

Development and Evaluation of Ecotourism Support System using Mobile Phone and Oneseg Broadcasting

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Abstract— On Awashima Island in Niigata prefecture, Japan, the tourist association conducts ecotourism specifically aimed at children. In the ecotourism, providing children with valid educational materials is important. Therefore, we have proposed an ecotourism support system that can provide video content as educational materials by using mobile phones and Oneseg broadcasting. In an experimental evaluation of the proposed system, a content scheduler of the system has increased the number of accesses per hour to the ecotour page by offering appropriate content to the tourist. The breakdown of accesses was that the number of accesses per hour to the ecotour page was 0.14 on a ship bound for mainland, and was 0.34 on a ship bound for Awashima Island. These values have indicated that content scheduler has effectively provided content. As a result, a conversion rate of the ecotour page was 30.6% which is quite high, so Oneseg broadcasting is useful for advertising ecotourism.

Keywords— Oneseg Broadcasting, ISDB-T, Mobile Phone, Data Broadcasting, Eco Tour, Limited Network Environment

I. INTRODUCTION

With the growing recognition of ecology, ecotourism has become very important and widely conducted around the world. On Awashima Island in Niigata prefecture [1], Japan, the tourist association conducts ecotourism specifically aimed at children [2]. In the ecotourism, providing children with valid educational materials is important, but papers or books are only available at present.

Furthermore, visitors to Awashima Island have to take a ferry for transportation. Presently, the ferry delay information is provided only by telephone calls to the ship company.

Considering these situations, we propose an ecotourism support system that can provide video content as educational material as well as provide ferry delay information by using mobile phones and the Oneseg broadcasting.

II. RELATED WORKS, CURRENT PROBLEMS, AND PROPOSED SOLUTIONS

A. Oneseg Broadcasting

Oneseg broadcasting, started in 2006, is a special broadcast form for mobile devices in Japan. Figure 1 shows the Oneseg broadcasting scheme. In the terrestrial digital broadcast system in Japan, each channel is divided into 13 segments. HDTV for home is broadcasted by 12 segments. The

remaining one segment is used for mobile phones. Table 1 shows some specifications of the Oneseg broadcasting [3].

TABLE 1. SPECIFICATIONS OF ONESEG BROADCASTING.

Resolution	Video: 320 × 180 pixels 320 × 240 pixels Text: 240 × 480 pixels
Frame Rate	15fps
Bit Rate	416kbps
Codecs	Video: H.264/AVC Audio: AAC, SBR
Maximum Power of Oneseg broadcasting with license free	500 μ V/m at 3m from antenna
Maximum coverage of Oneseg broadcasting with license free	about 1m in front of antenna

A specific feature of this broadcasting is that text is also broadcasted together with a video and links to web pages can be provided within this text. In addition, Oneseg broadcasted video can be recorded on mobile phones. The content of Oneseg broadcasting is usually the same as that of HDTV broadcasting, and this is called simultaneous broadcasting [4]. Furthermore, low power Oneseg broadcasting can be operated without a license, so we can broadcast original content in a limited area.

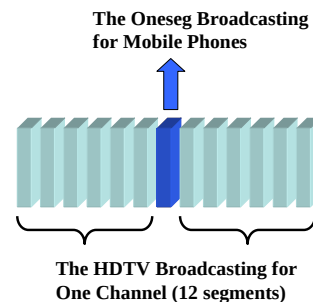


Figure 1. The Digital Broadcasting system in Japan.

B. Advanced Delivering of Ferry Delay Information

Visitors come to Awashima Island by ferry, and may participate in an ecotour. However, ferry delay information is

currently offered only by telephone calls to a ship company, so visitors cannot get this information in a timely manner. We propose solving this problem by providing the latest information to mobile phones through the use of the Oneseg text broadcasting.

