여행프로그램 데이터 서비스의 피처모델과 그에 따른 부가정보 전송 방식 연구
- 국내 위성방송사 환경 기반 중심으로

고 광 일*

*우송대학교 테크노미디어융합학부 미디어디자인·영상전공 교수

A Study on Feature Modeling and Data Transmission Methods of Travel Program Data Service: Focusing on the Domestic Satellite Broadcasting Environment

Kwangil Ko*

*Professor, School of Techno-Media Convergence, Woosong University, Daejeon 34606, Korea

[요 약]

COVID-19 사태로 침체한 여행심리를 회복해야 하는 배경과 여행프로그램이 시청자의 여행 의도에 긍정적인 영향을 미친다는 연구를 토대로, 본 연구는 국내 위성방송사의 방송 환경을 기반으로 여행프로그램의 부가정보를 제공하는 데이터서비스를 연구하였다. 구체적으로, 국내 여행프로그램을 대상으로 시청자의 선호 부가정보를 조사하고 데이터서비스 형상 결정에 사용할 수 있는 FODA 기반의 피처모델을 설계하였다. 그리고 피처모델을 기반으로 데이터서비스 운영에 필요한 부가정보와 국내 위성방송 표준인 DVB-S의 SI 기반의 부가정보 전송 방법을 고안하고, 이를 국내 위성방송사 데이터서비스 표준인 DVB-MHP가 정상적으로 처리할 수 있음을 프로토타입 구현을 통해 확인하였다. 본 연구의 부가정보는 하나의 데이터서비스로 복수의 여행프로그램을 지원할 수 있게 설계되어 국내 위성방송사의 데이터서비스 개발 비용의 효율성을 높이는 효과를 기대할 수 있다.

[Abstract]

Amidst the aftermath of the COVID-19 crisis, where travel psychology remains stagnant, there is a growing demand for travel recovery. Previous research has highlighted the positive impact of travel programs on viewers' travel intentions. In this context, this study focuses on a data service that provides additional information for travel programs within the framework of a domestic satellite broadcasting environment. Specifically, the study surveyed preferred additional information on domestic travel programs and designed a feature model using FODA that the satellite broadcaster could use to design the data service configuration. Furthermore, this study designed additional information required for data service operation and a method to transmit it, based on DVB-SI. It also performed tests to ensure the proper handling of the additional information using DVB-MHP-based data service. The additional information is designed to support multiple travel programs through a single data service, which is expected to increase the cost-effectiveness of data service development.

Ⅰ. Introduction

1-1 Research Background

The COVID-19 pandemic has had a significant impact on the tourism industry in Korea. According to a survey conducted by the Korea Culture and Tourism Institute in 2020, 49.6% of domestic tourism and 37.6% of overseas tourism were not possible due to COVID-19. The Business Sentiment Index(BSI) for the tourism industry fell from 57.3p to 31.3 in the first quarter of 2020. The decrease in tourism spending led to significant losses for the tourism industry, with damages estimated at 4 trillion won under the Tourism Promotion Act[1].

The broadcasting industry was also affected by COVID-19, especially in terms of travel program scheduling. The pandemic caused a general decrease in the desire to travel, and the fear of possible consequences of filming in an area with confirmed cases of COVID-19 led broadcasters to cancel popular travel programs. For example, KBS canceled 'Battle Trip,' which was the top-rated program in its time slot, and 'Walk Expedition,' which had maintained high ratings since 2005, was also discontinued. tvN also indefinitely suspended its flagship program, 'The Salty Tour.' Although travel programs have started to make a comeback since 2022, they still face the challenge of reviving the weakened desire to travel caused by the pandemic .

1-2 Related Research

Various research results have been published indicating that travel programs affect the travel psychology of viewers who watch them.

