Streaming Astronomical Events for Public Viewings: The 2009 Total Eclipse in Japan

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Summary

We describe our outreach activity to make high-quality images of the 2009 total solar eclipse freely available to the public and inspect the impact of events allowing public viewing of high-definition (HD) streaming video of the eclipse.

Introduction

A total solar eclipse is one of the most gorgeous astronomical phenomena known and attracts numerous viewers, including those who do not usually engage with astronomy. On 22 July 2009, the longest total eclipse of the century was visible in East Asia and Japan. The timing of the total eclipse meant that for some isolated Japanese islands it occurred when the Sun was high in the sky, making them an excellent location for viewing the eclipse.

However, from most locations in Japan, only a partial eclipse could be observed. This drove the decision to broadcast high-definition (HD) streaming images of the total eclipse from the islands, via the internet, to a much larger public audience. This audience may otherwise have missed this rare and beautiful phenomenon and the project aimed to use the total eclipse to generate interest in nature, science and, in particular, astronomy.

HD images were transmitted to selected science museums, universities and television stations. In addition, the HD images were converted to Windows Media Video (WMV) format and transmitted to 35 locations, which included community centres, public halls, science museums and public astronomy observatories.

The public-viewing events attracted 34 300 people. By the end of 2009, views of our videos — and those of the Japan broadcasting cooperation Nippon Housou Kyoukai (NHK) who used our images — on YouTube and other sites totalled over 770 000. The images appeared 72 times on 28 television programmes on 22–23 July and if cable television and communication satellite programmes were also considered, for which data could not be collected, it is estimated that the images were used in over 100 televised programmes.

To better understand the impact of such public outreach efforts, the public viewings were assessed to see whether they provided an effective way of sharing the experience of an astronomical phenomenon. Although other studies on outreach efforts have indicated that providing streaming videos for viewing on personal computers (PCs) is effective, the effectiveness of providing high-quality streaming for a large screen has not been sufficiently discussed.

In this paper we explain our methods of data transmission and preparation, present the results of the questionnaires taken at the events, discuss unexpected reactions of potential organisers of the public viewings and consider possible countermeasures.

This project was proposed by experts in large-capacity data transmission at the National Observatory of Japan (NAOJ), whose participation was essential to bring the project to fruition.

1. Project outline

1.1. Collaborations

From the beginning, it was clear that collaboration with other organisations outside NAOJ would be key. To publicise the project alone, collaborations were formed with the press, internet broadcast stations, video websites and other media sources, these being the experts in the wide distribution of content. Science museums and communication experts were also part of the collaboration to ensure that the contents were put to best use.

1.2. Choice of observation point

To obtain high-quality images it was important to observe the eclipse from land. After studying several potential observation sites the list was reduced to isolated islands and after comparing the probabilities of having good weather, the decision was made to film the eclipse from Iwo Island. Another advantage of Iwo Island was that no project or tour planned to observe the eclipse from it.

However, the Japanese Self-defence Force controls Iwo Island and access to it is not normally allowed. In fact, nobody outside the team thought that it would be possible. But, after interagency collaboration between the Self-defence Force, the Ministry of Internal Affairs and Communications and the Ministry of Education, Culture, Sports, Science and Technology (MEXT) the observations were given the go-ahead, as was permission to use the local infrastructure, such as lodging facilities and transport. The film team consisted of staff from several different organisations, including NHK, MEXT and NAOJ.

1.3. Transmission

Satellite communication was used to transmit real-time images of the total eclipse because no wired communications network system connects Iwo Island to the Japanese mainland. Figure 1 schematically displays the transmission strategy used to broadcast the eclipse images.

The video footage taken on Iwo Island with HD cameras by the NAOJ and NHK staff was transmitted by wireless communication to WINDS — a Japanese communication satellite. Since WINDS supports multipoint casting, the data were communicated to several receiving stations (the main and backup stations). At the main receiving station, the data were converted from radio to packet and then sent to NAOJ's server via the JGN2plus network — an extension of the Japan Gigabit Network 2, an open testbed network.

Between the receiving stations and the points of display a wired network communication system was used. The NAOJ server broadcast the live HD images via the internet to large museums and public halls. In addition to HD images, WMV-formatted data was delivered to smaller museums, community centres and public halls.

1.4. Procedure for live broadcasting

The procedure to receive the real-time images and copyright statement was complicated and was the source of significant negative feedback from users.

