A Hands-on Guide to Video Podcasting[1]

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Summary

Video podcasting, or vodcasting, is the latest evolution of the podcast revolution. The market for on demand multimedia content spans the gamut, ranging from portable media players to computers, and increasingly to televisions through home media centres. This new mode of accessing content is rapidly growing in popularity, particularly among younger audiences. Vodcasting allows a direct link between consumer and content producer, bypassing traditional media networks, making it ideal for EPO efforts. Even modest budgets can yield compelling astronomy vodcasts that will appeal to a large audience. Gateways like the iTunes Store and video community websites such as Veoh and YouTube have created new content markets where none existed before. This paper highlights the key steps for producing a vodcast and shows some statistics from two leading astronomy vodcasts. The reader will see how to make (or improve) a science video podcast and learn about some of the latest developments in this rapidly-evolving field.

Pod•cast
n. [backronym] P(ersonal) O(n) D(emand) (broad)CAST

Vod•cast
n. (1) stylish contraction for "video podcast";
(2) the next revolution in multimedia delivery to the public;
(3) visual content virtually any tech savvy Education and Public Outreach person can produce.

1. Introduction

Right up through the 1970s virtually all video content in the United States and Europe was produced by a few national networks, and could only be seen during specific time slots. During the 1980s and 1990s this "TV 1.0" era gave way to a fundamentally new paradigm of flexibility and choice. In the "TV 2.0" era viewers now had dozens, even hundreds, of niche-market networks, driven by a shift from broadcast to satellite and cable subscription, offering a much broader variety of programming. At the same time, the advent of the VCR, and more recently the Digital Video Recorder (DVR), has also increased flexibility by "time-shifting" content from its broadcast time to an individually convenient viewing time.

Figure 1. Apple iPods are not necessary for viewing video pod-casts, nor even necessarily optimal. The range of portable audiovisual playback devices continues to increase both in performance and in popularity. Seen here is a range of popular playback devices from computers to iPod Video products. Credit: ESA/Hubble (Raquel Shida) & Apple/ Microsoft.

Widespread broadband internet access is enabling a new revolution, commonly referred to as "TV 3.0". Viewers now have the option of bypassing networks and schedules altogether and downloading content on demand for viewing on their computer, portable media player, or television. This has an interesting side effect. There is no longer necessarily a network executive and programming schedule standing between the content producer and the audience; it has become a direct relationship!

One of the instruments of change is the podcast[2]. The "Personal on demand broadCAST" is really no more than an online media file posted alongside an XML file (Extensible Markup Language), known as an "RSS feed" (Really Simple Syndication, see Gay et al., 2007, for more background and a timeline of the early days of podcasting), that is updated as new content becomes available. Media portals or aggregators (such as Apple's *iTunes*) allow subscriptions to the feed and will automatically download new content in the background to their computers as it becomes available.

While the roots of podcasting are in the audio MP3 format, video, often delivered in the popular MPEG4 format, has become increasingly popular in recent years. As quoted in Glaser (2007) the results of the "Arbitron/Edison Internet and Multimedia 2007" study showed that 13% of Americans have listened to a podcast, and 11% have watched a vodcast, up from 11% and 10% the year before respectively.

The video podcast, or vodcast, has become a competitor for traditional television, thus defining the TV 3.0 revolution. Due to the plethora of video formats and download metrics it is not easy to estimate the use of on demand videos. Kirsner (2007) quotes eMarketer that about 107 million Americans watched web video at least once a month in 2006. Vodcast shows such as Lonelygirl15 are now attracting millions of viewers[3], surpassing small niche television shows.

2. Why Vodcast?

Vodcasting allows producers with the ability to tell a compelling story to generate some interesting visuals to connect directly to an audience. This opens up incredible opportunities for public astronomy communication. There are a number of compelling reasons why science communicators should consider vodcasting. The subsections below outline some of the most convincing arguments.

2.1 Astronomy is Visual

Of all the sciences, astronomy is arguably the most visual and is responsible for some of the most memorable images of our time. Video is a natural medium for astronomy communication because of the readily available image, illustration, and animation resources for production. This is illustrated by the fact that three of four vodcasts in the iTunes Science podcast/vodcast top 10 are about astronomy. Astronomy-themed vodcast content is highly appealing to audiences (Gay et al., 2007) and is a natural fit to the medium (Price, 2007).

2.2 Easy to Produce

The standards for online video content are dramatically more forgiving than for broadcast television. The reason for this is partly that a good fraction of the viewers watch on demand content on small and low resolution viewing devices (although the fraction of these may be decreasing if our experience from Hubblecast and Hidden Universe can be taken as an indication of the general trend, see Figure 12). Also, the "Do-It-Yourself style" of many of the established vodcasts lowers the technical expectations among the audience, and puts an emphasis on the content — the idea and the messages. For an example of this different "function, not form"-type content, see the excellent, very low-tech, but remarkably thought-provoking "Pinky Show's Ant's perspective on light pollution"[4]. While a broadcast documentary can cost tens of thousands of dollars or more to produce, effective vodcasts can be made on a shoestring and thus are within reach of even the smallest Education and Public Outreach groups.

It is to be expected that production values will go up with time as the resolution and viewing size increase. For tips on pod- and vodcasting production see Apple (2008b) and Apple (2008c).

Table 1. Top 10 of the iTunes Store Science podcasts/vodcasts. 3 of 10 podcasts/vodcasts are about astronomy, and these are all vodcasts (three out of four vodcasts in total in top 10).

Rank	Title	Type	Published by	Topic
1.	Wild Chronicles	Vodcast	National Geographic	General science
2.	NPR: Science Friday	Podcast	NPR	General science
3.	WNYC's Radio Lab	Podcast	WNYC public radio	General science
4.	Hidden Universe	Vodcast	NASA/Spitzer Science Center	Astronomy
5.	Science Talk	Podcast	Scientific American	General science
6.	Time's GreenCast	Podcast	TIME	General Science
7.	HD – NASA's JPL	Vodcast	NASA/JPL	Astronomy
8.	Second Opinion – PBS	Podcast	PBS	Health
9.	Hubblecast HD	Vodcast	ESA/Hubble	Astronomy
10.	60-Second Science	Podcast	Scientific American	General science

Figure 2. Who needs convincing? After introducing a High Definition format, the Hidden Universe (see below) briefly reached the top spot in the US rankings of all podcasts and vodcasts in September 2007, ahead of major players such as National Geographic, ESPN and HBO. New episodes of this vodcast are routinely downloaded 150,000 times in their first month online. Credit: Authors & iTunes Store

2.3 It's The Future, Not Just a Fad

The explosion of downloaded content over recent years (see for instance Kirsner, 2007) makes it clear that vodcasting is an inescapable trend, not just a fad of the moment.