Nam revealed that travel programs not only reflect the trends of travelers at the time but also lead travel trends[2]. Ju et al. experimentally proved that watching travel programs affects the travel motivations of tourists who visit historical landmarks through a survey[3]. Cho et al. revealed that overseas travel reality programs cause emotional changes in viewers and positively impact on their destination selection and visit intentions[4]. Lee analyzed the impact of travel programs on free travelers and the factors contributing to the popularization of travel programs[5]. Kim et al. also confirmed that the motivations for watching travel programs positively impact on the intention to visit travel destinations[6]. Ko conducted research on strategic utilization of travel program to improve viewers' travel intentions[7].

These studies suggest that the travel industry and broadcasters should strategically utilize travel programs to help recover from the reduced travel psychology due to the COVID-19 pandemic.

1-3 Reaserch Subject

This study is about a travel program-bounded data service providing additional information that viewers want while watching travel programs. Specifically, considering the broadcasting environment of the domestic satellite broadcaster, the study includes the following research topics.

This study conducted a survey on preferred additional information for various genres and formats of travel programs, and designed a feature model using Feature Oriented Domain Analysis(FODA)[8], a representative feature model-based analysis method, to help a broadcaster to determine the configuration of the data service(e.g. the range of travel programs supported by the data service, additional information on travel programs, and the temporal consistency between the travel program content and additional information) while considering the broadcasting environment of the satellite broadcaster that broadcast multiple travel programs through various channels.

Additionally, this study defined the information necessary for data service operation based on the feature model and devised a method to transmit this information through the Service Information(SI)[9] of DVB-S, which is the standard of the domestic satellite broadcasting. This study also confirmed whether the domestic satellite broadcasting data service standard, DVB-MHP[10], properly handles the additional information of this study using a DVB-MHP-based data service prototype.

Ⅱ. Preferred Additional Information of Travel Programs

2-1 Targeted Travel Programs

Table 1 analyzes several domestic travel programs

Table 1. Domestic travel program analysis examples

Program	Broadcaster		Description
Walk Expedition	KBS1	Genre	• Current affairs education program
		Travelling Site	• Overseas travel destinations
		Cast	• There are no other cast members besides the host who films the travel destination, and the host themselves is barely shown in the video
		Hosting Style	• A travel host explores local attractions with a focus on video and narration
		Main Content	• Introducing the history, nature, food, customs, architecture, and more of the travel destination.
		Other Features	• Conducting free interviews with people met during the trip
Battle Trip Season 2	KBS2	Genre	• Entertainment program
		Travelling Site	• Domestic and international travel destinations
		Cast	• There are 4 main hosts and 2 teams consisting of 2 or 3 people each to explore the travel destinations.
		Hosting Style	• After the two teams explore different travel destinations, the entire cast votes for their favorite destination
		Main Content	• According to the travel course designed by each team, the program will introduce food and tourist attractions
		Other Features	• Limitations exist in selecting travel destinations due to the short duration of the trip
Welcome, First Time in Korea?	MBC Everyone	Genre	• Entertainment program
		Travelling Site	• Domestic travel destinations
		Cast	• Main hosts consisting of three people including one foreigner, and other foreigners who are visiting Korea for the first time invited by the foreigner
		Hosting Style	• The foreigner selected for the program invites friends to travel around Korea together
		Main Content	• Experiencing personal experiences while traveling on a course designed by foreign participants
		Other Features	• A realistic struggle that foreign visitors to Korea face due to cultural differences
Travelogue Earth	EBS	Genre	• Travel documentary
		Travelling Site	• Overseas travel destinations
		Cast	• A host filming the travel destination
		Hosting Style	• Selecting hosts suitable for the travel destination and theme, and having the hosts conduct on-site exploration and direct narration
		Main Content	• Introducing lesser-known tourist attractions or indigenous ways of life based on specific themes
		Other Features	• Hiring a specialist who can speak the local language to serve as the host • Introducing one travel destination in four episodes, from Monday to Thursday, with a total running time of approximately 180 minutes

in terms of the genres, travelling site, cast, hosting style, main content, and other features. To ensure the universality of the study, various genres such as current affairs, entertainment, and documentaries, as well as domestic and international travel destinations were included.

