SWEDISH ICT

FUTURE MEDIA DISTRIBUTION

AN INNOVATION AGENDA FOR DIGITAL MEDIA DISTRIBUTION

2015

The agenda is written within the framework of the Strategic Innovation areas, a joint initiative between VINNOVA, the Swedish Energy Agency and Formas. The purpose of the Strategic Innovation areas is to create conditions for Swedish international competitiveness and sustainable solutions to global societal challenges.

A special thanks to the companies that actively have contributed to the agenda

Arkena

Ericsson

Peerialism

Spotify

TeliaSonera

TV4

Viaplay

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Summary

THE PURPOSE OF THIS AGENDA IS TO CREATE *a solid research and innovation program concerning digital media distribution. It aims at groundbreaking renewal and a sustainable development for both Swedish industry and Swedish society. The agenda starts out by mapping the state of affairs in the* ***Trends****-chapter, then points out difficulties in* ***Challenges****, provides* ***Goals****, and lists the means to achieve these goals in the* ***Activities****-chapter.*

Our vision in the year of 2025

The media distribution industry should be open and democratic. Media should be produced, distributed and seamlessly consumed by anyone, anytime, anywhere and in a sustainable way. The Swedish media industry will be world leaders in making this happen.

Trends

Users are becoming *prosumers*, both consuming and producing media. As more users demand immersive experiences through new formats such as 4K, the need for bandwidth will continue to increase rapidly. The energy consumption of devices and networks will also increase in step with this. As a result, users are also becoming more concerned about their integrity. Businesses are striving to integrate ICT (Information and Communication Technology) into all aspects of their activities, and to adapt their business models to the rapidly changing competition.

Challenges

As media becomes social, on-demand and pluralistic, the digital revolution may undermine the quality of content, as well as a the sense of collective identity underpinned by traditional, shared media. As demand grows, latency may well become a growing problem and the present and planned infrastructure may struggle to cope. Companies are being challenged through changing business models, increasing international competition, decreasing consumer loyalties, scepticism towards traditional advertising, and the need for costly infrastructure investments. Meanwhile, users are generally unaware of the carbon footprint their activities generate.

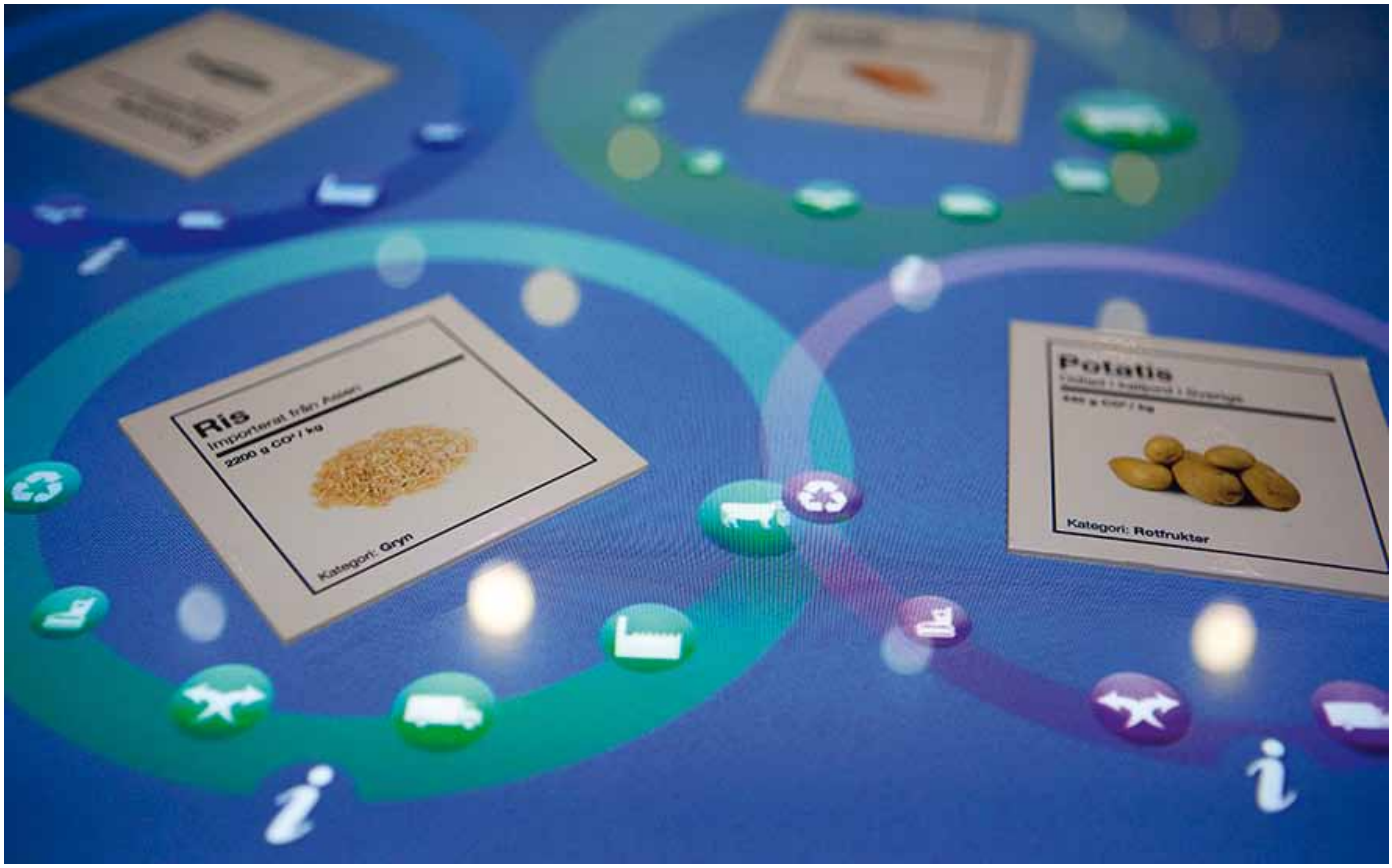
Goals

This agenda establishes a comprehensive set of goals; such as establishing sustainability metrics, increasing consumer satisfaction, stopping the current trend of employee reduction in the Swedish media industry, promoting a 25 per cent increase in market share, and ensuring Internet access for all.

