Around the World in 80 Telescopes

Douglas Pierce-Price
ESO ePOD
E-mail: dpiercep@eso.org

Simon Lowery
ESO

Michaela Emundts
mindandvision

Andreas Wojtaschek
mindandvision

Mike Simmons
Astronomers without Borders

Lars Lindberg Christensen
ESO ePOD

Pedro Russo
IAU/ESO ePOD

on behalf of the Around the World in 80 Telescopes Production Team [1]

Key Words

Web Communication
Live Webcast
Broadcast

Summary

"Around the World in 80 Telescopes" was a record-breaking and unprecedented, live, 24-hour public webcast featuring most of the research-grade astronomical observatories both on and off the planet. It was part of the 100 Hours of Astronomy Global Cornerstone project of the International Year of Astronomy 2009. The goal of the webcast was to give members of the public a snapshot of life at research observatories around the world during a single 24-hour period, showing viewers the wide range of astronomers' activities at many, often very different, observatories. Here we give a full overview of the various components that went into the planning and implementation of this event, which was coordinated and executed by the ESO education and Public Outreach Department.

Introduction

The "Around the World in 80 Telescopes" webcast was coordinated from the European Southern Observatory (ESO) headquarters in Garching, near Munich, Germany. The 100 Hours of Astronomy event took place from 2–5 April 2009, and "Around the World in 80 Telescopes" itself ran from 09:00 UT on 3 April to 09:00 UT on 4 April.

The original concept was to visit all the observatories at close to local midnight, following the night around the planet. The final schedule was more flexible than this, partly because the "local midnight" concept was based on the idea of ground-based optical/infrared observatories, but also for practical reasons to do with filling the timetable properly.

History

The concept of a webcast from research observatories first came up in February 2006 in discussions between Lars Lindberg Christensen, Dennis Crabtree and Ian Robson from the International Astronomical Union's Commission 55 (Communicating Astronomy with the Public). Commission 55 had been asked to provide input for the implementation and content of a year of astronomy to the IAU Executive Committee. The concept was initially fairly ill-defined, including ideas like: "Showing the global network of observatories and the daily lives of astronomers... Live transmissions... Get the public in direct contact with the scientists."

In March 2006 this evolved into the concept of a 24-hour webcast with, now in hindsight, rather long, 2-hour segments (i.e. 12 observatories in total). This idea was supported by the Communicating Astronomy with the Public meeting in Athens in 2007, at which a 24-hour global star party was also suggested. Early in 2008 the webcast and the star party were combined by the IAU Executive Committee IYA2009 Working Group and the combined project grew in duration to approximately four days (the "100 hours") to allow public activities to occur during the week and at a weekend, and to reduce the risk of poor weather affecting the entire event. As a result, the research observatory webcast became a major 24-hour event embedded in the overall four-day series of events.

Fairly late in the process, in April 2008, the IYA2009 Working Group were looking for suitable chairs for the two components and appointed Douglas Pierce-Price from ESO for the webcast part and Mike Simmons from Astronomers without Borders (AWB) for the sidewalk astronomy part.

Table 1. The scheduled timetable for the webcast in Universal Time. Note that a small number of slots were moved in the live event, and there was an additional pre-recorded video contribution, from SOFIA.