C. Improving of Ecotours with Recorded Oneseg Content

Ecotours use educational materials, which provide information about birds, fishes, flowers, etc. However, the existing educational materials are prepared only in text or a book. To improve ecotours, we propose offering the materials by using the Oneseg broadcasting. Recorded content on mobile phones can be effectively used during ecotours. Video content provided by mobile phones can be particularly attractive to children and will improve the ecotourism. Figure 2 shows the overall solution proposed in this paper.

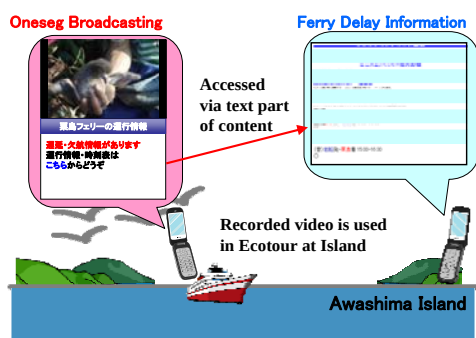


Figure 2. Proposed Solutions for improving Tourism on Islands.

D. Using Ferry Transport

All tourists come to Awashima Island by ferry and have about an hour of free time on the ferry. Therefore, it would be useful if tourists could browse the ecotour introductory and application pages while on the ferry. Additionally, the tourists may want video content of the ecotour during the trip from the mainland to Awashima Island, and they may want the video content for the next visit during the trip from Awashima Island to the mainland. Figure 3 shows two types of information provided to tourists. Therefore, it is important that the video content be able to change depending on the direction of the ferry.



Figure 3. Two types of information for tourists.

III. PROPOSED SYSTEM

A. Overall structure of Proposed System

Figure 4 shows the overall structure of the Ecotourism support system. The system consists of the following three subsystems: 1) a function for changing the broadcasting schedule of video content, 2) a function for replacing video content on a Oneseg broadcasting device and 3) a function for offering ferry delay information to tourists. The system comprises a content scheduler system, a content distribution system, and a ferry delay information system. The content scheduler changes the broadcasting schedule of content that are stored within the Oneseg broadcasting device. The content distribution system replaces new content with old content. Finally, the ferry delay information system offers the ferry delay information to tourists. Design and detailed procedures of the proposed three subsystems are given in the following sections.

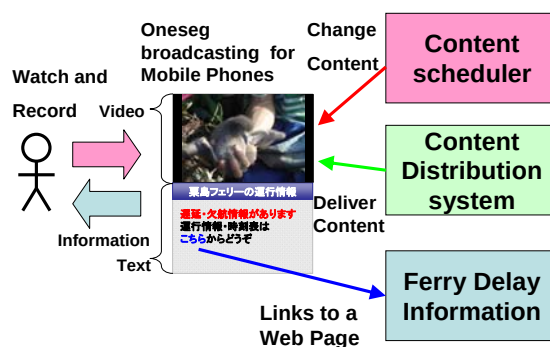


Figure 4. Proposed Ecotour Support System.

B. Content Scheduler System

We have developed the content scheduler which operates with a function of the Oneseg broadcasting device. The function changes the schedule of content broadcasting by receiving a control mail. Since a network is provided only at the Awashima harbor, the content scheduler should complete changing the broadcasting schedule of video content while ferries visit at the harbor.

Figure 5 shows the detailed operations of the content scheduler. The Oneseg broadcasting device connects to the mail box of the content scheduler through the wireless LAN when ferry arrives at the Awashima harbor (see (1) of Figure 5.), and this access log is recorded on the server. The content scheduler is monitoring the access log on the server (see (2) of Figure 5.). Then, the content scheduler sends the control mail when finding the access log of the Oneseg broadcasting device in the server (see (3) of Figure 5.). The Oneseg broadcasting device repeatedly tries to receive the control mail from the mail box of the server (see (4) of Figure 5.). As a result, the schedule of the video content broadcasting is changed in accordance with the control mail. According to the updated schedule, the Oneseg broadcasting device changes the content broadcasting when arriving at a harbor of the mainland.

