

Technical Note

Development and Evaluation of Ecotourism Support System using One-seg Broadcasting with Mobile Networks

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Abstract: On Awashima Island in Niigata prefecture, Japan, the tourist association conducts ecotourism specifically aimed at children. In this 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 One-seg 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 tourists. As a result, a conversion rate of the ecotour page was 30.6% which is quite high, so One-seg broadcasting is useful for advertising ecotourism.

Keywords: One-seg broadcasting, mobile phone, data broadcasting, ecotourism

1. 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 this 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 One-seg broadcasting.

2. Related Works, Current Problems, and Proposed Solutions

2.1 One-seg Broadcasting

One-seg broadcasting, started in 2006, is a special broadcast form for mobile devices in Japan. In the terrestrial digital broadcast system in Japan, each channel is divided into 13 segments. HDTV for homes is broadcast within 12 segments. The remaining One-segment is used for mobile phones. **Table 1** shows some specifications of One-seg broadcasting [3].

A specific feature of this broadcasting system is that text is also broadcast together with video, and links to web pages can be provided within this text. In addition, One-seg broadcast video can

Table 1 Specifications of One-seg broadcasting.

Resolution	Video: 320×180 pixels 320 \times 240 pixels Text: 240 \times 480 pixels
Frame Rate	15 fps
Bit Rate	416 kbps
Codecs	Video: H.264/AVC Audio: AAC, SBR
Maximum Power of One-seg broadcasting with license free	$500 \mu\text{V/m}$ at 3 m from antenna
Maximum coverage of One-seg broadcasting with license free	about 1 m in front of antenna

be recorded on mobile phones. The content of One-seg broadcasting is usually the same as that of HDTV broadcasting, and this is called simultaneous broadcasting [4]. Furthermore, low power One-seg broadcasting can be operated without a license, so we can broadcast original content within a limited area [5].

Although several experiments of One-seg broadcasting have been reported, there has been no substantial experiment carried out as to the effective use of text, particularly interactions with mobile networks and web services [6], [7], [8], [9]. In this paper, we propose such a solution for an ecotourism support system.

2.2 Advanced Delivery 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 One-seg text broadcasting.

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2.3 Improving Ecotours with Recorded One-seg Content

Ecotours use educational materials, which provide information about birds, fishes, flowers, etc. However, existing educational materials are prepared only in text or a book form. To improve ecotours, we propose offering the materials by using the One-seg broadcasting. Recorded content on mobile phones can be used effectively during ecotours. Video content provided by mobile phones can be particularly attractive to children and will improve ecotourism. **Figure 1** shows the overall solution proposed in this paper.

2.4 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 video content for their next visit during the trip from the island to the mainland. **Figure 2** shows two types of information provided to tourists. Therefore, it is important that the video content be able to change depending upon the direction of the ferry.

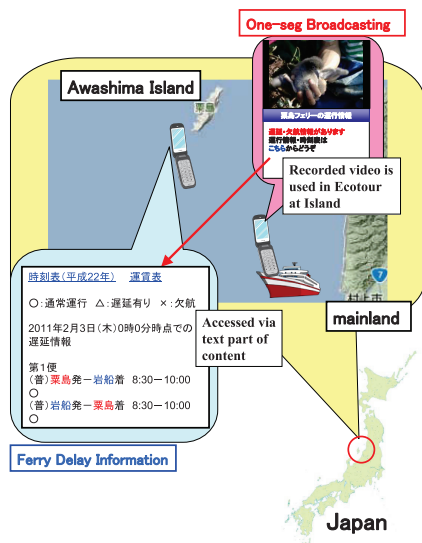


Fig. 1 Proposed solutions for improving ecotourism on islands.

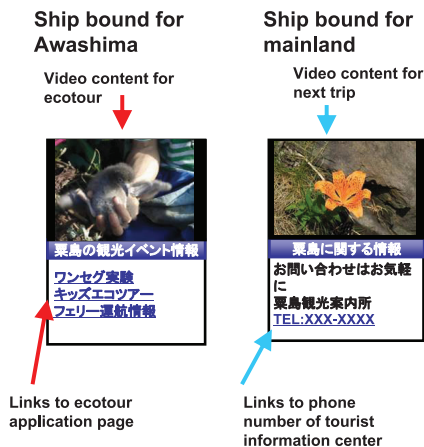


Fig. 2 Two types of information for tourist.

3. Proposed System

3.1 Overall Structure of Proposed System

Figure 3 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 One-seg 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 is stored within the One-seg 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.

