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During the boom in Dotcom and telecommunications in the late 1990s, the growing mobile communications industry was searching for new business opportunities. The solution was found in the hype of e-business, which seemed to offer great opportunities for the IT industry. Instead of being locked to the desktop and the fixed line Internet everything should be mobile. By using the mobile handset to data transmission and access to the mobile Internet, e-commerce would become mobile: M-commerce.

The first attempts of creating m-commerce by WAP were failures from the beginning and the second round of attempts were delayed by the financial crisis in the telecommunications sector. However, the mobile operators and content providers had success with a simple form of m-commerce in the increasing use of texting (SMS) furthermore the growth of mobile subscribers had continued, creating more mobile subscribers than fixed line subscribers. The competition is fierce in the mobile communications industry, both for manufactures and operators. The operators is competing with other operators and non-network operators with continuously falling prices, but the operators has to increase revenues since they had spend many money on licenses for new 3G mobile communication networks and on upgrading the existing 2G network to 2.5G i.e. GPRS. The new market for the operators was expected to be data transmission, mobile services and m-commerce, but the existing services are still sparse and the users are missing. M-commerce seems nevertheless to be moving out of a laboratory research phase and the terminals are improving technological, but there are still many problems regarding m-commerce e.g. solid business models, content, services and a mobile payment system. Especially the role of the operators and the financial system and the extent of integration between platforms, applications and hardware are unsettled in the m-commerce industry.

The actors in m-commerce are the operators, non-network operators and manufactures of mobile phones, financial organisations, content- and platform providers (including diversifiers of the mobile platform), retailers, users and regulatory bodies. In the case studies we find different problems when these actors are being combined. The case studies are[1]: Operators and the financial system in The Digital Mall; platform, content providers and the operators with Mobital and Mobile Gatekeeper; the operator and the functionalities for the users in Personalized Mobile Broadband Services (PMBS); the content providers and service for the content providers (platforms) with MobileContent; diversification of

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[1] The case studies are made from desk research and interviews with John Lundsgaard and Michael Skriver, Spar Nord Bank (The Digital Mall); Peter Balling, DCE (Mobile Gatekeeper, Mobital); René Rolander Nyggard, Net-Mill International (The mobile employee); Henrik Bruun, IT-Akademiet (Mobile Content); Yousef Jasemian, L.M. Ericsson; talks with Alf Præstgaard, Sonofon (PMBS) and Kjeld Jensen from the Digital North Denmark (DDN) secretariat. Likewise is information used from more informal talks with participants and formal presentations in the DDN policy program during the DDN project partner seminars in 2001-2003 and the DDN healthcare conference in 2002.

the mobile phone platform and content providers focused on other applications with The Mobile Employee and Remote Monitoring of Cardiac Patients.

1 Platforms and the move toward m-commerce: WAP in Europe and i-mode in Japan

In Europe the standard for access to and use of the mobile Internet or alternatively mobile reformatted 'normal' Internet pages, was Wireless Application Protocol (WAP). As analyzed in Fransman (2002) the industry in Europe and Motorola (US) believed that in order to create new mobile Internet services it was necessary and sufficient to create a de facto standard protocol. An organization, the WAP Forum was formed to create the standard, but it mainly consisted of mobile phone producers, while the service providers only had a small influence (Fransman 2003). Soon the mobile service providers ran advertising campaigns for mobile access to the Internet and the large manufactures of mobile phones added to the hype of WAP. However the development and production of WAP enabled phones were delayed and the market introduction was subsequently postponed[2]. When the WAP enabled phones finally were introduced in sufficient numbers, they had, at least initially, very little success. The consumers showed little interest and the early users where scared away by slow speed[3], no instant access[4] and a pricing model letting the consumer pay per minute. The first step in building the mobile Internet and its content was no success in Europe. WAP was early on declared a fiasco, but the simple service of text-messaging SMS that had some quiet years after its introduction in the mid-1990s has been a great success for the service providers. The number of WAP pages has been rather limited and potential possibilities for location-based services - where the user is offered different services and targeted content, based on their geographic location - has only been used sparsely. Mobile payment, which was believed to take off together with WAP, has also been delayed, partly due to problems between the operators and the financial system of control and division of profits.

