

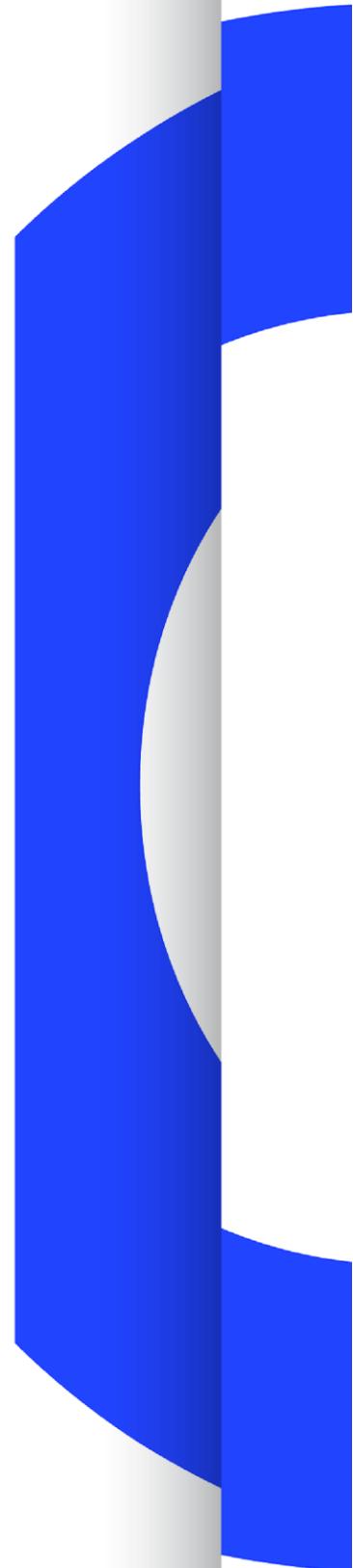
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OVER-THE-TOP DISTRIBUTION OF PSM CONTENT AND SERVICES

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Abstract

This document is a contribution to an ongoing discussion about the future distribution of Public Service Media (PSM) content and services. Among many important issues related to distribution the rise of the Internet as a principal distribution infrastructure undoubtedly stands out as the most important development in recent years.

Different Public Service Media organisations (PSMs) have, sometimes, quite different notions about the distribution of their content and services due to their individual remits or economic capabilities. Nevertheless, many challenges they are confronted with are similar as they arise from the changing audience behaviour as well as the technological and market developments.

Currently, dedicated broadcast distribution networks are particularly important for the universal distribution of linear radio and TV services. However, these networks are no longer capable of meeting all PSM distribution requirements, especially as they cannot support on-demand services and do not reach personal devices such as smartphones and tablets.

This is where distribution over the Internet comes into play with different Over-the-Top (OTT) models being used. Some PSMs are contemplating moving all their distribution to OTT in the long run. Whether such an approach will be possible and sustainable on large scale is a vital question for PSMs to be addressed in due time.

To understand if OTT distribution models will be the basis for, or are to become a crucial element of, future PSM distribution strategies some questions deserve particular attention:

- 1. Are OTT models expected to become a principal means of distribution for all PSM content and services and eventually render conventional broadcast distribution unnecessary? Alternatively, would OTT remain complementary to the broadcast infrastructure and PSM will continue to need to use both?*
- 2. Is the transition from dedicated distribution networks to OTT models inevitable and only a matter of time? If so, what are the drivers of this transition and how long might it take? Are there any alternatives?*
- 3. What impact would a full transition to OTT distribution have on PSMs? How far would OTT models be able to fulfil future distribution objectives of PSMs and their audiences?*
- 4. In the OTT world PSMs are small players. What can the EBU, together with the Members, do to ensure that they can prosper and make use of the opportunities provided by the technological developments and the features of the Internet?*
- 5. What issues related to OTT distribution need addressing to meet the requirements of PSMs?*

This report elaborates on these questions without aiming to give final answers. The primary motivation of this report is to facilitate the discussion and identify relevant issues that PSMs need to be aware of and address, to achieve their distribution objectives. In this respect, the report is not meant to deal with distribution in a comprehensive way but rather to concentrate on the option of using exclusively OTT models when considering future distribution strategies for PSM content and services.

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Over-The-Top Distribution of PSM Content and Services

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1. Background

PSM organizations (PSMs) are established by law and have a public service remit to inform, educate and entertain. The exact legal nature of each PSM organization varies across different countries, but in general, PSM's overarching goal is to deliver public value and to operate exclusively in the public interest. As part of fulfilling their remit, PSMs produce a whole range of audiovisual content and services, both linear and non-linear.

The activities of PSMs rest on two basic pillars. These are the production of audiovisual content and services, and their distribution to the respective audiences. While the content production seems to be naturally perceived as the core business of PSMs the distribution often receives less recognition. However, efficient distribution is vital to make PSM content and services available to the public.

In general terms, distribution is the act of getting products and services to customers in the way that companies want their products to be received, under the economic and technical conditions they must operate and the regulatory and legal obligations they must adhere to. This also holds for PSM content and services with the understanding that the regulatory and legal framework of PSM may be substantially more stringent than for typical commercial market participants.

Distribution of PSM content and services makes use of various, different means of technologies and networks. This is primarily because already in the past, no single technology or network has been capable of effectively distributing all types of audiovisual services at scale while satisfying all the PSM requirements, e.g. coverage, targeted devices, reach, quality of service, capacity, prominence, etc.

Distribution of PSM content and services is impacted by several factors, including:

- Audience behaviour and expectations, which is often influenced by the capabilities of user devices and the experience with innovative content and services available on the market.
- The development of technologies and their proliferation in the market.
- The availability and capabilities of user devices.
- The characteristics of networks used for distribution, both transport and access networks.
- The regulatory framework for distribution including spectrum, access, online platforms, etc.
- The business arrangements of stakeholders along the entire distribution chain, and
- The distribution costs.

In a distribution ecosystem based on traditional broadcast technologies such as terrestrial broadcast networks, or cable and satellites networks, production and distribution can be considered as quite independent, sequential tasks. This seems to be no longer the case in a broadband dominated network ecosystem. For example, production of content and services which shall be distributed exclusively over the Internet necessitates the inclusion of the right metadata to ensure that content and services may be found easily by the target audiences. Thus, distribution options must be taken into consideration already during the initial steps of production.

Distribution of PSM content and services refers to two broadly defined use cases:

- Stationary consumption e.g. in the home, and
- Consumption in nomadic or mobile conditions using personal devices and in cars.

For both use cases PSMs are concerned about:

- Connectivity, i.e. the technical possibility to deliver content and services.
- The distribution costs both for the PSMs and for users, and
- The regulatory safeguards to ensure prominence of and access to PSM content as well as service integrity.

Stationary access to PSM content and services in Europe is well served with traditional broadcast networks as well as fixed broadband networks which allow the distribution to TV sets and, complemented by WiFi, also to smartphones and tablets.

Nomadic and mobile access to PSM content and services also presents a mixed picture. Linear radio is universally available via FM and in many countries also DAB+ transmissions that can reach dedicated radio receivers, including those in cars. However, reception on personal devices (smartphones and tablets) is only possible via mobile broadband networks, which may not provide universal portable or mobile coverage required for a consistent performance within the coverage area.

Broadcast networks are designed to provide linear services to a large audience and across nation-wide territory in a technically and cost-efficient manner. Their operation is often regulated and PSM services have a favourable position.

While broadband networks are in principle also capable of carrying linear services, the position and role of PSMs in this domain is not as privileged as on broadcast networks. General purpose broadband networks accommodate many different users. Hence, PSMs are not only competing with other content providers for reach and prominence. They also must share the available bandwidth with cash-rich companies outside the media industry which may expose PSMs to a tightened financial competition scenario.

2. Content and Services

PSMs offer a great variety of different services. These include in the first instance traditional linear radio and TV programmes, but increasingly also on-demand content and services. Furthermore, PSMs use many social media platforms such as Facebook, Twitter or Instagram. Also, third-party video sharing platforms are employed.

The strength of PSMs lies in their ability to offer curated services. Linear services fall into that category but also the non-linear offers are curated, for example the BBC iPlayer or ARD-Mediathek

and many similar services provided by EBU members. Content available in these services has been carefully laid out by the editorial departments of BBC, ARD and other EBU Members.

Linear services are still the core business for most PSMs. They are widely used, but demand for them is slowly declining. There is an identifiable generation gap for linear services. Whilst they are strong in the 40+ age group, there is significantly less interest among people in the 14 - 29 age group.

In most countries the total consumption of non-linear services is still small in terms of data volumes and the time spent with them compared to linear services. However, consumption of non-linear services is strongly increasing primarily among the younger generation. Even the more senior audiences start to appreciate the flexibility that comes with non-linear services.

PSM offers on social media have become an indispensable way of making content and services available to users. This poses difficult challenges to PSMs when trying to be present on relevant platforms due to the many different social media platforms and their sometimes erratic and unpredictable popularity.

Some third-party online platforms can be utilized by PSMs to provide unedited live streams directly from events. This possibility can be used to extend the coverage to those events that cannot be easily accommodated in existing linear live channels due to lack of capacity, stringent programme planning workflows, or cost issues. Examples include small scale sports, cultural or community events, ad-hoc events, accidents and catastrophes; situations which cannot be planned for.

Without any doubt all these different types of services will continue to be attractive on their own for the foreseeable future. However, from both a service provider's and a user's perspective there seems to be high potential in combining them to create a more holistic service proposition and adding various degrees of personalization. The latter is subject to getting access to user data, i.e. personal preferences for content, preferred user devices, the consumption environments and conditions.

Based on gathered user data recommendations can be tailored which may turn into a very well-designed personalized offer. The simplest recommendation engine may just analyse the user consumption pattern and suggest similar content. This may become less interesting in the long run. PSMs may particularly wish to transcend this simple approach by putting forward content that may give the user a wider, more holistic media experience by offering diverse and contextual content according to their public service remit.

Personalization based on recommendation engines is an option driven by content providers and hence determined by their interests. Allowing users to actively influence the content and service offer may be another level of personalization. For linear radio and TV services this could for example mean the possibility to replace individual elements in the linear schedule by content from the corresponding non-linear databases. Even replacements with content from external sources, e.g. other SVOD subscriptions, could be conceivable.

