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# Fading public control of audiovisual media

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# Fading public control of audiovisual media

## 1. Introduction

The paper analyses the developments of public policy influence and control regarding public service media and the reasons behind these developments. The paper concentrates on television and only tangentially refers to radio. It, furthermore, focuses on the traditional audiovisual products of broadcasters and not on their web sites. The case is Denmark, where public service broadcast for decades has been very influential and continues to be used by audiences to a large extent. The overall conclusion is that public control in terms of policy directions and regulations are quickly fading regarding basic infrastructural issues, and that this is happening without any explicit policy decisions to that effect. On the other hand, interventions are becoming increasingly minutious in specific areas, where policy-makers can more easily have an influence such as, e.g., determining the conditions in public service contracts between the state and public service broadcasters.

The primary background for the fading policy influence and control is to be found in the changing technologies used for broadcast, multicast and unicast. While audiovisual broadcast traditionally has been distributed on terrestrial, cable or satellite infrastructures, video and sound are to an increasing degree distributed over Internet. With respect to terrestrial distribution, there is a close relationship between access to frequency resources and rights and possibilities to broadcast. Similar rights of way issues could be said to apply to cable distribution. Cable and terrestrial infrastructures are in different manners under national control and have been subject to infrastructure as well as content regulations. Satellites constituted a challenge to this kind of national control, which incidentally in some European countries, at a point in time, resulted in prohibitions to mount satellite dishes. However, in the EU an arrangement was found with the Television Without Frontiers (TWF) directive, later to become the Audio Visual Media Services (AVMS) directive. Internet, on the other hand, has been seen as an international infrastructure that cannot and even should not be regulated nationally, and it is taking long strides and difficulties to find acceptable ways to regulate Internet, infrastructure-wise as well as with respect to content.

Internet has thus, to a considerable degree, been considered to be beyond the influence and control of public authorities. A contemporary Danish example of the differences between how terrestrial broadcast has been considered as opposed to Internet distribution is the policy reaction when the former Danish telecom incumbent (Tele Denmark – now TDC) was sold to the US telecom operator Ameritech in 1997, and when it was politically realized that the Danish terrestrial broadcast infrastructure was owned by Tele Denmark. There was a policy outcry based on the argument that it would be unacceptable to have the Danish terrestrial broadcast infrastructure owned by a private US company. This stands in stark contrast to the total lack of policy discussion concerning the fact that the Danish incumbent broadcaster, DR, has chosen to use the US CDN (Content Delivery Network) Akamai for its streaming services. This may very well

be a rational and economically sound decision by DR, but the CDN infrastructure of Akamai is no less an asset owned by a private US-based company than was the case with Ameritech.

The issue discussed in this paper is whether, and if so in which areas, policy influence and control has been lost, why this is, and whether policy influence and control can be (re)gained. The primary case is Denmark, but developments in EU policies will also be included, as the national policy initiatives in the member states of the EU are influenced and, to a large extent, determined at an EU level. Furthermore, in spite of national specificities, the issues to be dealt with have many similarities in a range of countries.

The theoretical understanding on which the discussion is based is the supposition that the material structures play a decisive role in framing the development of policies – in this case that the Internet as a material reality in terms of technologies and functionalities strongly influences policy decisions (and lack of decisions) regarding public service broadcasting. This does not mean that the materiality of such structures have developed independently of business and policy decisions. It means that they constitute material structures based on a vast variety of business and policy decisions made at different points in time.

In terms of methodology, the paper is based on studies of documentary material regarding technology developments and policy decisions. It is also based on the long-standing studies of telecommunication and Internet developments and broadcast developments by the involved authors. It is meant to be a discussion paper laying the foundation for an assessment of the directions of public service broadcast and the material structures that undergird it. It is also the aim to examine the possibilities for policy action to (re)gain control of the distribution of audio and video in the new Internet-based era.

The structure of the paper is as follows: First, there is a section on the developments of technologies used for video and audio distribution - from terrestrial, cable and satellite to Internet distribution. After this, there is a section on the developments of Danish broadcast policies and regulations, taking the important EU context into consideration. This is followed by a section discussing examples of changes in the policy interests in directing infrastructure developments for public service broadcasting. Thereafter, there is a section discussing theory on the influence of the materiality of technological structures and infrastructures for the direction of policy developments. Before the conclusion, there is a section analyzing policy directions, the reasons for these developments in light of changing technology developments, and the potentials for policy intervention. Finally, there is a concluding section proposing an agenda for further research into the area of public service broadcast developments in light of technology developments and trends.

## **2. Technology developments in video and audio distribution**

This section includes an overview of technology developments used for broadcast and on-demand services. First, there is a brief presentation of the transition from analog to digital and from dedicated broadcast networks to the general Internet, and then there is an introduction to two

important technologies for Internet broadcast and on-demand services: Content Delivery Networks (CDNs) and Mobile Edge Computing (MEC).

Broadcast distribution technologies have gone through radical changes through history, namely the transformation from analog to digital technology on all broadcast distribution platforms, including the terrestrial distribution platform at the end of last millennium and beginning of the new millennium.

Transmission of TV signals using ground-based transmitters in a terrestrial network has traditionally been the most used and known delivery form for TV channels. In markets where other multi-channel platforms are not well developed, digital terrestrial broadcast platforms are highly important for the delivery of broadcast services. The major advantage of using digital terrestrial TV is the possibility for a relatively high number of TV channels in the terrestrial platforms. This is very important, as historically in the analog era, only a few TV channels have been available in the terrestrial platforms, primarily due to spectrum scarcity that in many markets resulted in monopoly or duopoly situations with little competition and variety. Digitalization also enables other qualities such as easiness of reception, mobility, higher resolution of TV channels, etc. (Tadayoni and Henten, 2013).