A brief introduction to the travel programs selected in this study is as follows. 'Walk Expedition' is a domestically longest-running travel program that has been airing since November 2005 until now, and it is a symbolic presence of a travel program that has formed a strong fan base. 'Travelogue Earth' has been broadcasted since February 2008, and according to the research conducted by the Korean Gallup Survey Research Institute in July 2022, it was selected as the most informative and educational program by Koreans[11]. 'Battle Trip,' which premiered in April 2016, gained high popularity to the extent that its broadcast time was moved to 9 PM in June 2017 to compete with news and dramas. Since then, it has maintained its popularity, and in December 2022, it achieved a record-breaking viewership rating of 4.3%[12]. 'Welcome, First Time in Korea?' which began in June 2017, features a new format that foreign guests participate. It is the only travel program in Korea dedicated exclusively to domestic travel.

In particular, considering the recent trend of many travel programs being planned as entertainment programs and the diversification of formats, two entertainment travel programs with distinct formats were included. 'Battle Trip 2' and 'Welcome, First Time in Korea?' respectively make competition among participants and the misadventures of foreign visitors experiencing Korea for the first time as their main

source of entertainment.

The analysis in Table 1 was used to survey the preferred additional information of viewers for each travel program in the research.

2-2 Preferred Additional Information

This study surveyed 32 university students to define the preferred additional information that viewers want for each travel program listed in Table 1. The students were asked to watch an episode of each travel program and then were surveyed on which additional information they wanted, with the following 7 items: ① location of travel, ② travel expenses, ③ customs and traditions, ④ tourist attractions, ⑤ restaurants and food, ⑥ information on hosts, and ⑦ information on participants.

These additional information items are set based on the elements constituting the format of the travel programs to be studied, but may be changed according to the intent of the broadcaster or program provider when developing the actual travel program data service.

In addition, the students were asked to rank the items they wanted for each travel program without any limit on the number of items. Additionally, through interviews, they were asked if there were any other additional information they wanted beyond those items in the survey.

Table 2 summarizes the additional information items selected by more than 50% of the respondents for each travel program, as well as those requested by more than 50% of the interviewees. It is interesting to note that for "Travelogue Earth," 68.8% of the respondents(22 out of 32) mentioned the synopsis of the previous episode as their preferred additional information. This is likely due to the format of "Travelogue Earth," where the program is divided into 4 episodes per travel destination.

The quality of data services that provide additional information for broadcasting programs largely depends on how useful that information is to viewers. Therefore, this study conducted a survey to investigate viewers' preferred additional information. The survey results were directly incorporated into the feature model, aiming to assist domestic satellite broadcasting companies in designing the structure of their data services.

Table 2. Preferred additional information

Programs	Items	Percentage
Walk Expedition	Location of travel	100%
	Tourist attractions	62.5%
	Customs and traditions	56.3%
	BGM	Interview (65.6%)
Battle Trip 2	Location of travel	100%
	Tourist attractions	96.9%
	restaurants and food	93.8%
	information on participants	87.5%
	Staying place	Interview (53.1%)
Welcome, First Time in Korea?	restaurants and food	100%
	tourist attractions	81.3%
	information on participants	62.5%
	Participant country information	Interview (78.1%)
Travelogue Earth	Location of travel	100%
	information on hosts	96.9%
	tourist attractions	90.6%
	Customs and traditions	62.5%
	Previous episode synopsis	Interview (68.8%)

However, it should be noted that this survey was limited to university students, which poses a limitation in capturing the preferred additional information of diverse age groups and professionals. We will address the limitation in future research tasks.
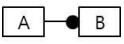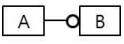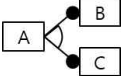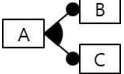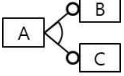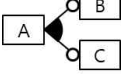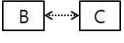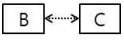
Ⅲ. Feature Model of Travel Program Data Service

3-1 Feature Model – FODA

In software requirements analysis methodology, a feature model is a representation of a software product or system in terms of 'features' such as functionalities and performances that can be perceived from a user's perspective. The goal of the feature model to provide a structured and systematic way to define and manage the features of a software system, making it easier to understand, analyze, and evolve. Feature models are commonly used in requirements engineering for configuring a software[13],[14].