For non-linear offers, personalization may result in personalized entry pages to the iPlayer, Mediathek and the like, combined with personal recommendations. Dynamic reconfiguration of the visible offer or recommended content based on current search queries may be other options for curation. With a view of targeting portable and mobile consumption of PSM content and services, geo-referenced recommendations that link the users' location or a planned route to available media may turn into a precious asset for PSMs.

3. Requirements for Distribution

Distribution of content and services is part of the PSMs' remit and obligation. The regulatory and economic conditions and constraints under which PSMs operate give rise to special requirements for distribution.

Some of the most important requirements are:

Reach

Reaching all age groups, all social milieus and communities, majorities and minorities, including in emergency situations.

Free Access

Accessing PSM content and services shall be free of charge for the users¹.

Contact with the Users

Establish and maintain direct contact to the users, i.e. without intermediaries.

Prominence

Maintaining prominence thereby reflecting the significance of the PSM in the market, including ease of access and use.

Access to User Data

Access to usage data to assist with editorial decisions and enable offering personalised services in full compliance with European and national rules in the field of data protection².

Control

Retaining control over distribution to:

- Preserve editorial control, service integrity and attribution - no modification of content or service by third parties, i.e. PSM content must be displayed on screen unaltered and without unauthorised overlays.
- Avoid blocking or filtering the service offer by the gatekeepers.
- Fulfil contractual obligations towards content owners (DRM, geo-restrictions).
- Manage the user experience, including quality of service.

Costs

Containing distribution costs.

Accessibility services

Keeping a low threshold for access to PSM content and services for people with disabilities.

These requirements are to be understood as a set of PSM objectives that should be achieved under ideal conditions. They are as far as possible independent from distribution options and do not reflect the current constraints of different distribution technologies or user devices. In reality, however, and depending on the issues at hand, they may only be partly achievable.

¹ A detailed treatment of the relevance of free-to-air distribution for PSM content and services is provided in the EBU Fact sheet <https://tech.ebu.ch/publications/relevance-of-fta-distribution-for-psm>

² At the EU level the relevant rules are General Data Protection Regulation (<https://gdpr.eu>) and the ePrivacy Directive (<https://ec.europa.eu/digital-single-market/en/news/eprivacy-directive>).

4. The OTT Ecosystem

Conventional broadcast distribution ecosystems constitute a closed end-to-end system where all elements from service creation and aggregation, play-out, transport, reception and consumption are tightly linked together by means of dedicated technologies concerning data formats, network technologies and the capabilities of receiving devices. It is a closed universe serving the unique purpose of distributing for example linear live TV programmes. All elements along the distribution chain need to be carefully adjusted and synchronized to achieve reliable service. For PSMs this means they need to set up playout systems which tie into the specific distribution mechanisms that in turn can only target dedicated receivers.

OTT basically decouples the tight link along the distribution chain, both technically and commercially. Instead of dedicated technologies, general purpose formats and transport mechanisms are employed. Moreover, in principle there is no need for contracts between PSMs and network operators.

Implicitly, OTT distribution is based on broadband IP networks, whether fixed or mobile, which are not managed end-to-end. In most cases transport is enabled in terms of best-effort communication between service provider and user. OTT distribution is enabled by making content and services available online and providing means to users to find and access these services. A prerequisite for the latter is that users have access to the Internet for which they must bear the costs themselves.

OTT distribution can utilise any technology or network that provides access to the Internet, while being agnostic to the underlying transmission technology. This also means that distribution can utilize a combination of multiple different technologies and networks that are operated by third parties for which PSMs do not bear the costs.

Even if at first glance this seems to be extremely attractive, there are several pitfalls that PSMs need to be clearly aware of. These principally concern technical, commercial and regulatory or policy issues.

4.1 Technical Aspects

As long as OTT distribution is based on best-effort transport mechanisms there is a high probability of clashing with the requirements of PSM organisations, such as guaranteed levels of quality of service or user experience. This is primarily because substantial parts of the distribution chain are beyond the control of media service providers. The Internet is the global network of networks and it represents a complex environment of interconnected broadband networks based on different technologies but using interoperable protocols. It has no single centralized governance in either technological implementation or policies for access and usage. Individual actors in the broadband distribution process implement their technical solutions on their respective networks.

Technically, best-effort quality is quite often adequate as the throughput and capacity of broadband networks continue to improve and dynamic adaptive streaming protocols such as DASH are prevalent to mitigate the impact of a variable throughput. However, as many different users compete for network resources, issues related to network access and capacity may be aggravated at times of a peak demand and in emergency situations.

To cope with such situations, PSMs have already started to make use of Content Delivery Networks (CDN). CDNs are managed networks that improve the best-effort quality users usually get through their ISP Access Networks by caching content closer to the end user.

Typically, CDNs will bring the content from the content provider to a caching server connected to the user's ISP Access Network and from there it will be delivered through the user's Internet connection.

Once the user requests a piece of content from a server through a website or an App, this request is directed to a CDN service which hosts the content as close as possible to the user. A dedicated unicast connection is established between the user and the CDN service provider after which the content is sent to the user's device.

In the unicast model, if several users are requesting the same content at the same time, for example if they want to watch a live event (e.g. sports, news, culture) a separate unicast connection is established for each user from the CDN caching server through the ISP Access Network to the user device. Thus, the traffic is multiplied by the number of users. Therefore, widespread distribution of popular content can lead to network congestion.

4.1.1 Access to content and services

Dedicated distribution networks such as terrestrial and satellite broadcast networks require system specific hardware components (tuners) in the receivers, without which, services cannot be received. In contrast, contemporary broadband networks, whether fixed or mobile, are service agnostic and allow any service to be delivered to a user device equipped with suitable software and sufficient processing power. Access to networks is technically enabled by general-purpose devices while access to services is based on special software, typically called Apps, or via Internet browsers. General-purpose devices are devices that can be used for more than one dedicated purpose such as smartphones, tablets, PCs, but also Smart TVs.

For the user to access media content and services it only requires download and installation of the appropriate App on the general-purpose device. Once connected to a broadband network that device can then access content and services available through the App.

PSMs provide their own websites and Apps through which users can have access to their content and services. This allows concentrating on the type and quality of content and the user experience without being concerned with distribution technologies. It simplifies the service provider's operation based on the assumption that access and provision of services to users is dealt with by Apps. The software is designed to autonomously determine a suitable operational mode for the best user experience depending on the technical capabilities of the user device, e.g. picture resolution, and the network, e.g. available bandwidth.

4.1.2 Reception environment: Stationary or Nomadic / Mobile

The environments in which users are consuming content and services of PSMs also need to be looked at from a technical perspective because they may impose different technical requirements.

Typically, two types of reception environments are distinguished: stationary environments and nomadic / mobile environments.

Stationary consumption of AV content and services occurs in users' homes, but it can also be an indoor work environment (office, workshop, etc.) An important element characterizing stationary consumption is that it is enabled through fixed reception installation.

Nomadic and mobile reception environments are basically the complement to a stationary environment. They refer to consumption scenarios in public places outside homes, offices and workshops. This could be under quasi-stationary conditions, meaning that the audience is using portable devices while being seated at a bus or train station, or at the airport waiting for a flight. The term nomadic is used to describe a sequence of locations in which media are consumed without

moving while watching video or listening to radio. Mobile consumption refers to a situation on the move. This could be while sitting in a car, a bus or a train.

In a nomadic or mobile scenario, AV content and services are consumed on a personal device, typically a mobile phone or a tablet, which rely on wireless connectivity. In practice this means either a mobile broadband network or a WiFi. In contrast to stationary consumption users normally only have limited control over the access networks under nomadic or mobile conditions. WiFi is available only in certain locations while coverage and performance of mobile networks vary strongly depending on the location. They may be good in urban centres but in the countryside, they may be inadequate for the consumption of AV content and services.

4.2 Commercial aspects, OTT market, and gatekeeping

From the commercial point of view, OTT distribution models are attractive to PSMs because the investments required to make the content and services available to large potential audiences can be small, especially for relatively limited usage, and the overall benefits outweigh the costs.

However, because of the way that broadband networks are currently designed and operated, i.e. based on unicast delivery, the OTT distribution costs for PSMs often scale with the size of the concurrent audience. The more users want to access content and services of a PSM the more distribution costs grow.

The cost elements for the PSMs may include:

- Investments in the development, operation, and maintenance of websites and Apps; This includes the cost of operating the origin servers.
- Costs of repurposing content for OTT distribution (e.g. encoding, re-formatting).
- Costs of adding the necessary metadata (e.g. to facilitate search and discovery online).
- CDN costs.
- Costs of access to the Internet.
- Costs of prominence. In the syndication model the PSM needs to negotiate a prominent position on third-party portals, e.g. on the most popular TV-sets, STBs, game-consoles and be available on all relevant App stores.
- The cost of content protection.

It is uncertain what would be the total distribution costs if OTT were the only available distribution option. Some EBU members experience OTT distribution costs to be substantially higher per viewing or listening hour than the equivalent delivered over broadcast networks, in particular satellite.

For example, EBU Members have a commercial arrangement with one or more CDN operators and CDN costs often represent the most significant part of OTT distribution costs. Even though the price per gigabyte of data on CDNs is constantly decreasing, this may not compensate for the currently observed growth in user demand in many European countries.

Other Members reported that the CDN market is currently sufficiently competitive, leading to a continuous decrease in traffic costs and the emergence of new commercial arrangements. Consequently, despite a substantial increase in their OTT distribution in terms of volume the associated costs did not substantially increase. It is yet to be seen, however, if this situation will persist.

The costs of network access for the users are normally covered by the users themselves, typically through a subscription to an ISP. While this reduces the overall cost for the PSM it may influence consumption, particularly where the subscription contract include limited data volumes as is still

prevalent on mobile networks. However, it can be observed that the costs of mobile data continue to decrease while the available volumes are increasing, and 'unlimited' contracts are available in many countries.

OTT distribution relies on IP-based broadband access networks, whether fixed or mobile. However, roll-out of broadband networks, is largely driven by economic considerations of telecom companies. They invest in the infrastructure when an attractive business case can be expected. This is usually the case in urban areas while in rural areas the business case is less appealing for them. The result is that broadband coverage in most countries is not universal and can be poor or non-existent in sparsely populated areas.