The new generations of TV standards utilize the spectrum more efficiently and, therefore, enable the possibility to increase the number of TV channels even more. As an example from the DVB family of standards, we see a technical development where the spectral efficiency of the new DVB-T2 standard is almost 40 percent higher than DVB-T (Fischer, 2010). This makes it possible to pack even more TV channels or TV channels with better quality (for instance HDTV) in a given frequency band. This has resulted in the creation of multi-channel platforms in the terrestrial networks in many countries. However, the precondition for multi-channel broadcast in terrestrial TV is that the political environment accepts using the resources to send more TV channels rather than better quality TV channels. This has definitely been the case in European countries that have created real multi-channel platforms in the terrestrial networks. However, in the recent decade, due to efficiencies achieved, more and more spectrum is taken away from the broadcast sector and allocated to other uses like mobile communications, the so-called digital dividend spectrum (Henten et al., 2010).

With respect to other TV infrastructures, Direct-To-Home (DTH) satellite networks were the first delivery networks to be digitized and cable TV the last platform to be fully digitized. Digitization of satellite networks for broadcast purposes was driven purely by cost reductions related to the transition to digital technology. Cable TV had, on the other hand, for long time enough capacity to deliver multi-channel TV services in analog form in a cost efficient manner. However, in recent years, due to huge demand for broadband services, many cable TV platforms in developed markets have become fully digitized.

The next wave of changes that has dominated the industry in recent years started around a decade ago and is mainly characterized by the use of IP-based broadband infrastructures as the distribution platform and a change from flow to on-demand media. The first deployment of IP based infrastructure for distribution of professional audiovisual content that directly competed

with dedicated multi-channel broadcast infrastructures was using managed IP network for distribution TV the IPTV platforms. As the IPTV is delivered over a managed network the operator can guaranty certain level of QoS and deliver qualities comparable with dedicated broadcast infrastructures. The major driver of IPTV development was the need to monetize the unused capacity in broadband networks by the broadband operators. Delivery of TV services was an obvious choice and became a standard service offered by many broadband operators .The emergence of IPTV created a new infrastructure for delivery of TV and consequently created more completion in the TV market but it didn't change the structure of the market. The revenue models were adapted from traditional multi-channel TV infrastructures, however with more possibilities for on demand services.

Another deployment of IP platform for delivery of audiovisual content is the Over The Top (OTT) TV, which means delivery of TV content over the best effort Internet, bypassing the traditional TV gatekeepers. While the first development (digitization of broadcast platforms) was mainly driven by the need for more capacity and higher technical quality and did not change the structure of media distribution, and IPTV was driven by the broadband operators' monetization of excessive capacity in their infrastructures, the best effort IP-based distribution, in particular the OTT paradigm, massively changed the structure of the market where new players have entered the scene. One of the most important drivers of these changes has been the massive development in the broadband infrastructures both in terms of reach and capacity.

Broadband networks of today and the future are capable of providing media services of high quality and high reliability. This is obvious when looking at the development of on-demand services, such as the OTT media services like Netflix, HBO, etc. However, broadband will not necessarily replace broadcast platforms. Broadcast platforms still can have a role to play in the provision of media services due to their fundamental characteristics such as managed one-to-many network using licensed spectrum, unified user experience, low latency and zero marginal cost of adding new customers. In the last couple of decades, one of the major questions regarding the future of broadcast media market has been on how we can utilize the strengths of broadband as well as broadcast platforms in the provision of media services (Gimpel, 2015; Leal et al., 2017). Many solutions have been proposed that have not worked due to the completely different technologies used in these platforms and the proposed business models - some examples being DVB-H in mobile broadcast broadband and HbbTV in the fixed hybrid broadband/broadcast (Domínguez et al., 2018).

In the transformation to IP-based distribution, broadcast media are undergoing radical changes, not only in the distribution platforms but also in access to the content and user experience. This is partly due to technological changes and partly due to the massive engagement of new market players, in particular from the IT sector in media service provision. The development hitherto has been dominated by huge investments in different competing solutions in broadcast and broadband platforms resulting in fragmented ways of access to the services, using different apps with their own content management and user interface logic resulting in non-unified user experiences. Furthermore, to access different OTT services one must have specific apps, which must be supported by the receiving device.

The new broadcast technologies and standards such as DVB-T2X, DVB-I open the possibility of re-introducing a unified user experience in an era where broadcast and OTT co-exist. Furthermore, broadcast technologies used in the 4G and upcoming 5G networks like LTE Broadcast (Yrjölä, et al., 2016) and eMBMS (Calabuig et al., 2015) are important developments that enable seamless delivery of content to the users deploying the most optimal combination of broadband and broadcast infrastructures. DVB-T2X is a gradual upgrade of existing DVB-T2 ecosystem to all-IP and may define a new TV service infrastructure inspired by the work done with ATSC 3.0 (Kim et al., 2018). DVB-I is a standard developed for accessibility of quality broadcast content over broadband. FEMBMS is a standard enabling broadcast in 5G mobile broadband networks. Using these technologies and other relevant technologies, the possibilities of forming a true converged broadcast-broadband service platform is in available.

### *Content Delivery Networks*

In recent years, we have seen a strategic focus on streaming services in many broadcast companies, including the Danish public service broadcast company, DR. However, Internet was not in its original architecture a medium to be used for broadcast services. The best-effort IP-based Internet cannot guaranty the Quality of Service (QoS)/ Quality of Experience (QoE) necessary for broadcast quality services. In the original Internet architecture, the QoS parameters were meant to be dealt with at the edge of the network, but massive use of the network for distribution of audiovisual content in a one-to-many architecture necessitated changes in the Internet infrastructure. As Sandvig (2015) puts it: 'As the Internet evolved, a remaining technical challenge was adapting its point-to-point architecture to the one-to-many asymmetries of audiences and attention'. Furthermore, 'A commercial breakthrough came when an MIT applied mathematics professor created the spin-off company Akamai', which established one of the world largest Content Delivery Networks (CDN), discussed more in the following.

To provide TV services with decent QoS/QoE using the open best-effort Internet infrastructure, it is important to push the content as close to the users as possible. This is done by using CDNs, which is considered as a suitable option to be deployed by telecom operators and ISPs internally within their network infrastructure by placing cache nodes in geographically distributed locations, close to end users (Haslinger, et al., 2011).

