

# Automatic software updates, data flows and energy demand

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Mike Hazas, 14 March 2016

**Abstract.** This paper makes the case that software updates contribute significantly to demand for Internet communication and services. Using available data, it explores some of the ways that software updates contribute to the growth of digital traffic volumes and peaks: these include automated updates, the raising of video and audio fidelity, major release events, and increased time-use of applications for communicating and watching video.

## Introduction

Information and communication technology (ICT) and the Internet are a growing category of energy demand, and currently at 5% or more of global electricity demand (Van Heddeghem et al. 2012). If we include consumer electronics such as TVs, set top boxes and home cinema amplifiers, then the share increases to 9%. With smaller devices, such as smartphones and tablets, the digital communication and services (as provided by cellular and broadband networks, and data centres) account for at least 90% of the energy demand over the device's lifetime: manufacturing, transport, charging and disposal account for 10% or less (Hischier et al. 2015).

Digital communication and services are growing quickly, as evidenced by the rise in the average UK household broadband data volume, from 17 GB in 2011, to 82 GB in 2015 (Ofcom 2015). While software updates are not as demanding on infrastructures as audio and video streaming, updates are significant, at more than 5% of downstream\* peak traffic in North America and Europe. Crucially, as some of the examples in this paper show, software updates are a key mechanism for the distribution of Internet-based communication and services. Thus, software updates have made the sharp rise in demand for digital communication and services possible, in a short span of time.

Personal and domestic digital materials (mobile phones, tablets, TVs, games consoles, laptops, set-top video streamers, Wi-Fi routers) are quite central to a variety of practices: communication, cooking, dating, watching video, following local wildlife. And yet, because of software updates, these materials can become quite dynamic. Software updates can create subtle yet significant changes in the interactive "material" of the device. This not only includes changes to the interface and layout of an app which might affect the basic mechanics of performances, but also how that app steers practice and draws upon resources.

Overall, we should be concerned with software updates for three reasons: (1) downloading an update results in energy demand due to the communications networks and data centres involved in their distribution; (2) updates can change the data consumption of applications, and thus the energy demand services (e.g. video streaming or social networking); (3) updates reconfigure *stuff* (mobile devices, computers, and consumer electronics), and thus can significantly change practice itself.

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\* "Downstream" traffic refers to data sent from elsewhere, to a premises or mobile device.

## Defining an update

I apply a broad definition of “software update”, to encompass all modifications to a device’s software, which might change how that device behaves, or the capabilities it provides. With very few exceptions, software updates for ICTs and consumer electronics are downloaded from a remote server, via the Internet. In this paper, “software update” includes three specific and significant things: (1) new apps downloaded from an app store or online marketplace; (2) new versions of those apps; (3) new versions or patches to the device’s operating system (e.g. Android, iOS, Windows or Mac OS).

During an update, data is “served” from data centres, and might involve data stored at multiple such sites (forming a content distribution network). The data is moved across core, metro, edge and finally premises networks. Data whose path includes mobile cellular networks requires more than double the energy of that using “fixed” lines like home broadband (Schien et al. 2013).

## Quantifying software update data volumes

It is difficult to get a handle on the Internet traffic volumes associated with software updates. Analysis of software marketplaces tend to focus on understanding factors tied to whether an application is popular or successful (Liu et al. 2015, Li et al. 2015, Khalid et al. 2015). Or, they seek to understand why software updates are not installed (Vaneia et al. 2014). In general, Internet traffic has a strong spatial variation, and there are few service providers that make public their traffic composition. Moreover, software updates do not get the dedicated treatment that categories such as social networking and video streaming do.

Still, there are some indicators. Sandvine define a marketplace as “where subscribers can purchase and download media including applications, music, movies, books, and software updates” (Sandvine Dec 2015, p. 16). Examples given are “Google Android Marketplace, Apple iTunes, Windows Update”. The “Marketplace” category is currently ranked third in peak period, fixed line downstream traffic in North America, at 6.79% (Sandvine Dec 2015, p. 2). In Europe, it’s 6.43% of downstream fixed and 5.97% of mobile cellular (Sandvine Sept 2015, pp. 2-4).

The data share of application updates can be quite significant indeed for handheld devices, such as phones and smaller tablets; this is because other data-intensive applications, such as watching and web browsing, tend to be used less on these devices with smaller screens. For a very small sample of eight Android devices, Figure 1 shows that data attributable to software updates was 14% of the total volume.