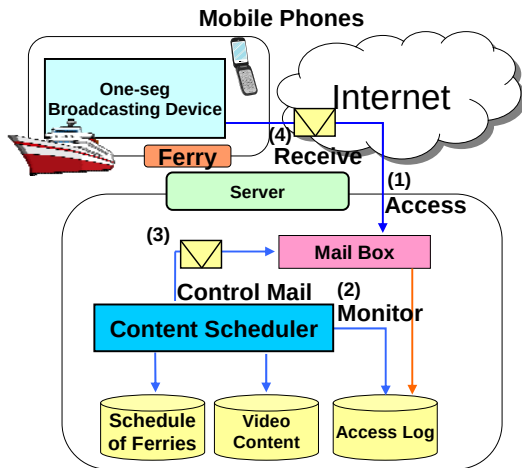


Figure 5. Mail-based Content Scheduler.

C. Content Distribution System

We developed two methods for replacing video content on the Oneseg broadcasting device. Figure 6 shows the detail of the content distribution system.

The method 1 uses mail attachment and replaces stored video content with the attached file. The new video content is attached to the control mail, and the broadcasting device replaces the content when receiving the mail. This method is easy to use, but cannot complete receiving video content when a network connection is terminated during the transmission, because the partially received file is deleted. It is difficult to replace the video content in the limited network environment, because ferries are not tied up a long time in the harbor.

The method 2 uses Hyper Text Transfer Protocol (HTTP). This method needs a web server, and therefore is more complicated than the method 1. When receiving the control mail, the broadcasting device starts downloading new video content from HTTP server, and replaces the stored content with new content when finishing downloading. Here, new content is uploaded to the server before downloading. This method can continuously receive video content by resuming the HTTP connection between the Oneseg broadcasting device and the server even when a network connection is terminated. Therefore, the Oneseg broadcasting device using the method 2 may finish receiving video content faster than the method 1.

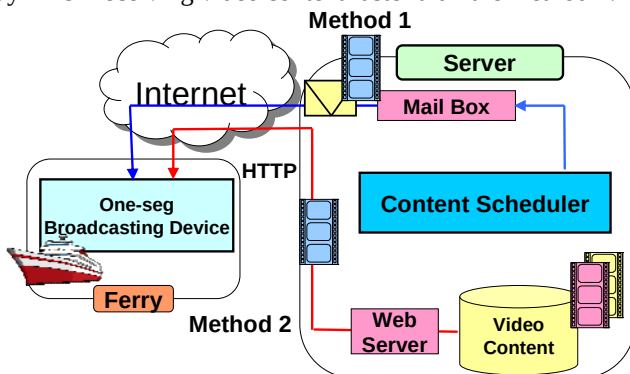


Figure 6. Content Distribution System.

D. Ferry Delay Information System

The ferry delay information page can be accessed by mobile phones of the tourists. The input page of the ferry delay information is designed so that the information is set through the simple web interface (See Figure 7.). So, employees of the ship company do not need expertise to update ferry delay information.

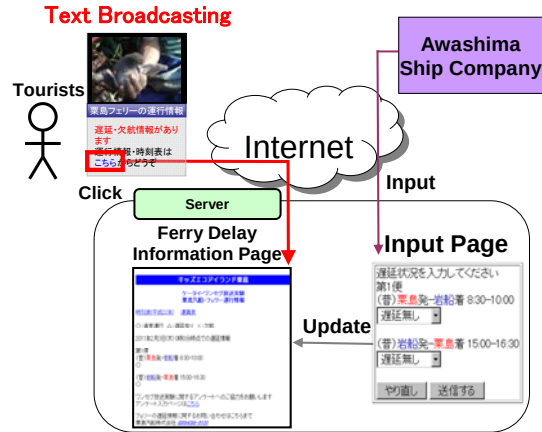


Figure 7. Ferry Delay Information System.

IV. EVALUATION OF SYSTEM

A. Installation of System

We have installed the proposed system in the ferry, and have started operating the system on May 14, 2011. Figure 8 shows the floor plan of the ferry. We have installed the devices on three places for Oneseg broadcasting. Passengers can watch Oneseg broadcasting in front of the antenna as shown in Figure 8. In addition, QR code is displayed on the poster printed above the antenna. So, passengers can access the ecotour page through QR code as well as a links given within Oneseg broadcasted text.

