Towards a Ubiquitous Media Environment
- Adding the e-newspaper Channel

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Abstract: As most of today's media houses publish in multiple channels, they also exist in a multitude of infrastructures. Given the ongoing diffusion of personal computers, handheld devices, and mobile telephones as well as the advent of new technologies such as the e-paper, a new type of ubiquitous information environment is emerging. In this paper we give an update on the development of e-paper technology and provide a literature review of infrastructure issues in ubiquitous information environments. From empirical results from 19 interviews and 9 workshops with newspaper managers and designers in Sweden, Belgium, France and the Netherlands, we address the following research question: *What infrastructure considerations arise with the introduction of a new channel in a ubiquitous media environment?*

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1. Introduction

The news publishers of today are often organized as media houses with multiple media channels, existing in a multitude of infrastructural environments, such as print, online, telecom and broadcasting. Given the ongoing diffusion of personal computers, handheld devices, and mobile telephones (Lyytinen & Yoo, 2002), as well as the advent of new technologies such as the e-paper (Ihlström *et al*. 2004), the media houses face new infrastructural challenges.

There are a set of trends that coincide with these challenges. First, the ongoing convergence of different information and communication technologies trigger the emergence of new channels for media content (Lyytinen & Yoo, 2002). Second, the main-stream consumer possesses nowadays a range of different stationary and mobile computing devices, producing new boundary-spanning use patterns and behavior (see e.g., Henfridsson & Lindgren, 2005). Third, the media industry converges in that the boundaries between different media domains are blurring (Fidler 1997). As a result of these trends, a new type of ubiquitous information environment is emerging.

A ubiquitous information environment is a heterogeneous assemblage of interconnected technological solutions to support mobility, mass scale and digital convergence (Lyytinen & Yoo, 2002). We use the term *ubiquitous media environment* (UME) to discuss the integrated infrastructures applicable to the news publishing industry.

The media houses are now facing an innovation, the e-newspaper published on e-paper technology. The e-paper is reflecting, giving the same reader experience as paper (such as high contrast and the possibility to read in sunlight) and is thin, flexible and non-sensitive. The e-newspaper combines the readability and overview from the printed newspaper with the possibilities of online media such as constant updates, interactivity and video, and is predicted to replace the printed edition in the long run. In this context it will also be possible to offer personalization, context awareness and location based services.

As stated by Sambamurthy and Zmud (2000) there is little understanding of the requirements for the heterogeneous infrastructures for offering services in multiple channels. In this paper we discuss the infrastructure's influence on the channels of today's media houses, i.e. print, online, telecom, broadcast as well as the new possible channel, the e-paper. The overall research question for this paper is: *What infrastructure considerations arise with the introduction of a new channel in a ubiquitous media environment?*

2. Method

This research can be classified as qualitative Information Systems (IS) research (Orlikowski & Baroudi, 1991; Walsham, 1995) in that it is orientated towards people's assumptions, knowledge, and experience of newspaper media and IT. In particular, the newspaper representatives' predictions of the challenges of introducing a new digital media, such as the e-paper were of interest.

The research was conducted within the DigiNews project (ITEA 03015) with partners from Belgium, Spain, Netherlands, France and Sweden. The project was initiated by Philips Applied Technology in Belgium together with the Swedish Newspaper Publishers' Association. The Swedish newspaper partners are Aftonbladet (AB), Göteborgs-Posten (GP), Nerikes Allehanda (NA), Norrköpings Tidningar (NT), Sundsvalls Tidning (ST), Sydsvenskan (SS), Östgöta Correspondenten (ÖC). European partners from the media sector are Concentra Media (CM), De Telegraaf (DT) and Le Monde (LM). The overall goal of the project is to explore research and development issues for an electronic newspaper of the future. The project aims at combining the accessibility, simplicity and mobility of printed newspapers, with the advantages of digital media, communication technologies and portable consumer electronics. The two year project will be finished at mid-year 2006.

Different types of data collection methods have been used, i.e. interviews with 19 newspaper managers and designers, and 9 workshops with newspaper representatives from management, IT, marketing and design (Table 1).

Table 1. Data collection activities

Interviews	Workshops
NT1 (Aug 25th 2004) Editor-in-chief new media	GPw1 (Jun 2nd 2004) – 6 participants
ÖC1 (Aug 25th 2004) Business developer	SSw1 (Sep17th 2004) – 8 participants
SS1 (Sep 16th 2004) Marketing manager	STw1 (Oct 6th 2004) – 5 participants
SS2 (Sep16th 2004) Layout director	ABw1 (Oct20th 2004) – 3 participants
ST1 (Oct 6th 2004) Quality Assurance Manager	STw2 (Oct 7th 2004) – Design focus group
ST2 (Oct7th 2004) Editor	STw3 (Nov 24th 2004) – Design focus group
ST3 (Oct 7th 2004) Web publisher	CMw1 (Oct 26th 2005) – 4 participants
AB1 (Oct 20th 2004) Editor-in-chief new media	DTw1 (Nov 22nd 2005) – 10 participants
AB2 (Oct 20th 2004) Layout director	LMw1 (Feb3rd 2006) – 3 participants
GP1 (Oct 27th 2004) Development director	
GP2 (Oct 27th 2004) Managing Development Editor	
ST4 (Nov 24th 2004) CEO	
CM (Mar 23rd 2005) Head of research	
NT2 (Apr 27th 2005) Head of Editorial Department	
DT1 (Nov 22nd 2005) Director of new media	
DT2 (Nov 22nd 2005) Development officer	
DT3(Nov 22nd 2005) Editor	
LM (Feb 3rd 2006) Chief Operations Officer and Managing Director	

