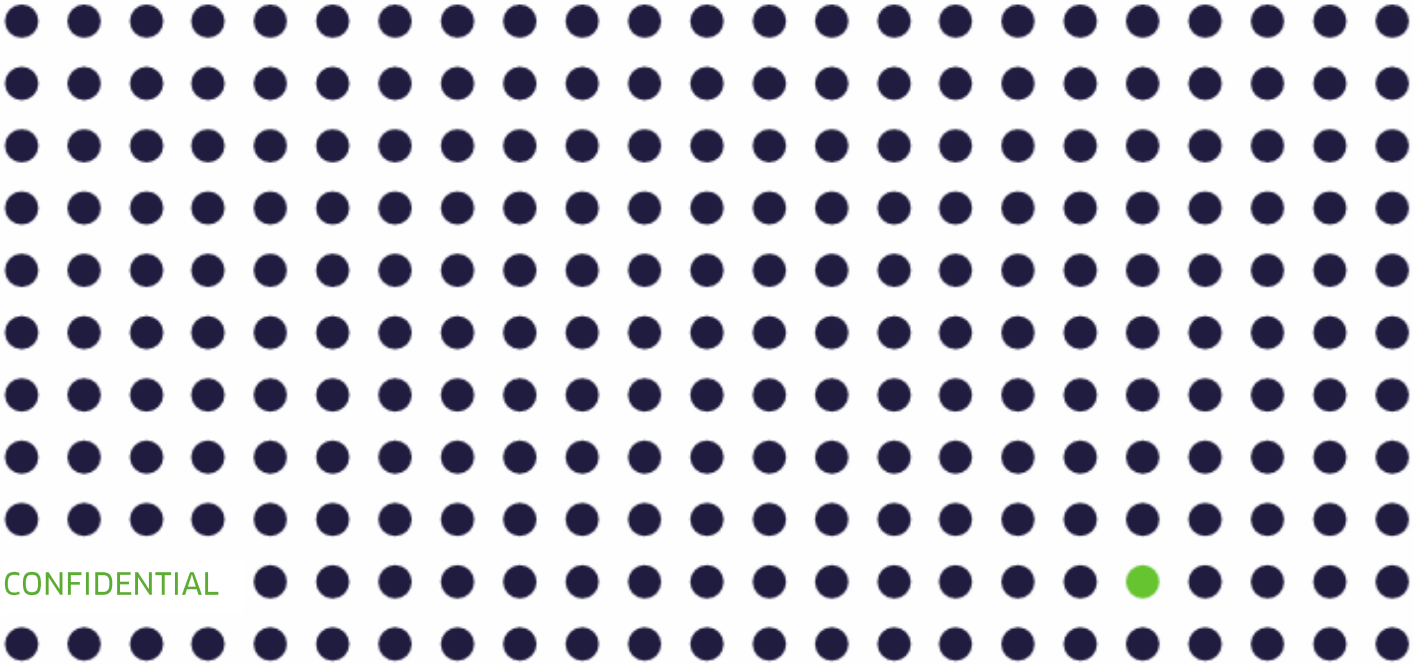
INCOPRO

Stream-ripping

A study on the growing threat

November 2016 | PRS for Music and The Intellectual Property Office



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Introduction

This report was commissioned by PRS for Music and the Intellectual Property Office to research stream-ripping, an increasingly popular method of music piracy.

Stream-ripping is the process by which licensed content is copied without permission, and therefore illegally, from third party streaming services such as YouTube and Spotify and then stored for later use on the end user's computer or mobile device. There are websites, software applications and mobile applications that are used to carry out this activity and this study looks at those methods in detail.

The specific questions that this study addresses are as follows:

- What proportion of the overall online music piracy usage is accounted for by stream-ripping, comparatively to more established forms of online music piracy?
- What are the most popular **stream-ripping services**?
- What are the most popular entry points to such **stream-ripping services**?
- What is the primary funding model(s) of **stream-ripping services**?
- How much stream-ripping usage is linked to the abuse of particular licensed music services (e.g. YouTube, SoundCloud)?
- How do **stream-ripping services** work in terms of the technology they use?

This report answers those questions in three parts:

- **Part One** of the report provides a picture of the UK music piracy landscape, considering the most popular **stream-ripping services** being used in the country, and the overall proportion of music content infringement which these services are responsible for when compared to older methods of piracy;

- **Part Two** focuses on the technical composition of **stream-ripping services** in terms of their technical infrastructure and functionality;

- **Part Three** investigates the user entry points to **stream-ripping services**, the licensed services being abused by these services, and finally the funding models of **stream-ripping services**.

Glossary

This glossary contains definitions of some of the terms and categories which are used throughout the report.

Stream-ripping services

Stream-ripping services are defined as any site, software program or app which provides users with the ability to download content without permission, and therefore illegally, from a third party internet stream which can be used offline. These services can be split into five further sub-categories, which have been considered throughout the report:

- **Download Apps** source and download content from licensed services – delivering through an app.
- **Download Sites** source and download content from licensed services – delivering through a website.
- **Stream-ripping Sites** allow the user to download content from licensed services, via the input by the user of the URL/link for where the content is made available on the licensed service.
- **Stream-ripping Plug-ins**, otherwise known as browser extensions, provide browser level functionality allowing for streamed content to be downloaded. The advantage of these services is that the ripping functionality can be turned on and off by the user in real-time without the need to switch between the streaming service and the stream ripping service. Content can also therefore be downloaded in bulk, removing the need to download files one by one.
- **Stream-ripping Software** is downloaded via developer websites, software or review sites, and allows for streamed content to be copied, or ripped, and stored as a downloadable file.

Established methods of piracy

- **BitTorrent** is a peer-to-peer (P2P) technology - this decentralised file sharing system provides an efficient way to transfer large files across the Internet. Each part of a file downloaded by a user is then transferred to other users – there is no need for a user to have the entire file on their computer to share.
- **Cyberlocker Host Sites** work by allowing users to upload files to a cloud storage server. It is possible for a user to access files on these sites through a link shared by the user that uploaded it.
- **Cyberlocker Link Sites** act as indexes or lists of links to content stored on cyberlocker host sites. Users can freely navigate content hosted on the site via the search functionality on the site or via search engines, meaning that files are easier to find for both would-be downloaders and copyright holders.
- **Proxy Sites** provide dedicated access to sites which have been blocked in the UK, allowing users to bypass this filtering and reach infringing content. These proxies may provide access to one or more blocked sites at the same time.

- **Other Sites** has been used to group a variety of other methods of content piracy such as newsgroups (a forum for the discussion of a particular topic where files can also be posted for others to download) and other less popular file sharing methods such as eDonkey (an alternative to BitTorrent which allows users to share files in a decentralised network).

Other definitions used within this report

- **APIs** (Application Programming Interface) make it easier to develop a computer program or website by providing a way to speak to another computer system to request information or exchange data. For example, API calls to licensed services can be used by stream-ripping services to request content that they can then extract the audio from.

- **DDLs** (Direct Download Links) are links which direct users to the download of a file.

- **Malware** is a computer program software which is specifically designed to damage or gain access to the user's computer.

- **PUPs** (Potentially Unwanted Programs) are computer programs usually installed in conjunction with a program which the user wants. For example, a user may download a program for a specific purpose and be offered a browser extension or other tool as part of the software package. PUPs are not always benign and malicious examples include adware and spyware.

Key Findings

- In relation to the more established and historically popular categories of infringing sites, those categorised as **stream-ripping services** are found to account for a considerable proportion of the overall music infringement activity in the UK. Usage of **Stream-ripping services** accounted for the majority (68.2%) of the top 50 specifically music infringing sites - 498,681 out of the total 731,492 top 50 usage;

- The **stream-ripping service** with the highest usage in the UK by far is the **stream-ripping site** *youtube-mp3.org* - the recorded usage in September 2016 amounted to 45.2% of the combined top 50 specifically music infringing site usage, and 66.2% of total stream-ripping usage from the same top 50. Overall, it is clear that **stream-ripping sites** are the most popular type of **stream-ripping service** in the region, due primarily to the overwhelming popularity of one site. However, since the research in this report was undertaken, action against the site and its stream-ripping functionality now means that it is geo-blocked in the UK;

- The legitimate streaming service most abused through stream-ripping is YouTube, both in terms of the number of sites which provide stream-ripping capabilities for the service (75/80 of the sample surveyed) and in the actual usage of YouTube specific sites. The service that is targeted does change slightly depending upon the type of **stream-ripping service** being used. **Download sites** are found to rely on both YouTube and SoundCloud as their source of ripped content, whereas the **stream-ripping sites** are generally more specific to one licensed service;

- The most common method of obtaining content via **stream-ripping services** is through the conversion of a link to a file; a user pastes their chosen link into the website, which then converts the content into a file for the user to download. The predominant method of content delivery is through direct downloads, straight to the computer or device being used to access the service, however, links to cloud storage services like Dropbox were also observed as a potential emerging method of access.

- The main user points of entry to **stream-ripping services** are found to be direct access to the services' domain and through search engines. The source of traffic is relatively balanced between direct access and search engine traffic for **stream-ripping sites** and **stream-ripping software**; however, this changes considerably for **download sites**, where search engines account for the majority of traffic. This difference in the origin of usage is likely to be due to users of **download sites** searching for the download of a specific song or album, which they are unaware has been ripped by the site from a licensed service;

- Web-based **stream-ripping services** rely predominately – and entirely in the case of **stream-ripping sites** – upon advertising. This changes in relation to **stream-ripping apps** and **stream-ripping software**, which also include payments as a source of funding. These services can charge for the initial download and installation and then for further enhancements brought about by upgrading to a premium license. Another stream of revenue to these services is the bundled software – in most cases this results in users receiving some form of **PUP** (potentially unwanted program) through the installation process which may have unintended or malicious consequences;

- A survey of the advertising found on the most popular **stream-ripping services** reveals malware/**PUP** advertising to account for the majority of adverts serviced to users (52.2%). Generic/other advertising was the second most common, accounting for a noteworthy 29% of advertising which funds unauthorised **stream-ripping services**. Scam (14.5%) and gambling (4.3%) adverts make up the remainder of advertising serviced.