As a primary means of distribution, the Internet would need to support the peak time demand for PSM content and services, including in emergency situations and when substantial network capacity is used by other applications (e.g. gaming, software downloads). Currently, capacity limits seem to be in access networks, rather than in CDNs (see Annex 3 for further details).

Another important aspect is the OTT market environment in which PSMs are exposed to global competition and an increased risk of gatekeeping. The Internet is also the place where global digital giants are increasingly becoming powerful gatekeepers to what the audience can watch and hear. These companies increasingly control large parts of activities on the Internet, acting as multi-sided platforms with global user base. Furthermore, in addition to being dominant social networks, video sharing or e-commerce platforms, some of the major players are continually expanding their control over different parts of the Internet, including cloud services, data centres, and network infrastructure.

An example that may help to understand the dimension of the change is the way in which continents are connected. In the past, the deployment of undersea cables or satellite networks was typically achieved through creating international consortia. This has nowadays completely changed, as the big US companies such as Google, Facebook, Microsoft and Amazon are now pursuing these kinds of network deployment independently. Based on their apparently unlimited financial resources and their existing cloud infrastructure, including powerful server farms around the planet, they set out to build their own network infrastructure to connect the world. Facebook is launching a global satellite network while Google offers FTTH in the US and in the end, they may globally control access to users by keeping them in their own networks³.

On top of the control of the physical Internet infrastructure Amazon (Amazon Prime Video), Facebook (Instagram) and Google (YouTube) are major content providers through their respective platforms. Furthermore, some of these companies are also the dominant global providers of public cloud services. This concentration of control may turn into a threat to the existing Internet ecosystem including PSM organizations that rely on the Internet to fulfil their remit.

In addition, in an Internet ecosystem PSMs are exposed to competition not only from commercial broadcasters and Streaming Video On-Demand (SVOD) providers, but also from telecom operators and other non-AV services, for example search engines and marketplaces which may divert the audience away from PSM offers already at the point of entry into the Internet world. PSMs will need to find answers to these issues by forging new and sustainable future distribution strategies.

Internet platforms, however, may or may not have their own content. They provide the infrastructure for the third-party content providers to ingest the content and at the same time provide an App for the user to access the content, thus acting as intermediaries between content providers and their audiences.

³ <https://blog.telegeography.com/telegeographys-content-providers-submarine-cable-holdings-list>

4.3 Regulatory, Policy and Legal Aspects

At an EU level there are currently few rules regarding OTT distribution that provide regulatory safeguards for PSM content and services⁴. Often there are horizontal rules that apply to all kinds of sectors, but very few specifically target audiovisual media. In some cases, the rules are not legally binding obligations but open the possibility for Member States to develop specific rules at a national level:

- The Audiovisual Media Services (AVMS) Directive provides first steps towards prominence and signal integrity. Regarding prominence, Article 7a of the AVMS Directive states that “Member States may take measures to ensure the appropriate prominence of audiovisual media services of general interest.” Regarding signal integrity, Article 7b of the AVMS Directive foresees that “Member States shall take appropriate and proportionate measures to ensure that audiovisual media services provided by media service providers are not, without the explicit consent of those providers, overlaid for commercial purposes or modified.”⁵ It needs to be underlined that the provisions on prominence are inviting, rather than forcing, EU Member States to draft binding rules at national level, whilst the provisions on signal integrity force Member States to adopt binding rules. Unfortunately, very few Member States have adopted rules on prominence in the transposition of the Directive into national law. The European Commission is, however, looking into the question of collecting and possibly aligning existing national rules on prominence mainly and will commission a study on this.
- Similarly, and regarding branding and attribution, the recently adopted EU Regulation on promoting fairness and transparency for business users of online intermediation services (Platform-to-Business Regulation), under Article 3 paragraph 5, indicates that “providers of online intermediation services shall ensure that the identity of the business user providing the goods or services on the online intermediation services is clearly visible.”⁶

However, the European Commission, being conscious of the role (big) platforms play in our democratic society, put forward two proposals in December 2020: the Digital Services Act (DSA) and the Digital Market Act (DMA), with rules for digital services in the EU such as social networks, online marketplaces and other online platforms.

The DSA’s objective is two-fold: removing obstacles to the free flow of digital services and fighting illegal content ensuring a high level of protection of fundamental rights. The DMA instead tackles the economic (gatekeeping) power of large online platforms to bring more fairness in digital markets. Given that both texts will apply across many sectors (e.g. travel, tourism, retail, media) and the financial interests at stake, they are expected to be among the most lobbied files in EU

⁴ The EU rules highlighted in this part relate directly to distribution of PSM content and services online, and especially via OTTs. There are more rules applying to the online environment, such as rules on copyright (especially with the DSM Copyright Directive 2019/790), on advertising (for instance the AVMS Directive) or on data (i.e., the GDPR 2016/679 and the ePrivacy Directive 2002/58/EC). Although these are key pieces of legislation, as they do not relate to distribution directly, it was decided not to include them. Finally, rules on must carry contained in the European Electronic Communications Code (Directive 2018/1972) are considered as not being relevant in the context of this report as they relate to controlled environments.

⁵ Directive (EU) 2018/1808 of the European Parliament and of the Council of 14 November 2018 amending Directive 2010/13/EU on the coordination of certain provisions laid down by law, regulation or administrative action in Member States concerning the provision of audiovisual media services (Audiovisual Media Services Directive). This text still needs to be transposed in many EU Member States. The EU text is at <https://eur-lex.europa.eu/eli/dir/2018/1808/oj>. A useful table listing the ongoing transpositions with corresponding national rules can be found at: <https://www.obs.coe.int/en/web/observatoire/avmsd-tracking>, showing that only AT, BG, DE, DK, ES, FI, FR, HU, LT, LV, MT, NL, PT and SE have transposed the text as of February 2021).

⁶ Regulation 2019/1150 published in June 2019 - its implementation is being evaluated. See: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1150>. This will, however, be a strong point of discussion in the upcoming Digital Services Act Package.

decision-making history. It may therefore take at least the best part of the next two years for these rules to be adopted.

There are already several points to be welcomed in these Commission's proposals. A positive point in the DMA is for example that large platforms will have to share the data with their business users such as content providers. That means that PSMs will have a guaranteed access to data generated on these platforms in the context of the use of PSM content and services. However, EBU Members have identified some points that need to be improved and additional points that need to be added⁷.

The adoption of meaningful EU rules for global online platforms is essential. They will play a key role in whether and how citizens access content and information online in the light of the obvious fact that online platforms impact opinion-making, free speech and ultimately democracy.

In this context, it is also worth noting that rules on net neutrality have existed at EU level since 2015, with the EU Open Internet Regulation⁸. They establish the principle that:

- When providing Internet access services, all Internet traffic should be treated equally.
- It is possible to offer services other than Internet access services which are optimised for specific content, applications or services, or a combination thereof, only if the network capacity is sufficient to provide them in addition to any Internet access services provided. Such services shall not be usable or offered as a replacement for Internet access services and shall not be to the detriment of the availability or general quality of Internet access services for end-users.

Case-law on zero rating has only recently started to develop with, for example, the first Decision⁹ of the European Court of Justice confirming that zero rating practices must be assessed on a case-by-case basis.

5. OTT Distribution of PSM Content and Services

There are two substantially different ways of distributing PSM content and services using OTT. These are based on:

1. A PSM's own Apps and websites, and
2. Distribution via third-party Internet platforms.

These two approaches substantially differ from each other, with particular respect to:

- Costs for the content providers and the users.
- Control that content providers have over the user experience.
- Branding and attribution of content and services.
- Access to user and usage data, and
- Compatibility with PSM remits.

In practice, PSMs use both approaches to OTT distribution, i.e. offering and maintaining their own Apps and website; and making use of third-party platforms. The choice between one or the other

⁷ EBU policy positions on online platforms are available at: <https://www.ebu.ch/legal-policy/online-platforms>.

⁸ Regulation 2015/2120 laying down measures concerning open Internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union (EU Open Internet Regulation). See: <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32015R2120>

⁹ Judgement of 15 September 2020, Telenor Magyarország Zrt. (Hungarian mobile telecoms operator) v Nemzeti Média-és Hírközlési Hatóság Elnöke, C-807/18 and C-39/19 - more ECJ Decisions are expected in 2021.

depends on the intended purpose (e.g. increasing audience engagement, promotion of own services, extending the reach, delivery of content to the end user) and may be tailored to specific types of content, target devices, or audience segments.

Some of the largest Internet platforms have a very wide reach and popularity, which makes them attractive for the distribution of PSM content and services. However, collaboration with these platforms can also be rather challenging, in the absence of appropriate regulatory safeguards for PSMs.

5.1 OTT Distribution via Content Provider Apps and Websites (Model 1)

Almost all PSMs also make all their content and services available over the Internet through their own Apps and dedicated websites, as illustrated in Figure 1. This kind of distribution rests on three basic pillars: these are online services where curated content is available, user applications enabling access to the services and the availability of network distribution infrastructure.

Examples of such services are the BBC iPlayer, ARD/ZDF Mediathek, YLE's Areena, NRK.TV, NPO Start, RTVE A la Carta, etc. While initially all services were intended to offer on-demand services exclusively, almost all of them now offer access to linear TV and radio services as well.

These services use playout servers to retrieve content from an origin server on which publishable content is stored. Play buttons in websites and applications trigger a redirection to the playout server. Servers could be operated by media service providers themselves or by third parties.

The second pillar of this model are the software applications that allow users to access content and services. These are dedicated websites or Apps for different devices. Websites can easily be hosted on any appropriate webserver, while Apps must be provided for the targeted devices and made available through the corresponding stores, i.e. for iOS, Android or the respective stores of smart TV manufacturers. The control of look-and-feel and technical features of the website or the App lie with the media service providers themselves.

The transport between server and user device could entirely be left to the mechanisms of the Internet along the paths of interconnections, peering arrangements and exchanges of the Internet which are all beyond the control of media service providers. Consequentially, quality of service and quality of experience on the user side can vary drastically. Even though this used to be the default in the early days of media service distribution over the Internet, this approach no longer seems to be the preferred option.

As introduced in § 4.1, nowadays, most media service organisations are making use of so-called CDNs. A CDN connects the server where content and services of media providers reside (the origin server) with the edge servers of ISPs connecting users to the Internet. Thereby, the unpredictable path through the labyrinth of the Internet is short-cut by a well-defined pathway.