The interview study included a total of 19 respondents ~~interviewed~~. Each of the semi-structured interviews was about 60-90 minutes in length. The semi-structured interview guide used at all sites facilitated the consistency of data collected between sites and interviewees. While allowing individual perspectives and experiences to emerge, the interview guide provided a systematic way of delimiting issues discussed in the interview (Patton, 2002). It covered a variety of topics such as organization, technology, business models, new services and design. All respondents had key functions within respective newspaper, e.g. editor-in-chiefs, managers, or designers (see Table 1). In the empirical results the abbreviations from this table will be used in connection to quotations to indicate the respondent.

The newspaper staff at the four first workshops and the three last was selected to represent managers, designers, marketing and IT people. In the beginning of the project we formed a design focus group consisting of representatives from Aftonbladet, Göteborgs-Posten, Norrköpings Tidningar and Sundsvalls Tidning that were specifically interested in design issues of the future e-newspaper. Two of these full day workshops concerned strategic issues as well and are therefore included in this paper (see Table 1). The results from the workshops are mainly illustrated in the empirical part concerning the pros and cons of today's media channels.

3. e-paper update

Electronic paper (e-paper) is the common term for several different technologies that can be used to produce screens with a number of specific characteristics. The e-paper is reflecting, giving the same reader experience as paper (such as high contrast, good color representation and the possibility to read in sunlight). The e-paper is thin, flexible and non-sensitive. In addition, it does not require high battery performance – ultimately, the screen image is stable and fix even when there is no electrical voltage applied. The three different technologies for e-paper, electrophoreses, dipolar rotation and electrowetting have earlier been described by Ihlström *et al.* (2005). In this paper we present an update of the development of e-paper technologies.

Sony has an e-paper product on the market already, i.e. the Sony LIBRIé, which has been launched in Japan. The product was designed for electronic books. Recently the Sony Reader (Figure 1) will be launched at the U.S. market. It has a 6-inch screen, weight is less than 9 ounces and one can do 7.500 page views for each charge by an AC adapter. It can hold up to 80 eBooks at the same time, and

Figure 1. Sony Reader [1]

allows PDFs, personal documents, newsfeeds, blogs and JPEGs. Sony will offer books for the device on a new web site called Sony Connects [2].

Figure 2. iRex iLiad [3]

iRex Technologies BV, a spin-off from Royal Philips Electronics, introduces the iLiad (Figure 2), a first generation electronic reader product, in April 2006. The Iliad includes an 8.1 inch screen with 16 levels of grey and 160 dpi resolution, Wi-Fi, USB ports and MP3 capabilities [4]. Using a special marker, readers can comment on articles and scribble their notes on the screen.

The Flemish newspaper De TIJD will be tested on e-paper in April this year. 200 readers will receive a device on which they will be able to read their daily newspaper. De TIJD e-newspaper will be updated throughout the day. In addition, touching an interactive advertisement will direct the reader to the advertiser's website. Other tools include extra buttons for financial stock exchange rates etc. The test will last for 3 months [5].

Fujitsu announced in December 2005 that color e-paper will be on the market in 18 months [6]. Key advantages of the Fujitsu e-paper (Figure 3) include the semipermanent memory display system, which maintains the image without power, and color that is three times as bright as other products by e-paper developers. It uses about one-hundredth the power of LCDs and plasma display panels when the image is changed, while being far lighter and thinner, as slim as 0.8 mm [7].
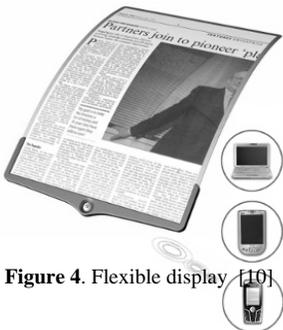

Figure 3. Fujitsu prototype [7]

Figure 4. Flexible display [10]

Plastic Logic has developed a flexible e-paper (Figure 4). Investors are e.g. Intel Capital, Siemens and BASF Venture Capital. Their technology allows printing electronics on thin, flexible plastic substrates using a process scaleable for large area, high volume and low cost [8]. On December 5th, 2005 Plastic Logic announced that they have developed the world's largest flexible organic active matrix display [9]. The displays are 10" diagonal SVGA (600 by 800) with 100ppi resolution and 4 levels of grey scale. The thickness of the display when

laminated is less than 0.4mm. They were showed at the 12th International Displays Workshop in Takamatsu in December.

Polymer Vision, a division of Royal Philips Electronics of the Netherlands, announced in September, 2005, a prototype rollable display technology that is called Concept Readius. The Readius (Figure 5) "mobile e-reader" features an e-paper based 320x240 5 inch roll up display and with four gray levels, the monochrome display provides a contrast ratio of 10:1. The compact unit can roll up into a 100x60x20mm rectangular prism [12].