In Japan the mobile Internet been a huge success, the number of i-mode users, based on the 2G standard PDC, is more than 20 million and is still growing along with the first 3G services. Contrary to Europe the Japanese mobile Internet has a lot of content and many external content providers. In Europe the mobile communication service providers had introduced a pricing model for external content providers that let the former keep the larger share of the money (30-40%). A pricing model that they also are using for logos, ring tones etc. and also seems to be applying to the forthcoming 3G services. However in Japan both the service provider and the external content providers earn money on i-mode. The consumer has to pay a monthly fee for I-mode access and data transmission to ex. The operator NTT DoCoMo and also a monthly subscription fee for each site they want to access. NTT DoCoMo collects the money and pays the external partner minus a 9% handling fee. This model seems to have had an important influence on the prevalence of mobile Internet in Japan. Due to the proprietary mobile network structure in Japan[5], the external content providers have to be approved by DoCoMo and

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[2] The mobile communication industry seems often to be delayed in the introduction of new products. When the GSM network was up and running, the phones were delayed and the media made a big fuss about the missing phones. The WAP acronym was known as "Where Are the Phones?". The history keeps repeating itself in respect to the introduction of MMS enabled phones and 3G.

[3] The speed of data transmission using GSM is 9.6 Kb/s

[4] The customers had to set up their WAP access themselves

[5] The mobile phones are operator specific and cannot be used on other networks.

they can only offer content to DoCoMo customers. The way of implementing I-mode has been different from WAP. It was not institutionalised in a forum and is much more directed at delivering a service. It has one-click access and is in that respect fulfilling a customer demand of entertainment or 'something should happen' all the time. The technical solution is not better than WAP, but the content and the management of the 'user experience' has been better, resulting in an immense success. The long transportation time to work in Japan, combined with a lesser share of internet access via PC's are likely to be important factors for the success of i-mode. However in Funk (2002) it is argued that these factors are only of minor importance, whereas the business model seems to a perfect match with more cultural oriented phenomena.

Funk (2002) argues that the tradeoff between Richness and Reach for fixed line Internet and the mobile Internet holds some explanation in the different approaches to mobile Internet services, see figure 1. The European and US approach has been from the richness of fixed line Internet with a focus on business users and popular fixed line Internet contents. This has started negative feedback loops since the service providers are offering services that only a few customers want, resulting in poor perception of the mobile Internet leading to little investment in content and the infrastructure (Funk 2002). By applying popular fixed line Internet services to the small, until recently non-colour screens, with slow speed a lot of the richness is lost and the mobile phone is more or less in direct competition with the pc, that has high speed and large colour screens. The Japanese approach has been different focusing on simple services and content. They started with entertainment and focused on young people. The major application is email and the main content is still entertainment. Only a few of the Japanese services and content are available on the fixed line Internet and are not very popular since they are too simple compared to the normal richness (Funk 2002). This has however created positive feedback loops, where functionality for the user has created a demand for better content, services and phones e.g. colour screens, cameras etc.

Figure 1 Japanese vs. US and European approaches to the mobile Internet
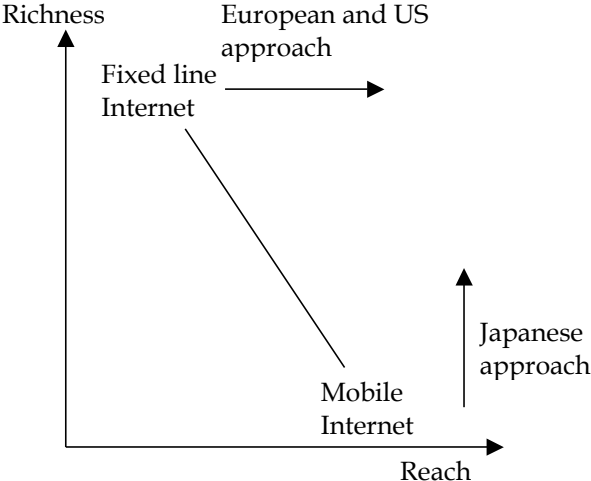
Source: Funk (2002)

The initial failure of WAP and thereby the failure of m-commerce, was also hit by the prolonged crash from the summer of 2000 in Dotcom, the successive turmoil in telecommunications and in 2001 also mobile communication. Since e-business no longer was a buzzword, it affected m-business nega-

tively. The European telecommunications operators had spent €100 billion on licenses to run 3G networks and had huge debts and saw the financial market turn against them, with dropping share prices. The technology that they had agreed on was harder to implement than expected, which caused delays in the roll out and in expected revenues. As a result the operators began focusing on their core business and somehow kept their non-motivating pricing mechanism for any potential m-business.