UT Time	Observatory
09:00	Gemini North Telescope
09:20	Subaru Telescope
09:40	United Kingdom Infrared Telescope (UKIRT)
10:00	W. M. Keck Observatory
10:20	James Clerk Maxwell Telescope (JCMT)
10:40	Canada-France-Hawaii Telescope (CFHT)
11:00	Submillimeter Array
11:20	Caltech Submillimeter Observatory (CSO)
11:40	MOA Telescope
12:00	Anglo-Australian Telescope (AAT)
12:20	GEO600
12:40	Nobeyama Radio Observatory
13:00	Gunma Astronomical Observatory
13:20	Okayama Astrophysical Observatory (OAO)
13:40	Themis (Observatorio del Teide)
13:50	SolarLab (Observatorio del Teide)
14:00	Quijote (Observatorio del Teide)
14:10	ESA's XMM-Newton & INTEGRAL
14:40	Atacama Pathfinder Experiment (APEX)
15:00	Atacama Large Millimeter/submillimeter Array (ALMA)
15:20	European VLBI Network (EVN)
15:40	Westerbork Synthesis Radio Telescope (WSRT)
16:00	LOFAR, the LOW Frequency Array
16:20	Virgo Gravitational Wave Detector
16:40	Plateau de Bure Interferometer
17:00	Jodrell Bank Observatory
17:20	Hubble Space Telescope
17:40	Swift Gamma Ray Burst Explorer
18:00	Fermi Gamma-ray Space Telescope
18:20	The NRAO Very Large Array
18:40	Himalayan Chandra Telescope
19:00	NRAO Robert C. Byrd Green Bank Telescope
19:20	SOHO and TRACE
19:40	STEREO
20:00	LIGO Gravitational-Wave Observatory
20:20	Galaxy Evolution Explorer (GALEX)
20:40	Chandra X-ray Observatory
21:00	Southern African Large Telescope (SALT)
21:20	Spitzer Space Telescope
21:40	Observatoire de Haute-Provence
22:00	Calar Alto Observatory
22:20	IRAM 30-metre telescope
22:40	Hinode (SOLAR-B)
23:00	Gran Telescopio Canarias (La Palma)
23:10	William Herschel Telescope (La Palma)
23:20	Telescopio Nazionale Galileo (La Palma)
23:30	Swedish Solar Telescope (La Palma)
23:40	Allen Telescope Array
00:00	Telescope Bernard Lyot (TBL), Pic du Midi
00:20	Parkes Observatory
00:40	Space Sciences Laboratory - UC Berkeley
01:00	Hobart 26m (Mount Pleasant Observatory)
01:20	AIGO Gravitational Wave Observatory
01:40	Shanghai Radio Telescope
02:00	Arecibo Observatory
02:20	ESO Very Large Telescope (VLT)
02:40	Concordia station, Dome C, Antarctica
03:00	Las Campanas Observatory
03:20	ESO La Silla Observatory
03:40	Rothney Astrophysical Observatory
04:00	Gemini South telescope
04:20	Cerro Tololo Inter-American Observatory
04:40	Molonglo Observatory Synthesis Telescope
05:00	McDonald Observatory (Hobby-Eberly Telescope)
05:20	Apache Point Observatory
05:40	Large Binocular Telescope Observatory
06:00	TAMA 300
06:20	Arizona Radio Observatory SMT
06:35	Vatican Telescope, Mt Graham
06:50	MMT Observatory
07:05	Kepler Mission
07:25	South Pole Telescope and IceCube
07:40	Kitt Peak National Observatory
08:00	Lick Observatory
08:20	CHARA (Mount Wilson)
08:40	Palomar Observatory

Planning

It was decided at an early stage to have a strong role for the central coordinating site, with host presenters speaking to the remote observatories, rather than simply having each observatory take full control of the webcast for a certain time. This was done to give a unified style to the webcast, and to avoid speakers giving monologues to the audience.

For the live video connections to the observatories from Garching H.323 videoconferencing was the most appropriate choice. It provides a robust, professional solution, and many observatories already have dedicated hardware for video-conferencing that supports H.323 (for example, from the manufacturers Tandberg and Polycom).

Segment content

Rather than a few long webcast segments (as in the original concept of 12 two-hour timeslots), we decided that a larger number of shorter segments would make the pace of the event more exciting and allow us to feature more observatories. For example, 20-minute timeslots allow a total of 72 different observatories to participate.

For ground-based optical and infrared observatories, which we aimed to visit at close to local midnight, we would, in almost all cases, not be able to see the telescope itself. It would also not be possible to see the telescopes of space-based missions live, for obvious reasons. To give viewers the opportunity to see these facilities in a way not possible through a videoconference unit, and to avoid endless shots of control rooms, we asked observatories to provide a short pre-recorded video about their facility, lasting approximately five minutes.

As an additional "news" element, we also asked observatories to provide a previously unpublicised astronomical image, while understanding that not all facilities would be able to do so.

To make things simpler for the large number of separate webcast segments, we adopted — wherever possible — a standardised structure for each segment:

1. Introduction from the host in Garching.
2. Pre-recorded video from the observatory.
3. Presentation from the observatory speaker, in the form of a loosely scripted discussion with the host.
4. Presentation of a previously unpublicised astronomical image, where possible.
5. Further discussion and questions.

Contacting observatories and constructing the timetable

The main call for expressions of interest was distributed through the IYA2009 Single Points of Contact (SPoCs) mailing list and to a list of Public Information Officers at astronomical institutions. We also approached certain observatories directly, and solicited suggestions for specific observatories, either to fill gaps in the schedule at certain times or to expand the range of observatories represented (for example solar or neutrino observatories, or observatories in specific geographical regions such as Antarctica).

It became clear that a standard duration for each segment of 20 minutes (subject to change in certain cases) was the most appropriate for the number of observatories participating. The optical and infrared ground-based observatories were ordered by time zone, with the aim of scheduling them close to their local midnight. There are clusters of many observatories corresponding to certain longitudes (for example Hawaii and Chile), so some flexibility was required. In most cases, radio telescopes were scheduled during the day and space-based missions were scheduled during office hours at the facility from which they would join the webcast. Furthermore, some observatories had specific timeslot constraints, which we accommodated wherever possible.