FODA is a representative feature model-based analysis method that defines the formal grammar and logical meaning for relationships among features, such as 'mandatory' or 'optional,' 'exclusive' or 'inclusive,' and 'interdependent,' as shown in Table 3.

Table 3. FODA grammar and formal semantics

Relation	Notation	Semantics	Description
Mandatory	A ●■ B	A⇒B	If you choose A then you should also choose B
Optional	A ○■ B	B⇒A	Although you choose A, it is not necessary to choose B
Alternative	A ● B / C	A⇔B∨C AND ~(B∧C)	If you choose A then you should choose one of B and C, but not both
Or	A ● B / C	A⇔B∨C	If you choose A then you should choose one of B and C, or both
Optional Alternative	A ○ B / ○ C	B∨C⇒A AND ~(B∧C)	If you choose A, it is not necessary to choose B or C. You cannot choose both
OptionalOr	A ○ B / ○ C	B∨C⇒A	If you choose A, it is not necessary to choose B or C. You can choose both
Mutual Dependent	B ◄┈► C	B⇔C	If you choose B (C) then you should also choose C (B)
Mutual Exclusive	B ◄┈► C	B∀C	If you choose B (C) then you cannot choose C (B)

3-2 Data Service Feature Model

This research considered the following factors in designing a feature model that satellite broadcasting companies can use when developing travel program data services.

First, the satellite broadcaster must determine the additional information that the travel program data service will provide. Since travel program genres and formats vary, and accordingly, viewers' preferred additional information may differ depending on the travel programs, viewer preference information such as shown in Table 2 can be usefully utilized.

Second, since the satellite broadcaster operates over a hundred channels, including terrestrial broadcasting, it broadcasts multiple travel programs. Therefore, the satellite broadcaster needs to determine the scope of travel programs that the travel program data service should support. This research was conducted on the travel programs in Table 1, but it is expected that there will be no significant difficulty in expanding travel programs based on this research.

Third, the satellite broadcaster can decide whether to display the additional information of a travel program in conjunction with the contents of the travel program or to show all additional information at once. Suppose the additional information is conjunctive with the content of the travel program. In the case, the data service prioritizes showing the additional information about the tourist attractions, and restaurants that currently appear in the travel program.

Fourth, the satellite broadcaster needs to transmit the information necessary for operating the data service to the data service. This information includes additional information of the travel program, and when the data service supports a plurality of travel programs, includes identification information of the travel program and the additional information belonging to each travel program. In addition, when additional information needs to be provided in conjunction with program contents, information on when each additional information should be exposed is also included. Since the information that the satellite broadcaster needs to transmit to the data service is related to other features of the data service, the feature model of this study defines the information that the satellite broadcaster must transmit as features and specifies the logical relationships with other features. Figure 1 shows the feature model for the travel program data service designed using FODA grammar that reflects the considerations described above. Viewer preference information in Table 2 is defined as a feature that must be provided for the travel programs. The feature model distinguishes whether the data service supports multiple travel programs or just one travel program and defines each case as a feature. Additionally, it distinguishes whether the additional information is conjunctive with the travel program content or not, and defines each case as a feature. And, in the feature model, the essential information that must be sent when the features are selected is also defined as features, and a 'mandatory' logical relationship is given between them.