2 The state of m-commerce – hurdles and success

The operators had an unexpected success with the platform of text messaging (SMS) in the late 1990s. The technology and service had existed on the marked for a few years, when the users began texting and number of SMS skyrocketed. The troubled operators however tried to capitalize on the success of SMS, by overpriced text messages. The overpriced text messages consists of a text message that is priced higher than the normal price since it is providing a service by enabling the user to example get new ring tones, logos or to participate in competitions or let the user vote in TV shows and other forms of entertainment. This business has developed to be an important revenue creator for the operators, although it is a very simple form of m-commerce. Some non-operator content provider have entered the marked and there is some competition, but a major share of the overpriced text message still goes to the company collecting the money and not the content provider[6]. Since the price is high and mainly targeted towards young people, the possible demand for these services is of a very limited size.

M -commerce is still at an early stage and there seems to have been a confusion of 'what is possible' and 'what people need'. There has been a mismatch of the expectations of people downloading movies to show on a mobile phone with a small screen or using WAP and what people needs. The new technology and devices where not socially accepted and adapted as soon as they were introduced to the market. The industry has in some degree neglected the customers desire for social connectivity in favor of an anonymous world of data. The m-commerce services are still very much like research in a laboratory and the technology and services needs to be socially shaped and the users needs to be somehow "educated" in or made familiar using the services. The strategy of the Danish operators seems today to be taking a starting point in the success of SMS, where they hope to persuade the consumer to begin sending picture messages (MMS) with their camera enabled mobile phones. By letting the user send pictures the operator hope that the user will evolve to use future services of 3G and 2.5G (GPRS). The MMS technology has however been less simple to adopt technologically than expected which has caused delays. The networks needs updating and the phones have not been as compatible as promised, resulting in problems sending a MMS from one phone brand to another phone brand and from one operator network to another. The phones have been missing or few, but expensive and the operators having problems in pricing models and agreements regarding pricing and transfer between different networks.

The m-commerce has been in a laboratory research phase with no applications and no users, with a missing social connectivity. But even if m-commerce initially has been a failure, the ongoing techno-

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[6] The typical price is 10 Dkr (1.35 €) of which 20% is value added tax, 30% goes to the operator, 30% to the aggregator, and the rest should cover development, burn rate and profits. The net cost of a SMS sent by a non-operator is approximately 0.13 Dkr (0.018€).

logical improvement of the mobile phones e.g. colour screens and data transmission combined with the social shaping of the use of mobile phones, might reveal that the 'fact' of m-commerce being a failure only is an 'opinion' and not a fact. In relation to direct m-commerce there is an increased diversification of the mobile phone platform. The phone is being used to different services and tasks that is not 'perfect m-commerce', but exploring the *always-on* feature of the mobile phone. The diversification is bringing wireless into existing business and also changing and creating new business. This is interesting since the shift from voice only to data transmission and m-commerce raises the demand for content. No users will use the mobile Internet if there is no content and the content providers have a hard time entering a market with no customers. Individual customers, firms and operators seeking growth in data transmission will demand content. That is a demand pull and a supply push. Content is a generic term and consists of different types of applications:

- Real content production e.g. news, movies, text, information etc.

- Games and other animated entertainment

- Other applications

The content builds on different platforms that enable access to the content. The platforms are ranging from the more generic types like WAP and SMS, to platforms building on these i.e. within the WAP standard. The platforms also consists of services for the content provider or a content 'infrastructure' that is the technological shells for presentation of real content e.g. software code to content management, streaming, billing etc. The platforms and the content are interrelated make demands of the infrastructure and leads to the functionalities for users, see figure 2.

Figure 2 M-commerce industrial environment

Extent of integration
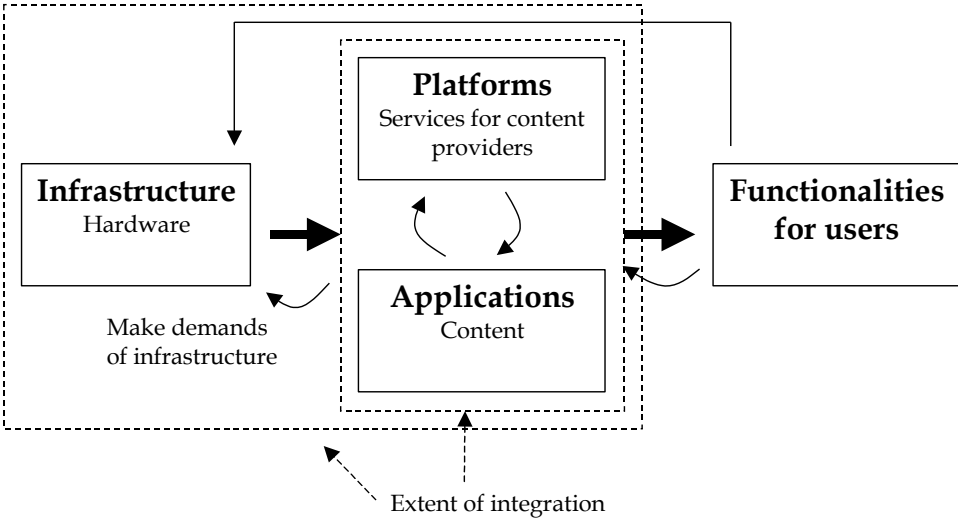
The extent of integration between platforms, applications and infrastructure is still not settled in the m-commerce industry. All of the three can be integrated, where the hardware manufactures define and develop the platforms, and also supply the content. That was the situation until recently, before the introduction of WAP, in which the manufactures delivered the mobile phone, with preinstalled applications. Infrastructure and platforms can be integrated with applications separated. The last situation is all three separated, where the industry is divided between several suppliers of hardware,