Part One: Stream-ripping in the context of the music piracy landscape

Stream-ripping can be defined as the process of obtaining a persistent copy of streamed content without permission, and therefore illegally, from third party streaming services. The user can create a downloadable file, from content that is available to stream online. This process can be done using audio files or music videos but in both instances, audio copies of tracks can be permanently downloaded after a format conversion enabling the user to store them and listen offline.

The first part of the report considers the most popular music infringing websites to establish a top site list. With the top sites identified, the position of **stream-ripping services** in relation to overall music piracy, which has traditionally been dominated by more established methods of piracy, is explored in detail.

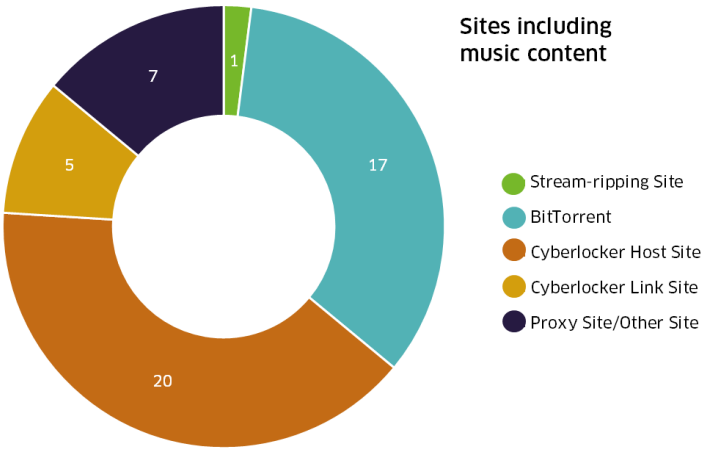
INCOPRO tracks over 17,000 websites in its Identify database and categorises them by reference to the content that is accessible via them and the methods by which they make that content available. Metrics are gathered, such as visitor traffic and hosting location, which enables insight into the various aspects of the piracy landscape. To assess the proportion of **stream-ripping services** in the overall music piracy landscape, the top 50 most popular websites in the UK, which make infringing music content available, have been analysed.[1]

Most popular content infringing sites which contain unauthorised music content

This section provides insight into the scale of stream-ripping in relation to overall content piracy in the UK. All infringing sites which contain music content (including those making music available alongside other types of content) have been ordered by their usage by UK users in September 2016.[2] The top 50 highest usage websites were then selected for further analysis.

Only one **stream-ripping site** features in the top 50 piracy websites. The most common categories of sites which contain music content are **BitTorrent** (17) and **cyberlocker host sites** (20) – both established methods of piracy. When combined, these two categories account for a significant majority (37/50) of the most popular music infringing sites. The third most popular category of site is the **proxy/other sites** category, which consists of 6 proxies.

This top 50 approach provides a full picture of sites which may be being used to infringe music copyrights. One limitation, however, is that it is unclear exactly how much of the usage of these sites, which contain an array of content types, can be attributed to unauthorised music consumption and how much relates instead to the other kinds of content being accessed (e.g. film, TV, books). For these more generic content sites, where various types of content are made available, film and TV content has historically accounted for a considerable proportion of the usage of such sites.



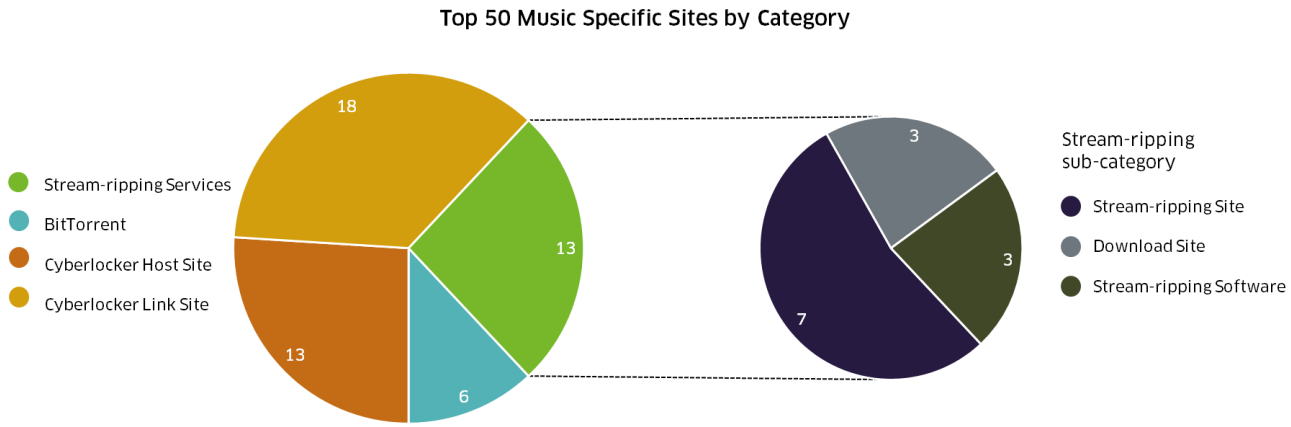
[1] For the purposes of this section, only those **stream-ripping services** which are provided via websites have been analysed, i.e. **download sites**, **stream-ripping sites** and **stream-ripping software**.
[2] The methodology used to calculate site usage is contained in *Appendix A*.

Only 2 of the top 50 sites[3] which have been considered above are music-specific sites. This means that a significant proportion of the usage of the other 48 sites could pertain to other types of content. It should be noted that the usage considered in this report represents that of the whole site and may not relate specifically to music piracy.

To illustrate this possible bias, the top 10 most popular music and top 10 most popular video torrents on The Pirate Bay, a **BitTorrent** site, were analysed. There were 99,636 users actively sharing TV/film torrents and 10,643 users actively sharing music content. This represents almost a 10:1 ratio in users actively sharing TV/film content versus music. Although only indicative[4], it is helpful to understand the context of music piracy on these websites.

Most popular sites providing unauthorised music content only

To provide a more music-centric landscape, the previous analysis was repeated focussing on websites offering music content only. This revealed an obvious change in the types of websites being used and especially in the prevalence of **stream-ripping services**.

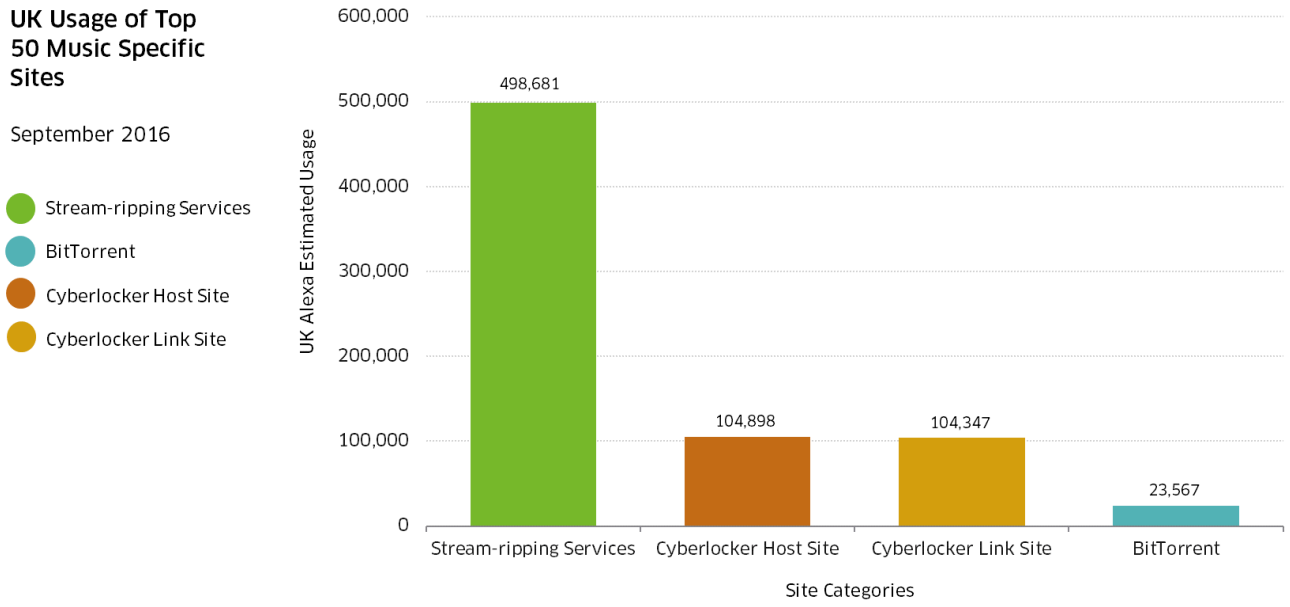


There is a difference in the proportion of **BitTorrent** sites being used for music specific content, the reason for this is likely to be that this method lends itself more to larger video file sizes than the comparatively smaller music torrents. This hypothesis is supported by the user sharing levels found in The Pirate Bay analysis above. Another reason for the lower presence of **BitTorrent** sites is that the sites that do specialise in music content tend to be private and not accessible to the general public.

The most noteworthy change brought about by this alternative top site grouping is the introduction of 12 additional **stream-ripping services**. Breaking down the 13 **stream-ripping services** into their respective sub-categories reveals 7 **stream-ripping sites**, followed by 3 **download sites** and then 3 **stream-ripping software** sites. These sites have replaced some of the **BitTorrent** sites from the previous top 50. There is also a significant increase in **cyberlocker link sites** (from 5 to 18).