One way of implementing CDNs in the operators' network is that a virtualized hierarchical CDN infrastructure is deployed in the telecom cloud. According to (Ruiz et al., 2016), this implementation is done using an architecture containing the following main components:

- Some (few) central Intermediate Cache Nodes receiving content from several sources
- A number of Leaf Cache Nodes placed close to end users
- A centralized CDN Admission and Control module that implements CDN access policies and redirects users' requests, e.g., based on their geographical location, to the (intermediate or leaf) cache node that will serve them

According to Ruiz et al. (2016), the Intermediate Cache Nodes and Leaf Cache Nodes distribute VoD and live-TV. VoD contents are prepared in intermediate cache nodes and stored in leaf caches

based on their popularity and live-TV is distributed from intermediate cache nodes and locally prepared in specific leaf cache nodes delivering TV channel to the users.

At the end of 2017, DR renewed and expanded its contract with Akamai and continues to use Akamai's CDN network. An important difference between the business model of using CDNs for distribution of TV rather than terrestrial broadcast network is that while in the terrestrial network the cost of distribution is not dependent of the number of users, in a CDN model the costs depend on the traffic carried in the network.

### *Mobile Edge Computing*

While development and deployment of CDNs have been important for enabling the distribution of streaming services using OTT technologies like HLS (HTML Live Streaming), there are some challenges using CDNs in particular when it comes to mobile networks and mobile devices. Specifically when it comes to the latency, pushing the content even closer to the users is important. In mobile networks, a new paradigm of Mobile Edge Computing (MEC) is emerging focusing on latency sensitive services and also the services where it is more optimal to do processing at the edge of the network rather than in devices (Mach et al., 2017).

Several definitions of MEC are proposed in the literature. Ahmed et al. (2017) provide a survey of MEC and its different use cases. One of the definitions they present is: 'Mobile Edge Computing is a model for enabling business oriented, cloud computing platform within the radio access network at the close proximity of mobile subscribers to serve delay sensitive, context-aware applications'. This illustrates the strength of the architecture for delivery of audiovisual services including broadcast services.

The huge advantage of broadcast has so far been the nature of the managed network and the dedicated spectrum to ensure a unified experience when receiving TV signals. This ensures a reliable high-quality low latency reception of a live signal. This is especially important when watching live shows or sports, where you should be able to watch the goal, when it is being scored, and not 30 seconds later due to limitations in the nature of the best-effort IP networks and the streaming protocols optimized to ensure somewhat reliable delivery in ever-changing network conditions (WiFi, mobility etc.). However, within wired and especially wireless IP technologies, newer and much more reliable low latency protocols are gaining momentum ruling out the obvious advantages of using broadcast over broadband. As seen above, in the mobile networks MEC is an obvious choice in this respect.

Martin et al. (2016) also have emphasis on the latency issue: 'MEC turns a base station into a service catalyzer, which dynamically improves application performance and user experience for a specific service. The target features span ultra-low latency and round trip time (RTT), optimized bitrates, extra physical security and efficient caching'. Furthermore, (Martin et al. (2016) propose a model where MEC, based on analytics changes between CDNs and by that delivers the best QoE. Viola et al. (2018) proposes a MEC proxy model to deal with the degradations of CDN performance and outage due to high concurrency rates of media sessions that impact negatively the Quality of



Experience. Both of these models emphasize that MEC is not a replacement for CDNs but is complementary to it.

When it comes to 5G and, in particular, in the use cases related to broadband, media and audiovisual streaming services will play an important role. High quality audiovisual content need high capacity in the network and pushing content even closer to the users become more important, both for saving valuable resources in the backbone but also to effectively deal with QoS /QoE parameters in media distribution. For this, using Mobile Edge Computing architectures in 5G in combinations with CDNs enables more efficient distribution platforms for media services and solves some of the challenges of using CDNs.

### **3. Developments of EU and Danish broadcast policies and regulations**

This section focuses on policies and regulations and aims at providing an insight into Danish broadcast developments in a techno-political perspective. As in other countries in Europe, television in Denmark saw its first trials in the early 1930s, but it was only in 1951 that television had its official start in Denmark. Danish broadcasting had basically adopted the British model of public service broadcast (PSB) with a state-owned monopoly broadcaster and license subscriptions. In 1953, 303 license payers were registered (Madsen, 2012).

Fast forward to the 1960s, where the number of license subscriptions in 1965 passed one million (Madsen, 2012), and where cable television started as small antenna societies in housing associations and residential neighborhoods. Later on, the idea to use such local networks as access distribution channels connected to a national fiber backbone network came up. The aim was to distribute television (and radio) via a digital backbone fiber network to local analog access networks, which is why it was called the Hybrid Network - Hybridnettet (Gyldendal). The idea was, furthermore, to combine audiovisual broadcast with other new communication services, which added to its hybrid character.

The establishment of the Hybrid Network was officially started in 1985 to be operated by the then local Danish monopoly telecom operators. The idea was that the local telecom operators would have monopoly on distributing satellite television channels and channels from the neighboring countries through the Hybrid Network. Private satellite antennas were, therefore, prohibited in a move to protect the monopoly rights of the telecom operators. However, this prohibition was lifted already in 1987, and the Hybrid Network never became a success and was officially closed in 1995 (Gyldendal).

The establishment of such a new monopoly network ran into the general move towards liberalization of markets including communication markets beginning in the 1980s and continuing in the 1990s. But the Hybrid Network became the foundation on which the later national telecom incumbent (Tele Danmark and subsequently TDC), which was created on the basis of the local telecom monopolies, would build its cable television operation, which incidentally survived the separation of telecom operation and cable television provision that the European Union instructed its member countries to implement in 1997.

Until 2001, terrestrial television distribution was also performed by the incumbent telecom operator. The incumbent operator thus not only operated the largest telecom networks in the country, but also the terrestrial television distribution network. This ended in 2001, when the terrestrial network was sold to Broadcast Service Denmark – a joint operation by the two national public service broadcasters, DR and TV2. (TV2 had started in 1988 following the end of the national broadcast monopoly of DR). With the digitization of terrestrial television broadcast, DR and TV2 established another company I/S DIGI-TV, and a Swedish television broadcast company Boxer became the operator of the terrestrial broadcast networks for all other television broadcast channels in Denmark.