Activities

To reach these goals we propose the following:

- **An independent expert council** for media distribution infrastructure.
- **A standardized big data platform** and visualised key metrics of media consumption patterns, in order to deepen understanding of user behaviour.
- **Mechanisms for effective** consumer information and consumer advice.
- **Establishing Swedish Media Labs,** excellence centres for research and innovation.
- **Building educational programs** for the media distribution field.
- **Establishing Open Media Labs,** resembling public libraries.
- **Sustainable business models** that allow users' freedom of choice, security and personal integrity.
- **Ecosystems for start-ups and SMEs,** both financially and technically.
- **Standardisation as well as open interfaces** to facilitate cooperation and free competition.
- **A *Clean Energy Index*** and a yearly report on major energy consumers and on the origins of the energy used.
- **Increased life-span of media equipment** such as computers, mobile phones, tablets and TVs, as well as routers or gateways, to contribute to more sustainable usage.
- **A robust, cost-efficient and sustainable** communication network infrastructure.



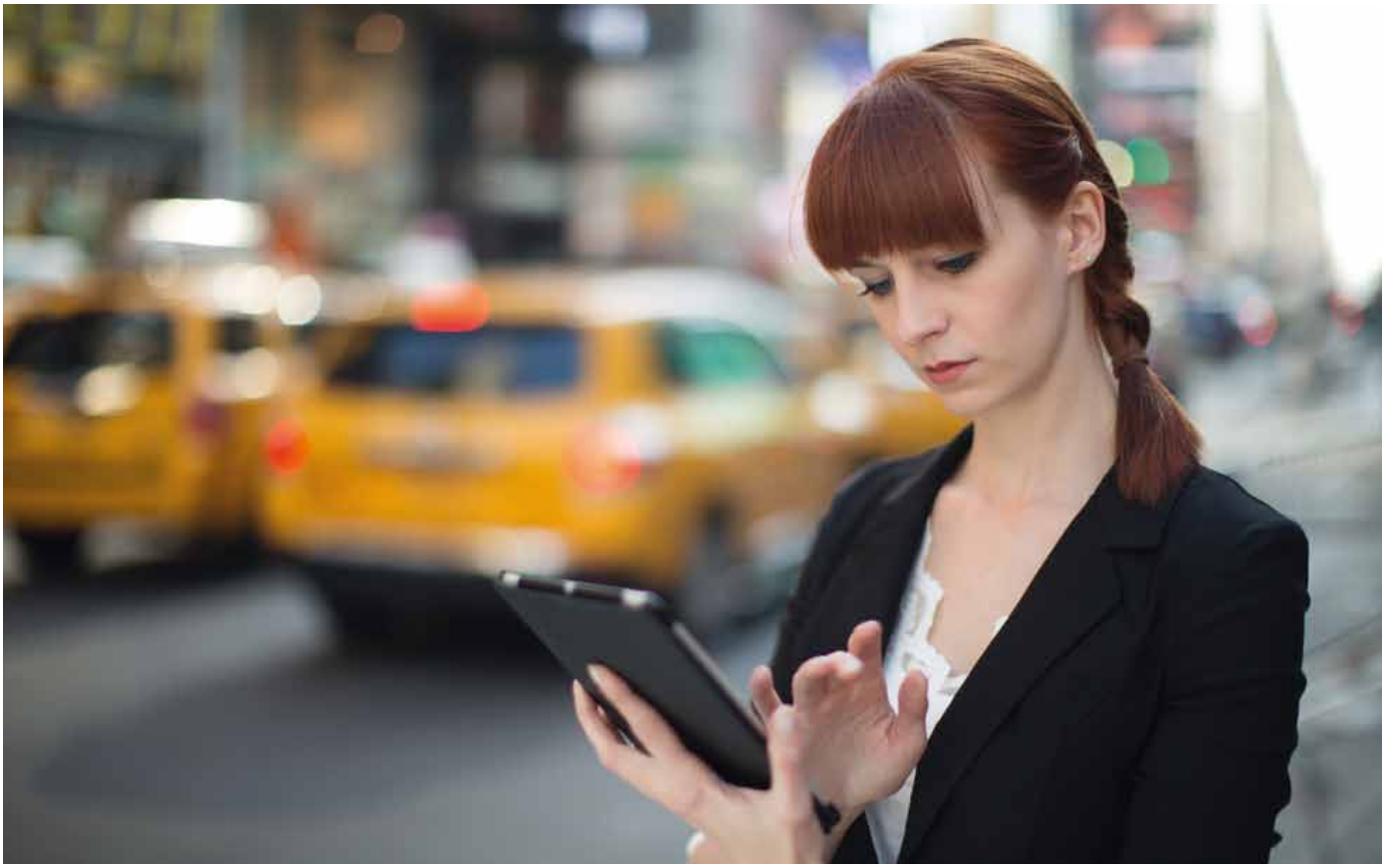
An ordinary day in 2025

Jenna's smart bed shakes her gently when the mattress sensors note that her sleep cycle is just right for her to wake up. As soon as Jenna opens her eyes, she gets her individualised news report delivered to her favourite wearable, in this case an integrated sleep mask.

Her children are already up, watching their favourite interactive and immersive show on the smart walls of their shared bedroom. Coming down for breakfast, Jenna continues viewing the same content as previously, in bed, only now on the smart kitchen screen. She likes to voice her opinion on the social-TV-morning show and watch it appear on the screen.

The fridge has detected that the orange juice is almost out, and ordered some more. Jenna is grateful for not living in the non-connected stone-age when you had to keep track of a myriad of similar petty problems. But, before grabbing a piece of the left-over chocolate cake, she turns on the integrity shield so that the insurance company cannot increase her life insurance fee for risking her health with such dangerous eating habits.

Smart apps for ordering food will emerge in the future. And connected packages will open new possibilities for industry as well as customers, but also raise social concerns like privacy and integrity.



Time to go to work. Jenna does not have to wait at the bus stop. Her home office provides immersive communication with colleagues all over the world. She occasionally does need to visit the company office, but then enjoys the social check-in at the subway, where she meets new business contacts.

The office day starts with a meeting in the immersive interactive meeting room. Colleagues from many different parts of the world join in. The CO_2 emission gains of non-travelling are gamified and visualised. A colleague has had to stay at home with his sick children and participates briefly.

After work, Jenna goes to her children's kindergarten. The kids are performing the Christmas play they have been practicing for so long. Unfortunately, their grandfather is sick, but he and their grandmother can watch it live from home and then talk to their grandchildren afterwards via interactive media.