Figure 5. Concept Readius [11]

Figure 6. HP prototype material [13]

Hewlett Packard (HP) researchers showed off a prototype using the new display technology at the National Gallery in 2004, saying it was the first step in breaking out of the 1,000-pixel-by-1,000-pixel display barrier through which we see much of the electronic world. Today HP are working with color and aiming at a light, thin and flexible display for electronic books, magazines, digital boards and TV. They showed their version of the future in November, 2005 (Figure 6), aiming at as low production costs as possible [13].

Siemens has unveiled paper-thin TV screens (Figure 7) that could be used as newspapers or magazines, which were shown at the Plastics Electronics trade fair in Frankfurt in October 2005. They claim it will be available in consumer products in 2007 with a resolution of 80 dpi [14]. Siemens' new color display screen can be printed directly onto paper or cardboard. This technology enables it to be thin, flexible, and affordable enough to be

Figure 7. Siemens screen [15]

mass-produced and included in books, magazines, labels, tickets, and a host of other traditional media [15]. Seiko Epson has also developed a flexible high definition 200 ppi display. The resolution of a 2-inch display extends to 320 x 240 pixels and Seiko Epson aims at commercialization in 1-2 years [16].

E-paper technology is not only used for eBooks or e-newspapers. Both Citizen and Seiko have launched watches with e-paper technology, i.e. e-watches and e-clocks. The benefits are that these watches are thinness, light weighted, they also have fully flexible form factor combined with substantially lower power consumption over traditional displays. Citizen has launched a large clock for outdoor use at buildings that is 3.0 mm thick, weighs 1.5 kg and are 1.3 m long [17] and Seiko has launched a line of wrist watches [18]. Lexar media has introduced a USB flash drive with an e-paper capacity meter that shows how much storage is left [19] and Chameleon has developed an e-paper carry bag that can change patterns and also features electroluminescence [20]. Several developments with add-ons to e-paper technology has also been developed, e.g. Apple has patented a touchscreen control interface that could be could apply to e-paper [21] and Epson has developed a flexible 8-bit asynchronous microprocessor, based on a low-temperature, poly-silicon TFT technology which is suitable for e-paper [22].

In December a new display set up at Tokyo station introduces e-paper (Figure 8). By showing six A4 sheets of e-paper on display for commuters in a transparent blue housing, it allows them to see how thin it is. The e-paper is being updated with news stories every five minutes [23].

Figure 8. Tokyo diplay [23]

Just to show how big this industry is expected to be, we give an example of analysts from IDTechEx who forecast plastic electronics will be a $30 billion industry by 2015, and could reach as much as $250 billion by 2025 [24]. In spite of that, Xerox has decided to close down Gyricon LCC electronic paper operation due to the market for electronic paper hadn't grown as quickly as expected. They will hold on to the technology and license it to other businesses [25].

4. Infrastructure issues in ubiquitous information environments

Nowadays, people are commonly using mobile devices for consuming services at different physical locations and in different social contexts. The integration of mobile devices and wireless communication services, distributed computing and communicational capabilities, as well as convergence of technology and media have emerged into ubiquitous information environments. Ubiquitous

information environments can be described as a heterogeneous assemblage of interconnected technological, social, and organizational elements that enable the physical and social mobility of computing and communication services (Lyytinen & Yoo, 2002). The challenges related to infrastructural issues of designing and distributing services to be consumed in such an environment are of diverse nature, at this novel stage of ubiquitous information infrastructures. Technical dimensions as well as social dimensions are involved in the construction of such an infrastructure (Lyytinen & Yoo, 2002; Jessup & Robey, 2002).

The evolvement of ubiquitous information environments indeed renders new challenges for content providing organizations. Offering mobile services requires delivery of services when ever and where ever users need them, and also for services to be accessible through multiple devices at different locations. One of the challenging conditions that apply to mobile environments is that users´ physical location might be a critical factor for effective service delivery (Satyanaryanan, 2002). In addition, to meet the personal needs of mobile users, ubiquitous services will require personalization, support dynamic mobility for services and users, and associated channel adaptation (Lyytinen & Yoo, 2002).

Thereby, distributing services in a ubiquitous information environment is challenging as they need to dynamically support users anytime anywhere. This means that the distribution of services has to be adapted to the dynamics of users´ environments in terms of changing technological capabilities in the environment, and to changing hardware capabilities (Banavar & Bernstein, 2002). The resources of the users´ devices regarding computing capability, disk space, memory capacity, screen size, resolution, battery power, and reception range are diverse (Satyanaryanan, 1996; Kleinrock, 1995). Services may be accessed through multiple devices by the same user, and seamlessly migrate to another during service delivery (Lyytinen & Yoo, 2002). As a result, services can not be designed on assumptions of devices or infrastructure capabilities.

Moreover, these requirements give that the environment must be capable of handling the dynamics of user's social environments, i.e. capable of context awareness. Context-awareness is often about physical location and user identity, but can also include knowledge about time, history, social context, other people, work or private etc (Aboyd & Mynatt, 2000). The multi-contextual nature of ubiquitous information environments requires seamless support for individual's context switches, to be a well working computing environment (Henfridsson & Lindgren, 2005).

