Impact of Internet and IP on Media Platforms and Infrastructure

Anders Henten
Reza Tadayoni

CICT, COM•DTU
Technical University of Denmark

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The paper aims at examining the Internet and the Internet Protocol (IP) as production and distribution tools for the media, with an emphasis on video distribution. Internet and IP enable changes in the production flows and structures of the media, e.g. the presentation of media products on different communication platforms. On the distribution side, emphasis is on the new distribution possibilities for the media established by Internet and IP as well as the potentials for self-configuring distribution and exchange of material as in the case of peer-to-peer communications.

1. Introduction

One of the fundamental technological developments in the communication and media areas is digitalisation. The transformation from analogue to digital technology is potentially a radical change, for instance, in the broadcast sector. In the paper, however, the main focus is not on the effects of this transformation but more on the digitalisation as the technological driving force for convergence (and divergence) and the synergies developed between the Internet and IP evolution and media developments.

The materialisation of the synergy between Internet technologies and the media is thus connected to further technological developments. This applies, e.g., to audio/video coding and streaming media technologies. It is not economically feasible to transmit audio/video in raw digital form to end users in any network. Only professional internal broadcast networks are designed for this task. Therefore, coding and compression technologies are important. Furthermore, even in coded form it will take too long time to download audio and especially video components within the current broadband networks. This has resulted in the development of streaming technologies which enable the users to start listening/viewing audio/video services without downloading.

Internet itself has had huge impacts on the development of the media and content industries, but the real use of media services over the Internet or other IP networks is dependent on the development of broadband technologies and infrastructures. Broadband is becoming more and more a driving force for the whole convergence process. Broadband establishes a platform for different services to be offered and for the development of interactivity. Broadband networks are competing technologies to other broadcast distribution networks. Broadband networks are also competitive in offering advanced services like Video and Audio on Demand (VAoD) and giving access to online archive material. An important question here is to what degree broadband replaces the traditional distribution system and to what degree it will be more efficient to have specialised broadcast networks and what the parameters affecting this are.

However, Internet does not only allow for the kinds of interactivity connected with VAoD and searching for text material. The question of interactivity goes much further, with Internet proving to be a technological platform for all kinds of point-to-point, point-to-multipoint and multipoint-to-multipoint communications, including blogs and peer-to-peer communications.

Looking at broadcasting once more, the development of the Internet and IP has, furthermore, had massive impacts on the production and contribution part. The widespread access to the Internet and advanced capturing devices establish a situation where every user of the Internet can be a contributor to program production. The entry barriers to establish freelance journalism has decreased and there are many sources for news in competition with the traditional news agencies. The entry cost of establishing a Web radio and Web TV station is far bellow the traditional broadcast stations and with much wider consumer base.

Moreover, mobile consumption has been one of the strength of broadcast services. This mobility has been a determining factor for the development of radio, long before residential communication became mobile. At present, we are witnessing that mobility comes to the media through mobile/wireless communicative networks. This is an important parameter in the future value creation and resource utilisation. Media products can be presented on different platforms, fixed and mobile, and this will not only lead to changes in the use of media products but also in their production.

Taking these kinds of developments into consideration, the overall aim of the paper is to document different implications that the Internet and IP and Internet related technologies have for the media.

There are two aspects of this. One is that what we understand as the Internet today is a complex set of technologies, where the different technological elements have different implications for the media. This is a very simple point but is now and then forgotten in simplified discussions on Internet implications. In addition, it is important to acknowledge that Internet and IP and Internet related technologies are not a finite thing but something that develops over time. Therefore one should not only take a synchronic view on Internet and IP implications but also include a historical and diachronic perspective.

The other aspect is that it is important, when discussing implications for the media, to differentiate between the Internet as a network and IP, which is the basis for the Internet but also can be used in other contexts and technologies, for instance dedicated networks or simply as standards used in different media technologies.

Finally, it should be noted that the present paper only deals with the technology aspects of the Internet and its implications on the media. In addition to the technology innovations related to Internet development, there are many other and as important innovations regarding governance and organisation and also commercialisation of the Internet[1]. However, these innovations are, in the present paper, taken for granted and only the technological potentials and limitations of the Internet and IP regarding media developments are taken into consideration.

2. Internet history

In the paper 'A Brief History of the Internet', a large group of the 'founding fathers' of the Internet starts out with the following statement:

> The Internet has revolutionized the computer and communications world like nothing before … The Internet is at once a world-wide broadcasting capacity, a mechanism for

[1] These aspects are dealt with in a paper by David Mowery and Timothy Simcoe: 'Is the Internet a U.S. Invention? – An Economic and Technological History of Computer Networking', University of California, Berkeley, no year of publication.