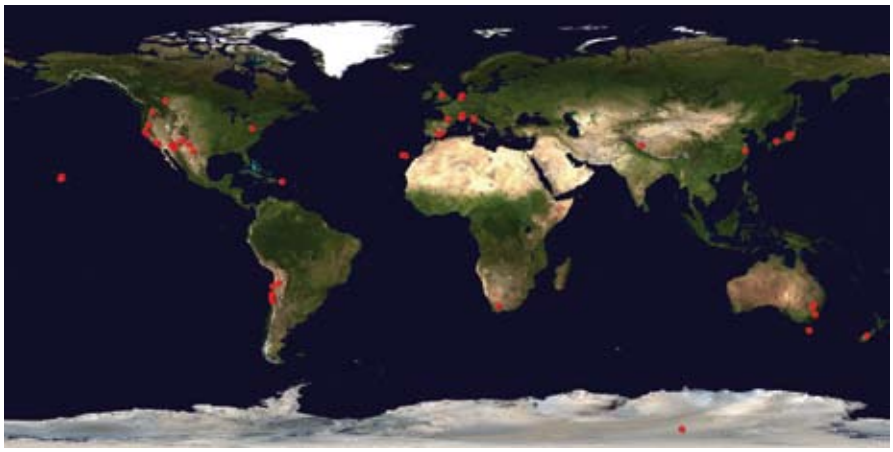

Figure 1: A map of the world, showing the global scope of the "Around the World in 80 Telescopes" 24-hour live webcast. The red dots show just some of the observatories (and ground locations for space-based telescopes) that participated in the event. "Around the World in 80 Telescopes" took viewers to every continent, including Antarctica! Credit: ESO/L. Calçada.

While we aimed to include many, if not all, of the "most advanced" observatories, no specific criterion such as telescope size was used. Neither was the duration of each segment weighted according to the perceived importance of the telescopes. It was also important to have a range of types of observatories and locations (we included observatories from all continents, including Antarctica).

After a lengthy scheduling process, the timetable no longer rigidly visited each observatory close to local midnight and it did not move uniformly westward around the planet. However, this had the advantage that a viewer watching an hour or two of the webcast would see a range of different kinds of telescopes in different locations.

Implementation

In the very early stages of planning, we considered doing all of the work to produce the webcast (videoconference links, overall video production, and web streaming) using in-house resources. However, it rapidly became clear that the technical aspects of the latter two components would be best handled by third parties.

Videoconference connections

As described above, we used standard H.323 protocol videoconferencing for the links between the remote observatories and ESO Garching. This provided a robust and high quality connection (where the underlying network connection was sufficiently good), ESO has significant in-house expertise in videoconferencing and most large observatories already use H.323-compliant systems.

A Tandberg 800 Media Processing System (MPS) multipoint control unit was used with multiple virtual "rooms" configured to provide the bridging capabilities needed, with participants being switched between rooms as necessary:

1. Dial-in room: this room provided a way for the few participants who could only dial in to ESO to dial directly to a given IP address. There was also an ISDN direct dial connection set up in this room.

2. Control conference room: each participant was placed in this room about 30 minutes before that observatory's segment, where they were greeted by the videoconference operator, using a Tandberg T1500 MXP unit in the "backstage" area, and given information before going live.

3. Live conference: participants were switched into this room for their live segments. Here a Tandberg 3000 MXP unit was connected directly to the video and audio mixers so that the observatory could interact with the host and be shown in the webcast.

In certain cases, several consecutive participants were needed, for example, from Teide or La Palma. To achieve this seamlessly, the multiple remote sites were connected in the live conference ("Room 3"), and all but the desired live participant had audio and video muted.

In most cases the bandwidth was set to 768 kbps, but in cases where this was not sustainable the bandwidth was reduced to accommodate the limited connection. The connection quality was tested by checking for packet loss and jitter while the remote site was connected to the control conference ("Room 2").

During the testing phase before the webcast, the main challenge was dealing with observatory firewalls, and required coordination between the network teams at ESO Garching and at the observatories.

The output from the Tandberg 3000 MXP (Room 3) was fed directly to the video production team's vision mixer and audio mixer, so that it could be seen and heard by the presenter and mixed into the webcast stream as needed.

If technical problems arose, the system we used could fall back on a basic (audio-only) telephone connection. We therefore requested that observatories send us a still image showing their chosen speaker on the telephone, to be used in such a situation. Fortunately it was not necessary to use this fallback option.

Public web pages

The public web pages about the webcast were hosted on the main 100 Hours of Astronomy website[2]. Here, we provided general information about the webcast, as well as a schedule for the event. Each observatory name in the schedule linked to a page of basic information about that observatory (description, photograph, Google Map showing location, and so on). All schedule times were given in Universal Time (UT), but with these times linking to pages[3] that presented these UT times converted into local times in major cities around the world. This was simpler than implementing a method for website visitors to view the schedule with local times in their own timezone.

Closer to the date of the webcast, the backend of the schedule was converted into a database with a user interface for changing the times of segments, and whether a segment should appear in the "Schedule" section (with an associated time) or in the "Archive" section (with an associated link to a recorded video). The schedule was also converted to update asynchronously using AJAX, so that the webpage would automatically reflect any schedule changes, without the whole page having to be reloaded. This was required so that embedded video players would not have to be reloaded. Finally, a Google Maps world map overview, showing the observatory locations, was also implemented.