This brief overview of national broadcast in Denmark illustrates not only the close connections between content production and content distribution in traditional broadcasting, whether terrestrial, cable or satellite. It also illustrates the continually changing relationships between content providers and network providers. These connections and relationships have traditionally been subject to policy intervention, and an important question raised in this paper is how these connections and relationships are being dealt with presently.

On the content side, broadcast content regulation has a long history in national legislations. However, the EU came to play a crucial role in content regulation with the Television Without Frontiers (TVWF) directive from 1989. An important driver behind TVWF was the rise of satellite television, where the footprint of satellite transmission would disregard national borders or the footprint could even be directed at other countries. This meant that it became difficult, if not impossible, to regulate content including advertisement on a national basis. The TVWF directive was, therefore, created in order to establish a common set of rules that should apply to all EU member states.

The TVWF directive was later followed by new generations of the original directive – now entitled Audio Visual Media Service directive (AVMS). The latest generation of the directive is from 2018, and one of the major issues and changes in the subsequent versions of AVMS has been the scope of traditional content regulation in terms of distribution platforms. The first AVMS directive only included linear, meaning one-way, broadcast transmission; the second AVMS also included non-linear on-demand audio and video transmission, for instance Netflix; the third and present AVMS, furthermore, includes audiovisual services such as YouTube that hitherto were regulated by the Information Society Services directive, which is also often called the e-commerce directive.

The technological development, on the one hand, with the public Internet increasingly being the platform for streaming distribution of audiovisual material including broadcast content, and the political development with content regulation basically being decided at the EU level, on the other, has meant that the space for national policy action has become rather limited. While there was a substantial political debate - as will be further described in the following section of the paper - in the end-1990s in relation to the digitization of the terrestrial television network with intense discussions on the importance of a national broadcast infrastructure, there is presently no policy debate on the changing infrastructure for broadcast in Denmark. The current political

debate regarding media developments in Denmark have primarily concentrated on the size of the cuts in the financial subsidies to the incumbent broadcaster DR.

DR has since the liberalization of the broadcast market in Denmark received by far the major part of the subsidies for public service broadcast from the license fee. Cuts in the percentage of the overall license fee received by DR have been seen also previously, but in connection with the latest political media agreement of the Danish parliament in 2019, the then liberal-conservative government implemented a 20% cut in the funding of DR. This has already had serious consequences for the number of terrestrial TV and radio channels of DR and will – if the current social democratic government does not stop the cuts – lead to further downsizing of DR.

The attacks on DR have mainly been driven by a combination of liberal-conservative-right wing policy makers and commercial media. There is a long tradition among policy makers on the right wing of Danish policies to accuse DR of being 'leftist' and to wishing to curtail DR, and there is a similarly long tradition for the commercial media to think that DR 'occupies too much space' in the Danish media landscape. For some years, there has, among other things, been focus on limiting the website of DR, which is one of the most visited websites in Denmark, with the claim that this license-funded website takes traffic away from commercial sites. The alliance between policy makers from the right and commercial media managed to get severe cuts in the budget of DR implemented in the latest media agreement.

In the policy debates leading up to the media agreement, it was clear that the primary focus was on the claim that DR is too big in Denmark, while the international perspective with the US-based media giants and their influence on media consumption and advertisement payments only to a modest degree affected the debates. This, in spite of the fact that the share of advertisement payments to primarily Google and Facebook keeps on increasing also in Denmark as in most parts of the world. The shares of Google and Facebook are at a lower level in Denmark than in a number of other countries, however in 2018, the foreign share (primarily Google and Facebook) of the Internet advertisement market was 61% and 35% of the total media market (Slots- og Kulturstyrelsen, 2019).

Media policies in Denmark tend to focus on the small issues, while the large issues seem to be of less concern. Policy intervention in the small issues even seem to increase. This has lately been very clear in the radio field. A private national radio channel, Radio24syv, competing with DR and funded partly from the national license fee pool was, in reality, excluded from bidding in a 'beauty contest' to continue their radio service by a political requirement that at least 70% of the editorial staff should work at least 110 km from the capital city of Copenhagen. This was a deliberate political move to exclude Radio24syv from bidding, which became entirely clear when, earlier in the process, the suggested percentage of editorial staff away from Copenhagen was lower but was increased when Radio24syv still considered bidding.

As another media policy initiative in Denmark, it has been decided to phase out license fee funding and fund public service channels and content via the state budget. Among media experts, this has for years been a debated issue, but it has never had any larger public attention. There can, indeed, be good social reasons for funding public service via the state budget, as the license fee is a kind of

head tax with the same payment per licensee notwithstanding economic ability. However, as it has been put forward by media experts (Nielsen, 2020), there is a risk of increased political intervention in the development of public service media when the funding of public service is more directly controlled by the government.

Developments in Danish media policies have thus lately indicated that there is a decreasing focus on the big issues and perspectives and, at the same time, an increasing intervention in the smaller issues. This is obviously a consequence of the notion that it is out of reach for Danish media policies to have any influence on infrastructural issues, and that policy control with content is seen to by EU policies. However, the implications are that there are no visions for the development of public service in the media area and how public service can be developed in the new international media contexts. At the same time, there is an increasingly close scrutiny of the day-to-day content programming – a scrutiny which will probably increase with the potentials for control with state budget funding of public service.

#### **4. Changing policy interests in directing infrastructure developments**

This section discusses three instances illustrating the changing policy interests in directing infrastructure developments. The first instance is concerned with the sale of the Danish incumbent telecom operator to an American operator in 1997. The second instance took place shortly after in 1998, when a public statement was elaborated and discussed politically regarding the establishment of the infrastructure for digital terrestrial broadcast. The last instance – or rather lack of instance – is the development where streaming of content from public service broadcasters has been outsourced to CDNs owned by international capital. There has been no public debate on this; it has solely been a commercial decision by the public service broadcasters, DR and TV2.