Ⅳ. Feature Model-Based Descriptor Design

This study devised a method for transmitting information based on DVB-Sls Service Information(SI)
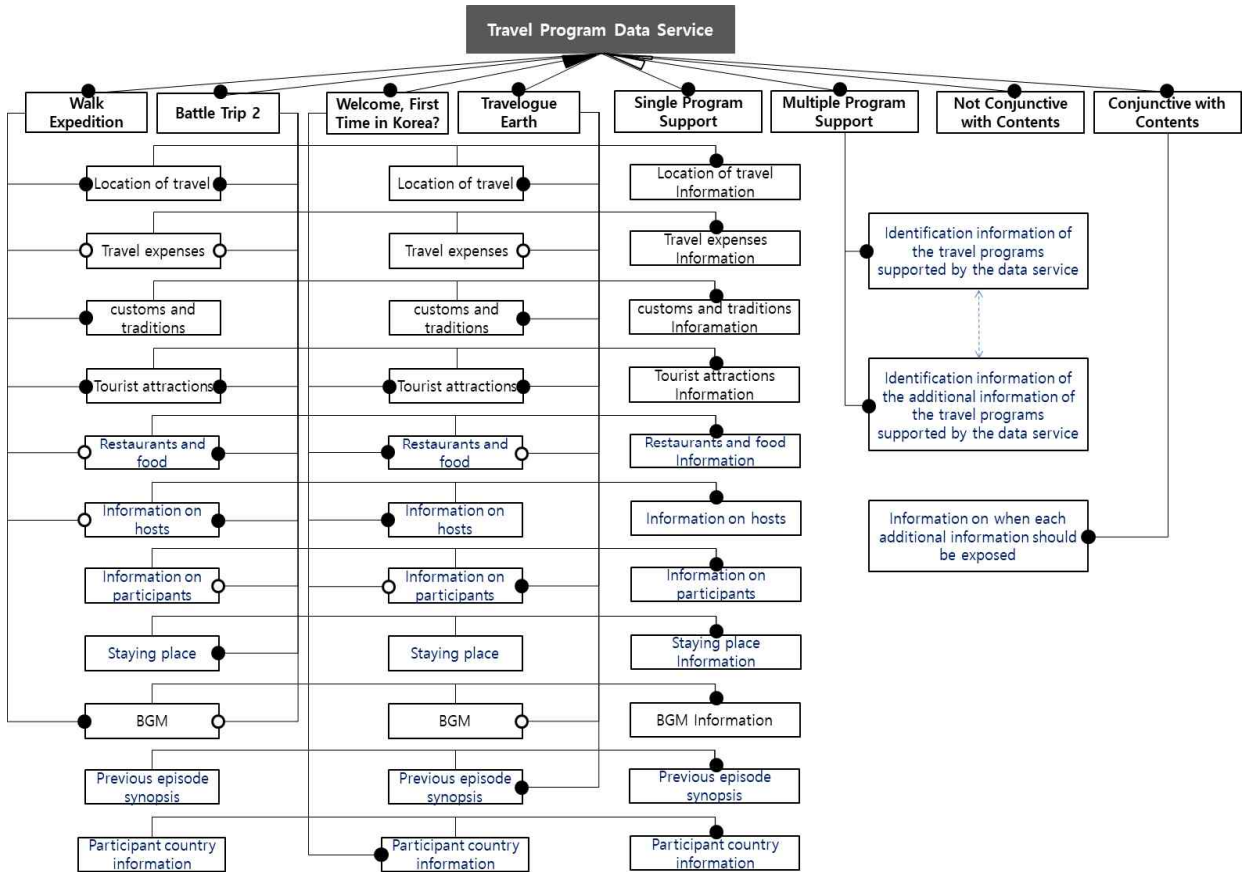
Fig. 1. Feature model of traveling program data service

transmission protocol, the domestic satellite broadcasting standard. Here, SI refers to various tables defined to transmit channel and broadcast program information to digital broadcast receivers, and the SI tables can include information arbitrarily defined by the broadcaster through a protocol called 'descriptor' within it. In this section, we defined the information specified in the feature model using the descriptor syntax of SI. to transmit it to the data service via the SI protocol.

4-1 Program Additional Information Descriptors

In order to define the additional information of the travel program specified in the feature model as a descriptor, the additional information needs to be defined in more detailed items, and the data type and size to express the content of each item must be determined. For example, the additional information <Location of travel> was defined as three detailed items, <continent name>, <country name>, and <region name>, and each detailed item is defined as a string of

up to 20 characters. Another example is that the additional information <Previous episode synopsis> was defined as two detailed items, <episode number>, and <synopsis>, and <episode number> is defined as a one-byte integer and <synopsis> is defined as a string of up to 256 characters. In this way, this study defined descriptors for all additional information specified in the feature model.