> information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location.[2]

This statement is absolutely true today – acknowledging, as they do, the previous developments of the telegraph, telephone, radio and computer, etc. – and is, indeed, the message of the present paper. But it was not true from the beginning of the development of the Internet. The capacities mentioned came later, for instance with respect to broadcasting. And - in total agreement, we take it, with the 'founding fathers' - the purpose of this section is to show that the Internet is not a fixed and finite thing; that Internet has developed over time with different implications for the media; and, that it will keep on developing technologically with future consequences for media developments. First and foremost, the Internet is not just the TPC/IP protocol suite; it is also the World Wide Web; and, the functioning of the present Internet is, furthermore, dependent on compression technologies, for instance MP3, and on streaming technologies and much more. The aim of the paper and this section is thus to go a couple of steps down in abstraction from 'the Internet' and look at the different technological elements and capabilities related to Internet.

Internet is based on packet switching technology in contrast to, e.g., the traditional telephone networks, which are circuit switched. This means that, based on digital technology, communications are split up in packets and do not occupy whole circuits but share the capacity together with packets from other communications. There are two basic kinds of packet switching technology, connection-oriented and connection-less. Connection-oriented means that specific paths are determined in advance, while connection-less means that packets from the same communication may follow different paths. Asynchronous Transfer Mode (ATM) is an example of a connection-oriented technology, and Internet is an example of a connection-less network.

In their historical account, the 'founding fathers' explain that packet switching technology was developed at different places simultaneously. Work had been going on at MIT and RAND in the US and at National Physical Laboratories in the UK 'in parallel without any of the researchers knowing about the other work'.[3] This happened in the beginning and middle of the 1960s, and in 1968 the

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[2] Barry Leiner, Vinton Cerf, David Clark, Robert Kahn, Leonard Kleinrock, Daniel Lynch, Jon Postel, Larry Roberts and Stephen Wolff: 'A Brief History of the Internet', http://www.isoc.org/internet/history/brief.shtml , no year of publication.
[3] Ibid.

overall structure and specifications of the ARPANET (the earliest precursor of Internet) were finalised. In 1969, the first small network was built including 4 nodes and in 1970, the forerunner of TPC/IP, the Network Control Protocol (NCP), was finished, which made it possible to develop applications for the network[4].

E-mail was one such application. The first e-mail program for ARPANET was developed in 1972 and quickly became one of the most popular applications, and it still is. In 1973, work began on developing the protocol suite later to be called TCP/IP, but it was actually not until 1 January 1983 that TCP/IP was established as the standard for ARPANET. And, it was not until this time that the term Internet was used. In the 1970s and 1980s, many different technology developments, either closely or more remotely related to or totally in isolation from but with important implications for what came to be the Internet took place. One such example is Ethernet LAN technology, which has played a central role for Internet development. Another is, as mentioned, compression technology, without which Internet would not be what it is today.

But from a media point of view, the most important thing is maybe that, in the 1970s and 1980s, what came to be the Internet did not have any implications for neither broadcasting nor the print media. It did not either have any immediate implications for the telecom sector – although this may seem strange today. But there were a number of other technology solutions being developed at the same time, some of them proprietary, for instance IBM's SNA, and another one in the telecom community. Indeed, packet switching technology also entered the telecom world but was developed on a track separate from the Internet community, for instance the X.25 standard for packet switching networks and the X.400 standard for message handling (e-mail). But today, almost nobody remembers these standards. And in closer relation to the media world, the major part of the telecom sector was, until the mid 1990s, primarily preoccupied with videotex with the French Télétel/Minitel project as the pre-eminent example.

It was actually not until the development of the World Wide Web (WWW) that the Internet began to have serious impacts on the media. Of course, the media also use e-mail and file transfer as any

[4] The paper by David Mowery and Timothy Simcoe explains that there was a parallel initiative in the UK at the National Physical Laboratories – starting even before the development of ARPANET - and that there was also a French initiative a couple of years later, starting in 1972, called CYCLADES. But none of these networks became successful, partly because of lack of funding, according to Mowery and Simcoe, op.cit. p. 8-9.

other sector internally in media companies and between business partners, and news group applications, bulletin boards and listservs were also developed earlier on. But for the general media products, the Internet did not play any significant role until WWW was launched. And even then, it took a while for the media as well as the telecom sector to realize that something had changed - which is, to some extent, still the case. The media and the telecom sector have still not fully adapted to the many uses of Internet. But they have realized its importance – as new possibilities or threats.