Finally, it's Friday evening! The family gathers in the sofa to participate in the latest immersive interactive 3D adventure. They will watch the World Cup football finals live from Australia together. Zlatan Jr seems to be in very good shape.

Consumption of media will be done by anyone, anytime, anywhere.

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Introduction

IN THE YEAR 2025, THE MEDIA DISTRIBUTION INDUSTRY *should be open and democratic. Media should be produced, distributed and seamlessly consumed by anyone, anytime, anywhere and in a sustainable way. The Swedish media industry will be world leaders in making this happen. This is our vision.*

Revolutionary change

Worldwide, revolutionary change in consumer behaviour, brought on by technical advances and new business models, is challenging Sweden's existing industries. The potential for innovation and improvement, however, is massive. Sweden is already a frontrunner within media, media services and media distribution. Users are spending more and more of their income on media. They want access to this media constantly and seamlessly, on a wide range of sophisticated devices. Traditional consumers have turned into ***prosumers***, both consuming and producing media. More and more companies are turning into media companies, communicating directly with audiences.

Keeping the edge

We believe that Sweden can remain a major enabler of new sustainable solutions, innovations, companies and services. Established enterprises such as Ericsson, Spotify, Skype and Mojang are all proof of Sweden's ability, competence and creativity. But advantages gained a decade ago must not be taken for granted. To maintain and improve this position, actions must be taken now.

This agenda does not limit its scope to any specific digital media distribution technique. It would be both expensive and unsustainable not to take advantage of hybrid uses of already existing distribution channels. As communication between individuals is an increasingly important way of using the media infrastructure, this agenda therefore also covers point-to-point communication.

Towards an immersive experience

Since the beginning of TV and moving pictures, the media industry has striven to provide a truly immersive experience. There is much left to do before this is fully realised, but with greater bandwidths and an increasing pace of innovation, this is no longer such a daunting challenge.

However, the broadcast TV market has changed very slowly, due to its very inflexible distribution system. The change from standard definition TV to high definition TV has taken about 30 years, and is still not complete – though to be fair, TV has moved from analogue to digital as part of this process. The difficulty in upgrading equipment along the whole of the distribution chain explains some of the delay. But now, as TV and video is increasingly being distributed over the Internet, which is agnostic to media types, the speed in change and types of formats will quicken significantly.

New formats

When 3D was reintroduced into the movies, TV-manufacturers launched 3DTVs, but these were not successful, and the hype is now over. The next video format is most likely the ***ultra high definition format,*** initially targetting 4K. It will probably be made available on streaming video services and later via regular broadcast. Netflix has already announced that it will begin providing 4K content. The ***high dynamic range video*** format, also in the process of development, displays a much greater range of dark and bright. For a full appreciation of new standard of media content, viewers need a new type of display.

Exploding demands

The current TV format trends will increase demand for network bandwidth. The 4K-format, for example, consists of four times more picture elements than HDTV, and each picture element requires more information. Fortunately, the coding technique, or compression, also develops quickly. Although new technologies may contribute to the growth of network traffic volumes, the overall increase in the required bandwidth may not be as large as it may seem today.

The strive to provide an immersive experience is making the screen sizes bigger and resolution higher, making the demand for bandwidth even higher. The next format will be 4K.

3

Trends

User trends

Media distribution used to be a one-way street, delivering content from creators and publishers to passive consumers as shown in ***Figure 1***. But today, as users produce, create and distribute their own media content, either alone or in collaboration with traditional service providers, every smartphone owner potentially has the power of a traditional media network, and every Facebook account the potential of a truly global audience. This empowerment of an audience morphed into media co-producers and co-distributors will continue, making the media landscape look more like illustrated in ***Figure 2***.

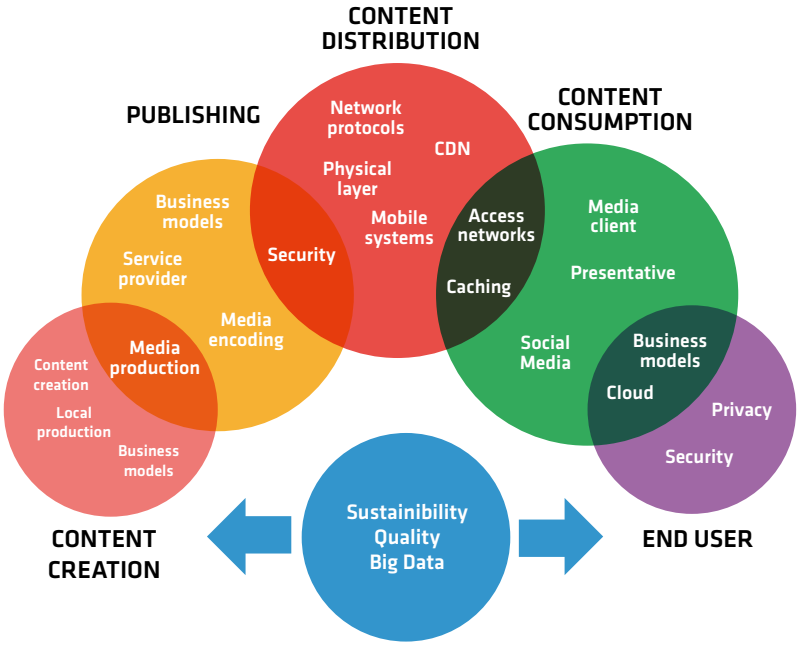

Figure 1

Figure 1
The traditional media distribution chain.

Users currently are choosing their mobile phone as the preferred platform and video as the preferred content. The numbers of users of media services, such as Netflix and Youtube, are growing at the speed of an avalanche. At the same time the introduction of new applications, such as the user-generated live streaming platform Twitch.tv, are hitting the networks and causing huge traffic volumes.