Video players for the webcast were implemented by embedding Flash video players for the stream from Ustream.tv. Observatories, media outlets, and anyone else interested were encouraged to embed the show on their own websites in the same way.

The Ustream.tv page for the 100 Hours of Astronomy stream was also customised, as far as was possible within the Ustream interface, to provide information about the event.

Video production

For the overall video production, we hired the German company *mindandvision*, who had also provided video production and webcasting for the German IYA2009 opening ceremony in Berlin. They were chosen in part because at this event they had demonstrated the ability to combine a videoconference connection (to ESO's Very Large Telescope on Paranal), a local host or presenter and an internet streaming provider well.

We selected a widescreen aspect ratio of 16:9 for the production, as opposed to the older aspect ratio of 4:3.

Pre-recorded videos

We requested that each participating observatory provide us with a pre-recorded video, or "trailer", approximately five minutes long, to give an overview of their observatory and show material that could not be shown during the videoconference link (such as animations, external shots, daytime views or helicopter footage). We provided a set of "ideal" and "acceptable" formats for this video, and then used the ESO in-house video team to convert all files into the single format requested by *mindandvision*.

As the webcast was global in scope, observatories were based in countries with differing video standards. In particular, while we worked internally with a framerate of 25 fps (frames per second), many observatories, particularly in the US, were in regions where the framerate standard is 30 fps. We therefore converted the footage framerate where necessary. In addition, not all observatories had 16:9 widescreen video available, so their footage was "pillarboxed" to fit the widescreen frame. Due to the large number of videos, we did not have time to make "tilt-and-scan" versions which would have filled the full 16:9 frame, and in some cases this was not possible anyway, because the 4:3 video contained material such as text captions or important graphics near the edges of the frame.

For another striking visual element, and to give a sense of geographical location on the planet during the webcast, we created a 15-second animation for each ground-based observatory in Google Earth Pro, with a zoom from space (showing the globe) down to the observatory site. These were played during the hosts' introductions to each segment.

Live video elements

Production of the live video elements was handled by the external company *mindandvision*. The local hosts were filmed against a bluescreen so that they could be displayed in a virtual set, with a virtual monitor in the background for displaying still images or video.

At the introduction of each segment the host was shown in the virtual set with a Google Earth zoom video on the virtual monitor where available. The host introduced the pre-recorded video for the observatory, before moving to the live videoconference connection. Three different shots were used during the videoconference: the host in a virtual set with remote speaker on the virtual monitor, remote speaker fullscreen, and host and remote speaker side-by-side in a "double box" layout. Switching between these shots, as well as display of on-air graphics and captions, was performed on the fly by *mindandvision*.

The hosts had a microphone and earpiece, and the producer could communicate with them through this. A teleprompter was used to provide guidelines for the hosts' speech, including default questions for the speakers from the observatories. These were intended only as guidelines, and the hosts were encouraged to ask different and/or additional questions, and to improvise an informal conversation. A laptop over the studio monitor, also visible to the host, was used for text messages such as questions from the audience.

Advance tests

Several weeks before the webcast, tests of the system (virtual studio, pre-recorded video, videoconference, host and remote speaker) were made using ESO's Very Large Telescope at Cerro Paranal as the remote site. This also provided a "preview video", which was made available on the webcast's Ustream.tv channel.

Filler material

During the advance tests, the typical segment lasted only about 15 minutes. We therefore suspected that we would need additional "filler" material during the 24-hour webcast. It was not possible to move the individual observatory segments closer together, as some were only available at certain UT ranges. Our plan was to use this filler material if we ran longer than about 5–10 minutes ahead of schedule, or if a technical problem meant we could not reach an observatory during the schedule. We planned to use individual chapters of the IAU's documentary *Eyes on the Skies*, and to repeat earlier segments of the webcast, if necessary. In the end only a very small part of this filler material was used.

Contingency plans

We constructed a detailed set of contingency plans for potential problems (technical problems with the videoconference connections, gaps in the schedule, and so on). These involved swapping observatories in the schedule, playing additional pre-recorded material, and falling back to an audio-only telephone connection with a still image of the speaker on the telephone.

Figure 2. Around the World in 80 Telescopes splash screen. Credit: ESO/L. Calçada.

Figure 3. Host presenters were filmed against a bluescreen (left), and composited into a virtual set with a virtual monitor which could display images or live — or recorded — video (right, upper). An alternative shot displayed the host presenter and the observatory speaker in a "double box" layout (right, lower). The videoconference feed or recorded video and images could also be displayed fullscreen. Credit: IAU/L. Pullen/ESO.

Host presenters

We identified six volunteer hosts, all of whom were ESO staff members. The hosts worked in pairs, swapping after every two observatories, for a total of eight hours each (divided into two shifts).

Web streaming video

Despite initial plans to generate the public webcast stream locally, it became clear that a better solution was to use an external provider. There are many such companies, and we investigated potential costs for the 24-hour live stream.