Content is either pushed from the origin server into the CDN or is pulled by the CDN. CDNs are in most cases not operated by the media service providers, instead, they have a contract with one or more CDN providers for distribution and caching. However, while the content provider does not have contractual relationship with the ISPs that provide Internet access to the members of the audience, the CDN operator does. Furthermore, many media service providers have created and operated their own CDNs from the early days of OTT distribution. An own CDN starts with a caching layer close to the origin server and connection arrangements to ISP, mostly through public Internet exchanges. Some media service providers also run playout servers inside access ISP networks. As this operation grew bigger outsourcing of CDN became more popular. Many media service providers, having evolved to online media companies themselves, combine own arrangements with those of third parties.

Figure 1 illustrates this model.

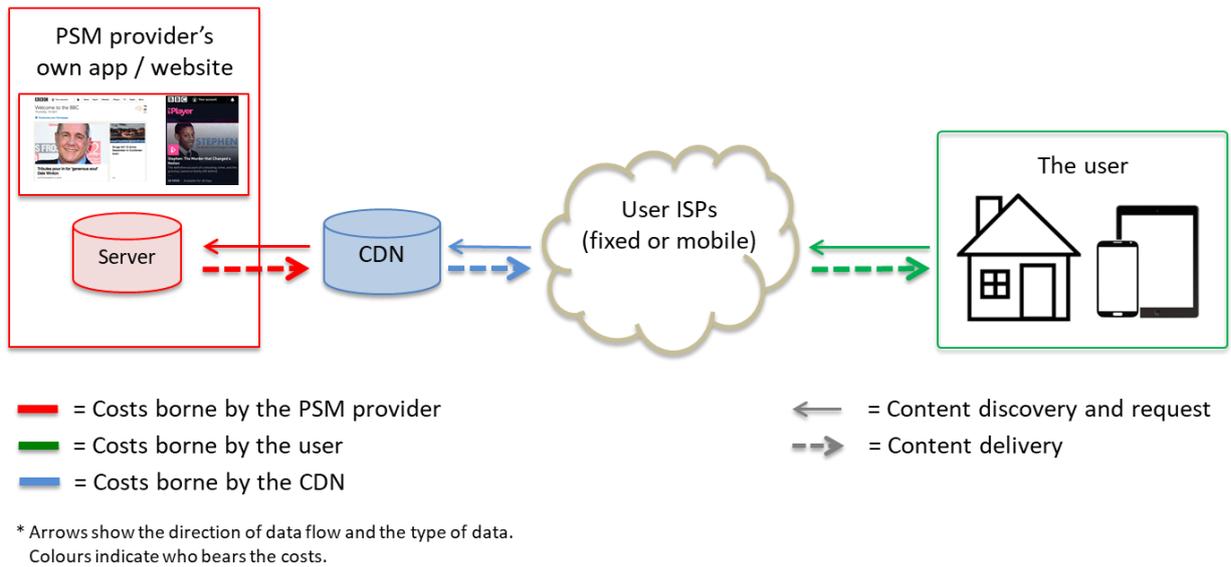


Figure 1: OTT using Apps and websites of PSM providers

5.2 OTT Distribution via Third-party Platforms (Model 2)

Under this model content providers will upload their pre-recorded content onto a third-party media platform or provide linear services for live streaming via such a platform. The platform will make the content accessible to the users, usually subject to its own standard terms of service. This model is depicted in Figure 2. Some of the most popular media platforms are, for example, YouTube, Spotify, iTunes or Facebook Live.

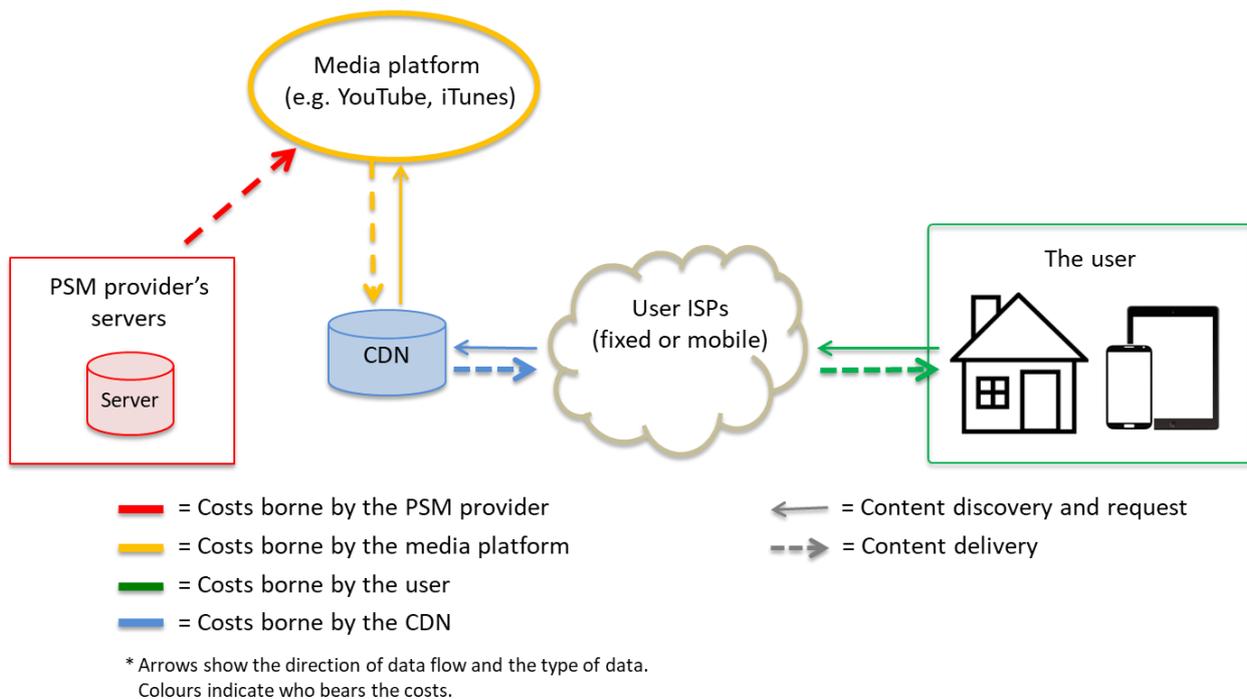


Figure 2: OTT - Distribution via third-party media platforms

The content provider only bears the cost of the upload onto the media platform as the CDN costs will be borne by the media platform itself and the users cover their own ISP costs.

Such platforms are normally designed to provide access to discrete pieces of content, rather than curated media services. A content provider may be able to create their own dedicated 'space' or 'channel' on the platform and users can 'subscribe' to that space. The platform's monetisation models include serving adverts alongside the content, monetising user data, or subscriptions. Revenue sharing between content provider and media platform operator is common. In some cases, this model is not aligned with PSM policies or regulatory framework.

Content providers tend to use different platforms for different purposes, such as increasing audience engagement, promotion and marketing, distribution of specific type of content, or targeting certain audience segments.

6. Implementation of the OTT models

PSMs are likely to use both OTT models (own Apps/website and the third-party platforms) at the same time for different reasons. The use of the models will be determined by each organisation's strategic requirements at a specific point in time e.g. access to larger audiences, access to data or access to specific markets such as youth markets. Therefore, the use of each model is likely to vary over time¹⁰.

Early in the growth of OTT delivery, PSMs developed their own Apps and websites as most viewing would have been via PCs and laptops. The proliferation of smart TVs opened yet another platform through which larger audiences could be reached. However, this was only possible if the Apps of PSMs were available for the respective Smart TVs or would be placed prominently in the manufacturer's own App portal. This posed an issue to PSMs which made them endeavour into syndication¹¹ arrangements with Smart TV vendors. Therefore, syndication became an important next step in the development of OTT distribution.

Syndication can be seen as an extension of OTT Model 1 where media service providers may also enter partnership arrangements with third parties to increase their reach. Under a syndication partnership, discovery of content and services is facilitated via a third-party's portal based on a contractual arrangement which may or may not imply payment. Such arrangements could be with other media service providers, smart TV manufacturers or service aggregators. The contract usually covers the terms and conditions of providing access to content and services of media service providers and may include provisions to ensure prominence.

One way of delivery is triggered via a deep link from the syndication portal to the content provider's distribution infrastructure - see Figure 3. In other cases, users are directed to the websites of media services providers, or the corresponding Apps are launched. Consequently, the delivery of content and services to the user is done in the same way as without a partnership.

¹⁰ The non-linear part of HbbTV services is delivered using OTT Model 1.

¹¹ The definition of syndication used in this report is different from the definition used in the US market. Syndicated services are editorially cohesive packages of content, often with associated metadata, functionality and branding that are made available to a range of third-party managed platforms. For example, the BBC syndicates the BBC iPlayer service to TV platforms, and the BBC Sounds service to mobile operating systems.

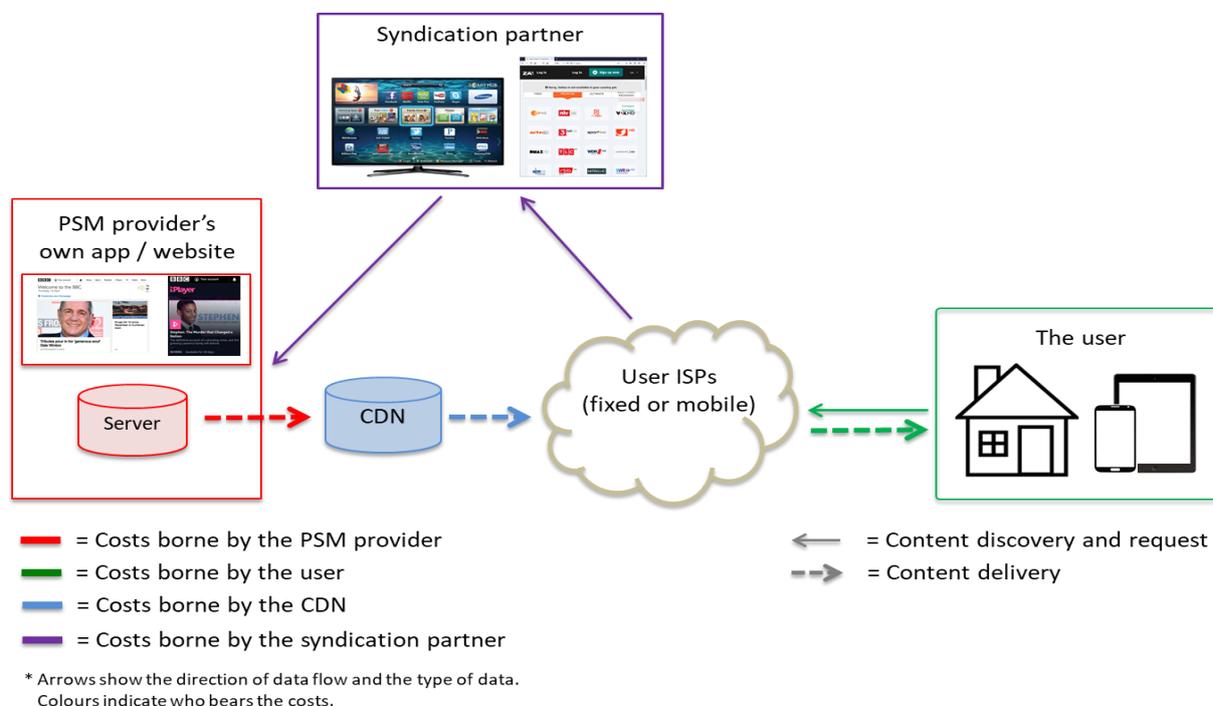


Figure 3: OTT based on syndication arrangements

The two OTT distribution models can be viewed as the opposite ends of a sliding scale of control with Model 1 giving PSMs the most control and Model 2 the least, with syndication lying somewhere between the two.