Figure 2

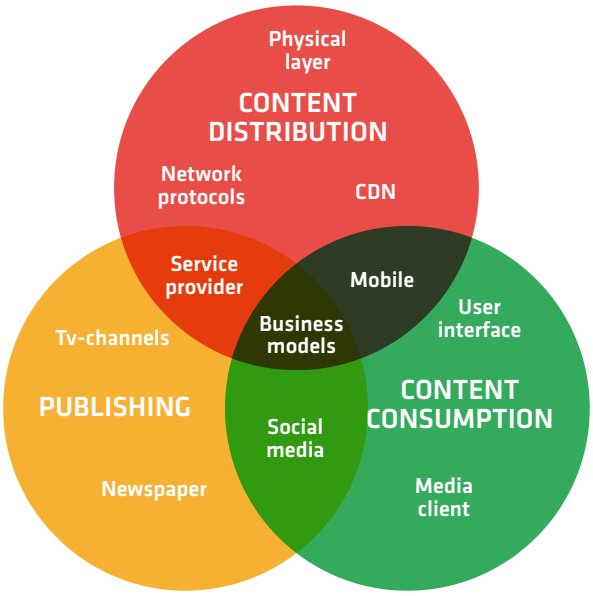

Figure 2
The modern media distribution landscape with a blurring of the traditional, distinct roles.

Constant connection

By 2025, we predict that the Internet-of-things paradigm will facilitate completely new services which will put even more strain on the network infrastructure. People will be constantly connecting to the Internet via new devices, perhaps smart contact lenses or empowered glasses, providing an almost completely immersive and integrated experience. Users will be able to communicate seamlessly and effortlessly with anyone, and everyone, on the planet using the devices they happen to be carrying with them or the new sensors and tangible devices available and embedded in the surrounding environment.

Before the digital revolution, users were forced to accept the choices that media monopolists made for them. These old, shared media consumption arenas are becoming less important. Users no longer exclusively turn to mass media for information and entertainment. They demand, and get, media that is tailor-made to the users' every need, shifting during the day with their moods and with the seasons. The result is a media landscape where few individuals are viewing the world through the same lens. This is a tremendous societal challenge.

Online all the time

We are also moving away from linear radio and TV to a so called ***pick-&-mix era,*** where audiences prefer ***Over-the-Top (OTT)***[1] services. The Internet is no longer a kind of media; it is carrier of all other medias.

[1] Refers to delivery of audio, video, and other media over the Internet without the involvement of a multiple-system operator in the control or distribution of the content, according to Wikipedia.

As these new individualists demand to be online 24/7, mobile media consumption will continue to grow. The small screens and extreme environments in which future media will be consumed poses new challenges. Moving from the passive past to an active future, consumers prefer interactive media. They do not want to be served, they want to affect and generate.

The array of choices creates a certain restlessness. Users scan content, jump between services and act disloyally towards their former media providers. They multitask, using several platforms at a time. They opt into computer game influenced experiences to get instant satisfaction. But this behaviour also creates a counter-movement, as users express a need for slower content, deeper analysis and sharper focus. In order to navigate a fragmented media landscape with an overload of choices, users turn to peer recommendations for advice, and create new, digital ***peg communities*** – loosely connected, momentary communities that often dissolve as quickly as they are created. Here, users get the satisfaction they are looking for: no commitment, a minimum of long-term responsibility and a maximum of great experiences.

Quality interaction

This craving for speed, shallow content and anonymity does not always allow for quality interactions. It also propels users towards demanding more authentic experiences. Therefore, younger user groups tend to follow brands that share their vision, be it climate, fair-trade or any other universal topic of responsibility.

More than ever, users turn away from advertising, which is not perceived as quality content. 21 % of all Swedes use an ad-blocker in their browser. This figure rises to 39 % in young males aged 15–22 years old. Also, they are not simply consuming content; they are sharing it and becoming brand ambassadors. Paid media has a new and strong competitor, or complement, in earned media, which users tend to trust more than paid media.

The importance of integrity and security increases with each surveillance revelation. A recent report, ***Swedes and the Internet 2014***[2], revealed a kind of ***Snowden effect***. One out of five Swedes worry about government surveillance. This is up from one in ten, in 2011. One out of four Swedes also worries that companies like Google and Facebook infringe on their privacy. This worry will most probably eventually translate into demands, new regulations and – in the long run – a stronger user empowerment.

[2] http://www.soi2014.se

Infrastructure trends

TV distribution is currently evolving from broadcast distribution, such as traditional TV, to on-demand distribution where each user can request content at any time. The new so called Over-the-Top TV services, such as Netflix and Viaplay, change the way users consume media content, moving from traditional, linear TV to this pick-and-mix-behaviour. ***'Whatever you want, whenever you want, wherever you are'*** is an often-used catch-phrase. This is critical for large live TV events, in particular in sports, such as the Olympics, but also for music events such as the Eurovision Song Contest. New distribution solutions will be needed to handle the resulting explosion of bandwidth requirements.

More bandwidth

Performance requirements will vary across media types. For example, TV distribution consumes by far the most bandwidth, but is usually insensitive to delays. Services involving some sort of communication or interaction between users such as telephony, video conferencing or gaming, are, on the other hand, very sensitive to delays. Music is not. Both fixed and mobile networks must be able to cope with these demands.

All types of media distribution increasingly take place over the Internet; this includes newspapers, magazines, music, radio and TV, records, CDs, DVDs and broadcast. All of these are now transferred to digital distribution. TV and video traffic, as noted above, already dominate Internet traffic volumes and have a large impact on the Internet as a distribution infrastructure.

The trend, from a few years ago, of distributing media via often illegal, peer-to-peer filesharing such as BitTorrent, is in steady decrease and attractive, legal commercial streaming services have taken their place. These provide convenient and user-oriented services at a reasonable cost, allowing consumers both easy access and a clear conscience.

Photo: Sweco Anna-Brita Krakenberger Arkitekt SAR, MSA.

Facebook data center in Luleå, Sweden. The media distribution trends will result in an increase in infrastructure investments of this type, especially in cold places with a stable power supply.

A new business

These trends have resulted in a new, important business: that of content distribution networks (CDNs). Service providers host and distribute content on a large scale on behalf of content publishers and owners. CDNs are mainly a business model. Content publishers buy a distribution service from a single, or a few, CDN operators (e.g. Akamai and Arkena) which then in turn place their content servers in many different Internet service providers' access networks across the world.

These CDNs, together with large service providers, such as Google, Facebook and YouTube, are driving parts of current infrastructure investments. They require great amounts of computing and large storage resources in huge facilities that host both their services and content. For Internet access providers, increasing volumes of TV and video are driving the investment in new access infrastructure, most recently focused on fiber.