Vodcasting is supported by powerful industries such as Apple, Google, and video community websites such as Veoh and YouTube. It is also claimed by some that vodcasts may be more effective in instructional situations. Cann (2007) found that the response rate to vodcast was nearly three times higher than to podcasts. The video on demand world of vodcasting is a permanent feature in the multimedia landscape.

2.4 Connect to Large Audiences

Increasing numbers of people are actively searching for compelling online content. The *iTunes* Store now offers over 100,000 podcast episodes (Apple, 2008a). This is particularly true for younger audiences, including children, who are growing up online rather than in front of the TV. Astronomy vodcasts can attract large audiences simply by existing. On 11 February 2007 three of the top 10 science podcasts in the iTunes Store were astronomy shows (see Table 1). Often viewers will find the content without having to be told about it. This is called "pull" distribution as opposed to "push" distribution (where the producer actively promotes and distributes material).

2.5 Online Distribution

The online distribution of video podcasts offers significant advantages over the shipping of more traditional physical audiovisual products like CD-ROMS, DVDs or magnetic tapes such as Betacam. It requires fewer human resources to distribute digital material once an online distribution platform has been constructed and, perhaps most importantly, digital products are available on demand, i.e. when the user needs them.

3. Vodcasting Case Studies

As examples of vodcasts we will look more closely at the production of two successful video podcast series: Hidden Universe and Hubblecast.

Figure 3 The Hidden Universe HD logo.

3.1 Hidden Universe

The Hidden Universe of the Spitzer Space Telescope, produced by NASA's Spitzer Science Center, was the first astronomy video podcast. The first episode went online in May 2006, and one year later it became the first astronomy vodcast to offer a high definition (HD) version. The focus is science, not human interest stories, with new episodes released at roughly monthly intervals.

Figure 4. Two different green screen studios. To the left is the Hidden Universe studio and to the right the Hubblecast studio with narrator Bob Fosbury and host Dr. J. The green screens in the background are used to create a combination of real footage and computer graphics. Credit: ESA/Hubble (Bob Fosbury/ Martin Kornmesser)

Figure 6. Impressions from the recording of the Hubblecast. To the left Dr. J is being styled. To the right the narration is being recorded. Credit: ESA/Hubble (Bob Fosbury/ Martin Kornmesser)

Hidden Universe uses two show formats: Showcase episodes are mini-documentaries (~5 min) featuring a host, rich visuals, and interviews, and Gallery Explorer episodes (~2 min) that display one or more related images with simple overlay text for background. A full Showcase feature takes about a full week of production time to complete, while a Gallery Explorer episode can be produced in about a day. As of February 2008, total downloads above 1.8 million, with recent subscriber surges reaching about 100,000 downloads per month (the HD version accounts for 90% of this traffic).

Figure 5 The Hubblecast logo.

3.2 Hubblecast

The Hubblecast is produced by the European Space Agency's Hubble Space Telescope group and started in March 2007 after the results from Hidden Universe and the Chandra X-Ray Observatory Podcast were presented at conferences. It features the latest news and images from the NASA/ ESA Hubble Space Telescope. The host is Dr. Joe Liske, a.k.a. "Dr. J.", from ESO. Dr. J. was selected from ten other very promising scientists at a screening session by a panel in a casting session slightly reminiscent of reality television. Despite the undoubted ability of many of the candidates, there could only be one host, and the ESO astronomer Dr. Joe Liske had the best combination of talents (ability to memorise text, English accent, presence etc.). His on-screen alias is "Dr. J" and he now receives fan mail on a daily basis via his MySpace page showing that the audience sees Dr. J. as a resource and wants to communicate with.

The production time for an episode is two to five working days, and up to 10 person-days are spent from concept to online vodcast in total. The duration of an episode is five to six minutes. Hubblecast has three channels: SD (Standard Definition), HD (from June 2007) and Full HD (possibly the first Full HD Vodcast in the world, from June 2007). Eight other on demand video formats are also made available online at spacetelescope.org.

More than a 1.8 million Hubblecasts were distributed in the first 11 months of operation (12 episodes). The download numbers seen in Figure 7 were derived from the web access log. Note that duplicate entries for same IP numbers were removed in the Hubblecast stats.

Further information about the Hubblecast is available in Christensen et al. (2007) and on the Hubblecast web page[5].

3.3 Other Astronomy Vodcasts

A number of other astronomy-themed vodcasts have entered the market since the premiere of Hidden Universe in May 2006. See Gay et al. (2007b) for a list of some of the astronomy vodcasts currently available.

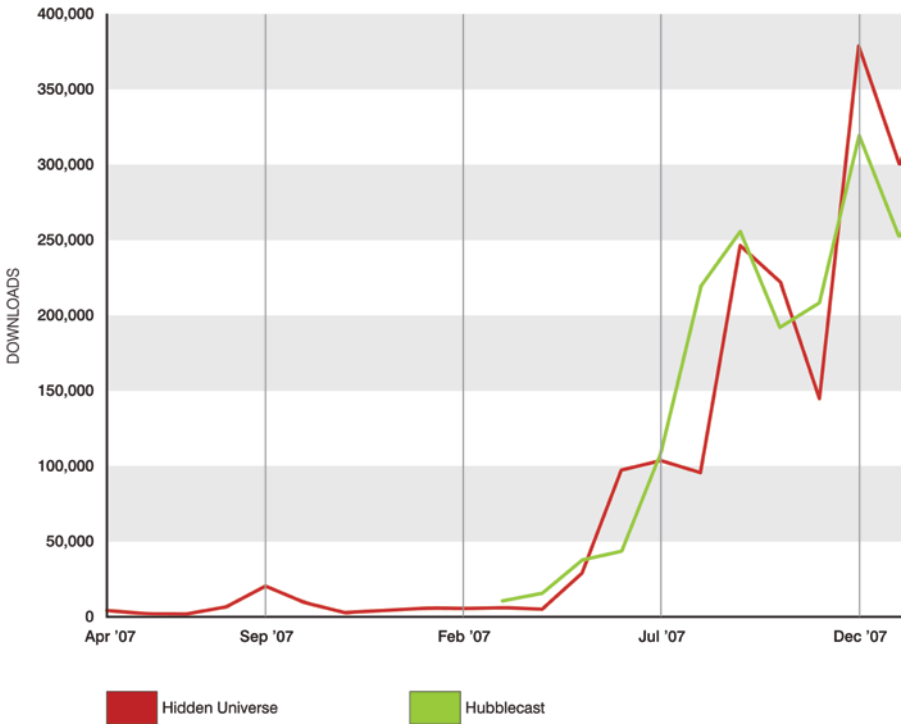

Figure 7. A popular vodcast can attract considerable interest. Here are the numbers of vodcast downloads per month for the Hidden Universe and Hubblecast accumulated over a period of 21 months. Despite being independent vodcasts there is a clear correlation between the two sets of download numbers. Note that Hubblecast started in March 2007. Credit: The authors & ESA/Hubble (Nuno Marques/Raquel Shida)