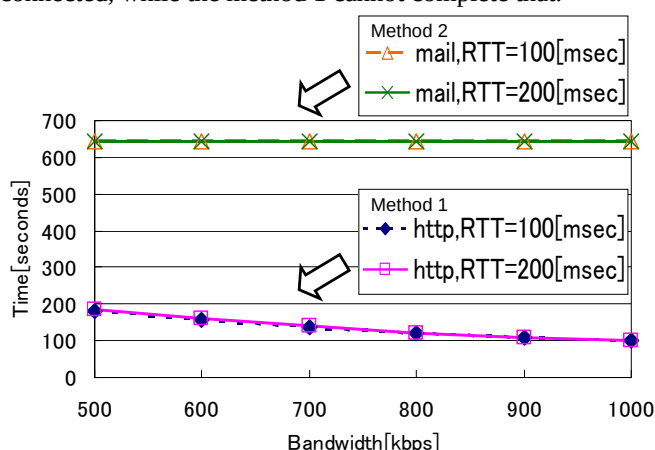


Figure 8. Installation Location within the Ferry.

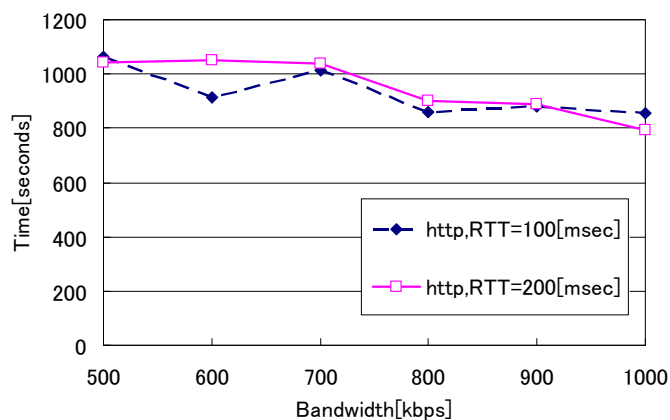
B. Performance of File Transfer Methods

We evaluated the methods of the content distribution system in an experimental environment where network outage is emulated by a Dummynet [5]. The proposed content distribution system receives video content by using each method in the network emulating a cellular network. The file size of the video content is 9.2MB (run time is 3 minutes).

Figure 9 shows the relationship between the time required for downloading the file and the bandwidth of the cellular network. As shown in this figure, when the network disconnection does not occur, the proposed system with the method 2 finishes downloading the content much faster than that with the method 1. Furthermore, the method 2 can complete the download even when the network is temporarily disconnected, while the method 1 cannot complete that.



(a) Without Packet Loss Environment.



(b) With Packet Loss Environment.

Figure 9. Performance of Content Distribution Method.

C. Analysis of Access Information

We have evaluated the number of accesses to the ecotour page from mobile phones in order to evaluate the effectiveness of the system.

Figure 10 shows the number of accesses to the ecotour page during a period of a summer vacation. The number of accesses to the ecotour page increases with approaching the touring season. Furthermore, passengers were interested in the ecotours and accessed the ecotour page after watching video content. The number of accesses to the ecotour page decreases around 15 August. An interval around 15 August is called the Bon holidays in Japan, and people usually go back to their hometowns. Therefore, the number of applicants to ecotour during that period decreases because almost all passengers are Awashima people.