[3] The **stream-ripping site** *youtube-mp3.org* and **cyberlocker host site** *purplinx.org*.
[4] The proportion of audio and video activity analysed relates only to The Pirate Bay, this may change on some of the other popular platforms and has only been used to provide an indication of the balance in downloads of these two different types of content. Another point to take into consideration is that the active users in relation to torrents is worldwide, therefore there is the possibility that UK users do not follow the global trend of video content being more popular than music.

The contribution of each type of site to the music infringement landscape, in September 2016, is shown in the graph below. The pie chart above showed that 13/50 websites related to **stream-ripping services** but the bar chart below clearly shows that **stream-ripping services** are responsible for the highest amount of use of the music specific infringing sites, accounting for 68.2% of the total top 50 usage.

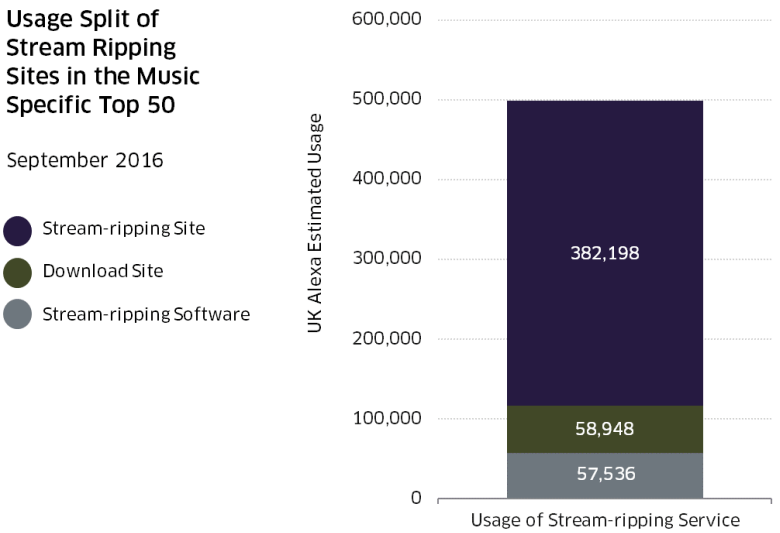


A significant portion of stream-ripping usage relates to only one site; *youtube-mp3.org* accounted for 45.2% of the usage across the top 50 music specific infringing sites in September 2016 and 66.2% of the total **stream-ripping service** usage.

To analyse the **stream-ripping services** further, the usage data has been broken down into the sub-categories and is shown in the graph (right).

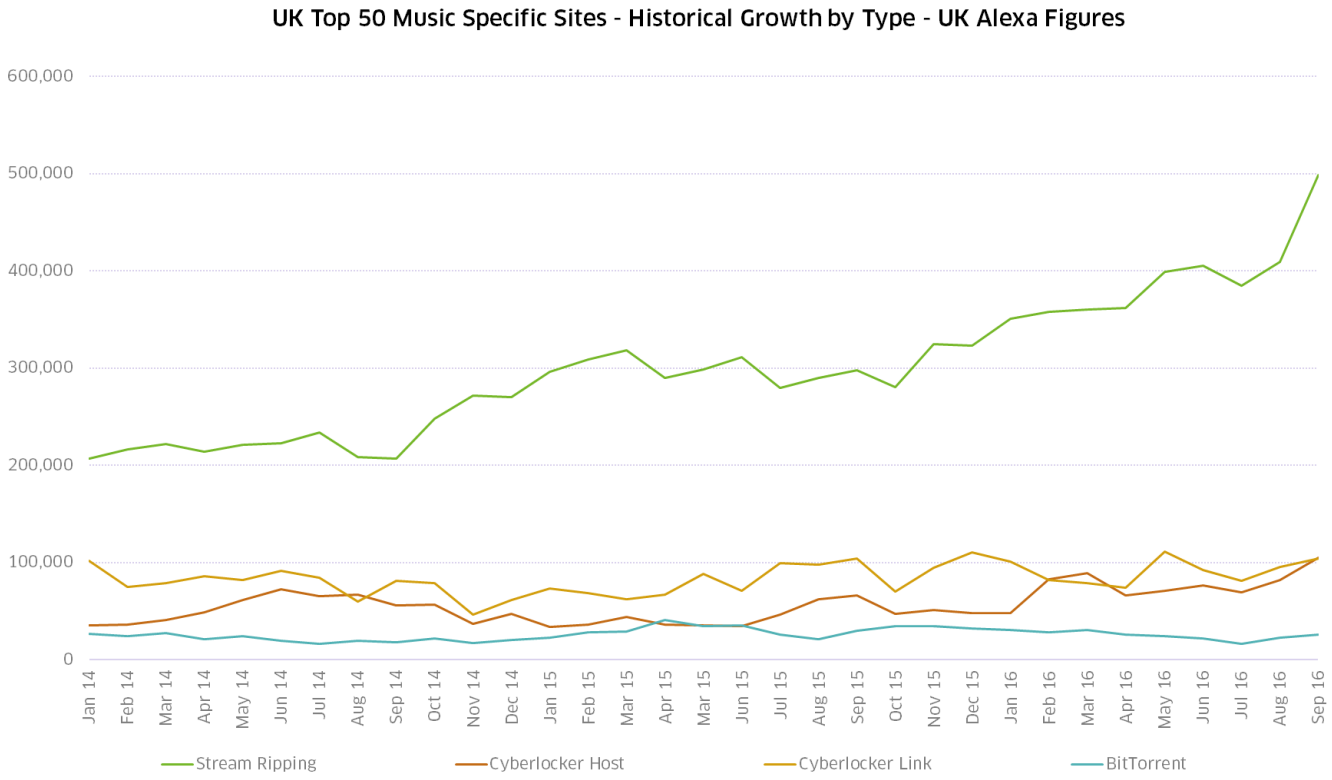
Viewing the data in this way demonstrates just how dominant **stream-ripping sites** are, accounting for 76.6% of the overall usage of the most popular **stream-ripping services**.

Download sites and **stream-ripping software** are responsible for a lower percentage, 11.8% and 11.5% respectively. The reason for this is likely to be the simplicity of using **stream-ripping sites**, making them the most accessible of all the types of **stream-ripping services**.



Changes in the music piracy landscape over time

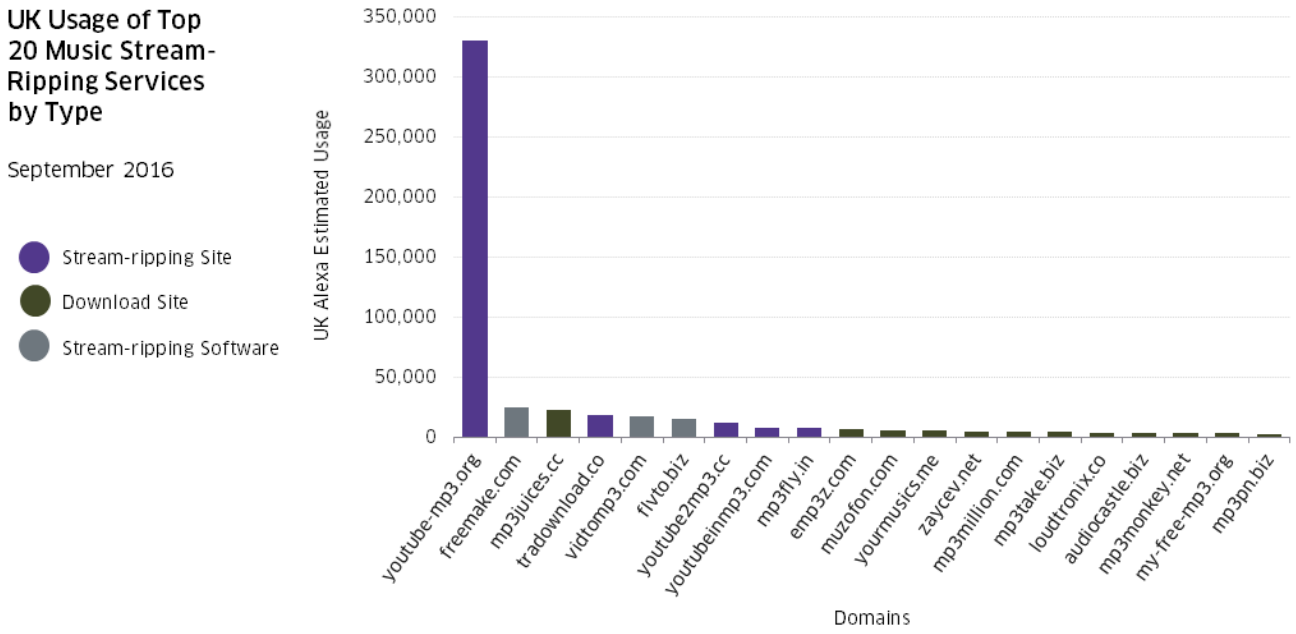
To understand the evolution of stream-ripping over time, the following graph displays data for the top 50 sites, which contain music content only, for the period of January 2014 to September 2016. Site usage has been combined by category to study the trends in usage over time.



The graph indicates that there has been a clear upward trend in stream-ripping usage over time, increasing by 141.3% over the recorded period.

Most popular stream-ripping services

To understand the drivers for this increase, the most popular **stream-ripping services** have been analysed to determine individual trends over time. As at September 2016, the most popular **stream-ripping service** is *youtube-mp3.org*, a **stream-ripping site**, which dwarfs the usage of all other **stream-ripping services.** The significance of the dominance is clear in the bar graph below.