For a webcast of this duration, a major part of the streaming costs is the bandwidth required. Relevant quantities include the bitrate of each stream, the maximum number of simultaneous streams, and the total duration. Typical quotes that we received for up to 2500 simultaneous streams at a bitrate of 400 kbps were approximately €5000. These arrangements would have fairly hard limits in terms of the maximum number of simultaneous viewers. In other words, even if our average number of viewers was below the limit, viewers at peak times would not be able to connect if we already had too many viewers. It was considered that the uncertainty of the scale of the event made this option unacceptable, in case (for example) an astronomy club, science centre, or other group were unable to make a connection for a public event. We were also unable to commit to an unlimited bandwidth arrangement, as this would have left us open to unknown costs.

Partnership with Ustream.tv

While making enquiries about streaming providers, we were contacted by the team at Ustream.tv, one of the major live webcasting companies. Due to the unique nature and scale of "Around the World in 80 Telescopes", as well as its exciting content, they were keen to stream the show and help us publicise it.

The 100 Hours of Astronomy task group came to an agreement with Ustream whereby they became a global sponsor of the 100 Hours project, in exchange for support and publicity. We also webcast the 100 Hours opening ceremony and science centre webcast through the same Ustream channel.

As a contingency plan, we considered using a backup stream through an alternative provider (to be used in the event of problems with Ustream). However, when problems did occur during the live webcast, we decided not to switch as we felt that the Ustream links had already been very widely disseminated.

Advertising

Ustream's business model is to provide advertising-supported streaming free of charge to the public (both broadcasters and viewers). So advertisements were included, both on the 100 Hours page at Ustream.tv and as embedded overlays on the live video stream. The former advertisements were not visible to anyone viewing the video in an embedded player on another page, but the latter were visible to all viewers.

There were a noticeable number of complaints from viewers about the advertising, which was considered by some to be intrusive. The advertisements served were mostly not clearly targeted at the field of astronomy, and in one case (on the Ustream webpage) promoted a pseudoscientific account of an alleged Earth-impacting comet in 2012.

We knew that we would have to accept advertising on the video stream, and it was considered that this was a better option than paying for a capped stream, or the impossibility of committing to unknown and unlimited bandwidth costs, for the reasons given above. Nevertheless, for future events, an alternative, advertising-free solution is clearly desirable, if such a solution can be found.

Publicity and media relations

The "Around the World in 80 Telescopes" media strategy was defined in collaboration with the IYA2009 Secretariat and the IAU Press Officer. This strategy included two press releases for 100 Hours of Astronomy: the first one on 10 February 2009[4] and the second on 30 March 2009[5], as well as a webcast-specific ESO press release on 30 March 2009[6]. One week before the second IAU/IYA2009 press release, a draft press release text was made available for translation to all IYA2009 National Nodes and participating observatories. This enabled the local organisers and observatories to promote their related activities in their national and local media. Moreover, professional TV stations and broadcasters, as well as various high-traffic astronomy websites, were contacted and invited to feature the event and stream.

During the weeks preceding the event several updates were distributed to the IYA2009 network via the global website and e-mail. A Twitter feed (@telescopecast) was also used to engage with the public before and during the webcast.

Figure 4. Video and audio mixing, including the virtual set and virtual monitor, as well as on-air graphics and captions were handled on the fly by the production team in the backstage area. Credit: IAU/L. Pullen.

Audience interaction

In addition to our Twitter feed, we set up various incoming email addresses for the questions and comments from the public. Some of these were read out during the webcast, and others were answered in e-mail replies.

Staffing and resources

The main direct cost of the event was the contract for the video production. Although the price for other video productions may vary according to external factors such as travel, subsistence costs and which elements are done in-house and which by the company, the costs for this event, which included two people travelling to Munich for a day of early tests in March (three days including travel time), and four people for the webcast itself (arriving two days before the event), were a total of approximately €18 000. Catering costs and taxi costs for the event were approximately €1000, giving a total event cost of just under €20 000. This does not include manpower, which adds up to an estimated 0.8 FTE.

In addition to the project manager's role in advance of the event, other people played important roles. In particular, two interns did much of the liaison with and collection of information from the observatories; dealing with approximately 80 observatories was a significant effort. The web pages were constructed by ESO personnel, and an external contractor was responsible for the dynamically updated content, with a database backend.

The videoconference connections were arranged and tested in advance by IT personnel at ESO.

During the webcast, team members worked in the following roles:

- Producer/coordinator (1 person)
- Videoconference support (2 people)
- Video production (2–4 people)
- Autocue control (1 person)
- Online support (~2 people): updating web pages, Ustream recording console, Twitter feed, e-mails.
- Hosts (six hosts, working in pairs and alternating after every two observatories, worked in two shifts each for a total of eight hours).

In addition, we had logistical support, for matters such as catering, safety, the provision of air mattresses for sleeping and arranging transport for people who had to travel during the middle of the night.