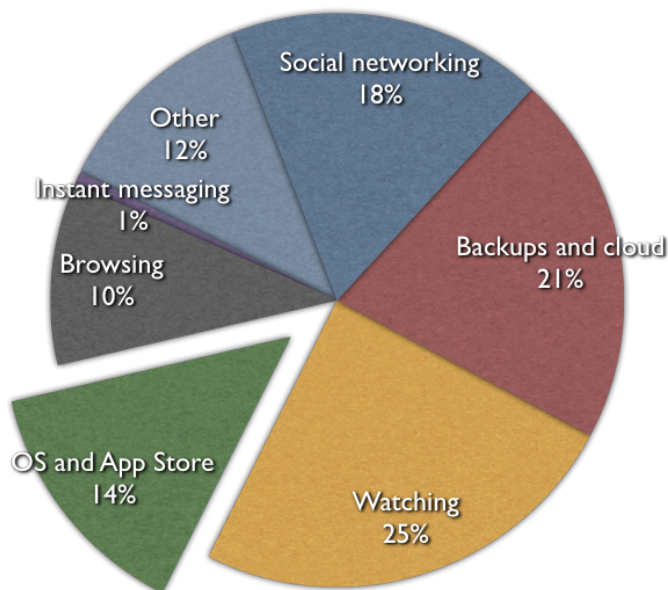


Figure 1 Average data volume composition for eight Android devices, computed from analysis by Bates (2016, Table 5.2).

**Gaming.** The figures above include any app downloaded using the Android Marketplace, and the Apple App Store. However, they do not include a significant category of software update: PC and console games. Game downloads and updates can be quite large (typically more than a gigabyte) and might be updated as often as once a week for actively maintained games. Xbox Live, the PlayStation Store, and Steam (an app store specialising in PC games) account for 1-2% of traffic most evenings in North America (Sandvine May 2015, p. 5). Most recently, gaming was shown at just over 4% of fixed downstream in North America (Sandvine Dec 2015, p. 2). This figure also accounts for traffic generated from online play of games, and possibly in-game voice communication between players; but it is likely that much of the figure is due to game downloads and updates. Indeed, some data shows that the traffic share of video game marketplaces like Steam are growing faster than other categories of data, and will be of concern for Internet service providers (Sandvine Sept 2015, p. 9).

### Peaks

Networks are pushed to all-time highs when large updates and major new software releases occur. Major releases of iOS occur yearly in September. Each year, the release causes significant peaks. For example, in September 2014, the release of iOS 8 caused a 10% rise in traffic leading to an all-time high for Virgin Media UK. After a major new version is released, updates to that tend to be released frequently. The release of iOS 9 (16 Sept 2015) was followed by two updates in the following two weeks (23 and 30 Sept). These updates are large, at over 800 MB each.

The release of a high-profile game can also be viewed as a major update event. The release of additional content for “Call of Duty: Advanced Warfare” caused Xbox traffic to grow to 12% of the total on a North American broadband provider, and stay that way for three hours (Sandvine May 2015, p. 5). The release of the beta version of FIFA 16 (a 4 GB download which was available for multiple gaming platforms) caused gaming traffic to triple for one

North American service provider, resulting in 8% higher traffic overall (Sandvine Dec 2015, p. 13).

It should be noted that software updates also form a significant part of the Christmas holiday peak, where many new devices and app vouchers are given as gifts. Christmas morning in particular tends to see App Store activity more than triple the typical (Sandvine 2014 1h, p. 13).

### Shaping demand and practice

The above discussion focuses on the demand generated by downloading software updates. But, the installation and running of these applications can have long-term consequences for Internet service demand. This shaping of demand is to a large extent, automated: once the update is downloaded and installed,<sup>†</sup> demand is changed by the new software.

Facebook's "Autoplay" feature causes video adverts to play at the side of the app or web browser interface. The Autoplay feature was deployed in different regions of the world, beginning in September 2013. There are strong indications that this caused Facebook-related traffic to increase by between 50% and 200%; the increase tended to be higher on fixed networks, compared to mobile ones (Sandvine 2014 2h, p. 9).