The infrastructure resources of a ubiquitous information environment must consequently enable processing and transmission in diverse ways, and in large scale. A global information infrastructure will be geographically spread and institutionally disperse delivering telecommunication solutions, wired and

wireless communication solutions (Lyytinen & Yoo, 2002). Not only need an infrastructure in a ubiquitous information environment support geographically distributed and mass scale distribution of services but must also support a wide variety of digital data such as text, numbers, audio, video and images (March *et al.*, 2000). The diversity of different digital data formats creates challenges for effective handling as there are no conceptual basis for representing the underlying semantics of for example a video (March *et al.*, 2000).

The rapid development of new technologies and the constant introduction of new computing devices and consumer electronics create fast changing scenery of ubiquitous information environments. This brings a number of challenges forth. The rapid advances in technology constantly changes how services can be produced, delivered and consumed. The infrastructure needs to be scalable for millions of users with a large number of devices. Further, the technical and software solutions must be generalizable across multiple application domains to be profitable for solution providers. All of these issues also have an impact on performance that will have to be on an acceptable level for consumers (March *et al.*, 2000).

Accordingly, IT infrastructure concerns global reach and range, scalability, flexibility, and openness to emerging technologies (Sambamurthy & Zmud, 2000). For a service provider, global infrastructures include a wide network of external actors and potential partners with steady or loose arrangements, some on a need basis. The desirable characteristics of ubiquitous information environments include independence of location, of motion, of platform and with widespread presence of access to remote files, systems and services (Kleinrock, 1995).

It is recommended for organizations to understand business and needs before integrating mobile technologies and ubiquitous information environments with their traditional business and their information systems (Andersson & Lindgren, 2005). A reference model for how to discuss attributes, features and structures in a ubiquitous information environment, suggested by Kleinrock (1995) includes *system state consistency*, *functionality*, and *locality* or *awareness*. System state consistency is about consistency at the level of files and databases etc, whereas functionality includes bandwidth, nature and quality of infrastructure. Finally, locality or awareness is about the users´ awareness of the environment as well as the environments awareness of the users and their profiles.

There is an ongoing convergence across the computing, communications, and content industry (Sambamurthy & Zmud, 2000). This convergence redefines the roles and relationships within and between the industry firms and has resulted in a development of new IT architectures. In turn, this has influenced how IT activities and relationships are organized. Driven by IT development, firms are developing market responsiveness and flexible ways of creating customer value.

The value chains being changed and reconstructed. Digital convergence, globalization and the competition constantly challenges the IT organization. Therefore, new strategic networks and alliances are being built with key technology partners (Sambamurthy & Zmud, 2000).

As a result, the emergence of ubiquitous information environments has impact beyond a single organization. The rapid development of technology supporting social and physical mobility exaggerates the span and the complexity if interorganizational coordination. In addition to the governance and control of infrastructure issues within an organization, a key challenge is the control and ownership across various media in multiple contexts (Lyytinen & Yoo, 2002). Thus, there is a need to integrate these issues in decisions and strategies as the rapid convergence media, service and product companies, causes profound changes in the organizational and industry structures and the associated value chains (Lyytinen & Yoo, 2002). How to manage infrastructure and strategy decisions in this very complex environment, having impact on external and internal organizational relations as well as on business and value chains is a major challenge for IS researchers (Sambamurthy & Zmud, 2000).

Clearly, IT logics have to be reconsidered to cope with such and environment. Sambamurthy and Zmud (2000) suggest a platform logic for IT activities related to IT architectures and infrastructure (see Figure 9). The platform consists of the elements *capabilities*, *relational structures*, and *integration structures*.
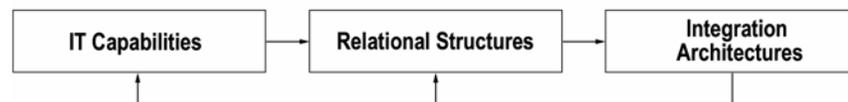

Figure 9. Overview of the platform logic (cf. Sambamurthy & Zmud, 2000)

Capabilities refer to the IT capabilities that are the most important and vital for successful business. *Relational structures* are the internal and external relationships that enable the IT capabilities, whereas *integration structures* refer to the integration between IT capabilities and relational architectures.

As recognized by March *et al*. (2000), new insights based on a thorough understanding of mobile environments and services are required. This literature review suggest a wide range of issues, technical, design related, organizational and business issues, regarding the infrastructures of ubiquitous information environments.

5. Towards a ubiquitous media environment

At present, many news publishing organizations are organized as media houses with a multiple channel publishing strategy. We start by discussing this environment and critical issues related to the distribution infrastructures and the ongoing development towards a ubiquitous media environment (UME). This part mainly derives from the nine workshops. Thereafter, we discuss the visions and challenges related to the introduction of a new channel, the e-newspaper, and discuss the major issues related to the introduction identified in the interviews illustrated with quotations. The quotations will be followed by a respondent ID that corresponds to the ID in table 1. Finally, we discuss the empirical findings in relation the literature and present a graphical overview of the infrastructure considerations of a UME.