In 1992, CERN released the first version of WWW. The central functionality of the web is hyper-linking, which makes it possible for the users to browse around and find information on the net. In 1993, a graphical interface for the WWW was developed resulting in the first popular browser, Mosaic. From then on, the implications of Internet have grown for the media. In some instances, Internet technology can substitute for technologies hitherto used and cause important upheavals in media industries. In other cases, Internet supplements existing technical solutions and business models.

The important thing in the context of the present paper is to step down from the highest level of abstraction dealing with the Internet as such and to look at the many diverse technological elements that go into what the Internet is today and what it will develop into in the coming years. Among these technological elements should be mentioned, e.g., streaming media, multicast, peer-to-peer, broadband and mobility. And, there are many others. With respect to the Internet itself – understood as a network of networks based on the TCP/IP protocol suite - the diffusion of IPv6 instead of the presently dominating IPv4 protocol will also have great implications. Among other things and in addition to an immensely expanded addressing scheme, IPv6 includes improved security, quality of service and enhanced mobility.

3. Internet and IP

The impacts of Internet on video broadcasting can be analysed in several ways. In this paper, there is a distinction between two ways: 1) the impacts of the Internet as a global interconnected network, and 2) the impacts of the Internet Protocol (IP) as an efficient and widespread technology. These to aspects are closely interconnected. However, the distinction helps in understanding the development, especially when it comes to the development of the IPTV and VoD services.

The first aspect, the impacts of the Internet, can be analysed by studying the development of Internet TV and radio, the use of Internet as a distribution channel for video and audio services, and the huge online activities of the traditional broadcasters. Here the development of streaming technologies and peer-to-peer (P2P) applications has been decisive. Furthermore, the development in audio/video compression, which applies to the general development of digital media, has been an important factor.

The second aspect, the impacts of the Internet Protocol, can be analysed by studying the diffusion of IP as the technology for 'closed'/'private' infrastructures, which do not necessarily interconnect to the general Internet. These so-called *managed IP* networks were initially developed within big companies as internal communication infrastructures, but presently the same types of infrastructures are developed in the residential markets, e.g., in broadband networks. The main difference between these infrastructures and the general Internet is that the general Internet is 'best effort' while, in the managed IP networks, it is possible to implement certain levels of QoS (Quality of Service). Another important difference is that the Internet is 'open' for service providers, but the 'openness' of managed IP networks depends on the applied business models of the owners of the infrastructures.

The underlying argument for the enormous success of Internet and IP and their influence on practically every media is connected to some of the design principles resulting in an efficient platform when it comes to resource utilisation as well as when it comes to service creation environment. One of the design principles of IP is effective scalability, which in the future development will suffer from shortage of IP addresses. This problem is, however, handled by the development of IP version 6, *IPv6*. Apart from solving the scalability problem, other issues like QoS and security are also addressed in the IPv6. The dominant Internet architecture, based on the client-server solution, is not necessarily the most efficient one when it comes to organisation of content distribution, e.g., in VoD provision. Here the P2P architecture, developed mainly for content sharing, can turn out to be more relevant.

3.1 The IP design

The emergence of the Internet, which is based on IP, is considered as one of the most radical innovations in the communication field in recent years. IP technology is designed in a way that enables a radically different environment for service development, innovation and competition, both when it comes to infrastructure platforms and service development platforms. In the following some of the important characteristics of IP platforms are outlined:

- Separation between network technology and services
- End-to-End architecture, and extension of intelligence from the core to the edge of a network
- Scalability
- Distributed design and decentralised control

The separation between the underlying network technology and the services, which are provided in the IP networks, removes entry barriers for the service providers in entering the network. The only precondition for service provision is access to the network. This has created huge dynamics in service development on the Internet. However, this also creates a problem of revenue sharing between the owners of the network infrastructures and the service/content provider. This is more obvious in the broadband IP infrastructures that are mainly provided by the telecom operators. Especially because the flat rate billing for connectivity has become a de-facto paradigm, it is obvious that the development in value proposition is mainly concentrated in the service provision.

End-to-End architecture and extension of intelligence from the core to the edge of a network is another factor that moves the development and innovation activities to the edge of network. The concept was first introduced in a paper named: ‘End-to-End argument in system design’[5]. Their main argument was that an efficient network design can be based on ‘dumb core network’, where processing is moved to the edge of the network.

[5] Saltzer J.H., Reed D.P. and Clark D.D. (1984), *End-to-end arguments in system design*, M.I.T. Laboratory for Computer Science.