TDC's privatization and acquisition by the regional US telecom operator Ameritech in 1997 and, consequently, the sale of the terrestrial radio and TV broadcast infrastructure in Denmark created a great deal of awareness about the transformation of media and the role of public institutions in Denmark at the end of the last millennium. Even though the sale of the terrestrial radio and TV network was not intentional and ended up being rolled back, it played a role in the discussions about the liberalization of broadcast media in Denmark.

In 1997, the Danish state entered into what was called a strategic partnership with Ameritech. The Danish state kept a small minority share in the company and the majority of shares were acquired by Ameritech. This was one of the biggest takeovers of Danish infrastructure by a foreign company and was carried out by a government led by the social democrats. In itself, this was a challenging task as the left wing parties traditionally have been against the transfer of ownership of infrastructural industries (telephony being one of them) to foreign companies. The fact that the government also sold the radio and TV infrastructure in the same package was even more critical and created protests and debate.

Prior to the acquisition of Tele Danmark, the monopoly on radio and TV transmission network was released and in an annex to the law of 1995, Tele Danmark's monopoly on ownership of the terrestrial radio and TV network in Denmark was removed. However, the radio and TV network

remained in the ownership of Tele Danmark and even though there was a dispute with TV2 regarding the ownership question, the radio and TV infrastructure was also sold. At that time, it was not only the left wing but also the Social-Liberal Party who protested. Among experts, it was commonly agreed that the sale of the radio and TV network was probably a mistake and should have been taken out of the contract. The problem, however, became relatively easy to solve, as Tele Danmark's new owners announced that they were not interested in the ownership of the terrestrial network. With respect to radio and TV, they wanted to concentrate on strengthening the cable TV infrastructure (<https://ing.dk/artikel/hovsa-der-rog-tv-masterne-28147>).

The Tele Danmark incident illustrates the political and ideological importance of the terrestrial broadcast networks as national infrastructural resources. The following incident sheds light on the same set of issues. During the 1990s, it was investigated and debated in industrial and political contexts what the implications of a digitization of the terrestrial networks would be and how it should be carried out. In the background was also the issue whether it was worth the effort to invest in and build a new digital terrestrial broadcast infrastructure when looking at the increasing importance of cable and satellite.

The change to digital in terrestrial networks was a complex process where different actors with different interests and agendas influenced the process. On the one side, the mobile industry pushed for getting access to the valuable spectrum resources used for TV, arguing that due to technological developments, less spectrum was needed for TV and, therefore, there was room for allocating part of the spectrum, originally allocated for terrestrial TV, to mobile communication. This was done later by re-allocating parts of the spectrum, the digital dividend, and using it for other purposes than for TV services. Some actors from the mobile industry even went further and argued in favor of out-phasing TV transmission on terrestrial networks as such, as satellite and cable were considered more appropriate and broadband networks showed decent potentials to be used for TV transmission in the future.

On the other side, the TV industry and the institutions behind it wanted to keep the spectrum for further development of the industry and argued that digitalization gave new qualities that were needed for this development (Iosifidis, 2006). The major argument for keeping the allocated TV spectrum for digital TV was the possibility for creating a terrestrial multi-channel platform to compete with satellite and cable and the fact that national government could apply their own regulations regarding access to the network and with respect to content regulation – within the bounds of EU regulation. Moreover, it was argued that terrestrial networks were superior to the other networks as none of the other ones could deliver mobility and portability. Furthermore, a new terrestrial network could enable the provision of local TV, and a geographic regionalization of TV was easier and more cost efficient to offer on terrestrial networks.

The third instance is much more recent and is concerned with using CDNs for streaming broadcast and on-demand services. DR has since 2014 used Akamai as CDN. This has been a purely commercial decision taken on the basis of the quality streaming that Akamai can deliver and the price Akamai demands. TV2 also uses CDNs, and in the latest round of call for tenders for CDN providers for the national TV2 channels and the regional TV2 channels, there were three winners

announced in the start of 2020. The three winners were IP-Only Networks AB from Sweden, Akamai Technologies Denmark ApS, and CenturyLink Communications NL BV from the Netherlands. It can be discussed how dependent DR and TV2 are on their CDN providers, as they can change CDNs when their contracts end – in contrast to terrestrial networks, where owners obviously can be changed, but where the number of networks is limited. Nevertheless, there are new CDN infrastructures that the public service broadcasters depend on and that are not under any network control by public authorities.

### **5. Theory on the influence of the materiality of technology structures and infrastructures**

Current massive changes in the broadcast area are related to the fact that Internet is increasingly becoming an important infrastructure for the distribution of audiovisual media content. For the first many years of broadcast distribution, the infrastructure was based on relatively stable terrestrial analog technology, and when changes came with cable, satellite and digitization of the terrestrial network, this did not fundamentally change the manner in which the broadcast sector was organized. However, Internet is at the root of such a fundamental change. It breaks down the tight connections between content providers and distributors – most clearly illustrated by the lack of necessity of having a right to use special frequencies for terrestrial broadcast, but also applicable to cable and satellite, where the term in the US has been ‘cord-cutting’. It also breaks down the territorial character of the audiovisual broadcast systems, which basically, in terms of distribution, have been nationally oriented except for satellite, which was the first international distribution channel. Furthermore, Internet provides interactivity in terms of on-demand services as either download or streaming and it provides a distribution channel for a multitude of new content providers.

A fundamental technological change is thus taking place, and this heavily affects the hitherto existing media systems. It is, therefore, important to base one’s research of the changing and arising new media systems on the fact that Internet is becoming a prominent distribution channel for audiovisual content. In the dominant media system research tradition epitomized by the seminal research model by Hallin and Mancini (2004), the implications of Internet are not embedded. Hallin and Mancini’s research model (2004) has four dimensions with respect to describing and comparing media systems in different countries: Structure of the media, political parallelism, professionalization of journalism, and the role of the state. Focus is on the traditional written press and the broadcast area and the implications of technology changes in these areas are not part of the model. The existing basic technological foundations for the press and the broadcast area are taken for granted, which can be a reasonable assumption in times of relative technological stability, but becomes a problem when the technological basis is changing fundamentally.