Table 4 shows an example of the descriptor for the additional information <Location of travel>. The descriptor_tag is an identifier that distinguishes the descriptor and uses a value in the range (0x80~0xFE) defined by the standard for user-defined descriptors. The descriptor_length indicates the size of the descriptor in bytes after this field, and the additional_info_ descriptor_ID is a unique identifier for descriptors managed by the satellite broadcaster. continent_name_length, country_name _length, and region_name_length indicate the number of characters in the continent, country, and region names, respectively.

Table 4. Descriptor for additional information of <Location of Travel>

N	Syntax	Ref.
1	Location_of_Travel_Descriptor( ) {	
2	descriptor_tag	8bits
3	descriptor length	16bits
4	additional_info_descriptor_ID	16bits
5	continent_name_length (= N1≤20)	8bits
6	for (i=0; i<N1; i++)	
7	char	16bits
8	country_name_length (= N2≤20)	8bits
9	for (j=0; j<N2; j++)	
10	char	16bits
11	region_name_length (= N3≤20)	8bits
12	for (k=0; k<N3; k++)	
13	char	16bits
14	}	

4-2 Additional Information Identification Descriptor

If the data service supports multiple travel programs, it must be able to identify each travel program and its associated additional information. To address this, this study defined a descriptor that can transmit the information for identifying the travel programs supported by the data service and the additional information belonging to each travel program as shown in Table 5.

Table 5. Descriptor for identifying travel programs and their additional information

N	Syntax	Ref.
1	Program_Identification_Descriptor( ) {	
2	descriptor_tag	8bits
3	descriptor length	16bits
4	program_number (= N1)	8bits
5	for (i=0; i<N1; i++) {	
6	program_ID	16bits
7	program_name_length (= N2)	8bits
8	for (j=0; j<N2; j++)	
9	char	16bits
10	additional_info_number (= N3)	8bits
11	for (k=0; k<N3; k++)	
12	additional_info_descriptor_ID	16bits
13	}	
14	}	

Program_number indicates the number of the travel programs supported by the data service, while program_ID is the unique identifier for each travel program managed by the satellite broadcaster. Program_name_length indicates the number of characters in the program name, additional_info_number indicates the number of the additional information provided by each travel program, and additional_info_descriptor_ID is the unique identifier for the descriptor managed by the satellite broadcaster, as in Table 4.

4-3 Additional Information Disclosure Timing Descriptor

When displaying additional information related to the currently broadcasted content of a travel program, the data service needs to know at what point during the travel program broadcast each additional information should be displayed. To address this, this study defines a descriptor for transmitting the display timing information of additional information. The display timing information for additional information consists of the travel program identifier, the number of program sections, the start and end times of each program section, and the identifier of the additional information to be provided for each program section. Here, program section refers to a specific area that is distinguished by meaningful information within the program, such as tourist attractions, participants,

Table 6. Descriptor for displaying time of additional information

N	Syntax	Ref.
1	Displaying_Time_Descriptor( ) {	
2	descriptor_tag	8bits
3	descriptor length	16bits
4	program_ID	16bits
5	section_number (= N1)	8bits
6	for (i=0; i<N1; i++)	
7	section_ID	8bits
8	start_time	16bits
9	end_time	16bits
10	additional_info_number (= N2)	8bits
11	for (j=0; j<N2; j++)	
12	additional_info_descriptor_ID	16bits
13	}	

restaurants, background music, etc., and the additional information provided within each program section remains constant.

Table 6 shows the descriptor defined to transmit the display timing information for additional information of a travel program. The section_number represents the number of program sections, and the section_ID is the unique identifier of each program section. The start_time and end_time are the start and end times of each program section, respectively, represented as an offset in seconds from the start time of the travel program.