Scalability is another main feature of the IP design. One of the barriers for further scalability is the shortage of addressing space in the current IPv4 systems. As discussed in the section on IPv6, the shortage of addressing space is a big problem for developing countries, mainly due to uneven allocation of the IPv4 addressing space.

Distributed design and decentralised control is another characteristic feature that obviously has improved conditions for development of services, innovations and creations of new businesses. Different networks can easily connect to other IP networks, including the Internet and obtain value added from network effects, etc.

These characteristics of the technology create good conditions for the development of competition where several actors can be involved in service creation and provision. The general Internet is the major IP network in the world but it is far from the only IP network. In recent years, several private IP networks have been established and utilized for both corporate and residential services, and the future of communication platforms, like the core of Next Generation Network architecture, is based mainly on IP technology.

3.2 IP version 6

The current Internet Protocol, which is primarily based on IPv4 has had a rapid growth both when it comes to the number of IP enabled devices and when it comes to applications and services. IPv4, however, suffers from major weaknesses when it comes to dealing with the rapid growth in the number of devices connected to the Internet and the new applications and services. This has resulted in the standardisation of a new version of the Internet Protocol, IPv6, to cope with the shortcomings of IPv4.

One of the main weaknesses of IPv4 is the amount of IP addresses available globally. The IPv4 address consists of 32 bits, meaning that there are about 4 billion addresses available. On the one hand, it is obvious that 4 billion addresses are not enough in a world, where more and more devices and terminals become IP enabled. On the other hand, even the current addresses available are allocated so unevenly that many of the countries lack IP addresses to develop their ICT infrastructures. For example, according to a consultation paper on 'issues relating to transition from

IPv4 to IPv6 in India'[6], 'India has merely 2.8 million IPv4 addresses compared to 40 million acquired by China'. Here it is important to note that any common US university has more IP addresses than India and that a US ISP, Level-3, alone has more IP addresses than China[7]. The distribution is much worse when it comes to less developed developing countries. Bangladesh, e.g., has about 150,000 IP addresses.

IPv6 extends the address room to 128 bits, meaning that the number of IP addresses will not be any problem in the foreseeable future. This gives the possibility for allocating more addresses to different countries and regions. Furthermore, the allocation of IPv6 addresses does not suffer from the historical legacy that resulted in the uneven allocation of IPv4 addressing space.

The other issues dealt with in IPv6 are related to the applications. The main issues here are QoS and security. QoS is important in relation to real time services like VoIP, IPTV, Interactive TV, etc. and security at IP level will be generally required by a number of services in the future.

3.3 Peer-to-peer technology

File sharing via peer-to-peer (P2P) networking is one of the most debated implications of Internet on the media. Especially the music industry but also the film industry is feeling threatened by unlicensed file sharing, infringing on copyrights. File sharing is thus clearly an example of implications of the Internet as a network.

P2P technology was actually one of the basic technology concepts of the Internet. It was described in the very first Request for Comments (RFC) from 1969 documenting the Interface Message Processor (IMP) for connecting computers on the ARPANET. However, the present Internet is dominated by client-server technology but allows for P2P networking solutions which are used in many applications. In the media context, the whole issue started with Napster. This was, however, not a pure P2P application but combined P2P elements (the sharing of files between users) with client-server elements (in the searching procedures).

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[6] TRAI: Consultation paper no. – 8/2005, TRAI, 'issues relating to transition from IPv4 to IPv6 in India, August 26, 2005.
[7] Ibid.

Presently, the Internet is mainly based on a client-server approach. There are a number of servers in the networks doing specific tasks, like e-mail server, web server, etc. The end users install clients on their IP terminal (computers, mobile phones, PDAs, etc.) and connect to the servers for specific services. There is, however, another approach that becomes more and more used, where the end users' IP terminals act both as a client and a server. In this approach the IP terminals connect directly to each other and share information, files, etc. This approach is called P2P to indicate that the peers communicate directly with each other.

P2P networking in its pure form means that all nodes of a network are equal peers. The combined resources of the network, including computing power and storage capacity, can be used by any of the nodes in the network and they are, furthermore, combined in an ad hoc fashion. The alternative network architecture is the client-server configuration where one or a number of the nodes function as servers for the other nodes (the clients). The two basic configurations can, as mentioned, be combined and are so in many of the applications based on the Internet.