This is the reason why, during past recent years, there has been an increasing interest in the material infrastructure of the media in media research (Gillespie et al., 2014; Bollmer, 2019). In social sciences in general, there is an ongoing ‘return to matter’ and materialism after a longer period of reigning social constructivism and critique of technology determinism (Fox and Alldred, 2016; Lievrouw, 2014). The ‘new materialism’ is not to be seen as any crude materialism of a

determinist character but as an interest in conducting research into the interaction between various human and non-human actors and a rejection of the dualism between base and superstructure (Fox and Alldred, 2016). In media research, the materialist trend is related to the increasingly dominant infrastructure for all kinds of media – in one word the Internet. Indeed, there has all the while been parts of media research that have had an emphasis on the materiality of the media. In his book from 1986, 'No sense of place', Meyrowitz's coined the term 'medium theory' to describe how the means of communication influence human communications. And, the most famous and controversial expression of this thought is McLuhan's often cited phrase, 'the medium is the message' from his book 'Understanding media: The extensions of man' (1964).

This phrase has been subject to much criticism for being technology determinist (Williams, 1974), and technology determinism is, indeed, always a danger if one focuses on implications of technology developments and puts little emphasis on how technology developments are shaped by social practices and society in general. However, if understood in the manner that the media for communications influence the ways people communicate, the content which is being communicated, and the manners in which 'messages' are being received and interpreted, the most provocative corners of 'the medium is the message' phrase can well be grinded and seen in light of a more dialectic relationship between technology developments and the social context in which they are developed and adopted. After decades of relative technology stability in the media and consequently emphasis on the content side, we have witnessed significant technology changes for the past two decades, which still and at an increasing pace are affecting media systems. These technology changes are centered on the Internet in its broadest possible conception comprising not only the core Internet communication technologies but also all its services and applications and ways of using the Internet. Other important technologies today such as big data and artificial intelligence have technology trajectories of their own, but are heavily influenced by Internet as an enabling technological platform.

Internet has become the platform for the ongoing convergences of hitherto separate ICT sectors, primarily IT, telecommunications and broadcasting. Other media types such as the press and publishing have also become part of such convergences - as have other sectors that in their points of departure have had nothing to do with ICTs, such as commerce, banking, and even manufacturing. Internet has become the enabling technological platforms for all kinds of businesses and general social activities. An important technological basis for this is the use of digital technology. Digital technology was not formerly the basis for neither telecommunications nor broadcasting, and it took decades for telecommunications as well as broadcasting to develop into being based on digital technology. Though this is the case today, it is not digital technology in itself which has facilitated the convergences we currently see in the ICT area. Isolated silos of digital telecommunications and digital broadcasting could easily have developed had it not been for the Internet. This is what we experienced with the development of various digital broadcast technologies, first and foremost the DVB (Digital Video Broadcast) technologies be it DVB-T (terrestrial), DVB-C (cable) or DVB-S (satellite). It is Internet, which became the foundation for ICT convergence.

Internet technology was, even till the end-1990s, an external set of technologies and practices for the telecommunications sector. The telecommunications sector finally ‘surrendered’ and telecom operators have become major Internet Service Providers. However, it was not within the telecommunications sector that Internet developed. It was on the basis of computer communications coming out of the IT area. And, as it happened, it was the military and security authorities, the computer science community and IT industry in the US that led the competition for developing new forms of computer-based communications (Mowery and Simcoe, 2002). These are the material realities that have to be included in the analysis of the developments of media systems - what we in a paper from 2015 called ‘The dominance of the IT industry in a converging ICT ecosystem’ (Henten and Tadayoni, 2015).

This does not mean that other sectors than IT do not influence the ongoing convergences. It does not either mean that it’s only a technology driven development – not even that it’s primarily a technology driven development. This depends on the phases of development, where technology drivers may be the dominant ones in some phases, while economic and political drivers may be the important ones in other phases. But it does mean that the material reality of Internet being the common infrastructure for all converging ICT areas has to be factored in in analyses of media systems.

## **6. Analysis of policy directions and the potentials for policy action**

The section on technology developments, from terrestrial, cable and satellite to IPTV, Internet OTT, CDNs and mobile edge computing, is an account not only of historical and recent developments of content distribution technologies but also of existing technologies. All these technologies are in use, providing different co-existing infrastructures and platforms for audiovisual distribution. In recent time, the most common traditional means of TV reception in Denmark has been cable and common antenna arrangements, followed by household satellite dishes and aerials. Detailed official statistics regarding modes of reception are not collected any longer in Denmark – the last official statistics being from 2014 (Danmarks Statistik, 2015). Less detailed (with respect to modes of reception) statistics are provided by the Ministry of Culture in the annual publication ‘Mediernes udvikling’ (‘Development of the media’). The share of the population in Denmark steaming content increased from 54% in 2017 to 57% in 2018, while the share of the population watching traditional broadcast flow TV decreased from 80% to 77% (Kulturministeriet, 2019). The number of households without any traditional TV signal reception increased from 3% in 2010 to 15% in 2018 – up from 10% in 2016 (Kulturministeriet, 2019). These figures indicate that the majority of those who stream audiovisual material also use other means of reception. With respect traditional means of reception, indications are that there are some 150,000 households still receiving TV via aerials (Elgiganten, 2020), which is a relatively small minority of those watching traditional flow TV.

The section on broadcast developments in Denmark illustrates the close relationships between distribution infrastructures and the content provided. In the monopoly era of broadcasting, broadcast frequencies were only available to the public service broadcaster. Shortage of broadcast frequencies was used as an argument in favor of monopoly, and this provided the public service



broadcaster with a very special position in the media market. This has tended to continue after the political decisions to end distribution monopoly, facilitated by alternative technological solutions – first cable and satellite and later terrestrial digitization and Internet distribution. In 2018, the PSB share of television watching was at 62% of viewers (Kulturministeriet, 2019) – including not only the incumbent PSB provider but also the main channel of TV2 and the regional TV2 channels. In 1992, the figure was 75% and then it fell to 54% in 2012, but has risen again since (Kulturministeriet, 2019). This shows that PSB television has a relatively strong position in Denmark in spite of many technological changes, but it is also a position that PSB providers are fighting for in many different ways when their programming just becomes one of many streaming options on the Internet.