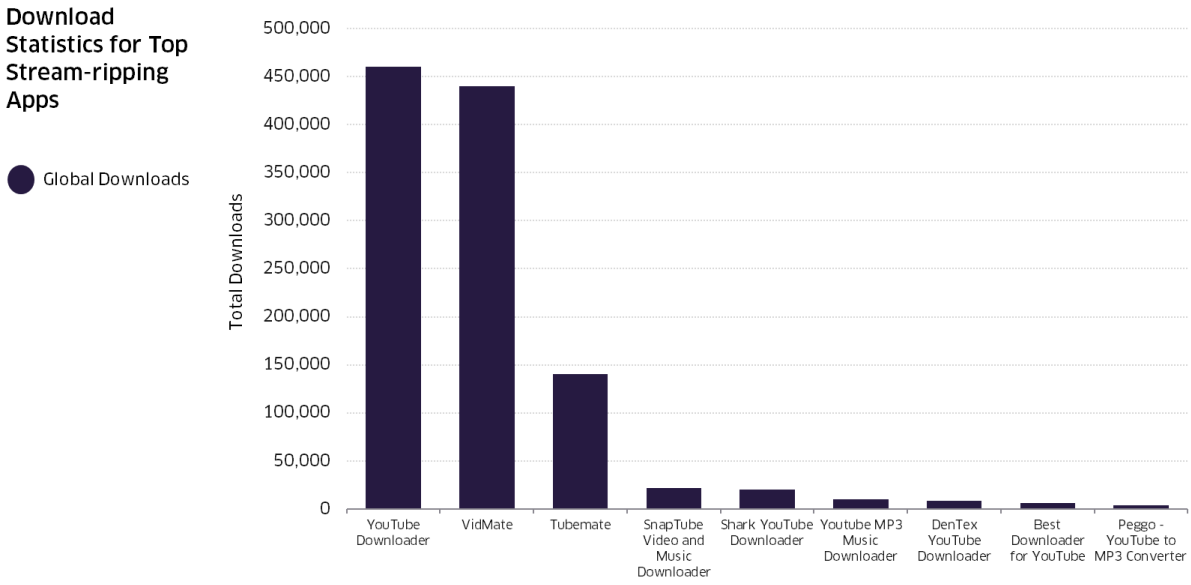
To put this usage gap into perspective, *freemake.com*, which was the second highest usage site, recorded only 8% of the usage of *youtube-mp3.org*, in September 2016. The site is unmatched in popularity when considering the alternative **stream-ripping services** in the UK and is found to have been popular for several years, with an average usage of 251,702 since January 2014. However, it is important to clarify that *youtube-mp3.org* has been geo-blocked for UK users since the completion of this report – removing its infringing functionality in the country.

Stream-ripping apps and stream-ripping plug-ins

So far in this report, the data has been taken from those **stream-ripping services** that operate via websites. Two important sub-categories that have yet to be analysed are **stream-ripping apps** and **stream-ripping plug-ins**.

Turning firstly to **stream-ripping apps**, a total of 10 popular apps were identified for analysis. Looking at the titles of these **stream-ripping apps**, 6 out of the 10 explicitly mention YouTube in their title, giving an indication of their primary source of content. Three others make potential references to YouTube, i.e. 'Tubemate', 'Pocket Tube' and 'SnapTube'.

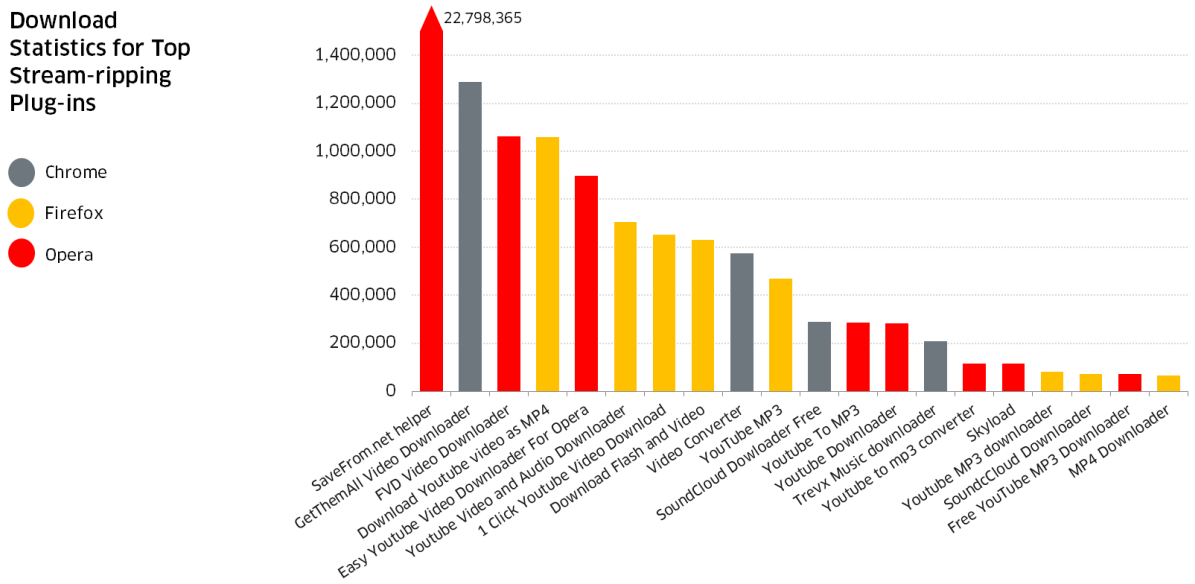
To measure the popularity of these **stream-ripping apps**, data on global downloads of apps was obtained and revealed 1,110,820 downloads in total as of November 2016. These download figures relate to downloads of the apps themselves which are considered in this report and not content downloaded through them. A breakdown of this data by **stream-ripping app** is shown below.[5]



There are a couple of important caveats to this figure; firstly, the data is global and not focussed solely on UK users and, secondly, there are a range of app stores online that make the Android apps available, especially the versions available for Android devices, but not all give download statistics. For this reason, the figure above is likely to be understated and the true figure considerably higher.[6]

[5] Please note that download statistics for Pocket Tube were not available and so do not appear in the chart below.
[6] There are also doubts about how often the figures are updated and how accurate they may be which cannot be ascertained. This data should therefore be treated as indicative.

Considering next the sub-category of **stream-ripping plug-ins**, a total of 20 were identified based on their popularity:



As the graph above shows, 10 of the **stream-ripping plug-ins** specifically reference YouTube as the content source, with several more referencing the download of music.

The data for **stream-ripping plug-ins** has two key limitations: firstly, like **stream-ripping apps**, the data is global and therefore UK downloads cannot be determined; and secondly, the most popular plugins are general purpose downloaders that assist in downloading content from links on a page and may not be used for stream-ripping specifically. As with **stream-ripping apps**, the data should therefore be taken as indicative to give an idea of the scale of the issue.

Part Two: Technical composition of Stream-ripping services

This section of the report provides a technical analysis of the top 10 **stream-ripping services**[7] in the UK as identified in Part One. The **stream-ripping services** are examined to determine their technical infrastructure and functionality.[8]

The following table lists the **stream-ripping services** considered and the key points which were considered are discussed below.

Domain	Category	Obtain Content	File Type	Quality (kbps)	Content Delivery
youtube-mp3.org	Stream-ripping Site	URL	Audio	128	DDL
freemake.com	Stream-ripping Software	URL & Search	Both	320	DDL
mp3juices.cc	Download Site	URL & Search	Audio	128 - 192	DDL
tradownload.com	Stream-ripping Site	URL	Both	128 - 256	DDL
vidtomp3.com	Stream-ripping Software	URL	Audio	128+	DDL
flvto.biz	Stream-ripping Software	URL	Both	128+	DDL/Email/Dropbox
youtube2mp3.cc	Stream-ripping Site	URL	Audio	128+	DDL/Dropbox
youtubeinmp3.com	Stream-ripping Site	URL & Search	Audio	128 - 192	DDL
mp3fly.in	Stream-ripping Site	URL	Audio	128+	DDL
emp3z.com	Download Site	Search	Both	192	DDL

The most common method of obtaining content via **stream-ripping services** is through the conversion of a link to a file; a user pastes their chosen link into the website, which then converts the content into a file for the user to download. This functionality was available on 9 of the 10 sites. This is an easy and certain way for users to obtain the content they want, as they have preselected the video or stream in advance on a site like YouTube and copied the link to it. Three of these websites also included a search function, allowing users to search for the track, album or artist names that they wished to download, with the source of the files coming from YouTube or similar. Only one of the websites, *emp3z.com*, did not contain a URL pasting functionality and relied solely upon search.

The file types available via these **stream-ripping services** are audio focussed; 6 sites provided audio-only ripped content and the other 4 sites provided audio and video stream-ripping capability. Although there may be some interest for users to download video content for offline viewing, based on the functionality supplied via these services, it is demonstrably less common than those wishing to rip audio.

Audio quality delivered by streaming services varied depending both upon the source used and the compression technique employed. The quality of an audio file can be measured in kilobits per second (kbps); an MP3 file at 192kbps is near CD quality audio. The lower the quality, the lower the kbps value. Most services in this sample provided audio files at a quality of 128 - 192 kbps. However, the source stream is expected to suffer degradation during the process of converting to a downloadable audio file, and streaming content is not always in high quality to begin with, so the user may find they have lower quality audio than they expected.

Due to the source content on streaming sites having been compressed during the uploading process, 320 kbps files (or higher) are unlikely to be obtainable through stream-ripping. Therefore, where sites offer 320 kbps quality (for example, *freemake.com*) the file is

[7] For the purposes of this section, as in Part One, only those stream-ripping services which are provided via websites have been analysed, i.e. download sites, stream-ripping sites and stream-ripping software.
[8] Please note that since the completion of this report, the ripping functionality of *youtube-mp3.org* has been removed in the UK.

likely to have been subject to upscaling. This makes the file a larger size but it does not improve the audio quality - it is actually detrimental to the clarity of the bitrate of the ripped files.

The predominant method of content delivery on stream-ripping services is through direct download links (**DDLs**), straight to the computer or device being used to access the service. This option is available on all of the analysed services and is expected to account for the clear majority of content being ripped.