Use of the two models provides opportunities to develop innovative services such as those targeting specific audience segments (e.g. young audiences), receiving devices (e.g. smartphones) or type of content (e.g. news, educational content).

As an example, during the COVID-19 pandemic, the BBC developed a suite of programmes and initiatives to support home learning under the BBC Bitesize brand. Educational resources can be accessed via traditional broadcast routes, on-demand and through social media platforms such as Facebook, Twitter, TikTok and Instagram. The social media routes have the content edited to suit both the delivery platform and the targeted audience¹².

Further examples of how PSMs provided the dedicated COVID-19 content, in particular news, by using multiple different online platforms, can be found both the EBU MIS report '*COVID-19 Crisis: Public Service Media Audience Performance*'¹³.

Recently, a shift in the use of the models could be observed as more prominent organisations develop and strengthen their own brand and identity within the marketplace. This is resulting in a move towards OTT Model 1 as the primary OTT distribution model and can give leverage when negotiating syndication contracts. As an example, Disney are removing their content from other service providers and are establishing a new strong brand in the Disney+ App. This gives them direct access to their customer base and access to all the associated data so they can target their content more effectively. The growth of their brand also gives them great leverage with syndication partners. Apple TV+ operates under a similar model. The concern for PSMs is the potential growth of the number of strong single brands and associated Apps, such as Disney+. With their superior

¹² A rapped synopsis of "An Inspector Calls" by JB Priestley on the [BBC Bitesize](#) TikTok channel aimed at teenagers.

¹³ The report is available for download from <https://www.ebu.ch/publications/research/membersonly/report/covid-19-crisis-psm-audience-performance>.

financial backing they can buy their way onto the valuable real estate of smart TVs, making it harder for PSM Apps to have prominence.

7. Fulfilling PSM requirements by OTT Models

PSMs use both OTT models for the distribution of their content and services. However, there are substantial differences between the two models with regard to their abilities to fulfil PSM distribution requirements, as outlined in the table below:

PSM Requirement	Apps & Web OTT	Third-Party OTT
Reach	Technically, the reach is potentially unlimited, i.e. as far as the Internet reaches. This means wherever users have access to the Internet, they may consume content and services. However, there are coverage and capacity issues which may be aggravated in emergency situations. For some content access may be geographically limited (e.g. available only within a given country or territory) to comply with the obligations relating to content rights or with PSM distribution objectives and policies.	Some third-party platforms provide the possibility of targeting specific audience segments for specific content.
Free Access	Internet access is not free.	Access to PSM content and services depends on the business model and policies of the third-party platforms. PSMs seek to ensure that for their content and services no extra charges are imposed on the users in addition to what they must pay for access to the Internet anyway. Moreover, users are “paying” by providing their data to third-party platforms. However, they may not know in detail what happens with their personal data, they may not have any means to control the usage of their data.
	To those people already having Internet connection, access to PSM content and services is provided without additional recurring charges.	
Contact with Users	Access to content and services on the Internet falls under the net neutrality rules. This means that direct contact to users is possible in principle. Websites provided by media services providers are accessible without any intermediaries and gatekeepers. However, for Apps this may be different as Apps are published through App stores which are controlled by the App store owners. This means App store owners decide on whether or not an App is available, and they may apply their own content-related, commercial or technical policies and rules which do not necessarily align with national regulation in the PSM organisations' home country ¹⁴ . However, once the App is installed on the user device direct access is granted.	Third-party platforms act as intermediaries between the PSMs and the users. In most cases this means that a relationship with the end user is entirely in the hands of the third-party platform, including content discovery and request, as well as delivery. A PSM does not have direct access to the users.
Prominence	As PSM organizations control their own websites and Apps they have full control over how the content is presented. In the syndication model prominence and attribution is usually defined in the arrangement between the PSM and the syndication partner.	Prominence of PSM content and services is controlled by the third-party platforms and, generally, depends on the expected popularity of the content and its monetisation potential for the platform provider. The platform provider has control over presentation of the content,

¹⁴ See for example: <https://www.tellerreport.com/life/2020-08-07-google-stopped-danmarks-radio-s-App-for-children---changes-after-criticism.Hyax-CHJiZw.html>

PSM Requirement	Apps & Web OTT	Third-Party OTT
	<p>There is currently no regulation related to the prominence of PSM content and services on the Internet.</p>	<p>recommendations, if any, and playout.</p> <p>Furthermore, content is subject to the platform's publishing policy and the criteria applied by the search algorithms, which are usually determined by the platform's business objectives not necessarily known to the PSM organisation, and the legislation in the territory where the platform operator is established which may be different from what applies to the PSM organisation. Consequently, access to some PSM content may be restricted or in some countries even blocked.</p> <p>On some platforms the content of PSMs is not properly attributed and does not bring any benefits to the PSM brand.</p> <p>Some of the largest Internet platforms operate based on their standard terms of service that are imposed on all users and are not negotiable. Prominence might be negotiated only with some third-party platforms.</p> <p>There is currently no regulation related to the prominence of PSM content and services on the Internet.</p>
Access to User Data	<p>Editorial decisions, personalisation of services and even decisions on resource allocation require information about users and usage. As PSMs control their own websites and Apps they have the possibility to gather data related to traffic and usage. This means that both websites and Apps must implement appropriate data gathering mechanisms. Granularity and completeness of data depends only on the design choice by the PSM but is not constrained by any third-party.</p> <p>User registration provides the most accurate and reliable way of gathering information. An alternative is cookie-based technology. In both cases a voluntary user consent is required in compliance with the regulation (i.e. GDPR and ePrivacy Directive in the EU).</p> <p>In the syndication model access to usage data is usually defined in the arrangement between the PSM and the syndication partner.</p>	<p>All user data are collected by the platform operator who also controls access to that data. As their business models in most cases includes monetisation of user data, they are reluctant to make the data available to PSM organisations. If the PSM wants access to any data, this must be negotiated and usually paid for. Completeness and granularity of data is often an issue.</p> <p>Consequently, the PSM has only a rather limited access to user data which is sometimes too coarse and incomplete to be useful.</p>
Control	<p>In this model the PSM retains a high degree of control over distribution. This particularly applies to service integrity, the look and feel of the service, prominence and attribution of content, and the ability to gather usage data.</p> <p>Nevertheless, the PSM does not have full control over the user experience as it strongly depends on the technical quality of the connectivity services, i.e. the available bandwidth and latency, the capabilities of the user device, and the conditions imposed by content owners (e.g. DRM, geo-restrictions).</p> <p>Blocking and filtering of the service is prohibited by the current Net Neutrality regulation.</p>	<p>The PSM has only limited control over the distribution as many key decisions are made by the third parties. The content is adopted into the platform providers' design and expression. The PSM has no influence on the playout.</p> <p>PSMs have limited or no possibility to negotiate the terms of services with third-party platforms. Furthermore, third-party platforms generally do not provide effective redress mechanisms, e.g. in cases where PSM content is taken down.</p> <p>In some cases, platform operators' business practices may be incompatible with the regulations under which PSM have to operate (e.g. in relation to advertising) which may prohibit or restrict the use of the platform by the PSM organisation.</p> <p>Third-party platforms follow their own content-</p>

PSM Requirement	Apps & Web OTT	Third-Party OTT
		related, commercial, and technical policies. In the past this has led to situations in which content has been removed or blocked which nevertheless was fully in line with the national conditions of the content providers.
Costs	<p>The main cost elements for the PSM in this model are the following:</p> <p>Investments in the development, operation, and maintenance of websites and Apps; This includes the cost of operating the origin servers.</p> <p>Costs of repurposing of content for OTT distribution (e.g. encoding, re-formatting);</p> <p>Costs of adding the necessary metadata (e.g. to facilitate search and discovery online);</p> <p>CDN costs</p> <p>Costs of access to the Internet;</p> <p>Costs of prominence. In the syndication model the PSM needs to negotiate a prominent position on third-party portals, e.g. on the most popular TV-sets, STBs, game-consoles and be available on all relevant App stores.</p> <p>Costs of content protection</p> <p>Users bear their own costs for access to the Internet.</p>	<p>The main cost elements for the PSM in this model are the costs of their own access to the Internet and of the upload onto the media platform which are comparatively low.</p> <p>In some cases, additional costs might be incurred such as:</p> <p>Costs of repurposing content for OTT distribution (e.g. encoding, re-formatting);</p> <p>Costs of adding the necessary metadata (e.g. to facilitate search and discovery online);</p> <p>Costs of prominence on the third-party platforms, in those cases where negotiation is possible;</p> <p>Costs of access to user data.</p> <p>The third-party platform carries all distribution costs including the CDN costs.</p> <p>In some cases, the third-party platform will provide revenue-sharing possibilities which may or may not be negotiable with the platform provider.</p> <p>Users bear their own costs for access to the Internet.</p>
Accessibility services	As the PSM controls its own websites and Apps it has the possibility to add the necessary functionality to facilitate access to PSM content and services for people with disabilities.	Access to PSM content and services for people with disabilities depends on the functionality available on the third-party platform.