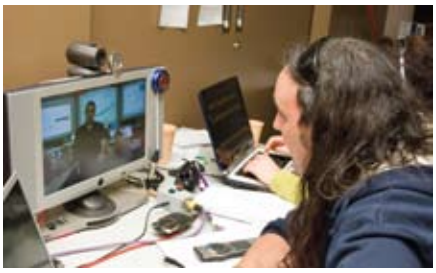

Figure 5. Observatories were connected to a videoconference in the backstage area about 30 minutes before going live, where they were greeted and given information while the connection was tested. Credit: IAU/L. Pullen.

Figure 6. Host presenters saw the teleprompter in front of the camera (right), a monitor showing the live webcast output (left, lower), and a screen for additional text messages (left, upper). Credit: IAU/L. Pullen.

Running the live event

The video production team arrived in the afternoon of 1 April to set up their video equipment and the set, including the lighting and bluescreen. The day of 2 April was spent in setting up and testing, as well as rehearsals by some of the hosts to familiarise themselves with the equipment.

Against the bluescreen, the hosts sat on a tall stool at a (real) table. The autocue was used for "basic cues" rather than to provide a complete script to the hosts. In other words, only basic questions were provided and the hosts were encouraged to use these as guidelines but to improvise, add variation, and ask further questions. The production team could also speak with the hosts through an earpiece, messages to be read out from the audience were displayed on a laptop screen mounted above the hosts' monitor, and simple paper printouts were also used.

The webcast began at 11:00 CEST (09:00 UT) on 3 April. While running through the scheduled observatories, we also kept our Twitter feed updated, invited members of the public to send messages and questions to a dedicated e-mail address, and read some of these out live. Others were replied to by e-mail.

Although we had prepared supplementary recorded material to fill gaps in the schedule, this proved to be almost unnecessary. There were very few cases where we had technical problems with a videoconference connection that required us to reschedule observatories. The main such case was that of the Shanghai Radio Telescope. While we were unable to include it at its scheduled time, we moved it to the penultimate position in the timetable, as we were able to shift the last observatory slightly.

Technical problems

For a 24-hour continuous live event, the webcast went very smoothly, with some minor errors over the 24 hours, for example in captions and video mixing. There were two main areas where other problems occurred: with the live streaming itself, and at the 100 Hours of Astronomy website.

There were two significant periods when we had problems with the webcast stream. The first occurred near the beginning of the 24 hours, when viewers were unable to watch the live stream, but our video was reaching Ustream because the video was appearing in the "recorded clips" archive on the site. This was resolved after about an hour Approximately half way through the webcast, we had a problem when we were unable to broadcast to Ustream. In both cases, a telephone call to Ustream appeared to fix the problem. However, we were fortunate to be able to speak to someone at Ustream during their local night, as we did not have a designated 24-hour support number.

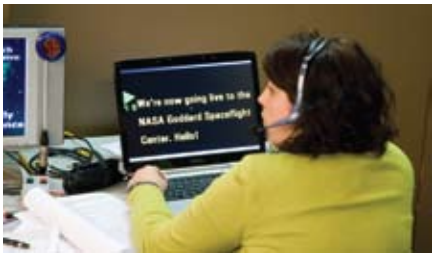

Figure 7. The teleprompter was controlled by an operator backstage, providing guidelines for the host presenters' speech. Credit: IAU/L. Pullen.

The main 100 Hours of Astronomy website[7] itself stopped working under extremely heavy load near the start of the "100 Hours" period. Therefore, during the webcast, we replaced our original content with static pages, and also made information available on the ESO website, which was under our direct control.

The 4am Project

As an interesting side result, at 04:00 local time during the webcast we took a photograph of the backstage team as a contribution to the 4am Project[8], which, coincidentally, was occurring during our event. The aim of the project was to encourage people to submit photographs taken at 4am (local time) on 4 April (4/4).

Metrics and results

Participating observatories

There were a total of 76 timetabled segments in the schedule, corresponding to over 80 telescopes (since some observatories had more than one telescope). In addition, we showed a pre-recorded video submitted by SOFIA when we had time available in the schedule. Different wavelength ranges were well represented, with radio, submillimetre, infrared, optical, ultraviolet, X-ray and gamma-ray telescopes. We also had neutrino and gravitational wave observatories. Ground-based, space-based and airborne observatories were represented. We featured telescopes on all seven continents, including Antarctica. Almost all "major observatories" were included, but we were, to a great degree, dependent on having observatories approach us directly (there was not time to chase individual observatories to participate).

This wide range of observatories gave us a wonderful sense of diversity in the segments, and in the presenters, as did the different things that some observatories did during their segments (roving tours, multiple cameras, presentation of models, rolling of additional video from the remote end, and so on).

Viewer numbers

Viewer metrics measured by Ustream are available for the webcast. We believe that these are underestimates, for two reasons:

1. We saw some periods during the webcast, especially during the second half, where the "viewer count" in the video player was simply not present, even though the live stream was running (i.e. no number was shown, not even zero) and we therefore suspect that not all the data were collected.
2. We know that there is a multiplication factor, as many places showed the webcast to a wider audience (e.g., in science centres and planetariums, at astronomy clubs, or on campuses).