V. Descriptor Transmission Method

The satellite broadcaster need to transmit descriptors to the data service. This study has designed a descriptor transmission method based on the SI protocol of DVB-S, as shown in Figure 2.
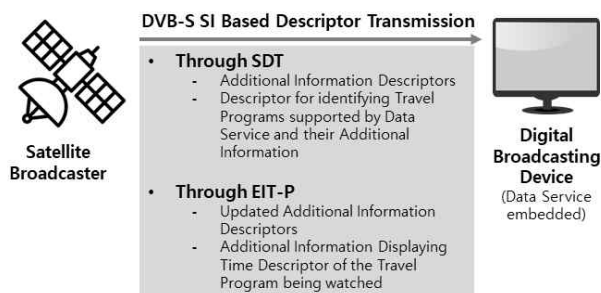

Fig. 2. A transmission method based on SI of DVB-S

All additional information descriptors for the travel programs supported by the data service are transmitted through SDT (Service Descriptor Table) of SI. Since the travel programs supported by the data service are broadcast on different channels, it is not possible to transmit the additional information descriptors for all supported travel programs through a channel where a specific travel program is being broadcast. Therefore, it is appropriate to utilize SDT, which is used when broadcasting information for all channels operated by the satellite broadcaster. For the same reason, the descriptor for identifying the travel programs supported by the data service and their additional information is also transmitted through SDT.

Note that broadcast programs can suddenly change due to unexpected events, such as urgent changes in presenters or adjustments in the length of the program due to other live broadcasts. To handle such cases, this study has designed the transmission method to transmit the updated additional information descriptors of a travel program that has undergone changes at the time when viewers watch the travel program through EIT-P(Event Information Table-Present) of SI. EIT-P repeats the information of the broadcast program being viewed within 500ms, so it is advantageous to transmit the latest information at the beginning of the broadcast program. The additional information displaying time descriptor was also designed to be transmitted through EIT-P as it can be changed by broadcast circumstances.

Through this design, the data service extracts information for identifying the travel programs it needs to support and the additional information of the supported travel programs from SDT. It obtains the latest additional information and additional information displaying time information of the travel program being watched from EIT-P.
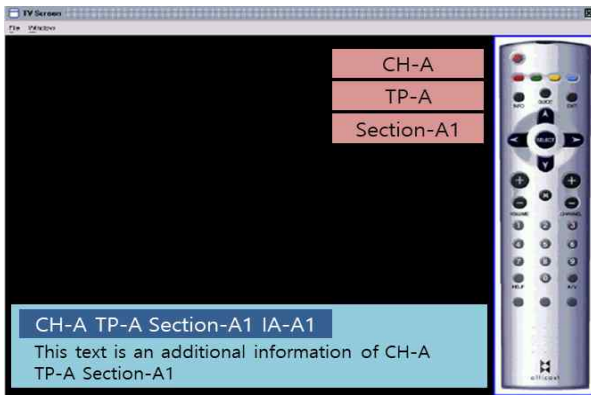
This study developed a prototype of the data service using the DVB-MHP-based authoring tool, 'altComposer,'[15] to test the DVB-MHP, the domestic statellite broadcasting data service standard, properly handle the additional information designed in this study. The altComposer allows the creation of DVB-MHP-based data services in a WYSIWYG manner, and supports the SI table setting and descriptor creation functions, enabling simulation of a data service operation environment of the domestic satellite broadcaster.