During the nine workshops we have worked in an iterative process collecting participants' views on the existing channels of today. Since only a few of the newspaper organizations have a broadcasting channel (e.g. TV and radio) we here focus on the three main channels, i.e. *print, online* and *mobile*.

For the *printed* edition most media houses own their distribution, but there exist some collaboration on this matter. For example, two newspapers that are located nearby each other have an agreement that one of the newspapers buy the distribution service from the other. Most media houses have experienced a failing advertising market and some decrease in subscribers which in some cases have lead to re-organizations and having to let employees go.

Some of the Swedish newspapers have invested in a joint company, i.e. Citygate, for mutual development of *online* services. They share the development costs and then market the services under their own brand. Examples of such services are: stock information, dating services, weather services, games etc. The online newspapers have found their place in the organizations and are considered an important channel for the media houses. In the initial years the media houses had a god economy and could afford experimenting online with little return on investment. But the more difficult times lately has lead to a more sober view on the online ventures with more expectations of revenues. The banner market has grown considerably during the last years, as well as revenues from services for which the users register and pay. Some of the media houses have incorporated broadcasting into their UME. This has required new competencies and a new way of thinking.

Since the media houses expect an ongoing trend in decreased advertising revenues, they have to find new ways to profiting. The *mobile* channels have just existed for a few years and the media houses all foresee revenues in this area. The main problem is the revenue sharing between the content providers

and the telecom operators, which today is in favor of the telecom operators. Another problem is the diversity of devices and the lack of standards. Some of the media houses have found a way around that by developing their own downloadable programs that runs on any mobile phone. The media houses are active in developing strategies for their mobile channels and are currently trying to find suitable business models as well as to developing new and value adding services.

In table 2, we present a summery of the most common views on the pros and cons of these channels with focus on the products/services. These views are from a media house perspective as well as from a consumer point of view.

Table 2. Pros and cons of today's media channels

Channels	Pros	Cons
Print	No power consumption needed Shareable Durable Portable Dispensable Scannable Good overview	Old news Waste of paper No interactivity Geographically limited
Online	Up to date Interactive Searchable Archiving No space limitations No geographical borders	Unsure business model Not mobile Poor overview
Mobile	Anytime, anywhere Push and pull Immediacy Personalization High penetration	Expensive Too small Poor overview Slow Lack of standards

As stated in the introduction the media houses are now facing an introduction of yet another channel, i.e. the e-newspaper published on e-paper technology. As this innovation holds the potential of replacing the printed edition in the long run, thereby reducing the distribution and printing costs dramatically, the media houses follows the development with interest. In the following we will focus on insights from the 18 interviews grouped into the following themes; general visions, infrastructure for distribution, relationship to other channels, organizational issues, and interorganizational issues. Thereafter, we summarize the expected pros and cons of the e-newspaper channel.

General visions
The respondents are in agreement on that the greatest gain for the e-newspaper channel is the possibility of reduced distribution costs. Even though many of the respondents believe that the printed newspaper will still be a parallel channel for a long time still, some think that the e-newspaper channel can replace the printed

newspaper in the long run, thereby being able to shut down the printing press, extinguishing the paper cost, and no longer be in need of physical distribution. In addition, geographical limitations are overcome.

> *The prime opportunity with the e-newspaper is to replace the printed newspaper, to get rid of the printing press and save the woods, and to get away from the physical distribution...But it has to be very simple and mobile. That is the vision but step one will probably be to complement the other channels and in step two it might replace the printed newspaper.[AB1]*

> *The most important problem that the e-newspaper can solve is the distribution. 40% of our costs are printing and distribution costs. In addition, many people can not get the newspaper, in Sweden as well as abroad, and this can be solved with an e-newspaper. [GP2]*

The device is expected to have some level of computing capability, memory and storage capacity. Mobility was considered an important property of the e-newspaper by the respondents. They assume that for the e-newspaper to be successful and meet user expectations it needs to be mobile and pocketable and light weighted. The idea to be able to deliver news services and updates, even very local news, anywhere and anytime is regarded as one of the advantages mentioned. If this can be accomplished with wireless technology, it is regarded as an attractive feature. This is a big step towards a UME.

> *One important advantage with the e-newspaper is the possibility of personalization. The most important requirement is color. [GP1]*

> *Wireless updates increases mobility. All reader types are more or less mobile. Mobile workers, travel to and from work, young readers are all mobile. Even senior citizens are very mobile today. That is why I believe we will be successful; we are much more mobile today. [ST1]*

Added value such as location based services, personalization and context aware services are expected to be important for a successful e-newspaper. It is predicted to change reader habits in the sense that you will have your own newspaper, that it is personal, and that you will bring it wherever you go and that you will read it several times during the day. However, there are contradicting views on personalization of content. Some believe that a careful approach to personalizing content is wise with the argument that part of the news experience is "not knowing" what you will read beforehand.

> *An e-newspaper will be read from the morning until the evening, it is mobile so you will bring it along all day. It will be MY newspaper. You can take it out of your pocket whenever you like. [ST2]*

> *I can imagine that we will adapt content for different target groups, geographically and interest wise. I think personalization of content is overrated. I have never wanted personalized services for myself. I don't think there is a reader demand for that. [NT1]*

A return channel, interactivity and color are regarded by the respondents to be important for adding value to advertisers.