The Swedish media distribution industry

Sweden is in a strong position to capitalize on the on-going media revolution. The nation's flagship in mobile communication systems, Ericsson, is a worldwide presence. Other companies, such as Spotify, Skype and Mojang, have grown to be household names both in Sweden and elsewhere. With a long tradition in freedom of expression and communication in the world, Sweden was an early innovator in these fields, explains some of the country's success, as does high education levels and a consumer base that includes plenty of early adopters. A stable environmental and political climate, no natural disasters above a strong storm or two and the absence of war in the last couple of centuries has also contributed to this.

Some of these advantages are no longer exclusive to Sweden, however. For example, not long ago, the extent of Sweden's broadband coverage was unique. Today, South Korea and several other countries rival it.

Fiber broadband is still the fastest, most secure and cost-effective access technology. As fiber coverage becomes widespread, Swedish industry will have to provide a world-class user experience with top quality, innovative business solutions and seamless transfer between different access technologies. The competition on the infrastructure market is currently hindering such an evolution.

Concurrently, the content distribution market is becoming more international; new global operators have already moved in on the Swedish market, breaking up the traditional media oligopolies. One result is a fragmenting of the landscape. Behind this seemingly sound competition there is, however, a movement towards new monopolies. One example would be companies such as Netflix who build intellectual property banks, i.e. manage to gather exclusive rights to large volumes of quality content. Another example is Google, with a base in an increasing number of content distribution patents and with its global market-leading position, strengthens the world-wide grip over what content is being distributed.

This could potentially be extremely detrimental.

Business trends

As traditional roles are blurred, stakeholders try to climb the value chain for increased profitability and expansion of their businesses. The media revolution will affect reliability, privacy, copyright, service quality and business models. In short, it will challenge the entire sector. The media consumption patterns that we see today will inevitably change completely. Users will not live ***with*** media, but rather ***in*** media. Enterprises increasingly adopt a professional way of working with their use of ICT (Information and Communication Technology) as part of their business processes. Various industry segments like utilities, media, transport, health and mining will integrate communications technologies as a consequence of all information being available online, in real-time. This will enable innovation and change the entire way enterprises are run and managed.

New business models enter media distribution, not least the OTT players providing services on the Internet, independent of the access network operators that provide the access service to users and consumers. As linear TV attracts less popularity and on-demand TV increases, new actors may emerge outside the traditions of distributed TV.

Infrastructure sharing

An emerging trend is towards infrastructure sharing. This is a particularly relevant trend, especially in the access portion of the network in connection with the open network business model.

Traditional vertically integrated operators, the so-called telcos, such as TeliaSonera, Deutsche Telekom and British Telecom, find it more and more difficult to adapt to this business model.

On one hand, they have business interest in keeping control of the end users by locking them to their infrastructure. On the other hand, infrastructure deployment is highly capital intensive and characterised by long payback periods. This fits poorly with telcos' business model, which rely on short investment horizons (typically five years or less). This pushes towards network sharing, either in the form of operator neutral open networks, or through so-called co-opetition models, in which different operators build infrastructures together. Another factor enhancing this trend is network convergence, both in terms of fixed-mobile (driven by smart phones seamlessly connecting to WiFi and cellular networks) and in terms of service delivery, thanks to the Internet Protocol increasingly taking up the role of a standard way of delivering content.

The value chain

The traditional value chain roughly looks like this:

The trends above are accelerating the change of this value chain. New business roles are appearing or becoming more obviously separated from others, such as trust identity providers, payment providers, and app platform owners. At the same time new actors are becoming very important and taking up additional roles. This is most obviously true in respect to giants like Google, Apple or Facebook. However, thanks to the inherent symmetry of the Internet (meaning that content and information can flow both to and from the end user), traditional stakeholders are taking up different roles. Today's end-users are not only consumers, but also content producers and owners, ranking and reviewing providers, and increasingly so.

The squeeze

Dark fiber[3] deployments are expensive, long-term investments. They are increasingly seen as an infrastructure that should be provided by society as a public-sector prerogative. Traditional vertically integrated telcos are struggling to find a logical role which is viable, squeezed as they are from below by infrastructure providers with long term investment horizons, and from above by specialized actors (Netflix, Skype, Whatsapp, Facebook and the like), with the need for better produce and delivery of new services and content. Admittedly, even though they hold a hybrid and sometimes contradictory position, they have weathered this ongoing evolution rather well in economic terms during the past decade or two.

Rewarding the consumer

Traditional commercial formats, especially in TV and the printed press, are losing their effectiveness; companies are looking for alternative forms of communication that will leave their customers amused, entertained, rewarded or tickled, rather than merely annoyed and disappointed. A number of fast-growing start-ups (Rabble, Wrapp, Groupon and Letsdeal) now provide targeted rebate and offering campaigns that hope to reach this goal. Gamification, an approach which leverages elements of game structure and design to encourage and drive engagement and behaviour, is also an emerging factor. It has become a hot topic, particularly in relation to mobile advertising.

[3] http://en.wikipedia.org/wiki/Dark_fibre

Sustainability trends

Recent studies have shown that ICT systems are responsible for as much as 10 per cent of the world's total power consumption. Data centres consume ever greater amounts of power. For example, the recently built Facebook data centre in Luleå in northern Sweden will, annually, consume as much power as it would take to heat tens of thousands of Swedish homes.

However, energy efficiency and sustainability have not been a major concern of media distribution development and research, which has, instead, focused on traffic optimisation and cost. Companies have regarded energy consumption merely as an operating cost, neglecting the idea that saving energy may actually attract more customers, not just save them money.

Thankfully, interest in energy conservation and sustainability is now on the increase. Greenpeace has published shocking facts[4] about the use of fossil fuels, and exposed how large American data centres and cloud providers owned by Microsoft, Apple, Amazon and Google as well as others, neglect the sustainability issue. Due to tax incentives and low energy costs, many of these giants have placed large data centres in rural parts of North Carolina, which has thus become a hotspot for data centres. Unfortunately, 60 per cent of this state's energy comes from the dirtiest energy source, coal. The server hall industry generates emissions of approximately 3 million tonnes of carbon dioxide (CO_2) per year for a 500 MW power plant. In contrast, because of a cool climate and an abundance of renewable energy sources, as well as its political stability, Sweden has emerged as a new and ideal location for large data centres.