One of the main challenges to make P2P networks operate efficiently is the location of information. This can be compared with the role of signalling in the telephony networks to locate the parties, which want to communicate with each other. Through the last 5-6 years, a number of P2P applications have been developed. Examples of applications are: 1) Napster, 2) Gnutella, 3) FreeNet and 4) BitTorrent. The aim of these applications has been to facilitate document sharing and mainly sharing of music and movies. Furthermore, the VoIP application Skype has based its signalling on the P2P approach.

Napster was the first large extensive P2P application for music sharing. Napster was developed in 1999 by a college student to share his music with his friends. Very soon after, Napster became popular among the users and very unpopular among the record industry and the content owners. Napster was closed down by a US court in mid 2000. Location of information in Napster was implemented by deploying a central index server, keeping track on available content on the net. So the approach was P2P but it still relied on a central server, which is why it was easy to bring a stop to the service by simply requiring that the index server should be closed down.

Gnutella on the other hand was designed with the requirement of not relying on a central server for indexing and locating of information. In Gnutella, every peer has connections to a few neighbour peers. For locating content, the peer will ask its neighbour peers, and if they don't have the content, they will ask their neighbour peers, and in this way finally the content will be found and a connection to the content location will be established. This approach doesn't have the weakness of Napster with regard to centralism, but it consumes much bandwidth by sending requests in several directions.

It is often said that the media industry has been slow in adapting to the P2P applications on the Internet, and that the failure to develop Internet based business models is the real reason behind their legal measures against file sharing systems and users. And, during the past couple of years, other players have entered the field of music and now also video distribution, first and foremost iTunes. However, the question in relation to P2P technology is whether the commercial media will be able to use P2P technology in their commercial operations. There are commercial successes using P2P technologies. Skype is one of the presently most prominent ones. But this is for telephony (interpersonal communications) and not for content distribution. When dealing with content, successful applications of P2P technology will depend on the development of the copyright concepts used by the artists and the media industries.

3.4 IPTV and VoD

IPTV and IP-VoD started by offering different services using streaming TV over the Internet. In the last 5-6 years, we have been witnessing the emergence of a huge amounts of *'on demand'* video services on the Internet, specific 'Internet TV' channels, and '*time shifted*' versions of part of programming from traditional broadcasters. This development has been intensified in the recent years, where the quality of streaming video signals are getting better and approaching the quality levels known from traditional TV services. Furthermore, in recent years, broadband operators deliver IPTV services in their managed IP networks. Here, it is possible to deliver even better quality than traditional broadcast TV and many broadband operators have plans for the provision of HDTV based in IPTV technology. Also in the managed IP networks a great deal of video content, mainly feature movies, is available in the VoD provisions. The IP-VoD is mainly based on client server architectures, but in the future development P2P can be used as a more efficient content organisation architecture.

Three observations are important in this development: 1) IP platforms, especially broadband platforms, are becoming a competing infrastructure for delivering of TV services. Until now, terrestrial, satellite and cable network have been the main delivery platforms and the main development has been towards digitalisation. 2) IP platforms, due to the inherent interactive component, are changing 'broadcast' in a fundamental way from a broadcast service to an *on demand* service. 3) The content providers can bypass service providers and directly offer services to the end consumers.

Regarding the first aspect, a number of broadband providers simply copy the business model from the multi-channel platforms like cable TV and satellite TV and offer services in different packages: Basic package, optional package, premium package, etc. They simply build up a head-end like cable TV, take feeds from different TV station, generate live stream, form different packages and send them to the consumers. The consumers must have IP set-top boxes that convert the IPTV to regular TV and send it to the TV. This model is used on many broadband platforms, mainly as a part of 'triple play' services, e.g., the NESA case in this paper. The model is also used on the general Internet, e.g., the Optimal Stream case in this paper. The case of mobile broadcast (in this paper DVB-H) will probably also use a 'mobile version' of this model.

The reasons for this development are directly connected to the IP design characteristics and the widespread use of IP and Internet. Furthermore, IP enables interoperability and synergy in content adaptation and service development, which is vital, especially in the multi-platform environment of media technologies.

The second aspect, *on demand* transformation, is important because the characteristics of IP platforms are used to add value to broadcast services. If we look at the composition of TV programs, we can see that the majority of programs are not live and are distributed at certain times by the broadcasting station due to planning considerations. In IPTV provision, this type of content can be put on a server so that users can use them when they want. Of course, when the main value of a program is connected to the ability to receive it live, IPTV must use its capability to offer it as live stream. A good case for this development is TV2 Sputnik, but also the way broadcasters use the Internet by simply putting a great deal of programs on the Web so that end users can use them on demand, either on their computer, TV, PDA, iPod, ….