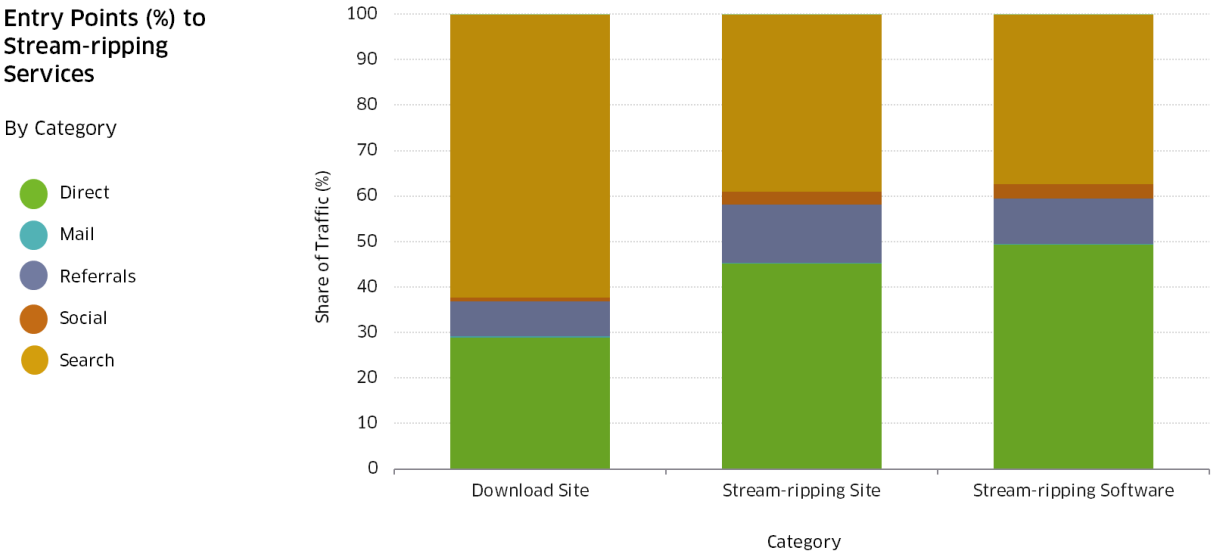
Notably, two of the services offer the additional capability of sending ripped files to a Dropbox account of the user. With this option users merely need to sign into their account to send the file to their personal cloud storage. This functionality would allow stream-ripping users to access their pirated content on multiple devices. The email function available on *flvto.biz* would also aid stream rippers in this regard.

Part Three: In-depth look at the most popular stream-ripping services

Part Three of the report focusses on how users find these **stream-ripping services**, the funding models of these services, the licensed services being abused by these **stream-ripping services** and finally where these **stream-ripping services** are located. The full list of 100 **stream-ripping services** used for the analysis in this part of the report has been provided in *Appendix D: Top **stream-ripping services** by sub-category.*

User entry points

A key question is how users find out about **stream-ripping services** initially. INCOPRO has used SimilarWeb[9] traffic source data to provide insight into how users find these services. The following graph displays the origin of traffic to a sample of the most popular **stream-ripping services**, categorising the sources of traffic as originating from direct access, mail, referrals, social networks and search engines.

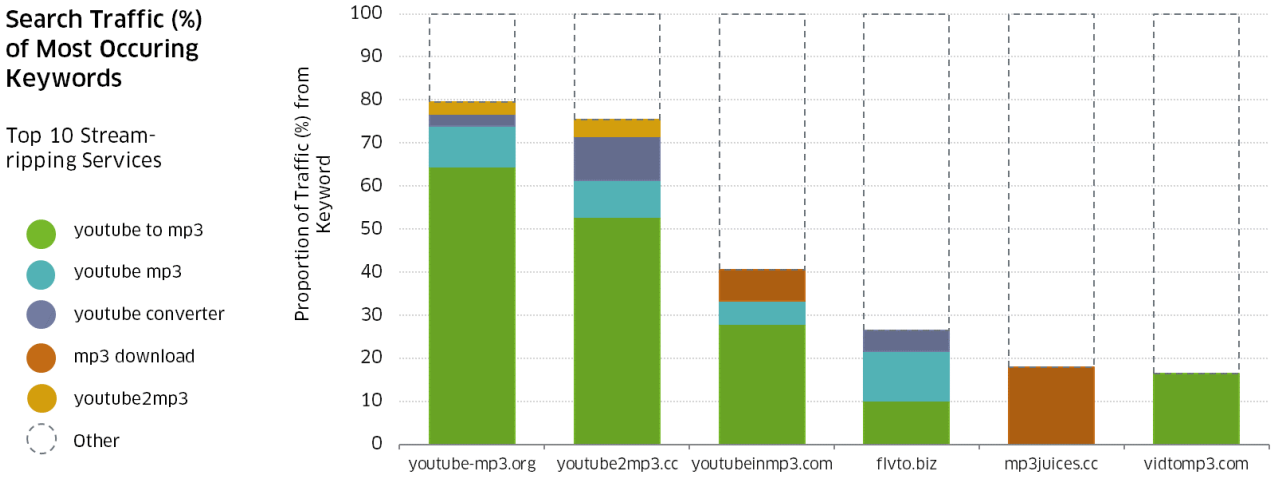


The stacked bars show that overall there are two major points of entry to the most popular **stream-ripping services** in the UK – direct access (green) and search engine (gold). **Download sites** receive the majority of traffic from search engines. This may be due to the indexing of individual pages for **download sites** by search engines and users can therefore find these sites after searching for specific content, such as an artist, track or album. If users become more familiar with sites they find in this way, they are able to navigate directly to the sites; and direct traffic might therefore increase over time as users remember the site name, use bookmarks or rely on the auto-complete function in their browser to find the site again from their browsing history.

[9] For more information about SimilarWeb, please see: *https://www.similarweb.com/corp/about/*

Search keywords

As search is a key driver of traffic, further analysis of the top keywords used to reach each type of site was performed. The top 5 keywords for each of the top 10 **stream-ripping services** were collated, yielding 50 total search terms. 5 of these 50 search terms were found to appear more than once, with the most popular of these 'youtube to mp3' leading to 5 of the top 10 **stream-ripping services**. The following graph displays the 5 most occurring search terms of the top 10 **stream-ripping services,** and the amount of search traffic for which they are responsible. These top 5 terms relate to 6 out of the top 10 sites with the remainder using other keywords

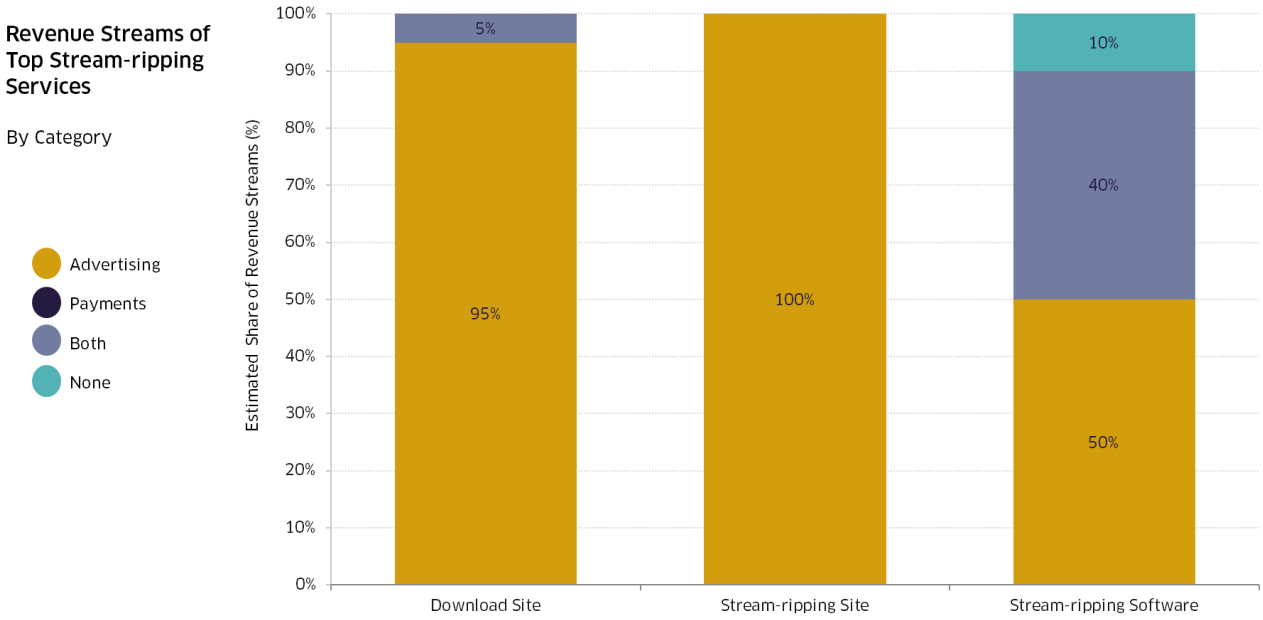


The graph shows the most popular search terms to be relatively generic stream-ripping keywords, with the main themes being 'YouTube' and 'MP3'. Notably, just these five search terms are found to be responsible for the clear majority of activity channelling search traffic to *youtube-mp3.org* (79.6%) and *youtube2mp3.cc* (75.4%).

It is worth pointing out that users also rely on search engines for navigation not just search. A user may type the name of the site they want to visit into the search engine and then click on the link to the site. It is therefore unclear if all users of search are looking for any **stream-ripping service** or for a specific one. With sites named *youtube-mp3.org* and *youtube2mp3.cc* receiving high proportions of search traffic the search terms 'youtube to mp3' and 'youtube mp3' the search traffic could be navigational activity to known sites rather than search discovery leading users to unknown **stream-ripping services**.