Cooling and energy

As TV and video streaming services grow in popularity, even more data centres and greater network capacity, including caches, are needed to store and transport content, increasing overall energy consumption further. On the other hand, the heat generated by data centres could be used for more positive ends, such as heating homes. Increased digital media consumption may well result in less analogue media consumption. For example, this may have been the last Christmas when stores carried CDs or DVDs. With fewer trucks shipping physical based media, there will be a CO_2 emission reduction. Fewer broadcast TV services will also potentially result in energy savings in other areas. This inter-relating cause and effect

[4] "How dirty is your data? A Look at the Energy Choices That Power Cloud Computing", Greenpeace International, 2011.

is complex and hard to specify. Estimating how various systems and solutions will affect energy consumption patterns is therefore very difficult, though necessary.

Current trends in media consumption have no place in a sustainable society. The exploding consumption and production of media content will create large digital carbon footprints that will, some day, have to be delt with. Innovative solutions that are both sustainable and cost-efficient will be imperative to keep up with the digital evolution.

It will be a great challenge to combine the current growth in media consumption with a sustainable society.

4

Challenges

THIS AGENDA HAS OUTLINED TRENDS *and opportunities spanning from user issues and traffic trends to technology and business models. We now turn to sustainable, scalable, future-proof solutions for Internet-based media distribution.*

User-related challenges

Many users have moved from inhabiting a collective identity, in a relatively homogenous, analogue society with a shared value-base, to a new individualism in a pluralistic, globalized, digitized world. Developments are driven by smart phones and tablets, by new services on the Internet such as video-on-demand, and by social media and user-generated content. Increased empowerment of media consumers will continue to affect services, architectures and business models.

Societal challenges: Towards responsibility

The know-how emanating from the traditional media industry must not be lost in the new media context, instead there is a need of transferring knowledge and experiences to a world where every individual should be able to shoulder the responsibility once carried by the old editors and publishers.

Previously, a few media platforms held a function as exclusive arenas for sharing experiences. As already seen in crisis management scenarios, authorities cannot easily reach the population anymore, due to the fragmentation of the media landscape. Thus, in this pick-and-mix media world, we need to explore how we can continue to share collective experiences.

Low content quality

Just as certain foodstuffs, such as candy or liquor, may deliver short term satisfaction, but harm a consumers health in the longer term, certain content may deliver quick, simple kicks or entertainment, but harm society in the long run. This could result in a weakening of democracy when citizens no longer are exposed to the information necessary for them to them to accept their societal responsibilities.

We need to explore this serious topic, discuss and if attractive future media distribution alternatives can halt the slow death of quality media outlets.

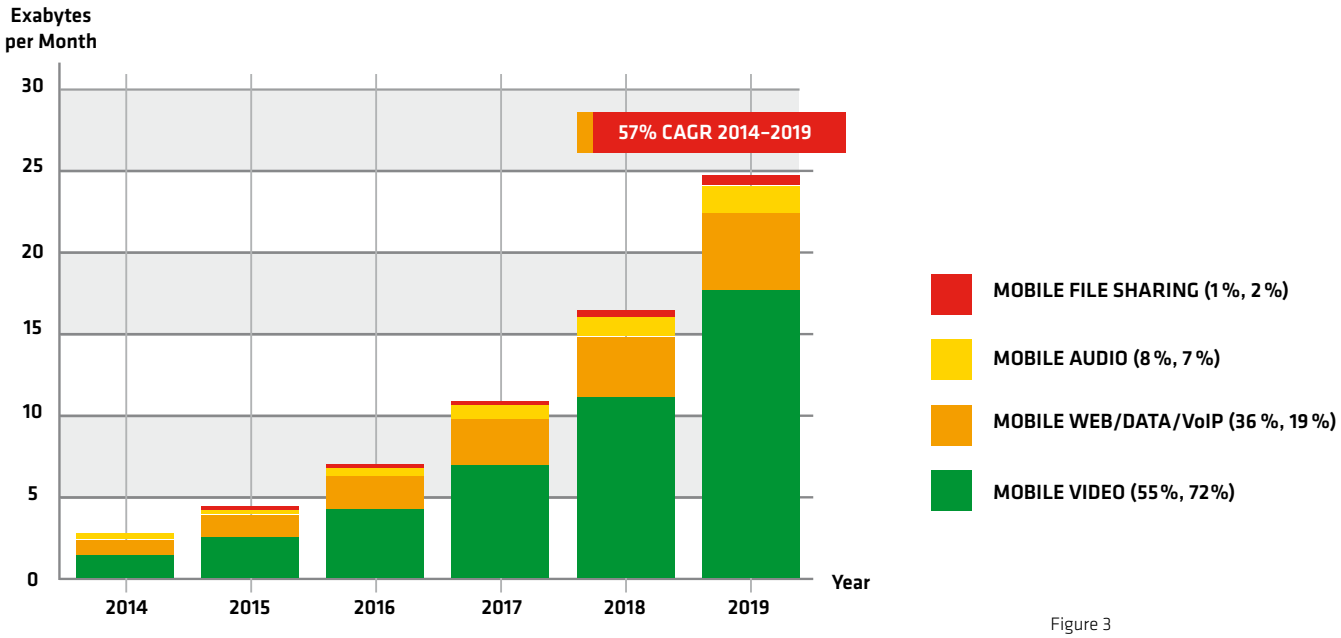

Figure 3

Business challenges

If new individualists are turning away from traditional business models designed to tempt them in, how do companies create loyalty and brand identity in the free-roaming, future media consumers?

When profits are increasingly found in the distribution layers of the media eco-system and no content can be locked in, content producers still need to be able to make sustainable business off their trade.

Safety and integrity challenges

Many of the digital giants have built their business models on gathering and exploiting vast amounts of user data.

If, and when, this policy turns around to bite them back, as a result of negative impact on the end user, what will be the result? The questions that arise from this exploitation of personal data are worrying on many levels, for society in general, and for the market in particular. An obvious risk is, the number of individuals who avoid participating will increase and that this movement of ”opt-outs” will create a potentially dangerous, societal divide.

Understanding the users and their evolving urges and trends pose a gigantic opportunity for both existing and new stakeholders in media distribution – especially in Sweden, with its legacy of neutrality, fairness and openness.

Figure 3
Data volumes will continue to grow very quickly, with an increasing share of media data.
Source: Cisco VNI Mobile, 2015

http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white_paper_c11-520862.html

High speed Internet infrastructure with low latency is needed to meet the growing media bandwidth demand.