3.2 Content Scheduler System

We have developed the content scheduler which operates using a function of the One-seg 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 the changing of the broadcasting schedule of video content while ferries are visiting the harbor. **Figure 4** shows the detailed operations of the content scheduler. The One-seg broadcasting device connects to the mail box of the content scheduler through the wireless LAN when the ferry arrives at the Awashima harbor (see (1) of Fig. 4), and this access log is recorded on the server. The content scheduler monitors the access log on the server (see (2) of Fig. 4). Then, the

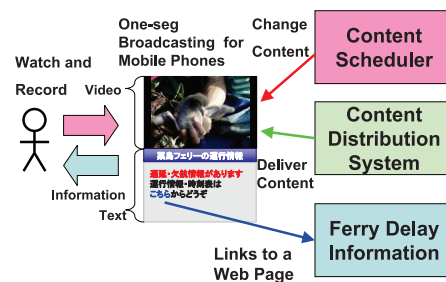


Fig. 3 Proposed ecotour support system.

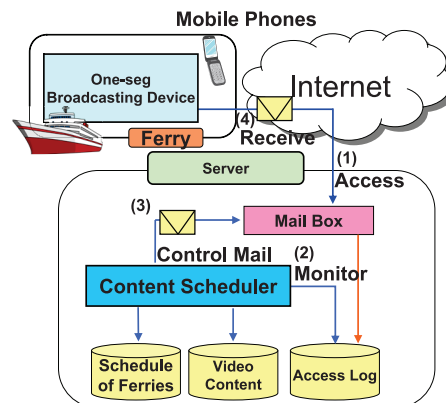


Fig. 4 Mail-based content scheduler.

content scheduler sends the control mail when finding the access log of the One-seg broadcasting device in the server (see (3) of Fig. 4). The One-seg broadcasting device repeatedly tries to receive the control mail from the mail box of the server (see (4) of Fig. 4). As a result, the schedule of the video content broadcasting is changed in accordance with the control mail. According to the updated schedule, the One-seg broadcasting device changes the content broadcasting when arriving at a harbor on the mainland.

3.3 Content Distribution System

We developed two methods for replacing video content on the One-seg broadcasting device. **Figure 5** shows the detail of the content distribution system. Method 1 uses a 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 harbor. Method 2 uses Hyper Text Transfer Protocol (HTTP). This method needs a web server, and therefore is more complicated than Method 1. When receiving the control mail, the broadcasting device starts downloading new video content from the HTTP server, and replaces the stored content with new content when finished 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 One-seg broadcasting device and the server even when a network connection is terminated. Therefore, the One-seg broadcasting device using Method 2 may finish receiving video content faster than Method 1.

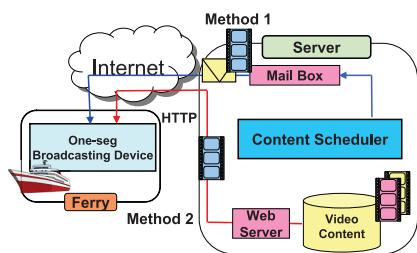


Fig. 5 Content distribution system.

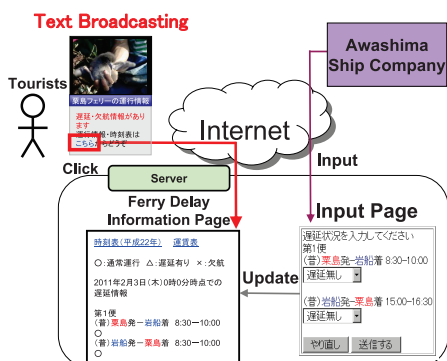


Fig. 6 Ferry delay information system.

3.4 Ferry Delay Information System

The ferry delay information page can be accessed by the mobile phones of the tourists. The input page of ferry delay information is designed so that the information is set through a simple web interface (See **Fig. 6**). So, employees of the ship company do not need expertise to update ferry delay information.

4. Evaluation of System

4.1 Installation of System

We installed the proposed system in the ferry, and started operating the system on May 14, 2011. **Figure 7** shows the floor plan of the ferry. We installed the devices at three places for One-seg broadcasting. Passengers can watch One-seg broadcasting in front of the antenna as shown in Fig. 7. In addition, a QR code is displayed on the poster printed above the antenna. So, passengers can access the ecotour page through the QR code as well as via links given within One-seg broadcasted text.

4.2 Performance of File Transfer Methods

We evaluated the methods of the content distribution system in an experimental environment where network outages are emulated by a Dummynet [10]. 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 9.2 MB (run time is 3 minutes). **Figure 8** shows the relationship between the time required for downloading the file and the bandwidth of the cellular network. As shown in this figure, when a 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.