Each of the two OTT distribution models have certain advantages and disadvantages for PSM organisations. Neither Model alone would be sufficient to fulfil all PSM distribution requirements. Therefore, as described in § 6, in practice PSMs use both OTT models and their various combinations.

PSM content and services continue to evolve in response to the changing audience behaviour and expectations but also to benefit from the rapid pace of technological developments. Furthermore, there are many different third-party platforms which PSMs may use for different purposes, whether to expand the reach, promotion and marketing, or guide the audience to their own websites and Apps.

8. Conclusions

Today, OTT distribution of content and services is widely used by PSMs around the world. What may have started as a nice-to-have activity has turned into an indispensable pillar of the general distribution strategy of PSM organisations. With the growing success of OTT distribution, the questions listed at the beginning of this report urgently need satisfying answers.

Clearly, this report cannot provide complete and extensive answers. Rather, it became clear in the course of its preparation that more work is required on individual aspects to fully grasp and understand the potential, but also the pitfalls of OTT distribution. For the sake of completeness, the questions are repeated with a short assessment in the light of the analysis carried out so far:

1. *Are OTT models expected to become a principal means of distribution for all PSM content and services and eventually render conventional broadcast distribution unnecessary? Alternatively, would OTT remain complementary to the broadcast infrastructure and PSM will continue to need to use both?*

PSMs enjoy special conditions, including regulatory safeguards when it comes to distribution of linear services on conventional broadcast distribution networks such as terrestrial or satellite, which in most countries still deliver the largest part of linear viewing and listening. These conditions are a prerequisite for them to fulfil their public remit and stand their ground in an increasingly competitive media market.

For OTT to become a principal distribution means for PSM content and services, appropriate regulatory safeguards would be required. Moreover, the economics of the distribution to very large audiences need to be affordable for PSMs and the coverage and capacity of broadband networks would need to be sufficient to meet PSM obligations. At the same time, conventional broadcast networks remain an efficient distribution means for linear services to large audiences, which is challenging for unicast-based OTT distribution. Therefore, it can be assumed that PSMs will continue to use both for a long time. Even though this makes things complicated and expensive it is strategically important for PSM to retain a certain level of control and flexibility in distribution.

2. *Is the transition from dedicated distribution networks to OTT models inevitable and only a matter of time? If so, what are the drivers of this transition and how long might it take? Are there any alternatives?*

User trends and expectations are the main drivers behind the move towards OTT distribution. PSMs must face the facts that the younger audience can effectively be reached only over the Internet and seem to be no longer interested in traditional broadcast channels. Personalization and time-independent media consumption can only be realized by employing distribution means which offer bi-directional communication. The OTT distribution models enable these new possibilities and, therefore, will play an important role in the future. They also bring flexibility and new opportunities for innovation in content and services. Therefore, OTT distribution is attractive to PSM organisations. However, there are issues with reach, coverage, quality of service, control over distribution, access to data, gatekeeping, and insufficient regulatory safeguards for PSM content and services. These issues may eventually be resolved but this is likely to take a long time. Therefore, despite the growing importance of OTT distribution it may be in the interest of PSMs to maintain a mix of different distribution options.

3. *What impact would a full transition to OTT distribution have on PSM? How far would OTT models be able to fulfil future distribution objectives of PSMs and their audiences?*

The requirements of PSM discussed in § 3 need to be applied to any conceivable distribution option to judge its usability and potential. As PSMs are on their way towards full-IP based production workflows, OTT distribution may nicely fit when it comes to bringing content and services to users. However, as the analysis of the two OTT Models described in §§ 5, 6 and 7 has shown, OTT distribution in its current form exhibits substantial shortcomings in fulfilling the requirements of PSM organisations. These are mainly related to the lack of free access to PSM content and services, potentially high CDN costs, and gatekeeping issues materializing in lack of prominence, branding or attribution, and the difficulties or inability of PSMs to negotiate the terms of service with third-party platforms. Furthermore, a full transition to OTT distribution without the appropriate regulatory safeguards would expose PSMs to the global competition but without certainty that they would be able to fulfil their remit in a cost-efficient way. The EBU and its members need to

continue their engagement with regulators and policy makers and invest in technical developments and innovative content and services.

4. *In the OTT world PSMs are small players. What can the EBU, together with the Members, do to ensure that they can prosper and make use of the opportunities provided by the technological developments and the features of the Internet?*

The key to success for small players is certainly to join forces. This seems to be an obvious conclusion even without an in-depth analysis. However, it clearly underlines the need for organisations such as the EBU, where the common requirements of PSMs can be formulated and presented to the relevant external stakeholders, whether the industry, regulators, or policy makers. The success of the EBU in 3GPP and elsewhere can be without doubt attributed to the collective size of the membership they are representing. In times when the main rule followed by the industry is business opportunities based on economies of scale the fact that the EBU Members collectively reach 1 billion people around the planet is an argument which cannot be neglected in a money-driven world.

5. *What issues related to OTT distribution need addressing to meet the requirements of PSMs?*

For PSMs the transition to OTT-only distribution raises issues related to costs, control and the insufficient regulatory safeguards. The extent to which these issues affect a PSM depend on the OTT distribution model and specific national conditions. One of the burning issues for PSMs that are distributing content through their own Apps and websites is certainly the costs entailed by OTT distribution. As long as CDN costs scale linearly with the number of requests for content, PSMs are running the risk that their success on the content side cannot be sustained economically. Hence, flat rate CDN costs could be an objective PSMs should pursue. If not achievable, alternatives for CDN usage need to be developed and deployed. And PSMs must be proactive in this. If they do not inject their requirements at the right points, there will never be any technological developments that fully suit their needs. However, the question of being PSM-friendly or not is not only a technical issue; it also has significant regulatory implications. A PSM-friendly regulatory framework for OTT distribution is certainly a necessary condition.

The Internet infrastructure, especially the access networks, need to be upgraded to become more suitable for real time PSM usage. This means upgrading physical cables and reducing the over-subscription at the aggregation points (DSLAMs and CMTSs, see Annex 3). In general, dimensioning the network more on peak load than on average usage is required. The need for robust, reliable means of reaching the public even in the event of crises and civil emergencies also places particular requirements on PSM distribution models, and these are no less relevant for OTT distribution. Such requirements may, however, be a particular challenge for OTT distribution.

In conclusion, OTT distribution is here to stay, it allows PSMs to innovate and keep up with the changing audience behaviour and expectations. Therefore, its importance is likely to increase in the future. However, OTT distribution is not without issues for PSMs, and it will take a long time to resolve these issues in favour of PSMs.

Therefore, a transition to OTT-only distribution is not viable in the short to medium term. PSMs are likely to continue using both OTT and conventional broadcast distribution for a long time to come.

Annex 1: Media Distribution over the Internet

The Internet is the global network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet has no single centralized governance in either technological implementation or policies for access and usage.

The Internet is the successor of the so-called ARPANET which was started in 1966 to enable access to remote computers¹⁵. One of its basic design features was the introduction of the TCP/IP protocol. The deployment was governed by the US Department of Defence with an objective to develop a fully decentralized, fail-safe computer network. There were and still are several organizations involved to coordinate the Internet and develop Internet standards (e.g. ICANN, W3C, etc.). Regional registries oversee and regulate the allocation and registration of Internet address resources in a specific region (e.g. Réseaux IP Européens Network Coordination Centre (RIPE NCC) for Europe, West Asia, and the former USSR).

The different networks constituting the Internet¹⁶ are interconnected in public peering¹⁷ and transit¹⁸ relationships that steer the exchange (routing) of Internet traffic data between each other either based on direct links using the Border Gateway Protocol (BGP) or an Internet exchange point. Network service providers of all sizes interact and interconnect their networks in various topologies and business relationships. Typically, one distinguishes between three tiers of networks. At the top of the routing hierarchy are the Tier 1 networks¹⁹, large telecommunication companies that exchange traffic directly with each other via very high-speed fibre optic cables²⁰. Tier 1 network providers typically do not charge each other any fees for the exchange of traffic in either direction due to typically balanced traffic in each direction. Tier 2²¹ and lower-level networks buy Internet transit²² from other providers, typically Tier 1 networks, to reach at least some parties on the global Internet, though they may also engage in peering. Finally, Tier 3 networks correspond to Internet access networks offered by Internet Service Providers (ISPs)²³ who sell Internet connectivity to the end users.

Internet Exchange Point (IXP)²⁴ interconnect lower tier providers more directly with the upper tiers to reduce cost, latency and overall bandwidth. There are about 250 IXP across Europe. Major European IXPs are DE-CIX (Frankfurt)²⁵, AMS-IX (Amsterdam)²⁶ and LINX (London)²⁷.

Content Delivery Networks (CDN)²⁸ are geographically distributed servers, or groups of servers, and data centres that host the content close to the end users which increases its availability while alleviating the traffic load on transit networks and interconnection points of the Internet. CDNs

¹⁵ <https://en.wikipedia.org/wiki/Internet>

¹⁶ <http://drpeering.net/white-papers/Ecosystems/Internet-Region.html>

¹⁷ <http://drpeering.net/white-papers/Ecosystems/Internet-Peering.html>

¹⁸ <http://drpeering.net/white-papers/Ecosystems/Internet-Transit.html>

¹⁹ https://en.wikipedia.org/wiki/Tier_1_network

²⁰ https://en.wikipedia.org/wiki/Fiber-optic_cable

²¹ https://en.wikipedia.org/wiki/Tier_2_network

²² https://en.wikipedia.org/wiki/Internet_transit

²³ https://en.wikipedia.org/wiki/Internet_service_provider

²⁴ https://en.wikipedia.org/wiki/Internet_exchange_point

²⁵ <https://de-cix.net/>

²⁶ <https://www.ams-ix.net/ams>

²⁷ <https://www.linx.net/>

²⁸ https://en.wikipedia.org/wiki/Content_delivery_network

form a kind of an overlay Internet optimized to transfer huge amounts of data based on their own infrastructure and business arrangements with other Internet players. Some content providers operate their own private CDNs, which are not available to third parties. Open CDNs allow customers to rent delivery capacity over the Internet, providing an overlay network with decentralised caches as service. In turn, a CDN pays ISPs, carriers, and network operators for hosting its servers in their data centres and Tier 1 providers for interconnection. Most major CDNs providers (e.g. Akamai Technologies, Amazon Cloudfront, Leaseweb, Limelight Networks, Level 3 Communications, Verizon Digital Media Services, etc.) act on a global scale.

