big Cake Mix-Up</Description>
            <ParentalRating region="1"
dimension="Children" value="TV-Y"/>
            <Ac3Audio audioId="1" lang="eng"/>
            <Ac3Audio audioId="2" lang="spa"/>
            <Caption lang="eng"/>
        </ShowData>
    </PsipEvent>
</PmcpMessage>
```

**Fig. 7 An example of PMCP information (add) message on case 1**

Fig. 8 is an example PMCP message of case 2 in Fig. 4. This example of PMCP message is used when OOB SI generator request specific PSIP information from the PSIP converter[2].

```
<?xml version="1.0" encoding="UTF-8"?>
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/1.1"
id="4297993104" origin="si_generator"
originType="Table_Generator"
dateTime="2003-12-17T09:30:47-05:00" type="request">
    <PsipEvent action="read" duration="PT24H">
        <EventId channelNumber="34-3">
            <InitialSchedule
startTime="2003-12-18T00:00:00-05:00"/>
        </EventId>
    </PsipEvent>
</PmcpMessage>
```

**Fig. 8 An example of PMCP request (read) message on case 2**

Fig. 9 is an example PMCP message of case 3 in Fig. 4. This example of PMCP message is used when PSIP converter send changed PSIP information to OOB SI generator as PSIP information changes[2].

```
<?xml version="1.0" encoding="UTF-8"?>
<PmcpMessage xmlns="http://www.atsc.org/pmcp/2004/1.1"
id="4294967295" origin="psip_converter"
originType="Table_Extractor"
dateTime="2003-12-17T09:30:47-05:00">
    <PsipEvent action="update"
startTime="2000-12-16T11:00:00-05:00" startFrame="15">
        <EventId channelNumber="57-1">
            <InitialSchedule
startTime="2000-12-16T10:00:00-05:00"/>
        </EventId>
    </PsipEvent>
</PmcpMessage>
```

**Fig. 9 An example of PMCP information (update) message on case 3**

## 4. CONCLUSION

We proposed the method for constructing the PSIP converter which is converting terrestrial PSIP information into cable PSIP information for a data broadcasting service in the interoperable network of terrestrial and cable, and defined the interface between the PSIP converter and the OOB SI generator with PMCP messages defined by ATSC T3/S1.

As result of that, the terrestrial PSIP information may be reused on the cable data broadcasting network. That is, the proposed PSIP converter can support changed cable PSIP information to a QAM modulator

as well as various types of the cable PSIP information to the OOB SI generator with PMCP messages defined by a hierarchical structure as per each channel, audio/video event, data event and so on.

Through a trial implementation by using the proposed methods, we will try to standardize the PMCP schema and retransmission service scenarios for data broadcasting service on ATSC T3/S1.

**References**

[1]  ATSC Standard A/90 with Amendment 1 and Corrigendums 1 and 2, "Data Broadcast Standard," 2002.

[2]  ATSC Candidate Standard CS/101A, "Advanced Common Application Platform(ACAP)", 2004.

[3]  Byungjun BAE, Joungil Yun, Young-Kwon HAHM, Soo-In LEE, Byung-Ha AHN, and Kyu-Ik SOHNG, "Real-Time Re-transmission form ATSC to OpenCable," IEICE transactions, June 2004.

[4]  ATSC Candidate Standard CS/75, "Programming Metadata Communication Protocol," 2003.

[5]  ATSC Standard A/65B, "Program and System Information Protocol for Terrestrial Broadcast and Cable, Rev. B," 2003.

[6]  ATSC Recommended Practice A/69, "Program and System Information Protocol Implementation Guidelines for Broadcasters", 2002

[7]  ISO/IEC 13818-1 | ITU-T Rec. H.222.0, "Information Technology – Generic Coding of Moving Pictures and Associated Audio Information: Systems", 1996

[8]  TTA Standard, "Standard for digital CATV transmitter/receiver interface," Sept. 2002.