Funding models

The funding models of piracy sites can typically be categorised as coming through either advertising or payments made directly to the site in the form of payment for services or donations. The following graph shows analysis of 70 **stream-ripping services** (40 **download sites**, 20 **stream-ripping sites** and 10 **stream-ripping software**).



This analysis reveals that advertising accounts for the majority of income associated with these sites, with 100% of revenue for **stream-ripping sites** coming from this source. For 2 of the **download sites** additional download capabilities were offered following a payment to the site.

The **stream-ripping software** category has a more diverse revenue stream. Software is usually distributed as freeware and relies upon advertising within the software or bundled in software (i.e. browser toolbars) to maintain the income necessary to keep the service running. Of the most popular **stream-ripping software**, 40% offered additional benefits in return for payment. These are designed to enhance functionality, such as the removal of advertising or multiple download capabilities, encouraging users to move to a premium version of the software.

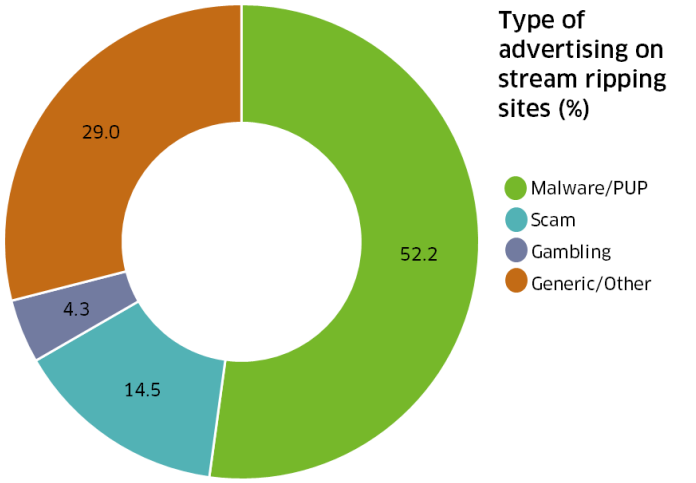
The funding model of **stream-ripping apps** and **stream-ripping plug-ins** relies almost entirely upon bundled software (including malware, adware and spyware being installed – perhaps unwittingly – by users) in the setup process rather than adverts, though these are still present in some apps. Most of these **stream-ripping services** therefore subsist through the inclusion of potentially unwanted programs (**PUPs**) which can only be avoided by opting out during a confusing installation process. As with **stream-ripping software**, a paid-for upgrade to an ad-free or enhanced version is another source of revenue.

Although most **stream-ripping services** rely on advertising as the primary source of revenue, it is difficult to estimate the level of funding attributable to direct payments; this could potentially represent more incoming revenue than that received by sites using only advertising as the sums involved are likely to be higher, though less in volume.

Type of advertising on stream-ripping services

The pie chart displays the types of advertising served when accessing a sample of the most popular **stream-ripping services** in the UK. To quantify the links and adverts present on **stream-ripping services**, all advertising has been assigned to one of the following four categories: malware/**PUPs**, scams, gambling links and generic/other advertisements.

Malware/**PUP** links were found to be the most prominent type of advertising served in the sample used, accounting for 52.2% of advertising delivered. These adverts are typically presented as necessary updates which must be installed to improve/repair/update a device in some way. An example of this has been included in *Appendix C: Malware on stream-ripping services*.



The second most common type was generic/other advertising at 29% - it is likely that the companies discovered to be advertising on such sites (some of which were well known brands) are unaware that they are being associated with pirated content alongside other potentially harmful advertisements.

Scam advertisements are relatively common on **stream-ripping services** and found to be responsible for 14.5% of advertising.

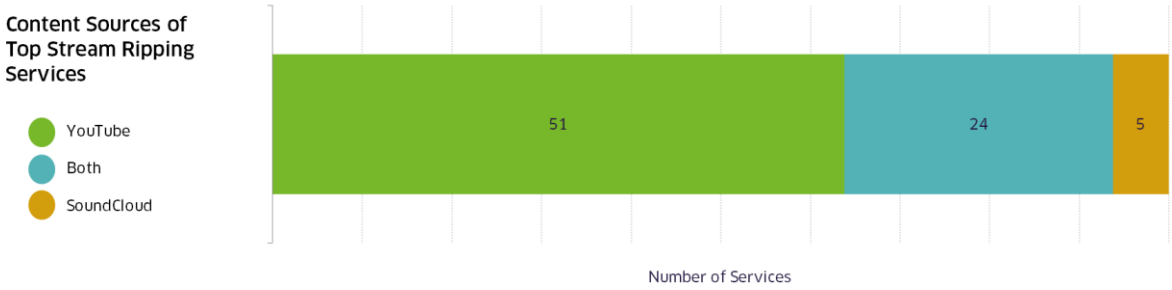
Licensed services abused through stream-ripping services

YouTube is the most abused licensed service by the sites which make up the stream-ripping landscape. This may be unsurprising given that YouTube is within the top 5 most popular sites in the world and has billions of visitors globally every month.

Abuse of this service means that the video stream is typically converted into an audio file and downloaded onto the user's device. As noted in Part One of this report, *youtube-mp3.org*, is a **stream-ripping site** entirely dedicated to ripping content from YouTube and is the most popular **stream-ripping service** in the UK. Most **stream-ripping apps** and **stream-ripping plug-ins** described above had YouTube as their primary source of content.

The following graph displays the service used as a content source for 80 of the most popular **stream-ripping sites**.[10]

[10] Only 20 of the 40 download sites have been used here, reducing the sample to 80 sites.



YouTube ripping is available on 75 of the 80 services surveyed, and on 51 specific YouTube only platforms. SoundCloud is the second most affected licensed service, with many sites providing YouTube ripping services also able to download audio streams from SoundCloud. However, only 5 of the total 80 sites included in this sample used SoundCloud as their exclusive content source (2 **stream-ripping plug-ins**, 2 **stream-ripping sites** and 1 **download site**).

It is important to mention that whilst not as popular as the above services, there are options for those seeking to rip content from other licensed services. Stream-ripping of the music streaming services Tidal and Spotify has been observed. Similar **stream-ripping services** can also be found for Deezer, with *Deezloader* and *MP3FY* both providing users with unauthorised downloads from the legitimate streaming service.

Server locations and hosting providers of stream-ripping services

Over half of the sites surveyed (36/60) were found to have their server(s) located in the USA. The location of servers is misleading in this case however, as 32 of these 36 sites use the popular content delivery network (CDN) CloudFlare. Another 8 of the sites were found to be using another popular CDN, OVH, bringing the total sites using either of these providers to an even more significant 40/60.

Content delivery network (CDN) services have risen in popularity over recent years. The most important aspects of CDNs is that they work to distribute load across several hosts, rather than one centralised server. There is a myriad of benefits which arise from this capability, including lower hosting costs, increased security against malicious attacks and increased performance and reliability.

However, due to the way in which CDNs work, the technology has brought with it concerns of protecting illegal websites by masking their true hosting company's location. This makes it difficult to pinpoint any identification details for who is running the sites, and where they are situated. The obfuscation of a site's real hosting location has the potential to increase the difficulty of DMCA notifications and any other complaints from copyright holders reaching a site's real host.

CloudFlare is one of the most popular CDN providers in use, with an alleged user base of over 2 million[11] sites using the service. The company's host of customers also includes some of the world's largest sites. The CDN provider recently came under fire in a Digital Citizens Alliance report (2016) for allegedly protecting piracy sites.[12]

[11] https://www.cloudflare.com/customers/
[12] https://media.gractions.com/314A5A5A9ABBBBC5E3BD824CF47C46EF4B9D3A76/0057c1cf-28f6-406d-9cab-03ad60fb50e4.pdf

Conclusion

Data considered in this report shows that stream-ripping is not a new phenomenon, it has actually been a popular route to music content in the UK for several years. The difference in usage of the generic content sites and music specific content top site lists demonstrates that stream-ripping is an issue affecting the music industry and that it has a dominant position within the music piracy landscape. Based upon the usage figures explored in this report, **stream-ripping services** are held responsible for a major proportion of overall music piracy levels occurring in the UK now and likely the foreseeable future.

It will be important to monitor the evolution of **stream-ripping services** and the way in which they are used. A key challenge in the future is likely to be the usage of **APIs** to provide stream-ripping functionality. Whilst beyond the scope of this report, we are aware that several sites can use the same **API**, which means that someone setting up a new **stream-ripping site** can use this **API** without needing to develop their own. The challenge will be to identify these **APIs** and find ways in which to disable them, thereby preventing their use by multiple sites.

A further future issue is cloud storage. Early signs of links to cloud storage services have been observed which may pose additional challenges in the future. The revenue streams for these services should also be watched closely, to see if they evolve their business models into paid-for services that give users access to higher quality conversions or other benefits.

Appendix A: Methodology

Selection of stream-ripping services

INCOPRO tracks over 17,000 sites, with many of the popular **stream-ripping services** already included in its Identify database before data collection for the report began. To provide the most complete picture of stream-ripping possible however, open source research was used to find and add additional **stream-ripping services** to the database. All sites and services were categorised as belonging to one of the following five major categories: **stream-ripping services**, **BitTorrent**, **cyberlocker host site**, **cyberlocker link site** and **proxy/other**. A further five sub-categories relating to **stream-ripping services** were identified and considered as follows: **stream-ripping app**, **download site**, **stream-ripping site**, **stream-ripping plug-in** and **stream-ripping software**.

To produce a list of the most popular 'top sites' all sites were ordered by their Alexa estimated UK usage. Alexa estimated usage (full Alexa estimated usage metric methodology below) was used in this report to analyse any potential shifts and trends in the usage of music piracy sites in the UK over time. The starting point for Alexa usage considered in this report is January 2014, with the end data point being September 2016. All sites being tracked by INCOPRO are categorised in several ways according to how content is made available on them and the type of content being made available. This report focuses upon the piracy of music content, therefore only sites which include music content were used in the dataset.