Infrastructure challenges

Media distribution, especially TV and video, dominates the increasing traffic volumes of the Internet and mobile systems, driving the deployment of new communication network infrastructures. The need for communication capacity also drives the development of other new technologies, such as specialized communication protocols and in-network content caching (i.e. short-term storage) solutions. Other media distribution services are sensitive to high network latency, or at the very least benefit from low latency; the time it takes from an input, such as a user mouse click, until the service responds with useful output, for instance by the playing of a song. The network part of this latency can often be substantial depending on, among other things, network technology, competing traffic, and the design of the service.

Technology challenges

More and more TV is distributed using individual streams. This is relatively inefficient compared to legacy terrestrial broadcast networks. Network and service latencies for many media services needs to be reduced. This requires innovation in link technologies, communication protocols and communication management algorithms. Live TV broadcast over the Internet to many viewers is an especially demanding service, requiring a combination of high capacity and low latency. Other challenges concern the development of new media formats and media encodings. Balancing the use of different distribution technologies poses yet another challenge. Different systems such as Internet and broadcast are competing in some areas for the same spectrum.

Societal infrastructure challenges

Access to sufficiently good Internet connectivity is becoming a necessity for all citizens in today's society. Several of these services underpin the basic rights of citizens in a democracy, not least freedom of speech. To this end, the cost of necessary investments in rural areas is a challenge. Additional regulation regarding network neutrality might be needed, to make sure that the infrastructure stays open to a multitude of services and service providers. The media distribution infrastructure has important relationships to business models that, in turn, lead to new challenges. New functions and mechanisms in a network operator's infrastructure, directly supporting media distribution, likely require cooperation with service providers in order for the investment to be profitable. Such cooperation might in turn require that special technology is developed to facilitate the cooperation.

Business challenges

The challenges and opportunities of the business landscape is an important part of the media distribution revolution. Issues within rights management and legal framework for content pose added challenges for business. Furthermore, services are increasingly international with strong trans-global players entering the Swedish market and challenging Swedish industry. There are also challenges with legal and regulatory issues, for instance, in finding the right balance between the actors, including consumers, and to avoid hampering healthy development of the market.

Commodification

Over-the-top companies challenge telecommunications companies. These OTT entities deliver content via the Internet, rather than as a premium service provided by the broadband network access provider. Netflix and Spotify are notable examples. This means broadband providers often seem equal in quality, with the only difference in device being price – it's as if the broadband providers' service were no more than a commodity, with the aim of pushing margins downwards.

Of course, network design and operation is still a complex business, and innovation is still there, potentially keeping margins at decent levels. But giving up the content part, especially TV packages, implies a big business model change. Not all broadband providers are impacted equally: large vertically-integrated actors (e.g. TeliaSonera, British Telecom, etc.) are those more directly threatened by the OTT services, because these compete with their core traditional high-margin services (mainly voice and TV).

Smaller ISPs (e.g. Bahnhof and Alltele), on the other hand often provide broadband access in an open network model and sell Internet connectivity without owning a real network. They are already commoditized and operate at low margins. But they also enjoy low risks and low capital expenditure, and can easily adapt and possibly ride the OTT wave.

A formidable channel

On the other hand, for actors other than broadband providers, OTT represents a formidable distribution channel and easy access to a world market. Until now Swedish start-ups and new media distribution companies have profited greatly – Spotify being the most prominent example. However, having an open door to the world also means removing primary barriers controlling entry into the Swedish market. Competition from large and powerful multinational corporations is a big threat to local actors, but it is not a new threat. Sweden has for long been an open, export-oriented economy. Swedish digital industry must focus on its inherent strengths; flexibility and innovation stemming from its small, young and dynamic companies.

Sustainability challenges

A recent research paper[5] has shown that the carbon footprint of the Swedish ICT extended network is an estimated 1.5 million tonnes CO_2, or 1.2 per cent of the overall Swedish carbon footprint. However, the corresponding carbon footprint in a similar, but global, scenario would be two to three times higher. This is due to Sweden's favourable electricity mix, with a high ratio of renewable energy sources such as water and wind power.

A chilly climate

As the chilly Nordic climate reduces the need for cooling, Sweden has emerged as a great place for deploying large data centres.

However, data centres will place high demands on both network capacity and electricity, which means that new data centre investments will also need major investment in other parts of the ICT arena, as well as in the power plants and electrical grids. New technology may decrease the future energy consumption in the ICT area. However, new user behaviour and traffic demands will, in all probability, increase the footprint. Furthermore, it is not clear how the future carbon footprint of ICT will develop.

[5] J. Malmodin, D. Lundén, Å. Moberg, G. Andersson, and M. Nilsson, "Life Cycle Assessment of ICT – Carbon Footprint and Operational Electricity Use from the Operator, National, and Subscriber Perspective in Sweden", Journal of Industrial Ecology, Wiley Online Library, 2014.

Therefore, when international companies make large infrastructure investments in Sweden, all national decisions regarding the environment and sustainability of ICT systems will have a large impact, not only on Swedish companies, but also on those major international companies.

A new index

Sustainability challenges affect the whole media distribution chain, from data centres and content storage, to home networks and user terminals. They will also affect business models, security and privacy. Users, however, are completely unaware of the carbon footprint of the media services. There are no frameworks or agreements on how to estimate power consumption and other environmental aspects of media distribution services and infrastructure. To remedy this, Greenpeace has proposed the ***Clean Energy Index***; a framework for classifying sustainability aspects of data centres. However, the index is currently available only for US based companies. A Swedish framework for how to estimate and classify different services' sustainability is thus sorely needed.

Increased digital media consumption increases the energy consumption. Solutions for sustainable power consumption are needed.

5

Goals

THE PURPOSE OF THIS AGENDA IS TO CREATE A SOLID RESEARCH *and innovation program aimed at groundbreaking renewal and sustainable development in Swedish industry and society. It intends to elucidate challenges, in order to exploit the opportunities of the present global media revolution.*

Long term goal

Swedish industry must remain a world leader in sustainable digital media distribution. Being at the forefront in setting standards and producing open solutions, will provide Swedish industry with a head start.

Short term goals

These goals should be reached in about five years.