> *To be successful in attracting advertisers color is a must. The ads must also be as effective for the advertisers as today's ads, I mean that customers react on them. It is also important that the ads are interactive and maybe it should be possible to search for ads. [GP1]*

> *Ads have to be in color, the price and the number of readers will determine of the advertisers will jump on the train. Interactivity is important to attract them. [ÖC1]*

Infrastructure for distribution

There are no clear ideas of what infrastructure that would be to prefer for the e-newspaper. The thoughts on what influence such a decision are focused on capacity, cost and value-chain. Multimedia content and interactivity are considered as important. The importance of stabile performance and secure delivery are stressed, and are regarded as prerequisites.

> *For us, it does not matter what the infrastructure for distribution is, the cheapest and most effective perhaps. Satellite or broadcast, broad band internet or mobile, wireless – I don't know. Everything is ok as long as it can handle multimedia, we must have support for that. The future is multimedia, it is only the printed newspaper that is not. [NT1]*

> *I think GPS technology is interesting. Depending on where you are the news could change, that would be truly mobile. [SS2]*

Relationship to other channels

One critical issue discussed, is the e-newspaper channel's relation to other channels. The respondents recognize that adding a channel might reduce consumer's interest for another. Some regard the printed newspaper to be the competitor, others think the online newspaper is. In the later case, the hope of replacing the printed newspaper is more restrained.

> *I think that all channels together will replace the printed newspaper. My wish is to have one editorial department that produces multimedia material that is packaged and spread I the different channels as it suits best. [NT1]*

> *I regard the e-newspaper to be a complement to other channels. Historically new channels have started as complementing channels and then maybe replaced others. There is no channel that has been completely replaced though, except for maybe smoke signals. I think the strengths of the e-newspaper are mobility, accessibility, updating possibility which enables for example to have the same newspaper when you are traveling as you do when you are at home. [GP2]*

There are also strategically and organizational considerations that are related to multiple channels. Some of the respondents regard the multiple channel environment of the media house to be necessary for future news publishing enterprises. In this thinking, one channel would not be regarded as more valuable than another, they would be regarded as an assemblage of channels that

together would reach the audience. Others have a strategy of prioritizing amongst the different channels, regarding some to be more important than others.

> *That we are a media house today, with many different channels, is not a coincidence. The grounds for choosing this path is that it is getting harder and harder to charge for content...We believe that our competitive advantage in the future is the newspaper brand and credibility in new media in multiple channels. [ST4]*

> *We prioritize our efforts and investments for different channels. The order is 1) the printed newspaper, 2) the web, 3) the PDF newspaper, 4) WAP services, and 5) e-newspaper. [GP2]*

Organizational issues

As illustrated by the quotations from the interviews with newspaper managers, adding a new channel will have an impact on the organizational structures. The organizing and competence profile of many newspapers is concentrated to the production of the printed newspaper. As new channels are introduced these structures are challenged. There are also strong traditions connected to the printed newspapers that have created attitudes towards introduction of new media. These attitudes build barriers that according to the respondents are difficult to challenge.

> *For us to succeed with the e-newspaper we probably would have to exchange the entire staff. The e-newspaper will require a totally different competence profile than the one we have today. E-paper is still hypothetical to us, but we can compare with the introduction with the web. The web was not taken seriously by the editorial staff, paper was prestigious, whereas the web was second-class. [SS1]*

> *Some professional roles will radically change. We are tremendously many editors for fairly little material. E-paper will bring a totally new way of editing. It will be more and more automated. The workload will be loading the databases and packaging the content. There will not be any press stop as today, but some do not realize that. There is nothing as reactionary as a newspaper editorial staff when it comes to change. The willingness to change is zero. It is in people's heads, you can not even talk about shutting the printing press down. For them the printed newspaper will be there for ever. To make the leave all of their traditions behind – I do not think so. [NT1]*

> *We used to have more technical people, but when the dot com balloon busted we let almost all of them go, they were 80 people. They had no editorial skills. Now we are retraining editorial staff to handle the technology. [DT1]*

But there are exceptions to this picture. One of the newspaper organizations is very positive to change and have a climate of welcoming new technology.

> *Our new editorial system is a multiple channel system. As soon as we have implemented this system we will create a channel for e-paper and test. We want to be first with e-paper. We want to hit the big dragons on their fingers. We can do that because we are not as sluggish and slow, idea to decision is a lot faster in our organization. [ST1]*

Interorganizational issues

There are contradicting views on ownership and distribution issues. Some respondents claim outsourcing to be their strategy and some regard ownership as important, even though referring to a joint ownership within the newspaper publishing industry.

> *We have outsourced the whole IT department, we do not house any online services our selves. Our core competence is not distribution, it is quality content. That is why we have outsourced distribution, and technology, even the payment systems. We will have the same strategy with the e-newspaper – if it requires technical competence – outsource. If it is cheaper – outsource. [DT3]*

> *We as newspapers must own the distribution channel. It does not work well for us as it is on the mobile phone side. I can imagine that we can give the e-reader to our subscribers and for a payment they can get access to additional content within a network of cooperating actors owning the infrastructure together. [ST4]*

Relationships between industry actors and relationships to consumers/readers are considered to be important key issues. Another critical relationship is to the advertiser organizations. These relationships are perceived as critical for business models and for strategic alliances.