In this study, a virtual satellite broadcaster was assumed to operate two channels, CH-A and CH-B, as the operational environment of the data service prototype. CH-A and CH-B were configured to broadcast programs TP-A and TP-B, respectively. TP-A was divided into two sections, Section-A1 and Section-A2, with additional information AI-A1 and AI-A2 associated with each section, respectively. TP-B was also divided into tow sections, Section-B1 and Section-B2, with additional information AI-B1 and AI-B2 associated with each section, respectively. (See Table 7)
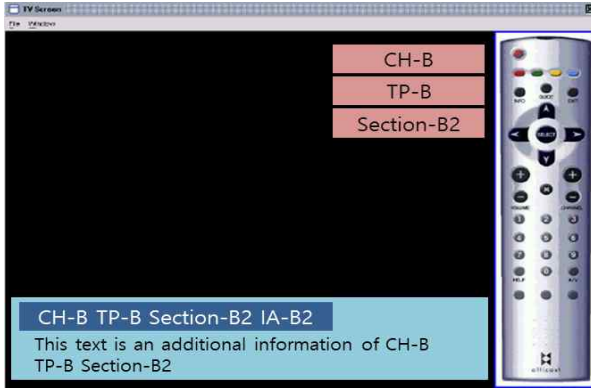
Figure 3 shows an example of running the data service on the DVB-MHP simulator provided by the altComposer. Channel switching is possible through the remote control emulator on the right side of the figure.

Table 7. Satellite broadcasting network configuration

Ch	Prog.	Section	Add. Info.	Content
CH–A	TP–A	Section–A1	AI–A1	This text is an additional information of CH–A TP–A Section–A1
		Section–A2	AI–A2	This text is an additional information of CH–A TP–A Section–A2
CH–B	TP–B	Section–B1	AI–B1	This text is an additional information of CH–B TP–B Section–B1
		Section–B2	AI–B2	This text is an additional information of CH–B TP–B Section–B2

(a) On selecting CH-A TP-A Section-A1, AI-A1 shows

(b) On selecting CH-B TP-B Section-B2, AI-B2 shows
Fig. 3. An example of running data service prototype

Ⅵ. Conclusion

This study aimed to develop a data service that provides preferred additional information for travel programs, considering the broadcasting environment of the domestic satellite broadcaster that broadcasts multiple travel programs through various channels. Specifically, we investigated preferred additional information for various genres and formats of travel programs, designed a feature model based on the FODA method that the satellite broadcaster can use when it configures its data service, defined the necessary information for operating the data service based on the feature model, and devised a method of transmitting the information using SI of DVB–S, the standard of the domestic satellite broadcasting.

The feature model, which models the features of software belonging to a specific domain, has been widely recognized for its usefulness in software configuration design through various studies. In this study, considering the significant impact of additional information on the effectiveness of data services, the preferred additional information was surveyed and intentionally included in the feature model. It is expected that the feature model with these characteristics will be effectively utilized in determining the configuration of data services for domestic satellite broadcasters.

Since travel program data services can be developed in various ways according to the requirements of domestic satellite broadcasters, there is a high possibility that the content of the additional information proposed in this study may change when applied to actual satellite broadcasting data service development. However, it is still meaningful to verify whether the domestic satellite broadcasting data service standard, DVB–MHP, can properly handle the descriptors and transmission methods of the additional information designed in this study. To accomplish this, the study developed a DVB–MHP–based data service prototype and confirmed that the DVB–MHP standard correctly processes the additional information descriptors and their transmission methods proposed in this study.

This study has the following limitations. When the preference additional information was investigated, only university students were targeted, so the preference additional information of various age groups and occupational groups could not be represented. In addition, this study chose the additional information items selected by more than 50% of the survey subjects as preferred additional information, which leaves room for controversy about reliability and validity because the number of survey subjects is not sufficient. These limitations will be the subject of future research.

This study is significant in that it suggests the possibility of increasing the utility of travel programs based on the broadcasting environment of the domestic satellite broadcaster that broadcasts multiple travel programs. We expect that providing appropriate additional information through the data service can have a positive effect on viewers' recovery of travel psychology.

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고광일(Kwangil Ko)

1995년 : 포항공과대학교 전자계산학과 (학사, 석사)

1999년 : 포항공과대학교 컴퓨터공학과 (공학박사)

1999년~2010년 8월: (주)알티캐스트 사업품질관리본부 본부장 및 서비스개발사업팀 팀장

2010년 9월~현 재: 우송대학교 테크노미디어융합학부 미디어디자인·영상전공 교수

※관심분야 : 디지털방송 소프트웨어, 스마트TV방송UI/UX, 소프트웨어공학, 요구분석공학, N-스크린 서비스, 소프트웨어 교육