In Part One of this report several data sets were created in this way – the top 50 piracy sites which include music content, the top 50 piracy sites which contain only music content, the top 250 piracy sites which include music content and the top 20 **stream-ripping services**. The technical composition in Part Two focuses on the top 20 **stream-ripping services** looking at the 10 most popular based upon Alexa estimated UK usage. Where site usage was not indicative of popularity, such as for **stream-ripping apps** and **stream-ripping plug-ins**, download figures were used to distinguish the most popular **stream-ripping services** in Part One.

The dataset used in Part Three of the report is a selection of the most popular service from each of the five stream-ripping sub-categories. The top services were chosen upon validation of a stream-ripping functionality targeted at legitimate streams and owing to their popularity or usage. Alexa estimated usage was used to identify the most popular sites, and where usage was not relevant (i.e. for **stream-ripping apps** and **plug-ins**) download figures were considered. The top 40 were used for **download sites** and the top 20 were used for **stream-ripping sites** and **stream-ripping plug-ins**. Where it was not possible to provide at least a top 20, a top 10 was used for **stream-ripping software** and **stream-ripping apps**. This selection of the most popular **stream-ripping services** comprises a sample of 100 services.

Metric collection and analysis

Research into the technical composition of the top 10 most popular **stream-ripping services** (based upon their UK Alexa estimated usage) in Part Two was conducted through accessing each service and investigating several technical infrastructure and functionality elements. This included how each service obtained content, the file types which were made available, the audio quality available, how content was delivered to users and whether an **API** or any type of facilitator was being used by the service.

Traffic source data made available by SimilarWeb was used in the analysis of the entry points to **stream-ripping services**. Data was available for **download sites** (40), **stream-ripping sites** (20) and **stream-ripping software** (10) - but not for **stream-ripping apps** or **stream-ripping plug-ins**. The origin of traffic data provides statistics for the proportion of traffic to sites coming from direct access, mail, referrals, social networks and search engines. This was analysed to comment on how traffic is being driven to **stream-ripping services** by their sub-categories. SimilarWeb also provides keyword data, this was considered for the top 10 highest usage **stream-**

ripping services (based upon UK Alexa estimated usage). The top 5 keywords for each site was provided from SimilarWeb, amounting to a total of 50 keywords which were analysed.

Research into the funding models of top **stream-ripping services** considered **stream-ripping software** (10), **stream-ripping sites** (20) and **download sites** (40). Funding for each site was categorised as one of the following four revenue stream options: advertising, payments, both advertising and payments, or no revenue stream where none was found. Where advertising was found on a site (on **download sites** and **stream-ripping sites**) the type of advertising was recorded as being malware/PUP, scam, or gambling, with all other advertising categorised as generic/other ads.

The section covering the licensed services abused through stream-ripping grouped **stream-ripping services** in terms of their content source: YouTube, SoundCloud or both. A total of 80 services were surveyed in this way (20 **download sites**, 20 **stream-ripping sites**, 20 **stream-ripping plug-ins**, 10 **stream-ripping apps** and 10 **stream-ripping software**). Analysis into the server locations of **stream-ripping services** and their hosting providers looked at 60 services, comprised from 40 **download sites** and 20 **stream-ripping sites**.

Alexa estimated usage methodology

INCOPRO chose Alexa as its first provider of traffic metrics and is working to integrate other data sources in the future. Many people have misconceptions regarding the data provided by Alexa, possibly due to several changes in methodology throughout their history and being slightly opaque about the detail of their data collection.

Prior to 2008, Alexa traffic estimates were based solely on their browser toolbar, which users had to manually install on their computer. In 2008 Alexa announced that they were no longer relying solely on the toolbar data, and instead pulled in data from a variety of sources, including buying data from ISPs. Alexa's methodology has changed again over the past few years, which appears to coincide with Alexa launching their direct site measurement program (Alexa Certified Metrics). Alexa has removed all text from their information pages regarding buying data from ISPs/collecting from a variety of sources, and now state the following (paraphrased):

- Traffic estimates are based on data from their global traffic panel, a sample of all internet users. The panel consists of millions of users using toolbars created by over 25,000 different publishers, including Alexa and Amazon.
- Some sites are directly measured by Alexa – site operators can sign up to Alexa's certified metrics program.
- Traffic Rank is a measurement of traffic to a website, relative to all other sites on the web over the past 3 months (a rolling 3-month period updated daily) and calculated using a combination of the estimated average daily unique visitors to the site and estimated number of page views over the past 3 months.
- Alexa corrects for biases in the demographic distribution of site visitors, they correct for potential biases in data collected from the various browser extensions, to better represent the type of visitors who might not be in their measurement panel. That being said, biases still exist.
- Due to the concentration of visitors being on the most popular sites, it is difficult to accurately determine the rank of sites with fewer than 1000 monthly visitors. Therefore, traffic rankings of 100,000 and above should be considered rough estimates. The closer a site gets to number 1, the more accurate its traffic ranking becomes.

Alexa's collection methods and traffic data were presented and explained in court last year by INCOPRO's Director of Technology, Bret Boivin. This evidence was accepted by the judge and formed an important part of the successful case against the defendant.

As there are several data providers that offer usage numbers for sites, and each provider applies a different methodology and draws data from different sources, INCOPRO has chosen to refer to the usage metric as an overall 'Alexa usage estimate'. This is to avoid

inconsistencies with other data sources, and because the focus of this report is concerned with the impact of enforcement as opposed to the number of users for particular sites.

To determine this usage metric, we translate the Alexa reach, which is expressed as number of users per million, for each site and user percentages into estimates of the estimated usage of a website. To do this, the global internet population has been obtained from the latest ITU Facts and Figures (published February 2013). Alexa reach data is tracked automatically by our system, along with several other key metrics. For this calculation, the 3-month reach data is used with the ITU figure to produce the usage metric.

Alexa also makes data available for territories individually where the website has enough traffic data in that country. This is expressed as a percentage of all users visiting the site. This percentage figure is used in conjunction with the above reach calculation to get the Alexa estimated usage metric for the site in each territory. We take the above calculations on a day-by-day basis and then calculate the median value for the month for each site, for both the global and country calculations. Given the fluctuations in numbers that can occur as a site decreases in popularity, this is the best way to remove any dramatic increases or decreases.

This Alexa usage estimate is used to show trends in relation to specific sites. Sites relevant to all aspects of the piracy landscape, from legitimate services to proxies used to circumvent ISP blocking measures are dynamically tracked by INCOPRO. We can also confidently assess the impact on other sites that are in the same type of "piracy market" and that might be expected to benefit from blocking applied to other sites. Our confidence on this stems from the fact that the INCOPRO system has tracked blocked sites and the key other piracy sites for a substantial period and has also tracked all known proxies for such sites. This tracking has had to be meticulous because the tracking is then used to notify ISPs of site and proxy domains to be blocked. More data sources are being identified and included in INCOPRO's Identify database in the coming months, which will increase the data points available for comparison.

As of November 2015, INCOPRO has been able to track all live domains relating to a specific website, rather than just the main site. As a result, the usage for any alternate domains being used have been included within the total usage data for this month.

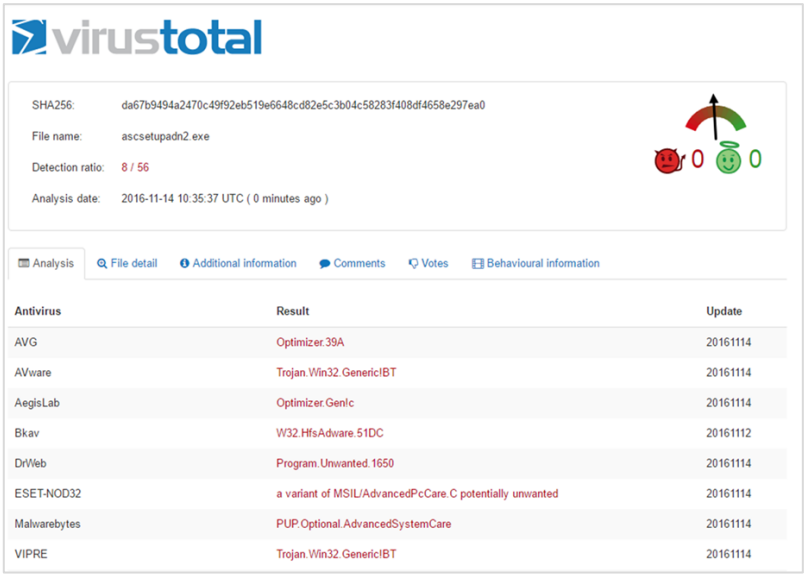
Appendix B: Top 50 music content sites

Sites Containing Music	Music Only Sites
vodlocker.com	youtube-mp3.org
unblocked.live	purplinx.org
youtube-mp3.org	freemake.com
thevideo.me	mp3juices.cc
kat.cr	junglesvibe20.net
mega.nz	tradownload.co
thepiratebay.org	vidtomp3.com
pirateproxy.red	tekstowo.pl
zippyshare.com	redmp3.su
torrentz.eu	flvto.biz
openload.co	israbox.co
uploaded.net	youtube2mp3.cc
proxybay.tv	youtubeinmp3.com
rapidgator.net	mp3fly.in
rutracker.org	funkysouls.com
extratorrent.cc	emp3z.com
ddltown.com	viperial2.com
banashare.com	soundpark.su
rarbg.to	what.cd
keep2s.cc	newalbumreleases.net
promptfile.com	k2nblog.com
nitroflare.com	muzofon.com
turbobit.net	yourmusics.me
chomikuj.pl	zaycev.net
itorrents.org	ivoox.com
ukpirate.org	mp3million.com
dfiles.eu	mp3take.biz
myvidster.com	audiomack.com
usenet.nl	songx.pk
filelist.ro	mp3freex.co
1337x.to	dimeadozen.org
iptorrents.com	hunt4tunes.com
ncore.cc	loudtronix.co
4shared.com	teledyski.info
uloz.to	freeallmusic.ltd
sendspace.com	audiocastle.biz
depositfilesonic.com	tudoparadownloads.com
kat.al	mp3monkey.net
linkomanija.net	albumkings.com
rlsbb.com	youtube-downloader-mp3.com
userscloud.com	my-free-mp3.org
arenabg.ch	tracker.beathau5.com
sceper.ws	mp3pn.biz
torrentproject.se	mixtapetorrent.com
warez-bb.org	mp3li2.com
limetorrents.cc	get-tune.cc
purplinx.org	mp3.skull.to
1fichier.com	mediaboom.org
isohunt.to	psychocydd.co.uk
filefactory.com	vubey.yt

Appendix C: Malware on stream-ripping services

Malware/**PUP** links account for the majority (52.2%) of advertising delivered to users of **stream-ripping sites**. It is therefore likely that these malicious adverts are responsible for a considerable proportion of the funding to these **stream-ripping services**.