The heterogeneous structure of the Internet has enabled new distribution models. The most important type of models for the distribution of media services are certainly the various OTT approaches.

Annex 2: Access Network Technologies

OTT distribution is in principle agnostic about the underlying access network technology. Today, most access networks will use one of the following technologies:

Copper Cable - DSL

The DSL access networks are based on copper cables originally rolled out for telephony. As copper lines are available in most households DSL technology was developed to provide broadband access. Although DSL is widely used for access to the Internet, it has two inherent problems: the limitations of the achievable bandwidth (which depends on the distance of the subscriber location from the aggregation point DSLAM) and the over-subscription.

The DSLAM is a network distribution device that aggregates individual subscriber lines into a higher-capacity upstream digital communications channel connection. ADSL-2 (the most used DSL technology) can provide a maximum bitrate of 25 Mbit/s at a distance of 300 m or less from the DSLAM and this drops to 16 Mbit/s at 2 km and 8 Mbit/s at 3 km. VDSL (Very high-speed digital subscriber line) and VDSL2 are the latest DSL technologies. VDSL can provide speeds of up to 52 Mbit/s downstream and 16 Mbit/s upstream over a single flat untwisted or twisted pair of copper wires. VDSL2 can exceed 300 Mbit/s simultaneously and 100 Mbit/s upstream at the distance of up to 300 m. This falls to 100 Mbit/s at 500 m and 50 Mbit/s at 1000 m but degrades at a slower rate from there.

Oversubscription is a common practice in telecom networks where the capacity of the upstream channel is smaller than the sum of the capacity of the subscriber links. When the total consumed capacity on the subscriber links exceeds the capacity of the aggregated upstream channel the quality of service starts to deteriorate. The usual multiplexing ratio is around 1:20 or more and in some countries are as high as 1:100. This level of over-subscription is usually adequate for a “normal” Internet use but is not suitable for simultaneous viewing of popular content where every user consumes most of their subscriber line capacity.

Coaxial Cable - DOCSIS

The DOCSIS (Data-over-Cable Service Interface Specification) networks are based on the coaxial cable TV networks. This is a shared infrastructure. A whole street or part of it shares the same physical coax cable. The IP-data is translated/encapsulated by a CMTS (Cable Modem Termination System) into a MPEG-signal that is transported via a RF carrier over a coax cable and the same signal ends up at every user connected on that cable. The limitation in this system is the number of users on one segment.

The most used standard is DOCSIS 3.0 with a maximum downstream bandwidth of 1.2 Gbit/s per segment using 24 8 MHz RF channels. Usually there are around 500 users connected to one segment. The maximum bandwidth advertised for DOCSIS subscriptions can be up to 500 Mbit/s per user but, obviously, this bandwidth cannot be provided to all users at the same time.

Optical Fibre - FTTH

Optical fibre networks are high-capacity networks. Internet subscriptions are often from 100 Mbit/s up to 1 Gbit/s or even higher. In these active optical networks, each user has the full capacity at its disposal. In practice, there are hardly any capacity problems with these active FTTH networks. Recently, more and more FTTH installation are of the much cheaper. Passive Optical Network (PON) type. In a PON the fibres are passively split. Such a PON has the same characteristics as a coax cable network although with much higher bandwidth and longer distances.

Mobile Networks

While the fixed access networks connect the premises, mobile networks offer the possibility of access to content anywhere. The current generation of mobile broadband networks is 4G/LTE and a roll-out of 5G networks has started in some countries. Mobile broadband networks are comparable to a cable network in the sense that the full capacity available in a cell is shared between all the users connected to that cell. The capacity in a cell depends on the amount of radio frequency spectrum deployed on that cell whereas the coverage depends on the transmitted power, the height and type of antenna and the propagation properties of the frequency range. Maximum downlink capacity in LTE is around 360 Mbit/s per cell whereas the theoretical maximum in 5G is 20 Gbit/s downlink and 10 Gbit/s uplink.

Other access network technologies

In addition to the four above mentioned technology access to the Internet can be provided by fixed wireless connections, over the satellite, or through the powerlines. As of today, these technologies represent comparatively small portions of all Internet connections.

WiFi

WiFi is a short-range wireless technology based on the IEEE 802.11 family of standards²⁹. It operates in unlicensed spectrum bands and is commonly used for indoor coverage and limited outdoor local coverage. WiFi is nearly ubiquitous and supported by virtually all consumer electronic devices (e.g. computers, smartphones, tablets, Smart TVs, home gateways, IoT devices, ...). To provide access to the Internet WiFi access points must be connected to an access network. While the latest WiFi standards support theoretical data rates of several hundreds or even thousands of Mbit/s, in practice the achievable data rates depend on spectrum occupancy and the data rate supported by the access network.

²⁹ For additional information see for example: https://en.wikipedia.org/wiki/IEEE_802.11

Annex 3: The limitations of Internet infrastructure: Netherlands case study

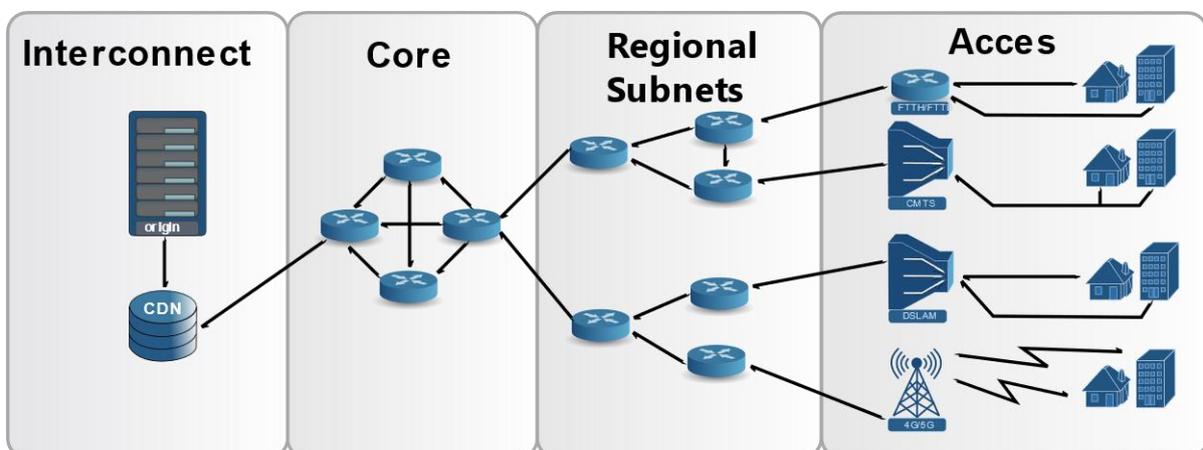
In recent years, the use of OTT services has increased from a limited number in 2008 to a share of about 25% in 2018. Nowadays the consumption of OTT-TV can be done basically anywhere. The main bulk of the OTT consumption happens in the home but 4G and soon 5G network offers the possibility to use OTT TV on the go. Also, the usage of OTT TV in the workplace increases especially when major sports events such as Tour de France cycling, or the Olympic Games happen during daytime.

The data in this Annex is based on a recent study (2020) commissioned by NPO the Dutch public service broadcaster into the capability of the Dutch Internet infrastructure of delivering large scale OTT services. For this study, a model of the (Dutch) Internet infrastructure is made. In this model the ecosystem to listen to radio and to watch OTT TV over the Internet consists of 5 fundamental elements: the user, the access network, the regional subnet, the core, and the content provider's origin and CDNs.

The core networks and regional subnets of the different ISPs are more or less the same in terms of high-level architecture and capabilities as far as PSMs are concerned. At the access level however, it is totally different.

The access networks are currently based on four different types of technologies: xDSL (Digital subscriber lines) using the "old" copper telephone networks, Coax (DOCSIS: Data-over-Cable Service Interface Specification) using the cable-TV coax infrastructure, FTTH (Fibre to the Home) recently installed optic fibre networks and 4G/LTE mobile broadband networks.

At the interconnect level the PSM's playout servers provide the content to CDNs (Content Delivery Networks) either owned by the PSM or subcontracted to other parties like EBU Flow, Akamai, Level3 etc. These CDNs are normally connected with high bandwidth connections to the ISP's core. There are usually very limited options to have a CDN deeper in the ISP infrastructure unless the CDN service is provided by the network owner. At the interconnect level there are also other (competing) parties that feed content into the ISP's network such as Netflix, Amazon, Google etc.



The end users are generally not interested in technical aspects of access network, core networks, CDNs etc. For them it is only the content and a high quality of services that counts. To be delivered to the viewer or listener the stream carrying PSM content must travel the whole path through all the elements. The path must be open and have enough bandwidth to allow an uninterrupted service that meets the audience expectations. This is the challenge.

The infrastructure

The access networks

Design and roll-out of access networks is largely based on economic considerations of telecom companies. The investments in the infrastructure are justified on business case. Generally, they are designed on a typical use case assuming that not all users request bandwidth at the same time. This is what drives the over-subscription and the density of DSLAMs or CMTSs in a network. In active FTTH networks the access network can handle all the traffic since each subscriber has the full capacity of the optical fibre. Because of economic reasons telecom operators are using more and more passive FTTH networks that have the inherent over-subscription similar as the coax cable networks have.

The core and regional subnets

The core of the network as well as the regional subnets all consist of high-speed high-capacity routers and switches interconnected by high-speed optic fibre cables. They usually reside in large datacentres with reliable power and cooling resources. Although the core and subnets consist of high-capacity equipment also here we see the effects of over-subscription. These networks are not designed for peak bandwidth demand but on the basis of average bandwidth determined by usage statistics.

The limitations of OTT

To assess the limitations of the infrastructure a model has been developed. The Dutch Internet infrastructure is one of the most advanced in Europe. 100% of households has Internet access and >98% has broadband Internet. Using the Netherlands as an example and showing its limitations gives a good insight in the possible challenges for the rest of Europe.