Also in September 2013, Netflix began allowing all subscribers to view content in "super HD" resolution, which generates between 11% and 50% more traffic than Netflix's previous HD video. For one service provider, this increased Netflix traffic by 10-15%, and overall peak traffic by 3-5% (Sandvine 2013 2h, p. 14). Since then, the pursuit of higher fidelity continues. Albeit with a limited library and a higher subscription fee, Netflix offer videos in 4K resolution (double that of HD). Netflix recommend an Internet connection of twenty-five megabits per second to support 4K viewing. This pursuit of higher fidelity is no doubt an important part of the story of the growth in the data demand of watching.

Also important is the role that updates to software's behaviour and functionality have in shaping practice. Four years ago, Netflix implemented "post-play". When an episode of a television or film series has finished playing, post-play automatically begins playing the next video. Now, Netflix continues playing a video if it is simply cursor over in the video selection screen. Netflix are currently testing the automatic play of film and television trailers when the user is browsing.

### Who is doing the growing?

Change is pursued by manufacturers, service providers, app developers and everyday practitioners. Pursuit is for ends including new applications, enhanced functionality, modern-looking or stylish interfaces (skeuomorphism vs. flat design), "smarter" behaviour, and higher fidelity. Figure 2 shows the growth in the numbers of apps available for Apple phones and tablets, from 2008 to 2014 (Adjust 2014). While not all apps released have a long lifespan, about one-quarter of apps continue to be maintained by the developer in the long term, which means periodic software updates (Carbunar & Potharaju 2015).

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<sup>†</sup> It is important to note that the downloading and installation of software updates, themselves, is often automated. Apple's iOS downloads major updates to the operating system with no option given to disable such downloading; the same is true for Windows 10. Software updates are also auto-downloaded by default on games consoles.

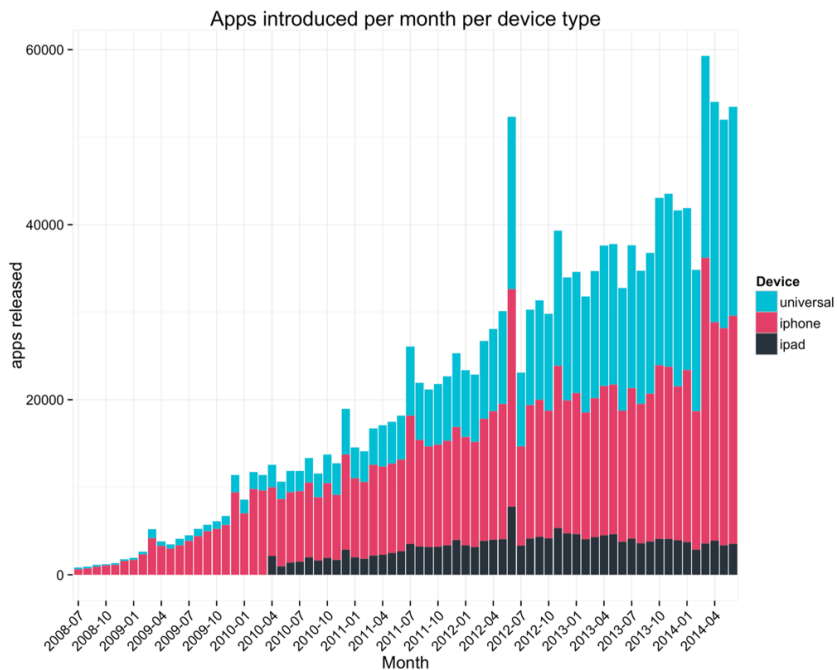


Figure 2: App growth for iOS, 2008-2014. Taken from Adjust (2014, p.1)

## Conclusion

I conclude by identifying four factors related to software updates, which contribute to the growth of Internet traffic volume. (1) Increasingly, updates are automated. By default, download and installation are completed on our behalf. (2) Updates increasingly include networked, “social”, and video-augmented features. (3) Updates tend to enable or encourage more time spent watching or communicating. (4) Updates tend to raise the fidelity of video and audio.

I would also like to point out two challenges in researching the effects of software updates. First, the traffic volume of software updates is not widely published by service providers and analytics firms who report on overall demand. Sandvine is the one of the few who categorise it explicitly. Even with Sandvine, there are questions of what portion of the “marketplace” and “gaming” traffic is due to downloading video and audio purchased in the marketplaces and playing online games. Second, the changes in practice due to software updates are difficult to track. Tracing change is a familiar problem in studies of practice, but analysing change due to software updates would need a peculiar sort of attention. Software updates can occur silently and quickly, and might not even explicitly be noticed by the practitioner, nor the researcher.

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