> *I think a shared infrastructure among content providers is to prefer. It is important not to become dependent on one or two operating companies that can hold the content providers hostage as their business model. [DT1]*

> *The business models have to be thought through. The one who owns the relationship to the customer or reader mediates, we can stimulate each other if we own that mediator role together in and industry network. [ST4]*

> *It is extremely important for us to keep our relationships with advertisers. Advertisement is 2/3 of our revenue. [GP1]*

In table 3 we present the perceived pros and cons of the e-newspaper. These issues have been discussed within the workshops and the views have been added in an iterative process.

Table 3. Perceived pros and cons of tomorrow's e-newspaper channel

Channel	Pros	Cons
e-newspaper	High readability Broad content base No computer feeling Up to date - more editions Durable Mobile and portable Anytime, anywhere Environmental friendly Interactive Personalization Searchable No geographical borders	Poor overview Another device Small screen size No color Expensive

Hereafter, we discuss the most critical considerations from an infrastructure point of view by comparing the issues raised in the literature with the empirical findings. We have organized the discussion according to the platform logic by Sambamurthy and Zmud (2000), i.e. *IT capabilities*, *relational structures*, and *integration structures*.

IT capability
Anytime and anywhere delivery of services for the e-newspaper channel is considered to be the most promising possibility by the media houses in our study. Some of the pros mentioned as the most important for the e-newspaper channel are the possibilities of personalization and local awareness. As illustrated by the quotations, there are however contradicting views on the importance of personalization. Still it is anticipated that the IT capability of the infrastructure and e-paper devices (i.e. a eReader device) must have support for location awareness and personalization functionality. As Satyanaranyan (2002) state this capability as critical for effective service delivery, it can be expected to be critical in a UME. Further, supporting users dynamic movements between physical and social context (Lyytinen & Yoo, 2002) and seamlessness (Henfridsson & Lindgren, 2005) are capabilities estimated to be of importance for an effective UME. As a result, the eReaders for consuming the services offered through this channel need enough computing capacity, memory and storage to support these capabilities as well as to support multimedia content presentation. There is a contradiction in the product development between IT capacity of the eReaders and the demand for a pocketable and light weighted device. Thereby, one challenging question to answer is: *What are the requirements on devices in a UME?*

Some of the capabilities of a UME are related to a well functioning return channel. In some cases automatic identification of device, location and other information related to context (Aboyd & Mynatt, 2000) need a return channel. In other cases users might actively be using a return channel, to interact with content such as advertising. The requirements on the return channel are related to the publisher push and/or pull strategies of service offers. Added to this, the return channel is a prerequisite for systems to be aware of users and for users to be aware of the environment (Kleinrock, 1995). This is preferred to be as unproblematic for users as possible and when possible wireless. The second critical question to answer is therefore: *What are the requirements of the capacity of return channels in a UME?*

The IT capacity of the delivering infrastructure in a UME is of course the most fundamental for the e-newspaper channel. All media houses are convinced that

the news services of tomorrow are multimedia content based. Thereby, the assemblage of technologies used for distributing the e-newspaper content need to have capacity for heavy traffic as well as for a large variety of data formats (March *et al.,* 2000). Furthermore, the infrastructure must be flexible and open to new types of technologies to meet the expectations by the media houses. Therefore, an important question for distribution is: *What is the minimum capacity level for the infrastructure in a UME?*

Relational structures
As our empirical findings show, the development of a UME will have large impact on the media houses. The structures for organizing competence, IT management and business value chains are all challenged. The logics for governing an environment of this character need to be rethought (Sambamurthy & Zmud, 2000). As testified, there are conservative attitudes and traditions in these organizations that are difficult to overcome as well. In addition to this, the interorganizational and customer relationships of the media house are challenged. One important aspect is the relationship to customers, in this case readers as well as advertisers. In the case of the printed newspaper the organizations own the distribution, or they have an alliance with another newspaper organization that does. In these cases they also own the relationship with the newspaper reader. For online and mobile channels the ownership of distribution is outside the media house, and sometimes the customer relation goes via an operator. These conditions have impact on the value chains and business models, and as stated by Andersson and Lindgren (2005), it is important to understand business needs in relation to ubiquitous information environments. As the empirical material show, this is one of the most profound issues for the media houses. Consequently, an important question is: *What are the desired structures for ownership of distribution and customer relations in a UME?*

The media house is part of a complex world with different alliances and structures for relationships in different channels. Each channel infrastructure has its network regulations, industrial standards and actors. In a global infrastructure, these relationships are increasing in numbers (Kleinrock, 1995). Today, some of the organizations have formed joint efforts to handle these relations, for example the Citygate initiative. For the e-newspaper channel it is important to ask: *What are the desired relations to providers of technical solutions?*

Integration architectures
The media houses discuss new structures for interrelationships regarding the integration of IT capabilities with the relational structures for business and relations to distribution owners and technical solution providers. This is a challenging avenue of large scale with many contradicting interests involved. Still this is a key area for strategic decisions (Lyytinen & Yoo, 2002;