Applicants first sent in their forms, then submitted a signed covenant stipulating the terms of use of the live video and the copyright notice. This rather complicated procedure evolved from the fact that WINDS transmitted the real-time images. WINDS is operated by JAXA and the National Institute of Information and Communications Technology (NICT). The WINDS project team insisted that the credit should be stated clearly in images of the real-time streaming, and that each receiver had to submit a contract.

Upon approval, users obtained a URL with which they could view the live images and were advised to test the connection to confirm that they could watch the webcast. NAOJ provided a server to broadcast a test video. Due to the decision to distribute high-quality WMV data the server capacity limited the number of receivers and so 35 receivers were accepted, based on a first-come-first-serve basis.

Some facilities abandoned the real-time WMV data coming from NAOJ's server. Although we reduced the quality of HD video when converting it to the WMV format, the required transmission rate was still too high for some facilities. These facilities were provided the real-time images by NICT, which had set up a new server for this project.

Figure 1. Schematic showing the transmission strategy for total eclipse images. The picture of Japanese communication satellite WINDS is courtesy of the Japan Aerospace Exploration Agency (JAXA).

2. Results

To the best of our knowledge, ten TV stations, a news agency, four science museums and a university primarily obtained HD images, which they distributed over their broadcasting networks. The WMV video was delivered to 35 facilities. We restrict the following discussion to the facilities to which we (NAOJ) provided the data, and exclude the facilities that obtained images from the NICT server.

Because public viewing was free of charge and staff working at the viewing points could not count attendance, the total number of public-event viewers is not accurately known. However, based on the capacities of the various viewing facilities, we estimate that over 5000 people viewed the event via HD images on large-screen displays (Figure 2). The public WMV displays were viewed by at least 29 300 people. Some facilities reported that the number of participants quoted could be an underestimate as the numbers at their events exceeded the venue capacity.

Figure 3 shows transmission rates for the facilities that received the WMV broadcast. Thanks to the connection test, most users enjoyed live video of the total eclipse. As Figure 4 shows, most facilities that received WMV video made it available for public viewing. Public viewings at museums, community centres and public halls were particularly popular and effective as the staff were acquainted with astronomy and could give lectures before, during and after the public viewing. Facilities with science communicators were also likely to have provided public lectures accompanying the total eclipse video.

Based on feedback from staff working at the viewing facilities, we determined that, because the total eclipse was observable in Japan, public facilities that previously were not sensitive to astronomy were motivated to show the real-time images, despite the locations being limited and far from the mainland.

Members of the public who attended the events commented in the questionnaires distributed that:

"The images showed the total eclipse with so much presence that we had the illusion of actually observing it."

"It was a good opportunity; listening to the explanation of the phenomenon, observing the partial eclipse with our eyes and watching the total eclipse on screens."

Several comments mentioned the sense of presence — something that the small screen of a PC would struggle to achieve. This is one advantage of having public viewing events. The real-time images also served as a backup for eclipse-observation events. Unfortunately, clouds covered a large fraction of Japan on the day of the eclipse, so observing the partial eclipse was difficult. However, even in these bad weather conditions, facilities were able to show our images of the eclipse to the participants and visitors.

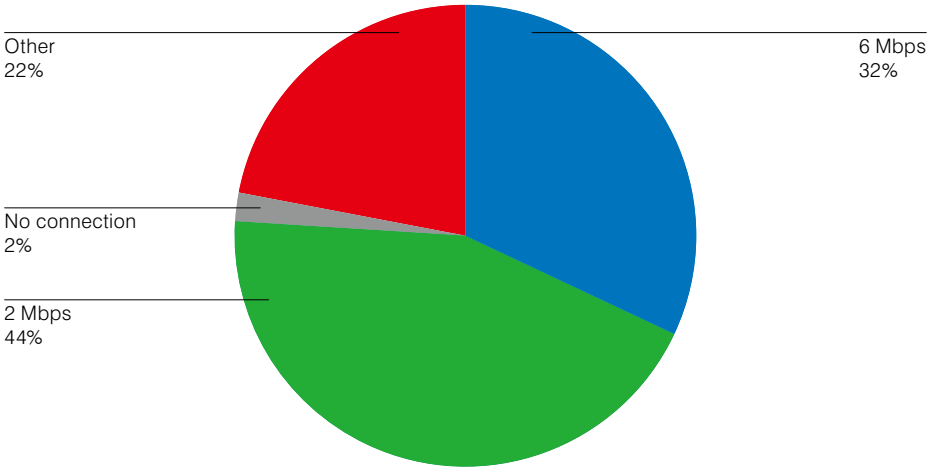

Figure 2. *Percentage of WMV receivers who obtained the given transmission rates. "Other" means users who did not respond to our questionnaire.*