Overall Swedish Industrial goals

- ☑ **The Swedish industry should improve** its market share on the Swedish national market by 25 per cent.
- ☑ **The value earned will have increased** by 50 per cent.
- ☑ **Stopping the current, ongoing** disproportionate reduction of employees in the Swedish media industry.

User-related goals

- ☑ **Amazing user experiences** with non-perceivable delay times.
- ☑ **Media consumption satisfaction index** will have increased by 20 per cent.
- ☑ **Media consumption experience** will be perceived as secure.
- ☑ **The users should be in control** of their own privacy and of their digital footprints.
- ☑ **Commercial content will be individualised** for an attractive experience.
- ☑ **Opting-out levels** will be down 5 per cent.

Distribution infrastructure goals

Technology

» **New communication protocols** and other networking technology will be developed in order to:
  » double distribution efficiency.
  » handle rapidly increasing traffic volumes.
  » halve network-induced (non speed-of-light-limited) service latency.

Society

» **A definition of a minimum, acceptable Internet** access service quality for all citizens should be developed. Since a large part of democratic expressions of public opinion uses this type of media, this must include TV and video.

» **All citizens should have Internet access** at an acceptable minimum service quality.

Business models goals

» **Long-term sustainable business models** should allow profitability for an array of stakeholders and companies of different sizes and with a wide geographical distribution.

Sustainability goals

» **A *Clean Energy Index*** framework for media services will be developed and disseminated, incorporating state-of-the-art, energy consumption and sustainability metrics.

» **Sustainable solutions in all areas** of media distribution will be promoted in order to facilitate a decrease of digital carbon footprints of Swedish Internet users.

New ways of interacting and sharing experiences will be possible in the future.

6

Activities

To reach the goals set in this agenda, several activities are needed.

General activities

» **Strategic advice to high-level decision makers**

An independent expert council for media distribution infrastructure should provide decision makers with the input they need in order to reach informed decisions. The expert council should work with the legal system to help create valid and applicable laws and regulations that uphold democratic rights as well as net-neutrality. This should lead to an open and secure infrastructure, meeting the demands of users as well as handling the increased bandwidth requirements. This should be coordinated with the Swedish Post and Telecom Authority (PTS).

» **Greater understanding of user behaviour and demands such as integrity, democracy and freedom of speech**

Understanding user needs and behaviour is vital in order to develop services and create a business intelligence edge. We suggest creating a standardised big data platform, visualising key metrics of media consumption patterns, opinion polls, interdisciplinary research into user behaviours, controlled and measured user experience experiments, interviews, service use monitoring, and so on.

» **Consumer information and consumer advice**

New technologies and new services, along with changing business models, can often be very confusing to the users. Effective consumer information and consumer advice is imperative to aid fair and equal participation in digital society.

Knowledge and competence

Technical research and innovation exchange must be strengthened. Researchers need to inform the industry of new techniques and trends. In its turn, the industry needs to inform researchers about their needs and problems. We propose forums and networks for knowledge exchange between academia, start-ups, SMEs and large companies.

» **Excellence centres for top level research and innovation (Swedish Media Lab)**

To help Swedish industry to keep their competitive advantage, we suggest establishing one to three excellence centres for

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research and innovation. The centres should attract top-level researchers. Their ambition should be nothing short of world class excellence, both in research and innovation.

» **Building educational programs**

Higher education in media distribution techniques needs to be enhanced, taking into account the cross-disciplinary nature of media distribution. This should lead to innovative higher education in digital media-related subjects, and to interaction with academic research. Innovative research should result in new and attractive programs and create a recruitment base for universities. Most importantly, it should establish a foundation for the supply of competence for the industry, as well as for new innovative businesses and start-ups.

» **Open Media Labs**

It has never been easier for anyone to produce and distribute videos, music or text over the Internet. However, it is also much harder to get noticed, seen or heard. A lot of creativity remains unused as many creators lack the equipment or knowledge to get started. In Open Media Labs, a new generation of collaborative environments, people could get technical help and instruction, borrow equipment and indeed learn from each other. These Labs could be set up in conjunction with youth clubs, social centres and other nodes. They would build on the knowledge gained from first generation media labs. Special media creation events and Hackathons could be arranged to further inspire the public to actively innovate their own media future.

Business in an open environment

» **Sustainable business models that allow users freedom of choice, security and personal integrity**

We see a need to work with new business models where stronger customer-relations and larger profits can be created without consumer lock-in (for short-term gain). To aid this evolving market, there will be networking activities arranged, such as workshops, courses, interactions with trade associations for a strengthened, cross-disciplinary competence designed to maintain Sweden's competitiveness.

» **Ecosystems for start-ups and SMEs, both financially and technically**

There is a large growth potential for the SMEs in Sweden. There will be activities on development of open access technology that

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can be used as platforms for new businesses and services. Working towards this will lower the threshold for SMEs to enter new markets without having to start from scratch each time. Furthermore, activities on increasing the interest for venture capital and crowd funding will also be done.

» **Standardization, and open interfaces, to facilitate for cooperation and free competition**

Standardisation is important not only for small companies, but also for the whole industry. It is the foundation and platform that businesses are built upon. It has been, and still is, very important for the telecom and networking industry. However, achieving such a working standard is always a long haul. We suggest that special resources are provided for driving standardisation issues in international standardisation organisations.

The development of standardised, open interfaces should be encouraged, since it will make cooperation and also business easier, enabling free competition.

Sustainability

» **Official sustainability labels**

Pointing out sustainable options to consumers has proven effective before. An official sustainability label similar to ***Bra miljöval*** or ***Svanen*** combined with information campaigns could make users aware of the impact of their choices.

» **Clean Energy Index**

We propose a ***Clean Energy Index*** and a yearly report that looks at who the big energy consumers are, as well as how their energy was produced.

» **Recycling and reuse**

In general, Swedish recycling is quite well developed, but not when it comes to obsolescence of equipment. A longer lifespan of computers, mobile phones, tablets and TVs, routers or gateways, would contribute to more sustainable usage. This would involve a greater use of spare parts, but also increased possibilities for upgrading software. If equipment can be made more durable and resilient, both physically and in its functional capability, it can also more easily be kept or used second hand. We propose working towards implementing such a scheme.


ANALYZE
NEWS

The agenda is written by Acreo Swedish ICT, Interactive Institute Swedish ICT, SICS Swedish ICT and Lund University.

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