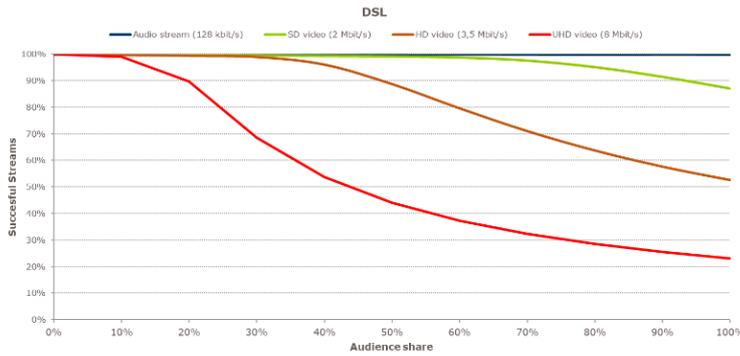
The model used to calculate the limitations of the Internet infrastructure is based on a varying input parameter: audience share (“which part of the populations is watching certain content at a certain moment?”). This includes the possibility that multiple users watch the same stream on one device. This audience share can be translated into several streams that is to be expected for each of the access networks. For this study, several different services are defined: audio (128 kbit/s), SD video (2 Mbit/s), HD video (3.5 Mbit/s) and UHD video (8 Mbit/s).

In the model the physical parameters of infrastructure elements are modelled. From the border routers, through the core and metro routers all the way to the end-user termination point. Usually, the upstream side of a network element is not capable of handling the sum of all the downstream maximum bandwidths. This phenomenon is called over-subscription. Most of the time this is a wise business decision. Not everyone is using its maximum bandwidth at the same time. However, linear television is “everybody at the same time”, especially for live content, sports events and breaking news; this is normal business.

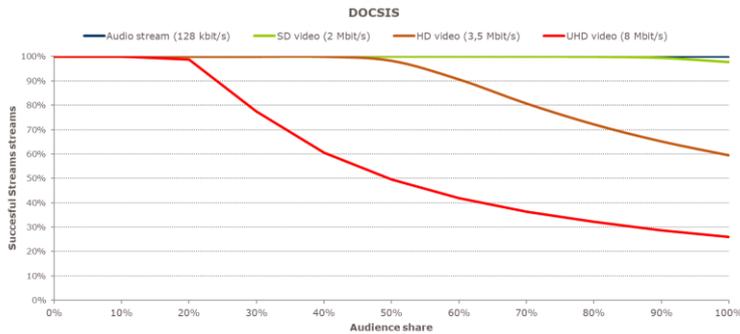
For the simulations it is assumed that the Netherlands has 16 million users. Research shows that the distribution of users over the different access technologies is about 31% for DSL, 37% for DOCSIS, 19% LTE and 13% FTTH. This can be different in other countries, but the principles still hold. This can be translated into several streams per access technology, based on the audience share of a service. With this number the load per network element is calculated. If a network element is overloaded, it will start dropping services and that is counted as an incomplete stream. The percentage of incomplete streams is the metric with which to assess the capabilities of the Internet distribution.

This calculation is done for each of the type of services and for an audience share from 0 to 100%.

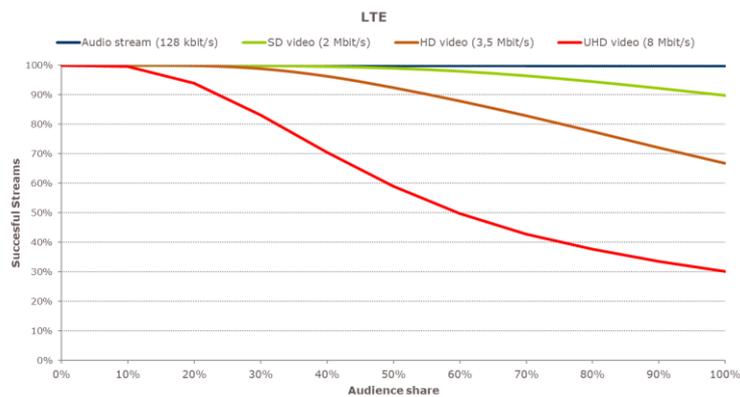
See the following images.



DSL				
Audience Share	10%	20%	50%	80%
Successful Streams				
Audio 128 kbit/s	100%	100%	100%	100%
SD Video 2 Mbit/s	99.9%	99.7%	99.2%	95.1%
HD Video 3.5 Mbit/s	99.7%	99.4%	88.8%	63.8%
UHD Video 8 Mbit/s	99.1%	89.7%	44.0%	28.5%



DOCSIS				
Audience Share	10%	20%	50%	80%
Successful Streams				
Audio 128 kbit/s	100%	100%	100%	100%
SD Video 2 Mbit/s	100%	100%	100%	100%
HD Video 3.5 Mbit/s	100%	100%	98.3%	72.2%
UHD Video 8 Mbit/s	100%	98.7%	49.5%	32.1%



LTE				
Audience Share	10%	20%	50%	80%
Successful Streams				
Audio 128 kbit/s	100%	100%	100%	100%
SD Video 2 Mbit/s	100%	100%	99.0%	94.5%
HD Video 3.5 Mbit/s	100%	99.8%	92.3%	77.5%
UHD Video 8 Mbit/s	99.6%	93.8%	58.9%	37.6%

The only access network that can handle all the scenarios is FTTH (point-to-point).

FTTH				
Audience Share	10%	20%	50%	80%
Successful Streams				
Audio 128 kbit/s	100%	100%	100%	100%
SD Video 2 Mbit/s	100%	100%	100%	100%
HD Video 3.5 Mbit/s	100%	100%	100%	100%
UHD Video 8 Mbit/s	100%	100%	100%	100%

In the Netherlands, even with its high-quality Internet infrastructure, when a HDTV programme (3.5 Mbit/s) exceeds an audience share of 10%, problems start to arise. An audience share of 10% is approximately 1.6 million viewers. A popular daily talk show already has this number of viewers. The eight o'clock news on average has 2.5 million viewers.

Conclusion: with the current Internet infrastructure a PSM cannot use OTT as its primary distribution. Especially the access networks need to be upgraded significantly. This might mean replacing DSL with better performing technologies, reducing the over-subscription in the network and dimensioning the network more on peak load than on average usage.

Annex 4: User Data Acquisition

The distribution of media content over the broadband networks allows the providers to gain an insight into user behaviour at the level of detail that is not possible with conventional broadcast networks. Whenever content is consumed over the Internet, the user leaves data 'traces', i.e. IP address, type of user device, time and date, content consumed, quality, amount of data, etc., which are typically stored in log files on the distribution servers and then aggregated for security, billing or analysis purposes (service-side data). More importantly, the media player on the user device provides the ability to collect in-depth information including detailed interaction data from the user itself (client-side data).

In addition to data on the use of content, demographic information about the people who use the content like gender, age, is becoming increasingly important for PSMs in terms of the design of offerings and distribution. A pre-requisite for the collection of this kind of user data is the introduction of a user login, where the information about users is requested as part of the registration process. The introduction of a login neither implies payment nor it prevents broadcasts reception without login.

The collection of data provides essential information for the PSM to better anticipate the content needs of their users and optimize its business processes from content creation to service offerings and distribution. It allows PSMs to offer tailored services, personalized recommendations and different kinds of additional content-related information. This ability is crucial for PSMs to remain competitive in their territories and fulfil their public service mission in the future.

Technically, there are two different ways of obtaining user data: user login and cookies.

All logging of technical and operational user data must be done in accordance with the applicable regulation such as GDPR³⁰ and with the consent of the user. The user consent is a matter of trust and, furthermore, if a PSM gains users' trust they are more likely to be willing to register and provide personal information. PSMs have a responsibility in this respect and they can exercise this responsibility with confidence if they have control over the entire distribution chain.

³⁰ EU General Data Protection Regulation (GDPR) - https://ec.europa.eu/info/law/law-topic/data-protection/data-protection-eu_en

Annex 5: Content licensing

Content is generally subject to copyright and licenses are used to grant rights to use the content, whether produced in house or purchased to broadcast. Licensing is a worldwide method of ensuring a single piece of content can be commercialised around the world without violating the content rights, especially in the Internet centric world we now inhabit.

Typically, the licensor (Content Owner) grants the licensee (broadcaster) the right (contract) to use a piece of content subject to a Technical Schedule that must be adhered to, otherwise the right to use this, and usually all content from the licensor, becomes void, with damages becoming payable to the licensor.

The Technical Schedule generally addresses protection of the content and may stipulate:

- a) All content must be encrypted in transit and at rest, internally and externally to prevent unauthorised leakage.
- b) Which, if any, Digital Rights Management platforms are acceptable and specify some of the settings to be implemented. E.g. AES, Widevine, Fairplay or PlayReady.
- c) Where device hardware root-of-trust DRM must be implemented e.g. HD / UHD.
- d) The geographical region the content is limited to and require an acceptable solution to be proposed to the licensor.
- e) Maximum bitrates and resolutions for SD, HD and UHD content streams and download files.
- f) The maximum number of devices a user of the platform can have registered to their account (e.g. 5) and the stand-down period between device changes (e.g. 30 days).
- g) The maximum number of concurrent streams of content the user account can consume at any one time. Generally live and VoD are both regarded as a 'stream'. i.e. a live stream on one device and one VoD file on another is a concurrency of 2.
- h) Content download limits e.g. maximum titles per device, maximum titles per account per month, etc.
- i) Which types of device can or cannot receive the content, and the caveats ensuring devices have not been tampered with, such as being jailbroken or rooted, thereby by-passing the OS/hardware level protections to stop unauthorised content extraction.
- j) If content can be sent to display devices, e.g. AirPlay, Chromecast, Miracast, etc.
- k) If content generally or individually have additional requirements in handling by the broadcaster (secure facility) or when distributed to the OTT platform.

For the PSM this can represent a challenge, due to the requirement of freely allowing audiences to engage with content, with Content Owners being reluctant to license content to operators of platforms where content can be extracted and leaked onto the Internet or increasing licensing costs as the Content Owner factors in the potential losses that may occur.

Even when a License is granted it may still contain geographical restrictions that need to be adhered to, or clauses requiring compensation if the content leaks from the licensee region into another licensee region, thereby causing material harm to the other licensee.

Therefore, most PSMs around the world, mitigate these issues by negotiating a more balanced version of the Technical Schedule which addresses both the Content Owners and PSM's concerns.