

## Could a Dalek download the Internet in just 22 seconds?

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08/04/2019

### Abstract

This paper investigates the feasibility of a Dalek, a villain from the popular British Sci-Fi show Doctor Who, being able to download the Internet in just 22 s, as shown in the episode “Dalek”. A number of assumptions were made regarding the size of the surface Internet in the release year of the episode (2005) and the download speeds of both 2005 and also the year the episode was set (2012). The various calculations made, led to the conclusion that the time taken in the episode was far too short, both when using download speeds of  $0.27 \text{ MBs}^{-1}$  in 2005 and  $3.25 \text{ TBs}^{-1}$  in 2012. The time needed was calculated to be 25,502 years in 2005 and 140 minutes in 2012.

### Background

Doctor Who is a classic British science fiction television series that first aired in 1963 and follows the adventures of a time-travelling alien called the Doctor [1]. The Doctor’s oldest and most-feared enemy are the Daleks, an alien race, whose only goal is the “extermination” of any species that does not conform to their sense of purity [2].

Following the show’s revival in 2005, the sixth episode in its first series sees the Ninth Doctor and his human companion, Rose, travel forward in time to the year 2012, and land in a vast military-like bunker deep beneath Utah in the United States of America (USA). The bunker belongs to the immensely rich Henry van Statten, who owns the Internet. The Doctor and Rose are taken to his most prized collection, a Dalek. Rose touches the Dalek, which re-energises it, allowing it to escape from its cell. The Dalek, seeking information about the rest of its fleet

computer and downloads the entire Internet in just 22 s, according to the episode [3].

### Aim

The aim of this paper is to determine whether it would be possible to download the entire Internet in the time that was portrayed during the episode “Dalek”, by comparing the Internet download speeds from the year that the episode was released (2005) with the year that the episode was set in (2012).

### Method

The first assumptions made were that the Dalek’s transfer and storage speed were assumed not to be limiting factors and hence, the Internet download speed, in either 2005 or 2012, was assumed to be the only limiting factor. The most significant issue when addressing the aim of this paper is that at any time, the true size of the Internet cannot be precisely known due to the intricacy and complexity of the Internet [4]. Resultantly, only the surface Internet was included in calculations, with both the deep web (sites that require passwords) and the dark web omitted [5].

In order to calculate the size of the Internet in 2005, it was assumed that the Internet at this time was comprised of the number of webpages, images, audio and video files indexed in 2005 [6]. It has been assumed that this source was accurate and thus calculations were modelled based on the surface

et that the Dalek was able to access. This information was used in addition to a source that stated the average website had 30 pages [7] and an assumption that each webpage contains a full page of text [8]. The size of the images, audio and video files were assumed to be the same within their respective groups [9]. Despite extensive research, no source could be found that discussed maximum download speeds in 2005. Instead, the average download speed in the USA in 2004 of

0.27 Megabyte per second ( $\text{MBs}^{-1}$ ) was used, which was assumed to remain constant [10].

The time required to download the Internet in the year of the episode's release (2005) was calculated by dividing the size of the Internet in 2005 by the assumed download speed of  $0.27 \text{ MBs}^{-1}$ . This time period was then compared to the time required to download the Internet of 2005, but instead using the much faster download speed that would be available to the Dalek in the year the episode was set (2012). This 2012 download speed was assumed to have a constant value of 3.25 Terabyte per second ( $\text{TBs}^{-1}$ ), where 1 Terabyte is equal to 8 million Megabytes, as achieved by the German-Karlsruhe Institute of Technology in 2011 [11].

### Results

When calculating the size of the Internet in 2005, the individual sizes of webpages was assumed to be 0.376 MB per page [8]. Audio files and images were assumed to have sizes of 3.5 MB and 0.003 MB respectively [9]. The video files were assumed to all be 10 minutes long and have a quality of 360p, this leads to a size of 53 MB [12]. These key results are summarised in table 1:

	Number	Individual size (MB)	Total size (MB)
<b>Webpages</b>	$5.76 \times 10^{11}$	$3.80 \times 10^{-1}$	$2.18 \times 10^{11}$
<b>Video</b>	$2.50 \times 10^7$	$5.30 \times 10^1$	$1.33 \times 10^9$
<b>Audio</b>	$2.50 \times 10^7$	$3.50 \times 10^0$	$8.80 \times 10^7$
<b>Images</b>	$1.60 \times 10^9$	$3.00 \times 10^{-3}$	$4.80 \times 10^6$

Table 1 – A summary of the number, individual size (MB) and total size (MB) of webpages, images, video and audio files that were assumed to constitute the entire surface Internet in 2005.

This gives an Internet size of  $2.19 \times 10^{11}$  MB in 2005. By dividing this Internet size by the assumed Internet speed of  $0.27 \text{ MBs}^{-1}$ , the time taken to download the Internet in 2005 would be 25,602 years. The speed required for the Internet of the day to be downloaded in just 22 s would be  $9.91 \times 10^9 \text{ MBs}^{-1}$ .

The time taken to download the Internet of 2005 was also calculated using the assumed 2012 download speed of  $3.25 \text{ TBs}^{-1}$ . By again dividing the calculated 2005 Internet size of  $2.19 \times 10^{11}$  MB by this much faster download speed, it was determined that the

time taken to download the Internet in 2012 would be 140 minutes.

### Discussion

From calculations, the time taken to download the 2005 surface Internet would be 25,602 years in 2005 and 140 minutes in 2012. Since both of these values are much greater than the 22 s it took the Dalek in the episode, it was determined that downloading the Internet in such a short space of time would not be remotely possible. This would not be feasible even at the superfast download speeds that would be expected in the underground bunker.

When comparing the time required to download the 2005 surface Internet, using the download speeds of 2005 and 2012, it is clear that there is a large discrepancy between these two time values. The most likely reason for this significant difference is that although a maximum download speed for 2012 was found, it was not possible to obtain a maximum value for the 2005 Internet download speed. This is a major issue when considering that the owner of the Internet (van Statten) should have the maximum download speeds of the time at his disposal. Instead, the average Internet download speed in the USA in 2004 was used ( $0.27 \text{ MBs}^{-1}$ ), which was the only value that could be found from a similar time period.

Furthermore, the premise that a Dalek can download the Internet is scientifically improbable, both in terms of the time taken to download (only 22 s) and to conceive that a Dalek has the hardware capacity to physically store such a vast amount of data. In reality, although the script writers of Doctor Who have not based the scene of the Dalek downloading the Internet in scientific reality, it is clear that they used artistic licence to maintain the level of excitement in the episode, while also demonstrating the immense power of the Doctor's most feared foe.

### Conclusion

In summation, various calculations were carried out, taking into consideration numerous assumptions, in order to determine the feasibility of whether the Internet can be downloaded in just 22 s, as shown in the "Dalek" episode of Doctor Who. In 2005 (the year the episode was released), it would take 25,602 years to download the surface Internet, while in 2012 (the year the episode was set), it would take 140 minutes. Therefore, the Dalek would not have been able to download the Internet in such a short space of time, as shown in "Dalek".

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