Samabamurthy & Zmud, 2000). Further, these integration structures must have the flexibility, the preparedness and the alertness that is required to meet the constant development and convergence of technology, number of and variety of devices as well as changes in customer needs and expectations. Drawing on Samabamurthy and Zmud´s (2000) discussion on integration architectures, the overall question for the emerging UME is: *How should the relational structures for offering services be integrated with the IT capabilities of a UME for a successful business agenda?*

Below in figure 10, we have graphically summarized the multiple channel environment of today's media houses and the considerations that need to be addressed related to infrastructural considerations for the introduction of the e-newspaper channel.
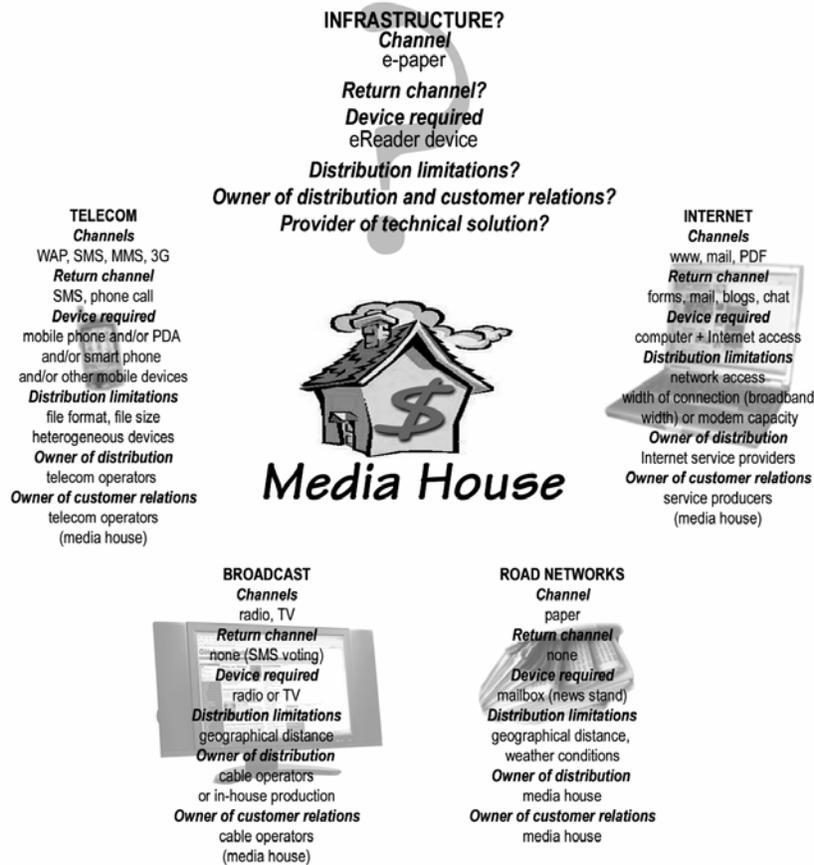

Figure 10. Infrastructure considerations

6. Conclusions

In this paper we addressed the research question: *What infrastructure considerations arise with the introduction of a new channel in a ubiquitous media environment?*

In order to answer that question we have conducted a literature review of infrastructure issues in ubiquitous information environments. From this literature review together with empirical results from 19 interviews and 9 workshops with newspaper managers and designers in Sweden, Belgium, France and the Netherlands, we suggest six infrastructure considerations. These considerations are presented in table 4 below.

Table 4. Infrastructure considerations in relation to the platform logic elements

Platform Logic Elements (Sambamurthy and Zmud, 2000)	Corresponding infrastructure considerations
IT Capabilities	*What are the requirements on devices in a UME?* *What are the requirements of the capacity of return channels in a UME?* *What is the minimum capacity level for the infrastructure in a UME?*
Relational structures	*What are the desired structures for ownership of distribution and customer relations in a UME?* *What are the desired relations to providers of technical solutions?*
Integration architectures	*How should the relational structures for offering services be integrated with the IT capabilities of a UME for a successful business agenda?*

As demonstrated in this article, content providers have indeed entered the ubiquitous era, with multiple of publishing channels, offering services for a multitude of devices, aiming at a wide audience. Addressing general infrastructure challenges in ubiquitous information environments, this article contributes to explicit the managerial considerations for content providing organizations attempting to offer services in a ubiquitous information environment. This research reveals the varying nature of considerations that apply to decisions on publishing channels in ubiquitous information environments. Traditional basic data for decision making on publishing channel has mainly been focused on IT capability. This data, such as computer device specifications, information on conditions in the use environment, available distribution environment, and suitable service delivery dead lines, i.e. who, where, how, and when, are no longer possible to answer unambiguously. The complexity of ubiquitous information environments, together with changed user behavior has changed this situation. We have empirically illustrated that the

relational and integrational considerations suggested by Sambamurthy and Zmud (2000) are as relevant as the issues of IT capabilities. We believe that this illustration of considerations for news publishers UME, could apply to any organization providing services for a wide audience in a ubiquitous information environment. As shown by this research, there are many research issues to address in order to understand the consequences for content providing organizations, technically as well as socially.

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