It is therefore quite plausible to double these numbers, or perhaps even apply a slightly larger multiplication factor. The raw numbers from Ustream are:

Ustream report about 107 000 unique viewers, with about 156 000 viewers in total. In addition, hundreds of people were continuously in the Ustream chat box, and indeed there were still a few hundred in there talking about the webcast several hours after it finished.

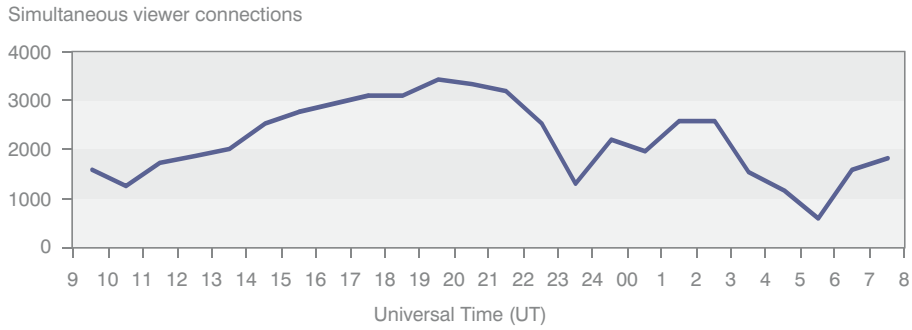

Figure 8. Number of simultaneous viewer connections recorded over the course of the webcast. Times are in Universal Time (UT) from 2009-04-03 09:00 UT to 2009-04-04 09:00 UT. Numbers were recorded by hand from the Ustream player display up to three times per hour, and the average is shown for each one-hour period. No values were recorded during the period 16:00–17:00 UT. The peak number of simultaneous viewers recorded was about 3600. We believe these figures are underestimates, for various reasons, as discussed in the text.

Astronomical images and observatory videos

While not every observatory was able to provide a previously unpublicised astronomical image, we did receive images from 47 of the participants. We also broadcast a total of 67 different pre-recorded videos from the observatories. In many cases, these videos were created for the webcast (sometimes by observatories who had not made video material before), but they are of course now also available for future outreach.

Web traffic

During the period 1–6 April (the "100 Hours" plus one day either side) the 100 Hours of Astronomy website served 2.6 million pages, with 230 000 visits from 170 000 unique sites. However, it also suffered under an extremely heavy load, meaning that we had to replace pages with basic, static content. It is therefore difficult to draw detailed conclusions from the web statistics, but there was clearly extremely strong interest in the site.

Lessons learned

Some lessons learned for future such projects include:

- It was more difficult than anticipated to get timely information from many observatories, despite deadlines. Earlier, harder deadlines may help in the future, although there will always need to be some flexibility.
- Local contacts at each observatory location are vital (national-level contacts can be helpful, but local contacts are needed to make the arrangements).
- With nominally 20-minute segments, there was essentially no empty time in the timetable (given the necessary breaks for switching observatories). The observatories had plenty to say, and the rapid schedule kept the event interesting.
- An improved, advertising-free web video streaming solution is desirable. The streaming problems, and the advertising, were the factors that created the most dissatisfaction among viewers. However, this may involve paying for the streaming. A direct technical contact number should be available and tested in advance.
- A standard computer running the stream in a browser is important so that a view of what the public see is also available.
- It was very helpful to standardise the segments as much as possible.
- Minor changes or problems are potentially multiplied by ~80. Coordinating so many observatories is challenging, but it is possible.
- With more time, it would be desirable to investigate rebroadcasting the stream through television channels, for example through the European Broadcasting Union.

- Having "Around the World in 80 Telescopes" embedded in the 100 Hours of Astronomy project, which also included sidewalk astronomy events and more, was helpful in terms of coordinating publicity and public participation. However, the implementation of the webcast could be kept mostly independent of the other projects, and this would simplify the organisation.

Figure 9. It's 4am on 4/4/2009 at the ESO headquarters in Munich, and the team is 17 hours into the live 24-hour webcast marathon of "Around the World in 80 Telescopes". This photograph was taken as part of the 4am Project. Credit: IAU/L. Pullen.

Feedback

Feedback, both from participating observatories and from viewers (by email and Twitter), is extremely positive. Example comments include:

Thank you so much! It has been an amazing event!

Wonderful, interesting and informative coverage.

This 100 webcast is wonderful, beautiful, inspiring and hugely Interesting!!! Thank you for bringing this to us. It is very well done and I'm greatly enjoying it.

I just wanted to congratulate you all on this amazing project. I've thoroughly enjoyed gaining an insight into the extraordinary people and their work across this planet of ours.

I started watching at the beginning from Gemini North and could hardly tear myself away. I managed to watch most of the amazing 24 hours, finishing off at Palomar. What an amazing ride. Thank you all for a truly groundbreaking programme!

This programme is excellent. Thanks so much for doing this! It is great seeing what these observatories are accomplishing.