4. Production Design

In designing a new astronomy vodcast it is worth starting by considering where it should fit into the overall podcast mediascape. Identify the specialty or niche that will make the podcast stand out. What is its intended audience and level of engagement? What is the scope of the topics to be covered? What is its signature graphical look, or style of the host or hosts? Although the aspirations in this initial brainstorming phase may be high, be realistic and make sure that the concept is feasible in terms of production time and costs. A steady stream of fresh and interesting episodes is one of the most difficult things to achieve in podcasting.
A typical production has three phases:

Pre-production

1. Concept development
2. Storyboard writing

Production

3. Filming of host and scientist interviews
4. Audio recording
5. 2D and 3D Animation

Post-production

6. Green screening/keying
7. Video editing
8. Music selection/composition
9. Encoding
10. Distribution

Most of these topics are discussed in greater detail below. Note that the some of the steps of the production process tend to interweave organically and the list above should not be seen as a strictly linear timeline. One of the advantages of the relatively small production teams involved in podcasting, as compared with television or movie production, is that the different steps can more easily interact with each other.

4.1 Production Resources

In a vodcast production where human resources are often restricted, it is vital to manage these resources and make the best of existing assets. These assets include (but are not limited to) images, animations, a host and scientists. In designing a vodcast, one should identify which assets are available and develop a show format to use as much in-hand material as possible. Minimising time-consuming custom production needs is critical for maintaining a sustainable production.

4.1.1 Images

Astronomy images are abundant and are a key resource for any vodcast. Most of the third-party astronomy images on the web are free for use in educational and communication purposes. Even static images can be fantastic for video if slow zoom and/or pan effects are added. This effect is also known as the “Ken Burns” effect after the American director who uses pans and zooms heavily on stills in his productions.

4.1.2 Animations

One or two well-chosen animations, either artistic or derived from science data/simulations, can help communicate a difficult science concept. While they can be time-consuming or expensive to produce, many institutions have broadcast-quality content available online that may eliminate the need for custom work.

Figure 8. The different steps of the keying process. The first image shows the scene as taped in the studio. Next, the parts of the image corresponding to specific colours are made transparent, allowing a digital backdrop to be substituted. Other parts of the studio beyond the green screen backdrop can be removed with a “garbage” matte drawn by hand in the compositing software (here the corners of the matte are numbered). The final composite allows the host to reside within a virtual environment that can be much more compelling than a static set. Note that with the careful application of a garbage matte, the videographer need only ensure that the host remain in front of the well-illuminated green screen. The rest of the background is irrelevant. Credit: Robert Hurt

4.1.3 Host

A regular host can give a personal touch and can help establish an identity for a vodcast. A host can also provide a visual focus when images or animations are not available to illustrate a point. He or she can even make low resolution content less obvious if it is presented as a "newscaster" style insert (limiting the number of on-screen pixels visible). It is critical to cast someone with clear speech patterns and good presentation skills with technical material; it is even better if they can memorise material rather than rely on cue cards.

4.1.4 Interviews

Scientists can bring a personal angle to technical results, and can be a great resource for video. By interviewing them several times on the same subject it is often possible to get a good, clear "take" that gets across key ideas. Plus, anything covered in an interview does not have to be written into the script, simplifying production. Note that not all scientists are equally suited to appear in front of a camera and it is good to screen a potential scientist guest in advance for his or her ability to present the material in a lively and concise way.

4.1.5 Production Time

Both Hidden Universe and Hubblecast use all four of these assets in their productions. Typical end-to-end production times are of the order of a week. However, the Hidden Universe Gallery Explorer format was specifically designed to include only readily available images and animations to provide a rapid-production option (about a day) to assure timely updates to the feed when a full Showcase production is not possible.

The average episode duration of both these vodcasts is on the order of five minutes. Our own experience shows that this is a suitable duration for this type of vodcast. There is a correlation between the size of the viewing device and the acceptable duration of video, as well as between the viewing distance and the acceptable duration (Rocketboom, 2007 and Cann, 2007). A viewer tends to watch shorter videos on small mobile devices with a short viewing distance, and longer videos on TVs or in the cinema with larger distance and a more comfortable viewing position and more suitable surroundings (darkness, acoustics etc.).

5. The Storyboard

Vodcasting is a very "light" medium; the format is short and it is essential to focus on key facts and make them as engaging as possible. The storyboard can make or break a production. It must encompass both the narrative and the visual content and effectively link them.

The first step is to identify the target audience. Is the product intended for children, laypeople, or the informed public? This determines the number of ideas and the level of background information needed to explain them. Traditional news criteria can help to determine the elements that make interesting stories (see for instance Christensen, 2007).

Adapting pre-existing material, such as a news release, can be a shortcut to researching and writing on a new topic. However, spoken dialogue has a significantly different character from written text, and it is important to carefully rewrite such material so it sounds right to an audience. It is also critical to make adjustments to the content if the source material was intended for a different level of audience.

6. Audiovisual Production

Once the storyboard is ready, the visuals for the vodcast must be assessed. Raw material for image and animation segments needs to be found online or developed using animation software. This process can start even before audio and video footage has been acquired if the timings for the storyboard are recorded; this can be done with timed read-throughs or even by using text-to-speech software.

6.1 Shooting Video

Any production with host or interview segments will need to shoot video. There are many options, ranging from on-location in an office, working in a controlled studio setting, or even using substituted backgrounds by shooting against a green screen.

Real footage is recorded with a camcorder either in-house or with the assistance of a small hired camera team, depending on the budget. Naturally, the better the real footage is, the more "cinema-like" the final result, and so using the best equipment that fits the budget is helpful. High definition video cameras today start at just a few hundred dollars (US), but the better quality equipment starts in the thousands of dollars. Advanced prosumer cameras such as the Panasonic HVX200 cost from 6000 US$ MSRP or the Sony HDR-FX1HDV from 4000 US$ MSRP.