4.3 Analysis of Access Information

We evaluated the number of accesses to the ecotour page from mobile phones in order to evaluate the effectiveness of the system. **Figure 9** shows the number of accesses to the ecotour page during a period of one summer vacation. The number of accesses to the ecotour page increases with approach of the tourist season. Furthermore, passengers were interested in ecotours and accessed the ecotour page after watching video content. The number of ac-

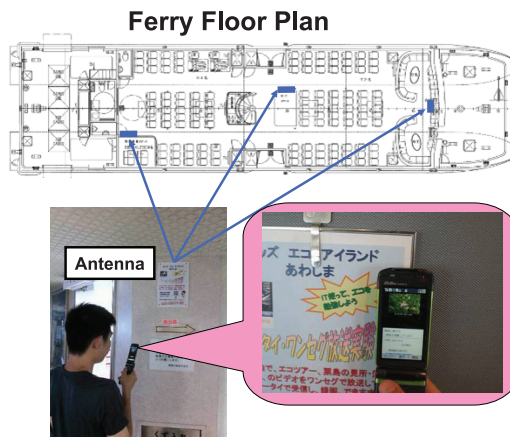


Fig. 7 Installation location within the ferry.

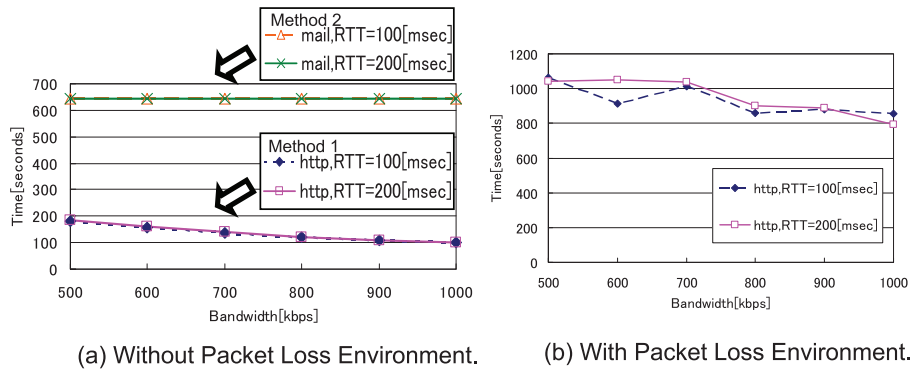


Fig. 8 Performance of content distribution method.

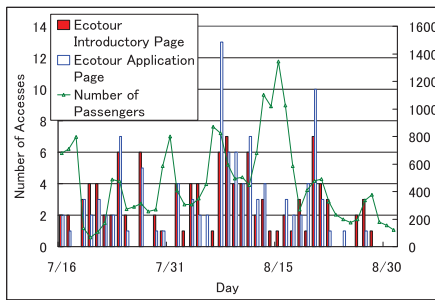


Fig. 9 Number of accesses of ecotour page during summer vacation period.

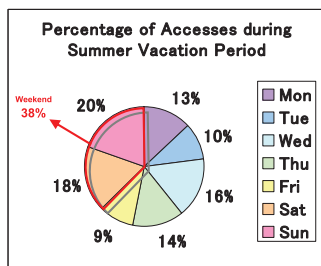


Fig. 10 Percentage of accesses during summer vacation.

cesses to the ecotour page decreases around August 15th. The period around August 15th is called the Bon holidays in Japan, and people usually go back to their hometowns. Therefore, the number of applicants to ecotours during that period decreases because almost all passengers are Awashima people.

Figure 10 shows the ratio of the number of accesses on each day of the week. As a result, the pages were accessed on weekends more frequently than weekdays. This is caused by the increase in tourists visiting Awashima Island on the weekends.

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 hour of travel bound for Awashima is more than that bound for the mainland. In other words, tourists access 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 ecotours.

Furthermore, Table 3 shows the CVR (Conversion rate) [11] 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 access. The number of applicants to the ecotour in the sum-

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 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%

mer vacation period was 34. The CVR was over 30.6%. It is reported that the average CVR of many e-commerce websites is about 2% [12]. Therefore, One-seg broadcasting is a good tool of advertising ecotourism.

5. Conclusions

We developed an ecotourism support system that offers educational materials and useful information related to ecotours by using One-seg 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 One-seg broadcasting device, 2) a function for replacing the stored video content with 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 a One-seg 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 tourists. 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 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 One-seg 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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