The section on instances where the ownership and existence of a terrestrial distribution infrastructure has been heavily discussed also includes an introduction to the fact that the increasing use of CDNs as infrastructures for broadcast distribution has been entirely overlooked in the public discourse on the future of public service broadcasting. The section shows that there was formerly an interest in having a nationally owned broadcast infrastructure that potentially could reach everyone. In the instance of the Ameritech take-over of the Danish incumbent telecom operator in 1997, the issue was that the terrestrial broadcast infrastructure more or less accidentally fell into the hands of a foreign telecom provider. When this was ‘realized’, the broadcast infrastructure was separated from the overall deal and maintained in Danish ownership (Rigsrevisor, 1998). In the instance of establishing a digital terrestrial infrastructure, it was discussed whether this was worth the effort and investment, taking newer forms of broadcast infrastructures and the growing demand of the mobile telecom operators for frequencies into consideration. However, there were strong proponents of building digital terrestrial broadcast networks with various arguments ranging from having national networks under some kind of national control that potentially could reach everyone, also for safety and security reasons in times of crisis, independence of public service broadcasters from private cable and satellite companies, and having networks where reception could be mobile in contrast to cable and satellite (Teknologirådet, 2000).

Importance has thus traditionally been attached to having (some degree of) national public control with broadcast distribution – especially public service broadcast. This control has been with terrestrial broadcast, as cable as well as satellite infrastructures have mostly been in private ownership. The same applies to Internet, and with Internet the general conception is furthermore that – as Internet is a global network of networks – it cannot, or only with great difficulties, be regulated nationally, unless one wants to go down the road that dictatorial regimes do, simply cutting off access to certain services or the Internet as such. This puts terrestrial infrastructures in a special position, as they not only traditionally have been under some degree of public control but also – as they are geographically confined – more easily can be made subject to national control. It is, however, a kind of national control that continuously becomes still more symbolic. Fewer and fewer people receive audiovisual content via terrestrial networks by means of aerials. Even though everyone in principle can receive the terrestrial signals, fewer and fewer actually have aerials that will allow them to ‘take down’ the signal. This also means that the special

position conveyed to the broadcasters that have access to their own broadcast frequencies becomes increasingly symbolic. While formerly the relationship between having control with frequencies and the content provided in a sense was the crux of the special position of public service broadcasters, this position is quickly fading away.

It is understandable that politicians shy away from regulating Internet nationally. This runs counter to the whole conception of Internet. However, when an increasing share of the population accesses content including PSB on Internet via broadband connections of different kinds, and when this content provision is organized by means of CDNs, which are owned by various capital arrangements including international capital, it is time to consider whether an increasingly symbolic policy regarding terrestrial infrastructure is the best way to support the public interest in public service broadcasting. Public service broadcasting has as mentioned, indeed, a relatively strong position in Denmark with a share of viewers that has even increased during the past years. One of the likely reasons for this is that public service broadcasters have been able to adapt to the changing media landscape content wise. The programming that they have is apparently sufficiently attractive for a large share of users. However, the question raised in this paper is whether this is a sufficient basis for supporting public service broadcasting in Denmark.

During the past few years, the notion of critical (national) infrastructures has become more prevalent. When Tele Danmark was sold to Ameritech in 1997, there were few voices of opposition claiming that the telecom infrastructure was a critical infrastructure – or rather the argument was that there needed to be a strong international player (which Ameritech was aiming at becoming at the point in time) to secure the ongoing development of the Danish telecom infrastructure. It was only the broadcasting part of the activities of Tele Danmark that was considered of such national importance that it could not be sold to a foreign company. The government at the time was a government of The Social Democratic Party as the dominant part in cooperation with a small left-liberal party, Danish Social Liberal Party. The then minister of finance, the social democrat Mogens Lykketoft, has since then several times stated that he regrets selling off Tele Danmark (e.g. Computer World, 2010). However, it is not only social democrats who believe that Denmark, at a point in time around year 2000, went too far in privatizing infrastructures. This also applies to liberal politicians, for instance the former conservative minister of industry, Brian Mikkelsen (Ingeniøren, 2019). The concept of critical (national) infrastructures is the term used when explaining that certain areas considered of infrastructural character should not be sold to private (foreign) companies.

The concept of critical infrastructure is not a well-defined term and is used to address many different situations and business areas. According to the US Cybersecurity and Infrastructure Security Agency (CISA), there are sixteen critical infrastructure sectors in the US including chemical sector, communications sector, dams sector, energy sector, etc. (<https://www.cisa.gov/critical-infrastructure-sectors>). This is a more broad conception than is most often seen. Often the term infrastructure is used to imply the sectors that in the traditional American terminology are called utilities, i.e. telecoms, broadcast, electricity, gas, water and roads. In a Danish context, a majority in the Danish parliament consisting of The Social Democratic Party, Danish People's Party, The Red-Green Alliance, and Socialist People's Party in April 2019 (Folketinget, 2018-2019) imposed on

the then liberal (Left, Denmark's Liberal Party) government 'to work in favor of Danish critical infrastructure either having public or a user-owned cooperative as majority owners' (*own translation*). The argument put forward in the decision was that 'critical infrastructure is of vital interest for society and its citizens, not least dealing with natural monopolies' (*own translation*).