6.2 Background Removal & Virtual Sets

It is not too difficult to create a completely imaginary set for your host or interview subjects. The backdrop can be as simple as an image, an animated background pattern, or even a "virtual set" constructed in image and 3D graphics editing programs.

The technique requires shooting the subject against a distinctively coloured backdrop that can be digitally removed, or "keyed" out. Typically these are bright blue or green screens; green is more commonly used as it is less likely to match common clothing or skin tones. Note that these green screen studio installations need not be permanent, but can be set up in about an hour or so, and prices for the backdrop starts below 100 US$/70 EUR. Common editing applications have tools for removing these backgrounds (see Figures 8 and 9).

Shooting green screen footage does place stronger technical requirements on the video equipment. The least expensive digital video cameras will tend to blur out colours, making it difficult to separate the subject from the background cleanly. This leaves an unnatural border that can ruin the effect. A good compromise is to look for video cameras that employ a 4:2:2 colour compression format (with a single colour sample for every 2x2 grid of luminance pixels). Note that colour sampling of 4:0:0 makes keying almost impossible.

It is useful to check online forums to see what results filmmakers have had with specific video equipment before committing to a particular camera.

6.3 Recording Audio

Audio quality is dramatically increased by using an external microphone. The camera's built-in system tends to be omni-directional, pulling in unwanted environmental noise, and even internal camera vibrations. Better options include highly directional shotgun/boom microphones near the camera or lavaliere microphones that clip onto the shirt. Wireless systems allow more freedom of movement, but even wired microphones with long cords can be used flexibly. A high quality microphone will make a big difference to how professional the production feels as audio problems are difficult or impossible to fix after the fact.

Figure 9. An example of the final product of a keying process: Dr. J, a.k.a. Dr. Joe Liske, from ESO, interacting with a globular cluster. ESA/Hubble (Martin Kornmesser)

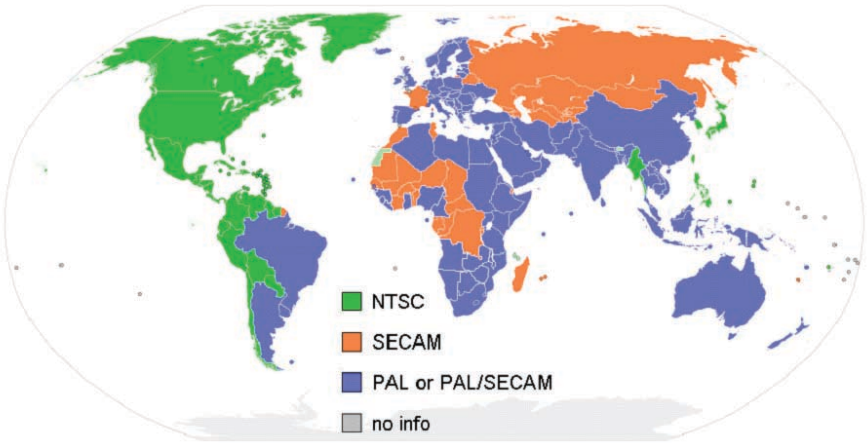

Figure 10. The global distribution of the PAL, NTSC and SECAM formats. From Wikipedia[8].

Clarity and diction are critical for any host or narrator. Very strong accents can be distracting. If a speaker is important to a story but difficult to understand, try to use her/him in shorter segments, and allow her/him to reinforce established points rather than introduce new material.

6.4 Music and Sound Effects

Music and sound effects can dramatically improve the impact of a video. Free sound tracks and effects from the web, as well as copyrighted "pay-per-use" stock music are available for the sound. Many so-called "net labels" exist and have favourable conditions for the use of the music. See Testtube[7] for an example. However, it may be interesting to collaborate with artists who can compose music and sound effects that will fit the specific needs of the project better. Often up and coming musicians will be willing to work for little or no payment in order to gain exposure and professional credits.

7. Editing

The post-production stage follows the recording of the audio and video. At this point the video footage is transferred to the editing system (digitally captured or directly transferred). The various "takes" are screened and the best are chosen and trimmed to remove unwanted parts. If shots are taken at different distances from the subject it is possible to edit a more dynamic sequence by cutting between wide and narrow shots. The remaining video, animation, image, and audio assets are assembled.

The storyboard serves as a template as the project is pieced together like a jigsaw puzzle in the editing software. Video and audio clips are added to the timeline to tell the story. Audio levels are adjusted to be consistent, video colours are corrected, and transitions are added where they improve the storytelling. Finally, extras like music and sound effects are laid into the timeline for the final polish.

Software and hardware that, only a few years ago, would have been considered inaccessibly expensive, is today surprisingly affordable. Mac and Windows computers now come standard with incredible computing power and data input/output rates, and almost any new high-end computer can be used for video editing. Key considerations are lots of storage space (7200 rpm drives, internal or Firewire, but not USB). High definition editing is particularly demanding and requires larger monitors and high performance video cards (this technology changes rapidly; it is worth consulting computer experts to find the best current video card options).

There are many powerful options for video editing software today. Industry standards now include suites like Final Cut Studio and Adobe® Premiere®, but even entry-level products like iMovie can produce a solid vodcast.

Hubblecast, for example, is produced on a high-end dual CPU (dual-core) Dell PC with 4 GB of RAM, Discreet's RTX-2 video card (for live previewing of Full HD footage), a 50-inch Pioneer 5070 plasma screen and a large external firewire RAID hard disk array. Hidden Universe is produced on a quad 2.5 GHz G5 Macintosh with 4 GB of RAM with a colour-calibrated 30" Cinema Display; Final Cut Studio and Adobe After Effects are the primary editing tools.

8. Video Formats

The broadcaster is faced with a dizzying array of image sizes and formats. Traditional US (NTSC) and European (PAL) formats have different frame rates and dimensions that have made production for the global market more difficult (a third format, the French SECAM, also exists). They do, however, share a common aspect ratio (4:3 in width:height).

High definition (HD) formats are quickly becoming the new international broadcast standard. While this makes the market more united and global, there are, unfortunately, an equally dizzying array of formats in these new standards as well. There are two image sizes (both with widescreen 16:9 aspect ratios) and a variety of frame rates and interlacing options.