The third aspect, bypassing the service provider, is not a new thing. In traditional analogue terrestrial broadcasting and Free-To-Air satellite broadcasting, there is no service provider. The programs are sent to the transmitters (satellite or terrestrial) by the broadcasters and received by the users. The service or *bouquet* providers emerged in the era of multi-channel TV platforms like cable and satellite. To establish a business model, the service/bouquet providers form different packages of TV channels and sell them to the end users. On the IP platforms, it is possible to continue using this model, and as seen above this is done by several broadband providers. It is, however, also possible for the broadcaster to bypass this service provider function and sell the services directly to the users. This is done by TV2 Sputnik. It is interesting to follow this development and to see if this is a successful organisation of service provision. Definitely this creates an incentive mismatch/conflict between broadband providers and content providers; a broadband operator does not get any revenue out of the huge traffic generated when the end users directly connect to a service like TV2 Sputnik. Another important question is if it is optimal for the broadcasters to maintain consumer subscription, etc.

4. Cases

4.1 Optimal Stream

Optimal Stream[8] is a company, which delivers IPTV to Danish households. At the moment, a number of Danish and foreign TV channels are available on the platform. There is a variety of examples of implementation of IPTV and of bringing broadcast TV to the IP platforms on the Danish market, and the Optimal Stream example does not change the current concept of the delivery of TV in a multi-channel environment. Optimal Stream offers live broadcast over an IP platform and organises the content in different packages like a cable TV system. Optimal Stream uses the Internet backbone as the distribution platform for their service.

[8] Source: https://www.optimalstream.net/

To be able to receive the TV channels one must have:

- A broadband connection of at least 2 Mbps
- An ISMA[9] compatible MPEG-4 set-top box or an ISMA compatible MPEG-4 player
- A subscription

The service is accessible from https://www.optimalstream.net/ , and the TV channels available on the platform are: Animal Planet, BBC World News, CNBC Europe, Discovery Channel Europe, Discovery Civilisation (from mid November 2005), Discovery Science, Travel and Living – Discovery (from mid November 2005) DR 1 & DR 2 (Danish Public Service), The UK Golf Channel, Horror Channel, NRK1 & NRK2 (Norwegian Public Service), Lokal-TV (Local TV in Copenhagen area), Pro Sieben (German movies and news), TV2 Danmark (Danish Public Service), TV Danmark 2, TV2 Norge, TV4 Sverige, and VIVA. The number of services is similar to the services available in the cable TV networks. The subscription cost is 99 DKK (about 15 US$).

Two observations about the Optimal Stream service:

- The quality is not as good as the Danish cable TV services. The advantage compared to the cable TV services is, however, that the subscribers are not dependent on one infrastructure. The services can be accessed whenever one has access to a broadband network
- Even though the service is similar to cable TV, it is not subject to cable TV regulations

4.2 TV2 Sputnik

TV2 Sputnik[10] is another example of IPTV services. It is offered by one of the public service broadcasters in Denmark. Contrary to Optimal Stream, TV2 Sputnik is not just copying the broadcast model from cable TV to the IP platform. There are two main radical differences in TV2 Sputnik's adaptation to the IP platform: 1) Sputnik uses the 'on demand' approach, i.e. the content is not a live transmission of TV2's different TV channels, and the users can select between various

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[9] ISMA (Internet Streaming Media Alliance) is an alliance of hardware manufacturers, software firms and service providers. The objective of ISMA is to create a common international standard for streaming, which can be deployed in a platform independent manner. According to ISMA, the goal of the alliance is 'to accelerate the adoption and deployment of open standards for streaming rich media content such as video, audio, and associated data, over Internet protocols.' For more information please refer to http://www.isma.tv/

[10] Source: www.tv2.dk

content from these programs in a ‘time shifted’ manner, and 2) TV2 as a content provider offering the services directly to the end users and does not go through a service or package/bouquet provider.

The first point illustrates the utilisation of the strong interactive component, which is a natural characteristic feature of the IP platform, and the second goes against the dominant paradigm introduced in the cable and satellite models and later adopted in different digital TV platforms, where the content provider goes through a service provider, which maintains Conditional Access etc. However, like Optimal Stream, the Internet is used as the distribution platform.

TV 2 Sputnik is organised in collaboration between TV 2 Danmark and Nordisk Film A/S (a subsidiary of Egmont). The collaboration between TV2 and Nordisk Film was settled in December 2004 and TV2 Sputnik was launched in April 2005.