I'm very impressed by your presentations, and the production quality is better than most television broadcasts!

Just wanted to say that this broadcast has been the best thing I've ever seen on the internet and one of the most interesting things I've seen in my life. Thanks for the amazing, brilliant, superb work and hope to see all the sections on a DVD or something in future. I'd sure like to watch them over and over again.

**applause* *applause* *applause* *applause* Best web tv I've seen.*

Further tangible outcomes

As a result of "Around the World in 80 Telescopes", we have 24 hours of archived video footage, which is available for online viewing and download[9] (without advertising, as the archive is not only at Ustream). This includes many hours, in total, of outreach videos from the observatories, which can be used independently of the webcast. We are also discussing the possible use of the webcast material in, for example, television programmes. ESO has released an episode of its ESOcast video podcast which shows the making of the webcast[10].

There has been significant interest in a DVD containing highlights of the 24 hours, and this is a project that we are actively considering. However, it will involve a further investment of time, effort and funds, as the archive will need to be edited down to fit onto a single DVD. A final decision on whether to do this has not yet been made.

In addition to the video material, the observatories produced almost fifty previously unpublicised astronomical images, which will also play roles in future outreach activities.

We have developed expertise in running events of this kind, and will discuss the project in talks, beginning with a talk given at the European Week of Astronomy and Space Science (Joint European and National Astronomy Meeting) 2009.

Legacy and conclusions

"Around the World in 80 Telescopes" was the first time that so many research observatories were linked for an outreach activity (and possibly for any joint activity). The webcast was exciting for both participants and viewers, and the wide range of observatories gave a striking demonstration of the global diversity of astronomy.

Taking part in the webcast galvanised, or encouraged, observatories to engage in outreach during the International Year of Astronomy, often in new ways, for example with the creation of outreach videos about their observatories. Not only will the material created be useful in the future for these observatories, but these newly developed skills will play an important role in further outreach activities. We are extremely grateful to all the observatories that participated for their hard work and enthusiasm, and will be distributing certificates of thanks.

We used cutting-edge technology to put the programme together, and despite some technical challenges during the webcast, none of the timetabled observatories were missed out.

"Around the World in 80 Telescopes" was an ambitious, unprecedented and historic event. It was a great success, and we are grateful to the observatories, and the many viewers, who took part in this global astronomical journey!

Notes

[1] In addition to the listed authors, the webcast production team also included: Catherine Moloney, Karin Ranero, Raquel Shida, Mariana Barrosa, Luis Calçada, Martin Kornmesser, Herbert Zodet, Olivier Hainaut, Gaitee Hussain, Markus Kissler-Patig, Joe Liske, Nadine Neumayer, Colleen Sharkey, Berkan Maruthadiyan, Stefan Grohmann, Lee Pullen, Thomas Simon, Gabriele Zech and Britt Sjoeberg.

[2] http//www.100hoursofastronomy.org

[3] http//www.timeanddate.com

[4] http//www.astronomy2009.org/news/pressreleases/detail/iya0904/

[5] http//www.astronomy2009.org/news/pressreleases/detail/iya0908/

[6] http//www.eso.org/public/outreach/press-rel/pr-2009/pr-13-09.html

[7] http//www.100hoursofastronomy.org/

[8] http//www.4amproject.org/

[9] http//www.eso.org/public/events/special-evt/100ha/

[10] http// www.eso.org/gallery/v/Videos/esocast/ESOCAST7_P_FLASH.flv.html

CAPjournal submission guidelines

We are keen to encourage readers to submit their own articles, reviews, etc. Some key points are addressed below.

Technical and esoteric language should be either avoided or used with a footnoted explanation if absolutely required. All contributions will be made to conform to British spelling and punctuation practice. Figures and tables should be referred to 'Figure n' and 'Table n' respectively. Acronyms should be spelt in full once and then parenthesised; henceforth they can then be used as lettered acronyms. Numerals should be used for numbers greater than two words and always for numbers greater than ten.

Manuscripts should be delivered in MS Word or text (.txt) format, with no formatting apart from bold, italics, super- and subscripts. Hard carriage returns after each line should be avoided, as should double spacing between sentences. If the contribution contains figures, these may — just for the sake of overview — be pasted inline in the Word manuscript along with the caption (Word files below 4 MB are encouraged). However, images must also be delivered individually as Tiff, PDFs, vector-files (e.g. .ai, .eps) in as high a resolution as possible (minimum 1000 pixels along the longest edge).

Copyright

Authors are solely responsible for ensuring copyright clearance to reproduce illustrations, text, etc., for which they themselves do not own the copyright. CAPjournal accepts only original submissions and will only reproduce previously published work by special arrangement.

Contact

Submissions should be sent to the Editor:
editor@capjournal.com

Submit articles for one of the following journal sections:

- Announcements
- Reviews
- News
- Resources
- Innovations
- Research & Applications
- Letters to the Editor
- Opinion
- Best Practices
- Interviews

www.capjournal.org

Online issues
Free subscriptions
Article submission

Sponsors