Interlacing is a workaround to compensate for limited signal bandwidth that allows a complete video frame to be rendered in two separate passes. Alternate lines of an image

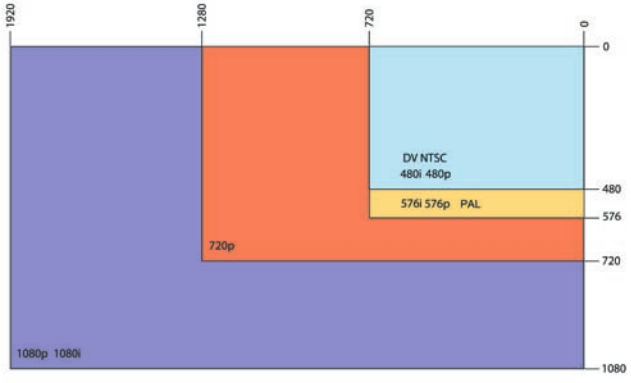

Figure 11. The difference in video format sizes. Credit: Wikipedia[9] & ESA/ Hubble (Raquel Shida)

Table 2. Summary of video formats.

Format	Dimensions [pixels]	Interlacing	Field/Frame Rate [fps]
NTSC (broadcast)	640 [720] x 480	Interlaced	60 (fields)
NTSC	640 [720] x 480	Progressive	24, 30
PAL	720 [768] x 576	Progressive	25
HD (720p)	1280 x 720	Progressive	24, 25, 30, 50, 60
HD (1080i)	1920 x 1080	Interlaced	50, 60 (fields)
HD (1080p, "Full HD")	1920 x 1080	Progressive	24, 25, 30

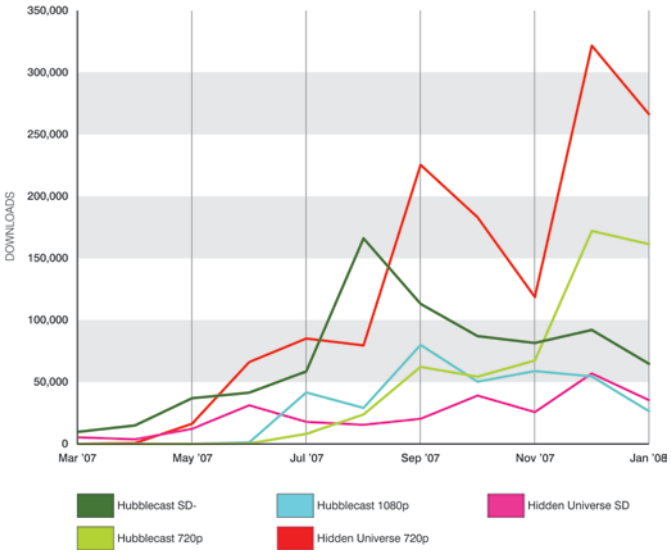

Figure 12. When plotting the number of vodcasts distributed decomposed into format groups, SD (Standard Definition, SD- denotes formats smaller than or equal to SD), 720p and 1080p (full HD, only Hubblecast) it is clear that HD, especially 720p, formats are on the rise and have started to dominate. For Hidden Universe the 720p format is extremely popular and outperformed SD a few months after launching Hidden Universe. Credit: The authors and ESA/Hubble (Nuno Marques/ Raquel Shida)

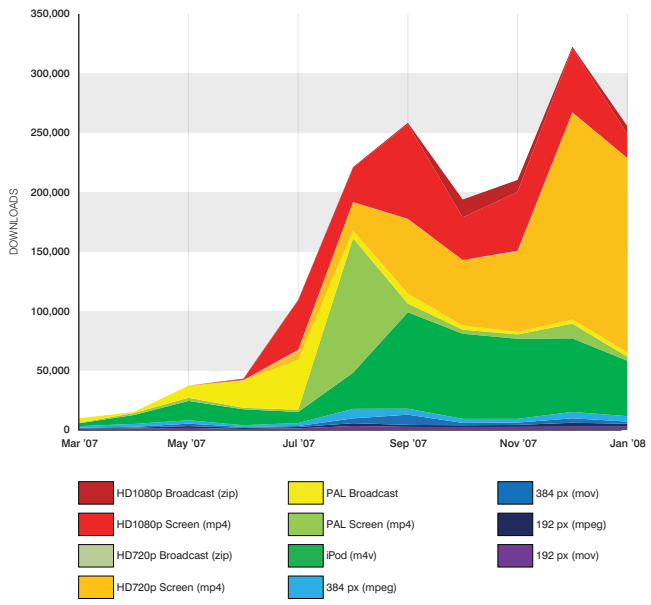

Figure 13. What formats do users choose? This download chart for the Hubblecast shows the increasing resolutions arranged vertically with the Full HD format on top and the smallest available format at the bottom. Credit: The authors and ESA/Hubble (Nuno Marques/Raquel Shida)

(a field) are sent in one pass, and the complementary interlaced field is filled in on the next pass. While this does create a faster-refreshing screen, the resulting interlace artefacts can create an unpleasant effect for computer/online viewing in various broadcast situations. It also makes the footage difficult to rescale to other sizes and formats. These factors make interlaced formats unappealing for vodcast work.

Table 2 and Figure 11 summarise the major video formats. Vodcasters may find it advantageous to produce their projects in a standard television broadcast format even if it is not going to be the final distribution format.

What is the best format for vodcasting? There is no easy answer. Lower resolution formats and lower frame rates make for smaller files and faster download speeds that match to a wider cross section of hardware. For longer format shows (half-hour or more) this may be a practical distribution limitation.

However, modern computers are now easily able to play back and display HD material on computer screens. Many consumers already have HD or Full HD plasma or LCD screens in their home, and media centres and HD players such as Apple TV are becoming increasingly common. Paradoxically, most normal consumers are not able to find much HD content to display on computers or TVs today and this is definitely a niche that can be exploited for science communication purposes.

Choice of aspect ratio is the most significant production consideration when deciding between SD and HD formats. The traditional 4:3 aspect ratio follows the dimensions of older televisions and monitors. The HD 16:9 widescreen format is quickly becoming the universal standard for new televisions as well as many laptops and monitors and is arguably the more forward-looking choice today.

The other consideration for the distribution format is the target hardware platform. For instance, video iPods can handle footage up to 640 x 480 pixels at frame rates of up to 30 fps (frames per second). The newer Apple TVs have an added potential to handle 1280 x 720 frames at up to 25 fps (720p/25). Most new computers can display 1920 x 1080 pixels at up to 25 or 30 fps. Of course once a master video file has been created, it is easy to downsample it to lower resolutions using encoding tools. Flicker is visible at 720/25p

Table 3. Overview of the 11 different distribution sizes and codecs available for the Hubblecast. This overview can be used to interpret Figure 13.