TV2 Sputnik offers two different services: ‘Sputnik TV’ and ‘Sputnik Film’. The first one is an ‘on demand’ version of regular TV channels and contains news, documentaries, series, etc., and the second one is a VoD service, where one can choose between different movies. The film titles available in ‘Sputnik Film’ are both Danish and international, all provided by Nordisk Film.

The service is based on Windows Media Video 9 (WMV9) and can be accessed by computers or by TV through computers or dedicated boxes delivered by KISS technology. Regarding broadband connection, one needs a minimum connectivity of 512 Kbps down stream for ‘Sputnik TV’ and 1 Mbps for ‘Sputnik Film’. Optimal quality can be obtained by having at least a 1 Mbps for ‘Sputnik TV’ and 2 Mbps broadband connection for ‘Sputnik Film’.

With regards to the video streaming quality, ‘Sputnik TV’ transmits in 800 Kbps and 380 Kbps and ‘Sputnik Film’ in 1.3 Mbps and 800 Kbps. The so-called ‘sure stream’ technology is used, where the stream automatically adapts to the capacity available at the end user site and uses the most optimal streaming connection: The higher speed connectivity at the end user site, the better streaming quality.

To be able to access ‘Sputink TV’, one must have a subscription:

- 20 DKK[11] per 24 hours access
- 49 DKK per one month access
- 139 DKK per 3 months
- 269 DKK per half year
- 499 DKK per year

For 'Sputnik Film' one must typically pay between 20 - 45 DKK for a movie, and the subscription lasts 24 hours. With regard to 'Sputnik Film', it is required that one must live in Denmark to be able to use the service. Selected programs like TV2 news and weather forecast are available for free, however, with reduced quality - about 100 Kbps.

4.3 NESA

NESA A/S[12] is an energy utility company operating in the vicinity of Copenhagen. The company has its core activities in electricity distribution and trade and is the biggest electricity provider in Denmark with 535,000 customers. For the past 15 years, the company has been deploying fibre cables to support its core activities, e.g. through an IP based control system for their electricity installations, and the company now owns more than 25,000 Km of fibres and more than 700 Km of fibre traces.

In 2002, the company diversified into the broadband market and started implementing and testing a FTTH network. In the end of 2004, the company had 800 homes actively participating in a commercial pilot project. The deployment strategy of the company is to lay down empty micro-duct-tubes with power cables for subsequent blowing of fibres. The company has already connected 20,000 homes with tubes and intends to lay tubes to 200,000 homes in the next 5-7 years.

According to NESA there are several important synergies between electricity supply and fibre optic infrastructure supply: a) common network planning, b) common digging projects, c) common network control and monitoring, and d) common service organisation. The cost of the fibre cable

[11] 1€ = 7.5 DKK
[12] Source: www.nesa.dk and interview.

itself is minor in relation to the ground work and as NESA phrases it: "It should be illegal not to establish fibre connections to the household when a digging project is ongoing".

NESA provides an operator independent network, where different service providers can access the households through NESA's network. NESA owns and controls and maintains the broadband network and physical infrastructure. Today there are four service providers competing on four service types (see following figure).

	Internet	VoIP	Video-on-demand	TV
CyberCity	X			
Dansk Bredbånd	X	X	X	X
J-net	X			
V2tel		X		

The customers pay a fixed monthly fee of € 50 for access to the infrastructure and then buy services directly from service providers through a web portal.

Dansk Bredbånd is the provider of TV in the NESA network. They use IPTV and offer different cable TV like packages and VoD services. Dansk Bredbånd uses a cable TV like service provision system, organising the service in different packages. In this way, it is similar to Optimal Stream. However, the main difference between NESA and Optimal Stream is that NESA does not use the general Internet as the distribution platform. They use their own managed IP network which connects to Dansk Bredbånds managed IP network.

The TV packages contain local, national and international channels targeted at broad audiences. There are also specific packages for people with specific interest.

The cost of TV packages are (the prices are incl. Internet access):

- Basic package (10 TV channels + a number of radio channels): 75 DKK per month
- Advanced package (FastTV) (46 TV channels + a number of radio channels): 245 DKK per month; this package includes the basic package

Additional packages:

- International Package (6 TV channels): 69 DKK per month.
- Canal+ (5 TV channels – film and sport): 219 DKK per month.
- Private Gold (24 hours' eroticism): 69 DKK per month.

Furthermore, Dansk Bredbånd offers VoD for between 15-39 DKK per month.

When introducing future services, NESA does not encounter technical limitations but considers standardisation as a barrier to the development, especially in set-top boxes for IPTV.