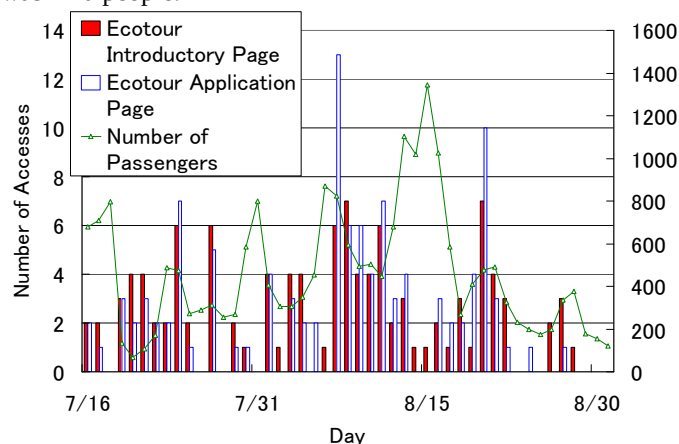


Figure 10. Number of Accesses of Ecotour Page during Summer Vacation Period.

Figure 11 shows the ratio of the number of accesses on each day of the week. As a result, the pages were accessed on weekend more frequently than weekdays. This is caused by the increase in tourists visiting at Awashima Island on the weekends.

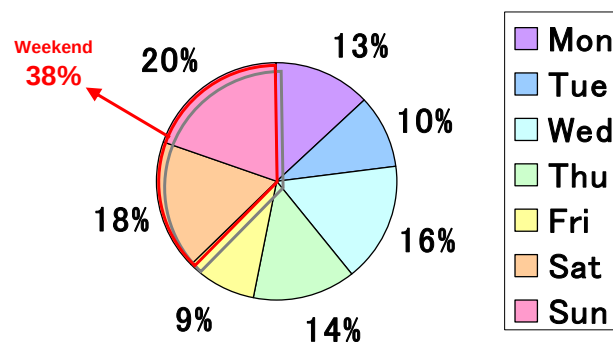


Figure 11. Percentage of Accesses during Summer Vacation.

TABLE 2. NUMBER OF ACCESSES PER HOUR FOR EACH DIRECTION.

	Sailing Time[h]	Number of Accesses	Number of Accesses per hour
Line bound for Awashima	112.15	38	0.34
Line bound for mainland	111.25	16	0.14

Table 2 shows the sailing time of ferries in each direction and the number of accesses to the ecotour page during the sailing time. The number of accesses per an hour of a line bound for Awashima is more than that bound for the mainland. In other words, tourists access to the ecotour page by watching video content before arriving at Awashima Island. Therefore, it is concluded that the content scheduler is useful for attracting tourists to the ecotours.

TABLE 3. CONVERSION RATE OF ECOTOUR APPLICATION PAGE.

Number of Accesses to Ecotour Application Page	111
Number of Applicants to Ecotour	34
Conversion Rate	30.6%

Furthermore, Table 3 shows CVR (Conversion rate) [6] of the application page, the number of accesses to the page, and the number of applicants on the page. CVR is an evaluation index of e-commerce websites and stands for the ratio of applicants per an access. The number of applicants to the ecotour in summer vacation period was 34. CVR was over 30.6%. It is reported that the average of CVR among many e-commerce websites is about 2% [7]. Therefore, Oneseg broadcasting is good tool of advertising ecotourism.

V. CONCLUSIONS

We developed an ecotourism support system that offers educational materials and useful information related to the ecotours by using Oneseg Broadcasting and evaluated the effectiveness of the system. The system consists of three functions: 1) a function for changing the broadcasting schedule of the video content stored on a Oneseg broadcasting device, 2) a function for replacing the stored video content with a new content and 3) a function for offering ferry delay information.

As a result of an experimental evaluation, we indicated that the developed file transfer method can replace the video content on the Oneseg broadcasting device, even in a limited network environment.

In addition, the content scheduler of the system increased the number of accesses per hour to the ecotour page by offering appropriate content to the tourist. The breakdown of accesses was that the number of accesses per hour to the ecotour page was 0.14 on a ferry bound for the mainland, and was 0.34 on one bound for Awashima Island. These values indicated that the content scheduler provided content effectively.

The conversion rate of the ecotour page, i.e., the percentage of ecotour applicants to the number of accesses to the page, was 30.6%. This value is quite high, so Oneseg broadcasting is useful for advertising ecotourism.

For future work, we will consider the use of the proposed system to applications other than ecotours.

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