Name	Size	Encoding	Compression	Colour in Figure 13
1080p Broadcast	1920 x 1080	HDV Mode-2 (m2t format, MPEG2 transport stream)	Light	Crimson
1080p Screen	1920 x 1080	H.264	Hard	Red
720p Broadcast	1280 x 720	HDV Mode-1 (m2t format, MPEG2 transport stream)	Light	Pale green
720p Screen	1280 x 720	H.264	Hard	Orange
PAL Broadcast	720 x 576	AVI DV	Light	Yellow
PAL Screen	720 x 576	H.264	Hard	Leaf green
iPod	640 x 480	H.264	Hard	Green
384 px	384 x 288	MPEG1 encoded	Hard	Blue
384 px	384 x 288	Quicktime Sorensen-3	Hard	Dark blue
192 px	192 x 144	MPEG1 encoded	Hard	Indigo
192 px	192 x 144	Quicktime Sorensen-3	Hard	Violet

Figure 14. The iTunes page for Hidden Universe. The SD Format (before May '07) had typical 3-month downloads of 3,000 and a cumulative 1-year download of 12,000 per episode. With the arrival of the HD Format (May '07), the typical 3-month download per episode exceeded 100,000 (!) and has pulled the typical SD 3-month download to 6,500 per episode. Even SD gets a bump in attention from the HD channel! Credit: Apple Store

and 1080/25p due to the large frames and the relatively slow refresh rate.

If one were to distribute and play raw, uncompressed footage, it would be highly impractical and extremely strenuous for the hardware. For the final distribution it is necessary to "encode" the videos into a compressed format designed for easy playback and with a smaller file size. One of the best video "codecs" now in use is H.264 (MPEG4 part 10). Within the limits stated above, this format is compatible with iPods, many other portable media players, and computers running Apple Quicktime. It is also Adobe's newly-adopted standard for flash video. However, offering vodcasts in multiple formats can reach audiences with older hardware; common choices are MPEG1 and Sorenson 3 Quicktime. In addition, posting minimally-compressed high-quality formats makes it easy for television broadcasters to include the content in news and documentary programming. The path from conceiving a vodcast idea to seeing it appear in a TV programme has never been shorter.

A good batch compression tool can simplify the creation of media files. Once this has been set up for the desired formats/codecs and sizes it is simple to take a final source file and create multiple versions of it. Naturally it makes sense to produce a vodcast at the highest desired dimension and frame rate, and then downsample to lower quality as needed. Compressor — part of Final Cut Studio — is used by many Mac users. ProCoder is a good tool for PCs to batch compress many different formats from the largest format in the workflow.

For Hidden Universe the original production format was designed to be 4:3 (640x480) at 30fps. When it moved to a HD format the production was redesigned to a 720p frame at 24 fps. This was aimed to match the hardware capabilities of the Apple TV system, but also offered advantages on HD production. Mastering to a film frame rate of 24 fps cuts down on the number of rendered frames per second, and working with the smaller HD 720p framesize creates edit files that are more that a factor of two smaller than 1080p. This has made HD production more time and resource efficient.

Hubblecast is, in contrast, produced at a full 1080/25p resolution.

In a time of rapidly advancing technology and consumer interests there is no simple answer to the seemingly simple question: "What is the best format to use for vodcasting?" But with the rapidly increasing market for HD televisions and related hardware, there is already a surprisingly strong trend towards large-format content. Since introducing both the 720p and 1080p formats for Hubblecast, download statistics for recent months have shown these HD options account for at least half of the total downloads

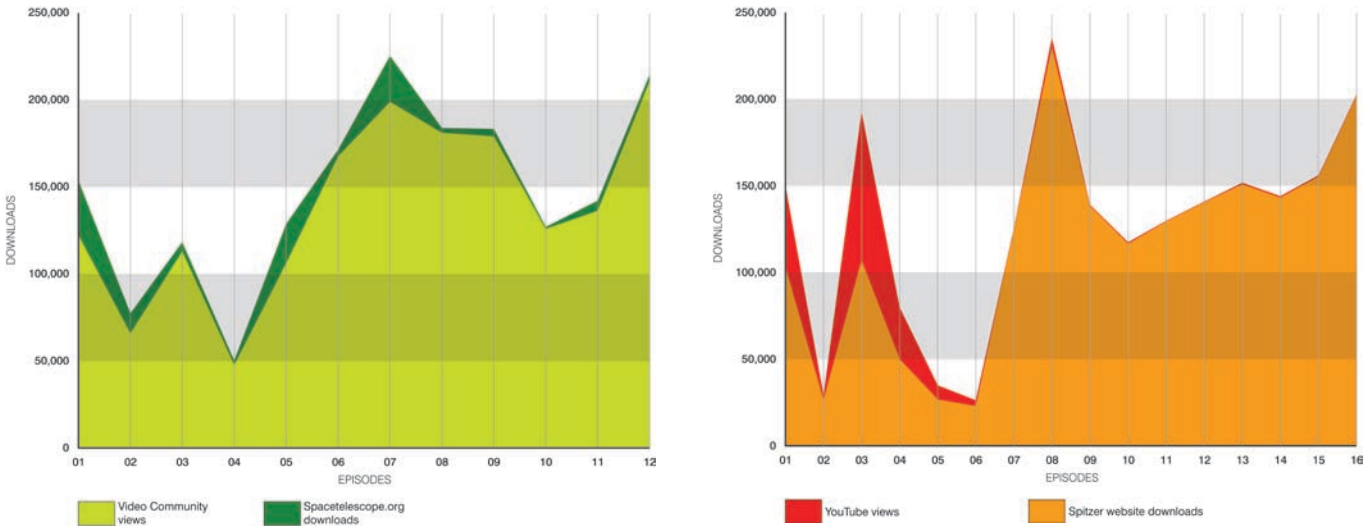

Figure 15. Hubblecast and Hidden Universe downloads per episode. The weak bimodal structure seen (a bump in the beginning, and also a bump for the more recent episodes) may be due to two different interacting effects: the longer any podcast episode is available, the more downloads it will have and the user base is still on the increase, giving more downloads of the later episodes. Video community downloads (in red) make up a maximum of 5 - 20% of the total. Credit: The authors and ESA/Hubble (Nuno Marques/Raquel Shida)