4.4 DVB-H

Mobility has been propagated as one of the strengths of some of the digital terrestrial broadcast standards, including the DVB-T standard. This has, not least, been an important argument that promoters of terrestrial digital TV networks always have put forward to legitimise the use of this standard even in countries where other multi-channel infrastructures (cable and satellite) have been reasonably well developed - the argument being that terrestrial DVB (DVB-T), in contrast to satellite and cable, makes mobility and nomadic use (indoors as well as outdoors) possible. This is a valid argument as long as it concerns nomadic and mobile use of TV as we know it, which is typically used in camping vans, cars, busses and trains. However, when we discuss mobile use of personal (hand-held) terminals, there are restrictions in DVB-T's possibilities for supporting mobility. One of the major problems is power consumption, which can be handled when watching TV in a train or a bus, but which will be a practical problem when using a mobile phone or PDA to watch TV. This problem has been taken care of in new mobile broadcast standards. The DVB group has standardised a new standard DVB-H, which is based on DVB-T but reduces the power consumption and other limitations of DVB-T when it concerns mobile use.

An important aspect of DVB-H, which is relevant for this paper, is that it is based on IP Data Cast (IPDC). This is mainly done to get synergy from the developments in the IP world. The synergy is gained at the service and content side as well as at the hardware/terminal side. Even though one of the reasons for using IPDC is the potentials it creates for accessing Internet content and services, the DVB-H IPDC network is a managed IP platform. The use of the IP platform in offering DVB-H services is a good example of IP's impact on broadcast TV as IP technology as well as access path to content on the general Internet.

5. Conclusions and discussions

The aim of the paper is to emphasise the important implications that the Internet and the Internet Protocol (IP) already have and will even more so have in the coming years. As examples, the paper touches upon the implications of peer-to-peer technology for the music industry and the increasing importance it also has in the video area on the film industry. The implications of the Internet are felt in almost all areas of the media in the production phases (for instance information gathering by journalists) as well as the distribution phases (for instance online radio). But it is not only the Internet as such but also the Internet Protocol, which deeply affects the media area. Significant implications may actually not be related to the Internet as a network but to the use of IP as a common technology platform for the development of media industries. This applies, for instance, to the upcoming mobile broadcast area. Such developments are, of course, closely related to the development of Internet as a world-wide network, as the basic protocol used is the Internet Protocol. However, they are not strictly Internet developments and do not necessarily use the Internet as transmission network.

This is important to remember in order not to limit the implications of Internet and IP to the Internet as such. IP will increasingly function as a common technology platform for convergence developments among the different media branches. Digital technology is the basic technological precursor for convergence developments between broadcasting and other media industries and the IT and telecom areas. However, IP is the most likely candidate for the actual materialisation of such convergence possibilities.

In this context, it is furthermore important to consider that the Internet is not a fixed and finite thing. Basically, the Internet is defined as a network of networks using TCP/IP. TPC/IP is thus the basic defining criterion of the Internet. But Internet is much more than this. A host of different technologies are part of what we presently understand as the Internet. This is also part of the explanation why a historical approach is helpful in understanding the implications of Internet and IP. The first 'generations' of Internet did not have any implications for the media. It was only when the World Wide Web was developed that Internet began to impact on the media. And, many other technology solutions such as compression and streaming technologies are equally important for Internet to have impacts on the media.

In connection with this historical approach, the discussion could be raised whether the media industries have underestimated the importance of Internet and IP for the development of their business areas. This certainly seems to be the case. The question can be divided into two aspects. One aspect, the fundamental one, deals with the question whether the media industries have not sufficiently realised the implications for their business areas of the convergence tendencies technologically enabled by digital technology and more specifically packet switching technology. The other aspect concerns the more specific development of Internet and IP as the dominant technology trajectory of digital and packet switching technology. With respect to both aspects, the answer is yes, however with the modification that industries often quite reasonable will seek to exploit their existing technological bases as much as possible before venturing into new technology solutions and the more specific modification that Internet and IP were not the only technological options available until a few years ago. At present, Internet and IP certainly is the dominant avenue, but this was not the case a few years ago.

The final issue to approach here is whether the media, conversely, have affected the development of the Internet and IP. The paper describes the influence of Internet and IP on the media, but does the influence also go the other way round? The answer is affirmative, and it applies with respect to the Internet as such as well as the use of IP in non-Internet contexts. The potentials in using the Internet as a network platform for media industries contributes to the development of Internet and Internet related technologies, and the same applies to the use of IP as a common technological platform for convergence developments in the media.