software, services and content. The extent of integration depends on the actors and the demand from the users, which is depending on the functionalities. The manufactures want to be a supplier of total service with infrastructure, platforms and applications, but the operators also want to control the market for platforms and applications with a minor role of the manufactures. In the same time many new actors enter the market for platforms and/or applications. There are however several hurdles before m-commerce can move out of the laboratory research phase and evolve.

Two of the initial hurdles in m-commerce seem to be business models and payment systems. Before it becomes commerce, some kind of payment or money transaction is needed, except from sponsored services. This payment can take various forms either on the monthly telephone bill to the operator, subscription fees, direct mobile payment etc. The operator has had a head start in m-commerce, since they have easy access to the customer and have a lot of information about the customer and his location. The operators also have a functioning payment system and with the initial price model for access to the mobile Internet – paying per minute – they had a lot of control of the market. GPRS and other systems with always-on data transmission facilities makes it cheaper for access to the mobile Internet, by paying per byte of data transmission, but the payment for the services or goods are still unsolved questions of how much, who and how?

3 Industry structure

The actors in m-commerce are the operators, non-network operators and manufactures of mobile phones, financial organisations, content- and platform providers (including diversifiers of the mobile platform), retailers, users and regulatory bodies. These are connected in a wide variety of ways in which everybody have contact with the user. This contact have however so far not been used to create a successful mobile Internet focusing on value added for the user.

In García and Steinmueller (2003) the m-commerce industry is described as being formed by a service infrastructure supporting mobile transactions between different groups of actors and high technology providers, that supply service providers and actors with technology that makes the mobile transactions possible, see figure 3. The high technology providers both provide hardware and software. The service infrastructure contains mobile operators, financial organisations and others. The actors can be consumers, users and retailers i.e. firms selling ring tones, logos, information services directly to the consumers.

Figure 3 Case studies in the M-commerce industry structure
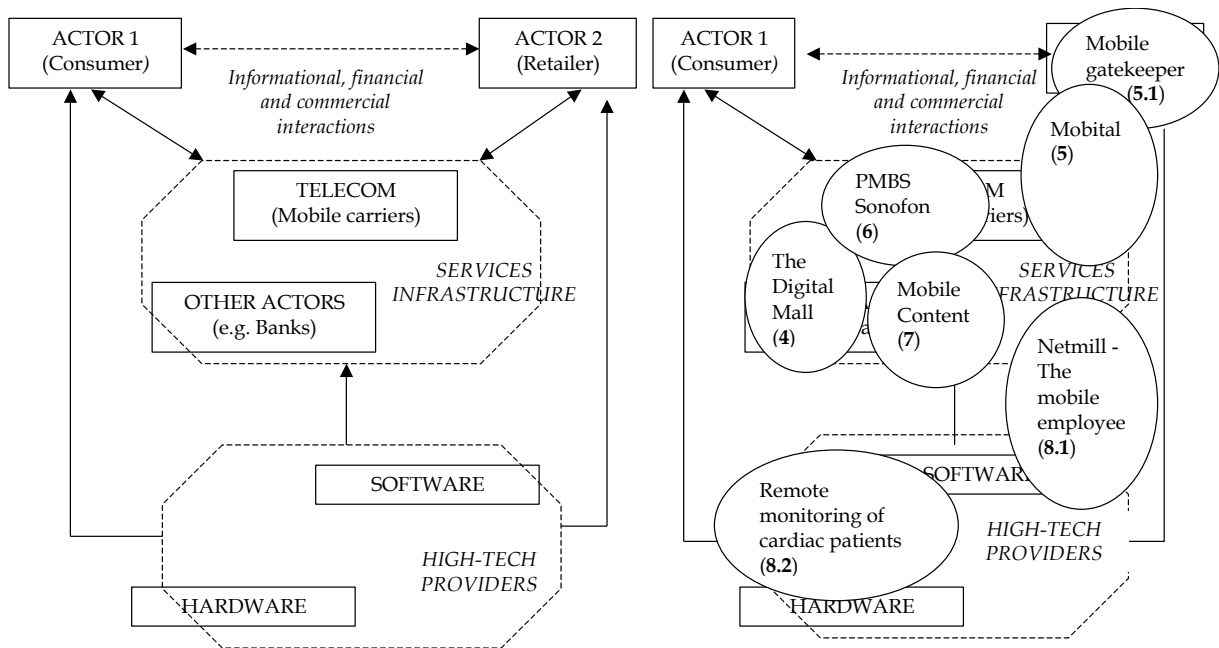
Source: Structure adopted from García and Steinmueller (2003).
Note: the number in brackets refers to the number of section, the case study can be found in.