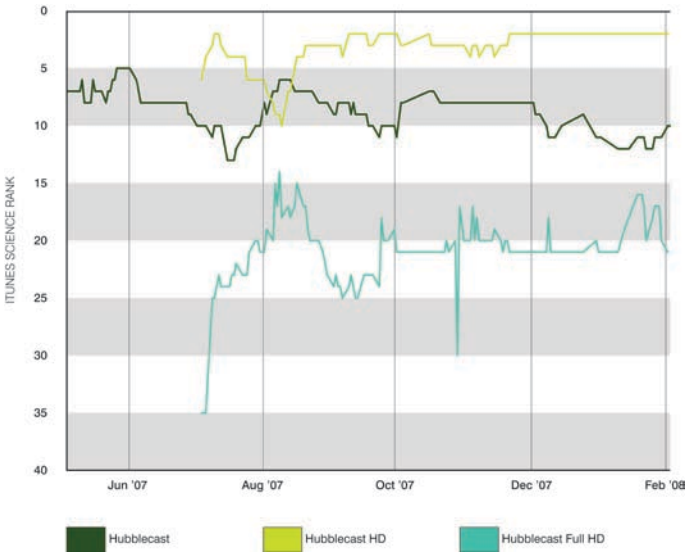

Figure 16. The US iTunes rank in the Science section for the three different Hubblecast channels: SD, HD and Full HD. The HD version (720p/25) is the most popular in iTunes and Full HD is the least popular of the three. Credit: The authors and ESA/Hubble (Nuno Marques/Raquel Shida)

Figure 17. Special iTunes features, such as this Outer Space feature, can boost downloads significantly. Features promote different podcasts across many interest areas and formats. Credit: iTunes Store

and, in January 2008 as much as 75% (see Figure 12). For Hidden Universe the 720p format is even more dominant and is downloaded almost 10 times more frequently than SD.

By analysing the 11 different sizes and codecs available for the Hubblecasts it is possible to obtain even more fine grained information about user download behaviour. Figure 13 shows a further decomposition of the download data into the 11 different codecs/sizes (an overview is seen in Table 3).

Although the user's selection of formats is heavily influenced by small scale fluctuations created by individual files being promoted at different times by different sites (the "slash-dot effect"), some conclusions can be drawn from Figure 13 and 12.

- 720p downloads are increasing with time, indicating that the format is getting a larger user base.
- Full HD downloads seems not to be increasing.
- Total HD (720p + 1080p) started to dominate in October 2007.
- Formats aimed at on-screen viewing with smaller file sizes are especially popular.

The HD format is also extremely popular for Hidden Universe and has begun to outperform SD.

9. Distribution — All about the Ratings!

The final important step in a vodcast production is the distribution and promotion of the video. The primary distribution of vodcasts today is through the iTunes Store. The ITunes page for Hidden Universe is seen in Figure 14.

As the XML feed at the iTunes Store is updated with information on new episodes, this information is displayed for casual browsers looking through the podcast section. As with TV, better visibility will give higher ratings. A good name to the vodcast channel, a "sexy" description and a recognisable icon are critical elements for success. Learn from other vodcasts — what looks interesting and why? Episode titles and descriptions are important

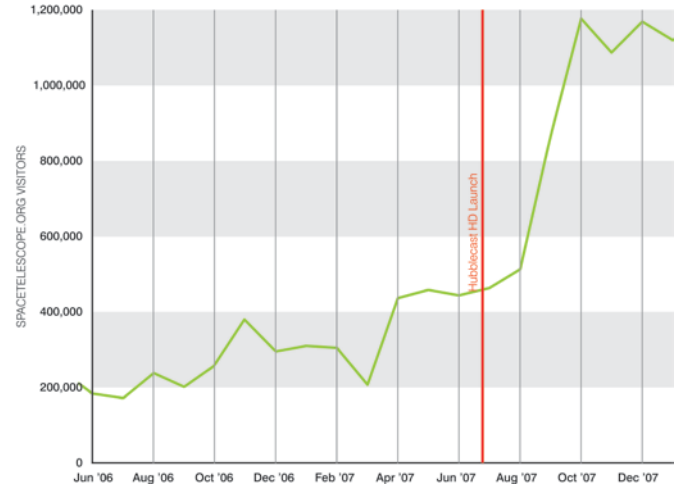

Figure 18. Web visitors on spacetelescope.org as function of time. A dramatic increase seems to coincide with the launch of the Hubblecast in March 2007. Credit: The authors and ESA/Hubble (Nuno Marques/Raquel Shida)

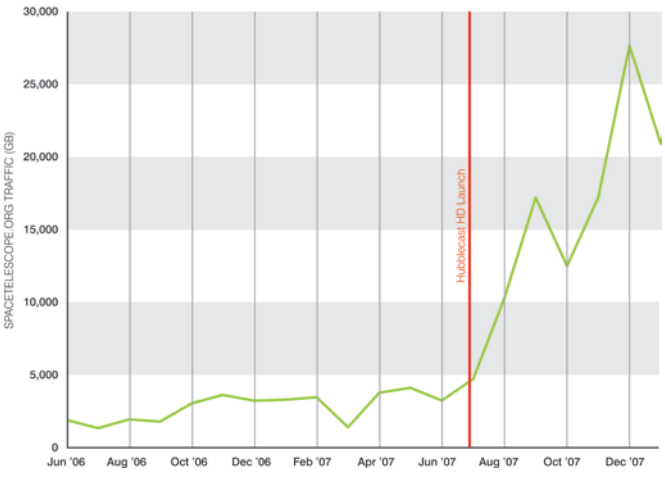

Figure 19. The distribution of HD material may make you more popular, but certainly puts a strain on web servers. The jump in overall (all products) web traffic from spacetelescope.org since the introduction of the HD formats June 2007 (marked by the line) is shown. Credit: The authors and ESA/Hubble (Nuno Marques/Raquel Shida)