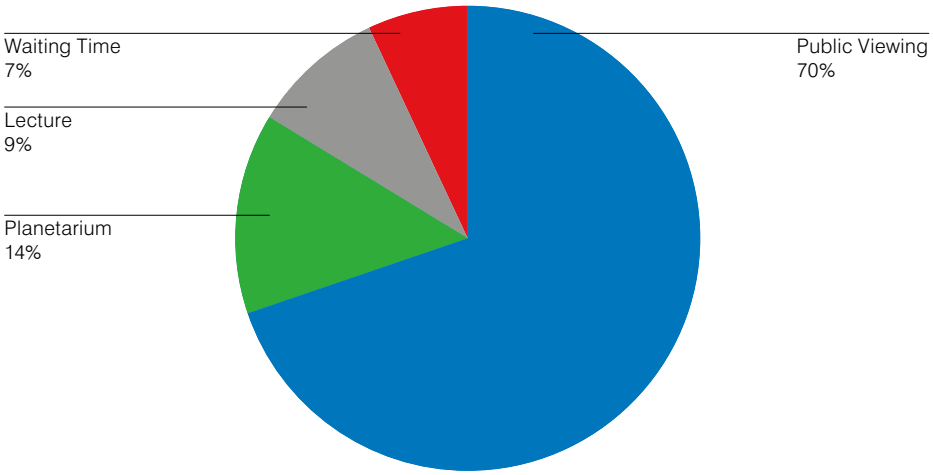

Figure 3. *Use of WMV real-time video.*

3. Lessons learnt

Providing a variety of delivery methods is important. For the sense of presence and to share the excitement with other people, large-screen public viewing of high-quality images is effective. However, watching images on a PC is more convenient and so is also an option worth offering.

As previously noted the copyright and permissions procedure for the live broadcasting was poorly received and the main source of negative feedback. These demands were relaxed after the recorded tapes arrived in Tokyo because, at this point, we no longer needed to transmit the images via WINDS. At present, the recorded images are freely available with only a short copyright notice. Experience from this project and from exchanging the videos and images with many science communicators showed that, to maximise propagation effects, recorded video and images should not be highly protected by copyright but should be made freely available to the public.

Projection of real-time images on a large screen requires wideband communication

Figure 4. Participants at a public viewing. Credit: JIJI Press Ltd.

Figure 5. Participants enjoy a collaboration combining the movie of the eclipse with a musical performance. Credit: Keio University.

network systems. Today's network capacity limits the amount of data we can transmit to personal terminals. Thus, choosing the appropriate data quality is important; images that can be browsed comfortably should be provided for individual use, whereas transmitting HD images is more suitable for museums and public halls, which could use them to conduct various outreach and educational activities. In other words, for today's outreach activities, both the images and the delivery methods must be optimised for either large screen or personal display.

4. Recommendations

We recommend preparing a beginners' manual or question and answer document before any public announcement of this kind of project. After we announced our intent to deliver images of the total eclipse from Iwo Island, groups that did not know how to connect to the internet asked us to provide real-time images. We realised that a phenomenon such as the total eclipse attracts people from outside astronomy, or even the natural sciences. People who have no experience of public outreach activities for astronomy and little knowledge of the internet. This resulted in an unexpected workload for us, because our manual was not written with this target audience in mind, so we had to answer each group individually and on a very basic level. In particular, those designing the HD images requested aid in providing lectures and setting up network systems. The level of support we could provide depended on the organiser's resources. If the staff at all the groups that planned to receive our streaming images had been sufficiently educated in information technology (IT), our workload would have been much lighter. These problems may have been avoided and the workload reduced if a frequently asked questions document or manual for beginners had been produced. A step beyond this would be to organise a help desk or call centre, if possible.

5. Conclusion

Although the number of YouTube viewers was much larger than the number of public-event participants, we do not feel that this justifies total reliance on the individual communication method. Because science communicators were usually present at the public viewing events to explain the astronomical event, these outreach activities proved important for providing a deeper understanding of the astronomical phenomenon and astronomy in general.

To organise a successful public viewing event using HD video streaming, we recommend preparing a detailed manual for IT beginners in advance. To maximise the use of the recorded video and images, they should not be highly protected by copyright but be made freely available, and both the images and the delivery methods must be optimised for either large screen or personal display.

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Biographies

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