The question could then be whether broadcast is a critical (national) infrastructure. It will probably be seen as so in a broad conception of the term. However, if the infrastructure is to be seen as a natural monopoly – as indicated in the decision of the Danish parliament – it is clearly not a critical infrastructure. There are many competing broadcast infrastructures and it is not possible to claim that just one provider (a natural monopoly) would be able to provide cheaper services of the increasingly broad range of audiovisual services provided via different broadcast technologies. However, this issue only touches upon the conveyance systems. If the question is whether public service broadcasting as a service is a kind of natural monopoly, the answer is more difficult. The question is here whether just one provider can deliver better and cheaper public service broadcast to the public than a range of different public service providers. The political answer in Denmark has leaned towards a 'no'. With the establishment of TV2 in 1988, a public service broadcast duopoly was created, and since then the policy direction has been to distribute parts of the public service broadcast license fees to alternative content providers. The question thus becomes whether one can have public service broadcasting without a unitary large public service broadcast institution. This is, as at now, an unresolved political question. However, the political tendency is to believe that public service content production can be spread over a large number of companies. And, furthermore, that this content can be offered on a broad Internet-based market, where the public service content is just a smaller portion of all the content marketed.

## **7. Conclusions and further research**

Three research questions were posed in the introduction: Whether, and if so in which areas, policy influence and control has been lost? Why this is? And, whether policy influence can be (re)gained? The answer to the first question is that policy influence and control surely is fading if not lost, and that this primarily applies to the physical infrastructures for media distribution. The answer to the second question is that the fading control of infrastructure is related to the changes in distribution technologies – from dedicated infrastructures to the general Internet. The answer to the last and third question is more uncertain and is in need of far more research and debate.

The country case of the paper is Denmark, and the focus is on public service media. Denmark has a strong tradition in public service media, however, many of the issues dealt with and the conclusions drawn will also apply to other countries. The overall conclusion is that policy influence and control with public service media is quickly fading with respect to infrastructural questions, and that this is happening without any significant public discussion. Policy intervention in more detailed matters with respect to public service broadcasters and their daily decisions, on the other hand, is increasing and is likely to increase even further when funding for public service media will come from the state budget and not from license fees.

With the danger of underestimating the importance of public service contracts and the daily decisions of public service media, one could say that policy influence and control with 'the bigger

picture' is dwindling, while intervention in 'small matters' is growing. This was illustrated well in connection with the latest Danish media policy agreement in 2019, where emphasis was on cutting the budget of the incumbent Danish public service broadcaster DR, while very little attention was paid to the increasing role and central position of the US-based so-called tech giants.

Danish media policies are squeezed between the European AVMS directive determining the general framework for content regulation and the strong position of the US-based tech giants. But while the AVMS is a question of delegating political power to a higher positioned policy institution, delegating power to the tech giants is a question of handing over power to not only private interests but also foreign private interest on which Danish policy makers have very little influence.

A central reason for this situation relates to technology developments – from dedicated broadcast infrastructures to the general Internet. It is obviously also a question of many years of policies of liberalization and privatization that, on the other hand, also have influenced technology developments. However, it is difficult to circumvent the importance of technology developments where the Internet has become the general infrastructure for all digital communications including media distribution. New platforms to complement terrestrial broadcast have gained importance during many years and digitization of information and communication technologies (ICT) has also been ongoing for a long time. But it has been the increasing importance of Internet which has formed the basis for the ICT convergence developments, which are fundamentally changing the media scene.

The tradition for policy control with broadcast media in general and with public service media more specifically has been based on public control with radio frequencies. In terrestrial networks, those who have control with the frequencies also have control with access to broadcasting and broadcast content. The political control has thus been associated with control of infrastructure. If control is limited to content quality, and if funding for public service content is increasingly dissociated from public service institutions, the risk is that public service content becomes very narrow and the public service audience likewise. Time and again it has been discussed politically and in the media whether this or that program is indeed public service or whether it's just common entertainment. And, in many instances it is just common entertainment and even low quality entertainment. However, this discussion disregards that the issue of public service content is not only a question of the individual program but also a question of the overall programming, and this has been where access to frequencies has been important.

The question is whether public service media can maintain a strong position in the media market without any control of infrastructure. At two instances mentioned in the paper, the Ameritech take-over of the Danish incumbent communications provider and the decisions regarding the establishment of a digital terrestrial network, there were intense political debates about the importance of having a publicly owned broadcast infrastructure. With the Internet increasingly becoming the infrastructure for media distribution and CDNs facilitating this, there is practically no public discussion on this development. If a discussion came up today on the future of the digital terrestrial networks, there would surely be a range of people defending the terrestrial networks as

a fortress of public service broadcast. However, with the very low and still decreasing number of people accessing television via aeriels, this has become a very symbolic 'fortress'.

Lately, at least in Denmark, the concept of critical infrastructure has increasingly been used – not in debates on media distribution, but more in discussions on water and electricity. As mentioned in the section of the paper regarding policy directions and the potentials for policy action, there is no clear definition of what critical infrastructure includes, but the Danish parliament has decided 'to work in favor of Danish critical infrastructure either having public or a user-owned cooperative as majority owners' with the argument that 'critical infrastructure is of vital interest for society and its citizens, not least dealing with natural monopolies'. With this clarification in mind (natural monopoly), the media distribution infrastructure is clearly not a critical infrastructure, as there can be and are competing infrastructures. As mentioned in the section, the question could be whether public service institutions constitute a critical infrastructure. The trend in Danish policy debates and policy decisions is clearly that this is not the case. However, this is still not settled in the sense that it is not clear whether one can maintain public service broadcasting without strong public service organizations.

In addition to these policy issues, the paper also discusses the theory framework for analyzing these developments. In much media research during the past decades, there has not been much focus on the infrastructural issues and the importance of this for public service media and content. During the past few years, however, more attention has been placed on the implications of the material aspects of social developments. This paper has the aim of illustrating the importance of this approach to media studies. This not only entails the central position of Internet as such on media developments, but also the fact that in the convergence between media, telecommunications and IT, it is the IT area and the US-based tech giants, which have come to dominate the media. This is also a material reality that has to be included in the analysis of media developments.

When it comes to further research, and indeed a great deal of new research has to be made in this field, many issues stand out and among them the most important ones are whether and how it is possible to regulate Internet as an infrastructure, what a critical infrastructure is and what the implications are, and how a greater emphasis theoretically on the materiality of media developments can improve analyses of media developments.

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