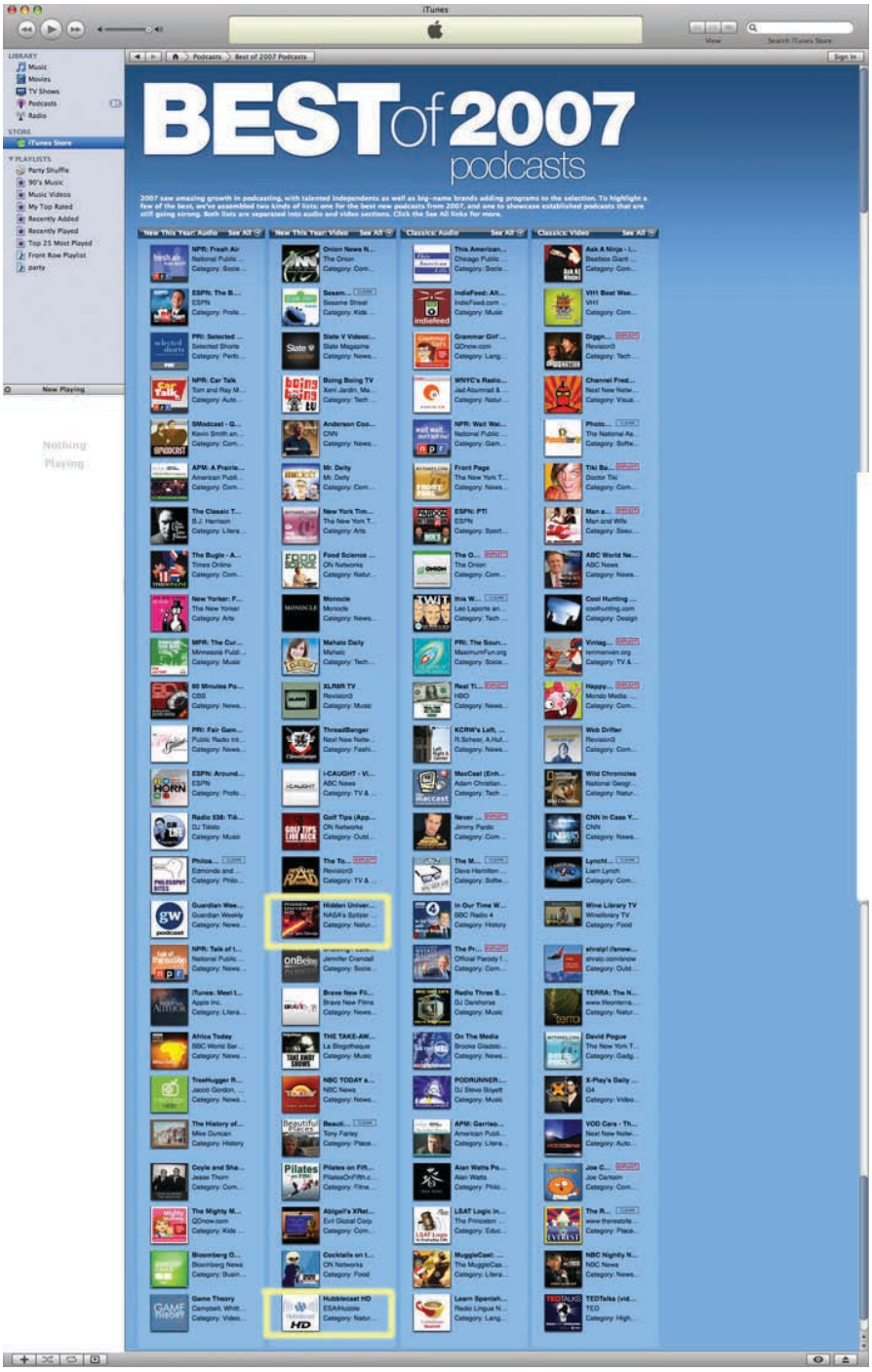

Figure 20. Two astronomy vodcasts actually made it into the Top 25 for New Vodcasts of the year 2007: Hidden Universe and Hubblecast. Credit: iTunes Store

since casual browsers often sample an episode before subscribing. Waste nothing in your description; the first few words can be pivotal in capturing a potential subscriber's interest!

Video community sites such as YouTube, DailyMotion, blip.tv and Veoh can be good additional channels for promoting a vodcast. Download numbers from these pages can be substantial (up to 20% of the total, see Figure 15).

9.1 Webstats

It is interesting to look at a vodcast's potential influence on web statistics. It is perhaps surprising that a single product, such as a vodcast, can have a dramatic effect on the overall web statistics for an EPO office. Figure 18 shows the jump in web visitors to spacetelescope.org after Hubblecast launched in March 2007 and more dramtically after Hubblecast HD launched in June '07 (marked with a line). It is impossible to disentangle the effect of the vodcasts from that of other products and campaigns, but the increase in visitors is striking and is likely mainly due to the vodcasts.

However no measurable effect on the number of web hits was seen. This is not unexpected as every vodcast only accounts for one hit (compared to hundreds of hits per "real" visit). As expected, the Hubblecast HD launch also gave rise to a surge in web traffic (seen in Figure 19). This has become quite dramatic in the most recent months as the HD downloads have increased (see the discussion above).

10. Conclusion

Based on the experience drawn from the two successful vodcasts, Hidden Universe and Hubblecast, we feel confident in saying that vodcasts are here to stay. Delivering content in multiple formats to appease both the desires of instant gratification and of premium viewing quality seems to maximise the potential audience. Our experiences show that being one of the first providers of a new format can pay off, so watch out for new trends, platforms and formats! Whereas the HD formats seem to be on the way to dominate the market a note of concern may be appropriate. The largest part of the population on Earth do not have access to high speed networks and computers. In order not to make the digital divide[10] wider it is advised to maintain some formats in lower resolution.

At the time of writing, 12 episodes of Hubblecast and 16 episodes of Hidden Universe have been released and both vodcasts have been downloaded more than 1.8 million times each. The two vodcasts are — at least for the time being — regularly ranked among the 10 most-viewed podcasts in the science category in the US iTunes, and among the US Top 100 podcasts in total. In 2007 the two vodcasts were even ranked among the best 25 new vodcasts of the year (see Figure 20). Not bad for science communication products!

We plan to keep up with the steady stream of exciting space images seen through the eyes of Hubble and Spitzer, presenting the latest science to the younger generation for as long as this segment of viewers enjoys our work. Who knows what the next trend will be? Vodcasts in 3D HD? Or will there be another even more exciting medium that can help us bring the stars to everyone on Earth? Only the future can tell…

Acknowledgements

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Notes

1. Parts of this paper have appeared in the proceedings from the 2007 ASP EPO meeting and the proceedings from the Communicating Astronomy with the Public 2007 conference.
2. See for instance http://en.wikipedia.org/wiki/Video_podcast and http://en.wikipedia.org/wiki/Podcast
3. According to Wikipedia (accessed 11 February 2008) the LonelyGirl15 series had more than 70 million combined views as of September 2007.
4. http://www.pinkyshow.org/archives/episodes/070118/ (accessed 11 February 2008).
5. http://www.spacetelescope.org/videos/hubblecast.html
6. Averaged over October, November, December 2007.
7. http://testtube.monocromatica.com
8. http://en.wikipedia.org/wiki/Image:PAL-NTSC-SECAM.svg (accessed 11 February 2008).
9. http://en.wikipedia.org/wiki/Image:Common_Video_Resolutions.svg (accessed 11 February 2008).
10. See for instance http://en.wikipedia.org/wiki/Digital_divide

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