On the homepage of vidtomp3.com, one of the UK's most popular **stream-ripping sites**, the advertising banner provided a link to download the known **PUP** PC Speedup Pro. The installation .exe was scanned with virustotal.com, an online virus and malware scanning service, where 8 of the antivirus solutions used by the service found the .exe to be potentially unsafe.



Appendix D: Top stream-ripping services by sub-category

The top **stream-ripping services** considered in this report are representative of the most popular services in use at the time of carrying out this research, in November 2016. It is important to note that sites and services are constantly changing in several ways; examples of this include re-directing to different domains, changing their operating models and going offline or being taken down.

Category	Host/Name
Stream-ripping App	*Best Downloader for YouTube*
Stream-ripping App	*DenTex YouTube Downloader*
Stream-ripping App	*Peggo - YouTube to MP3 Converter*
Stream-ripping App	*Pocket Tube*
Stream-ripping App	*Shark YouTube Downloader*
Stream-ripping App	*SnapTube Video and Music Downloader*
Stream-ripping App	*Tubemate*
Stream-ripping App	*VidMate*
Stream-ripping App	*YouTube Downloader*
Stream-ripping App	*Youtube MP3 Music Downloader*
Download Site	*4sharedmp3.xyz*
Download Site	*abmp3.me*
Download Site	*aiomp3.com*
Download Site	*audio.naij.com*
Download Site	*audiocastle.biz*
Download Site	*audiopoisk.me*
Download Site	*comtunes.com*
Download Site	*emp3z.com*
Download Site	*emp4.link*
Download Site	*free-mp3-songs.com*
Download Site	*get-tune.cc*
Download Site	*loudtronix.co*
Download Site	*lyricmp3skull.co*
Download Site	*mediarockz.info*
Download Site	*mp3bit.net*
Download Site	*mp3downloadonline.com*
Download Site	*mp3goo.com*
Download Site	*mp3juices.cc*
Download Site	*mp3li2.com*
Download Site	*mp3million.com*
Download Site	*mp3monkey.net*
Download Site	*mp3pn.biz*

Category	Host/Name
Download Site	*mp3shared.com*
Download Site	*mp3songx.com*
Download Site	*mp3take.biz*
Download Site	*mp3to.co.in*
Download Site	*mp3va.com*
Download Site	*mp3wix.com*
Download Site	*muzofon.com*
Download Site	*my-free-mp3.org*
Download Site	*onemp3.co*
Download Site	*oonly.com*
Download Site	*playtopmusic.com*
Download Site	*redmp3.su*
Download Site	*songmirror.top*
Download Site	*telecharger-mp3-gratuite.net*
Download Site	*tubidydb.com*
Download Site	*wanmp3.com*
Download Site	*yourmusics.me*
Download Site	*zaycev.net*
Stream-ripping Site	*2conv.com*
Stream-ripping Site	*anything2mp3.com*
Stream-ripping Site	*clip.dj*
Stream-ripping Site	*clipconverter.cc*
Stream-ripping Site	*convert2mp3.cc*
Stream-ripping Site	*convert2mp3.net*
Stream-ripping Site	*flv2mp3.org*
Stream-ripping Site	*fullrip.net*
Stream-ripping Site	*listentoyoutube.com*
Stream-ripping Site	*mp3fiber.com*
Stream-ripping Site	*mp3fly.in*
Stream-ripping Site	*onlinevideoconverter.com*
Stream-ripping Site	*tradownload.com*
Stream-ripping Site	*videograbby.com*
Stream-ripping Site	*vubey.yt*
Stream-ripping Site	*youtube2mp3.cc*
Stream-ripping Site	*youtubeconverter.me*
Stream-ripping Site	*youtubeinmp3.com*

Category	Host/Name
Stream-ripping Site	*youtube-mp3.org*
Stream-ripping Site	*yt-mp3.com*
Stream-ripping Plug-in	*1 Click Youtube Video Download*
Stream-ripping Plug-in	*Download Flash and Video*
Stream-ripping Plug-in	*Download Youtube video as MP4*
Stream-ripping Plug-in	*Easy Youtube Video Downloader For Opera*
Stream-ripping Plug-in	*Free YouTube MP3 Downloader*
Stream-ripping Plug-in	*FVD Video Downloader*
Stream-ripping Plug-in	*GetThemAll Video Downloader*
Stream-ripping Plug-in	*MP4 Downloader*
Stream-ripping Plug-in	*SaveFrom.net helper*
Stream-ripping Plug-in	*Skyload*
Stream-ripping Plug-in	*SoundcCloud Downloader*
Stream-ripping Plug-in	*SoundCloud Dowloader Free*
Stream-ripping Plug-in	*Trevx Music downloader*
Stream-ripping Plug-in	*Video Converter*
Stream-ripping Plug-in	*Youtube Downloader*
Stream-ripping Plug-in	*YouTube MP3*
Stream-ripping Plug-in	*Youtube MP3 downloader*
Stream-ripping Plug-in	*Youtube To MP3*
Stream-ripping Plug-in	*Youtube to mp3 converter*
Stream-ripping Plug-in	*Youtube Video and Audio Downloader*
Stream-ripping Software	*4KDownload*
Stream-ripping Software	*aTube Catcher*
Stream-ripping Software	*DVDVideoSoft*
Stream-ripping Software	*FLVTO*
Stream-ripping Software	*FreeMake*
Stream-ripping Software	*iSkysoft*
Stream-ripping Software	*KeepVid*
Stream-ripping Software	*SaveFrom.net*
Stream-ripping Software	*SnapFiles*
Stream-ripping Software	*VidtoMp3*

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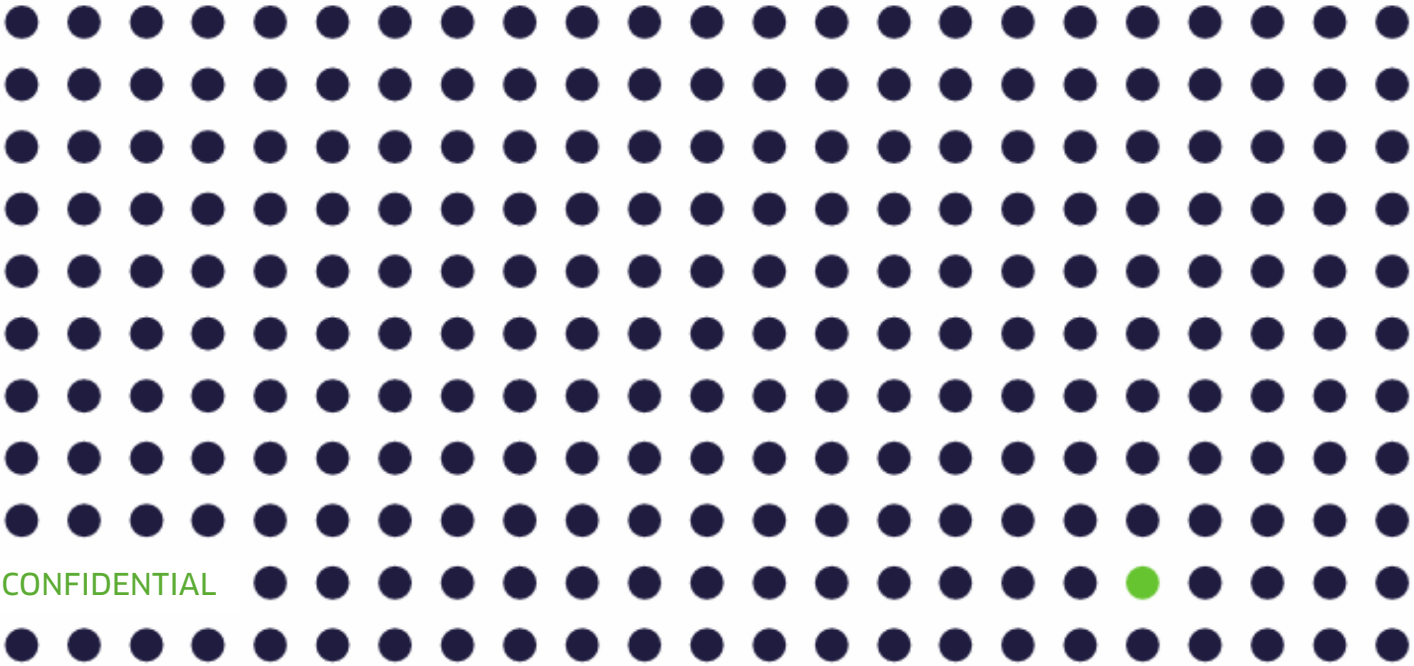

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New Penderel House, 283-288 High Holborn, London, WC1V 7HP E: enquiries@incoproip.com T: +44 (0)20 3051 0494 www.incoproip.com