Figure 3 is focused on the actors and their possible interaction, but since everybody is connected in a variety of ways, it has limited explanation power regarding the interesting complex of problems in the industry. Many of the problems in the development of the m-commerce industry relates to the combination of these actors and the extent of integration between infrastructure, platforms and applications. Especially within the m-commerce service infrastructure is the extent of integration between platforms and application unsettled. The control of and access to the users are creating unsolved problems, since all the actors: operators, non-network operators and manufactures of mobile phones, financial organisations, content- and platform providers, retailers, users and regulatory bodies are connected to each other. In the case studies we look at different cases where the different actors are cooperating or competing. From the case studies we find various problems when these actors are being combined.

4   Operators and the financial system: The Digital Mall

In the late 1990s and early 2000s, the operators and the financial system where looking for new business opportunities and markets The operators, in this case a large local based mobile communication service provider with more than 1,000 employees wanted to enter m-commerce, but had problems since regulations prevented the operator from being a bank, that is, they where not allowed transferring money between different users and let the user have an account. The operator could however collect the money on the telephone bill. The financial system, in this case a large local bank, wanted to make money on the Internet and had customer accounts and systems for transferring money. The regulations however did not allow then becoming an operator, making mobile payments. Cooperation

between the two sectors is still missing, partly because of hesitating operators, difficulties in deciding on share of costs and profits, and control of the payment system.

The bank in had cooperation with the operator in 2001 introduced WAP banking. The WAP bank was integrated in the bank's home banking system and allowed the customers to see balances and transfer money. The bank and the operator wanted to push the use WAP banking and offered all the banks more 1,000 employees cheap WAP enabled phones and subscriptions. The service did never become a success and was closed August 2003, while their Internet based home banking has been very successful.

In 2000-1 the operator and the bank had very good relations. The bank wanted to use its bank engine to create new projects on the Internet and the operator was very interested in telephony, payments and creating traffic on their network. The bank had the idea when the Digital North Denmark (DDN) ICT policy program was launched. They used their personal network and contacted the operator that was interested and a logistics company, a supermarket chain, and a software company also joined the project. The bank was supplying the financial transaction system; the operator was involved in the network and Internet side together with the software company; the transportation company was to do all the transport and the supermarket chain was to deliver the goods, but also contribute with knowledge regarding the very complex logistics of groceries. By combining the competences of the members a digital mall was to be developed, which should be the electronic shopping site on the Internet preferred by citizens of North Jutland. The mall was intended to attract "Business-to-Consumer" (B2C), "Business-to-Business" (B2B) in the industrial sector and to be the site where the state, county and municipalities would undertake their purchases. "The Digital Mall" was developed with a focus on North Denmark but later the concept could be extended to the remaining country. The philosophy behind the project was: Think big and keep expanding your market continuously - with a focus on a future use of the Mobile Internet. It was planned to enable mobile access and mobile payment. The main idea was to create a common portal where different shops were collected. The idea has also been used other places, but to overcome some of the problems with e-commerce e.g. trust, payment, return policy etc., they wanted a single standard payment system and a single return and complaint site, thus signaling that e-commerce is simple, the partners and the payment system can be trusted and if anything goes wrong the return policy is shared and easy. They wanted well-known brands and high security. The project however ended shortly after the start, basically because a 'focus group' approach based series of interviews with potential customers clearly indicated that consumers were not willing to pay the extra costs for the new services. One of the problems is that the revenue on groceries is quite low since the market is very competitive and even though the potential customers would like to use the Digital Mall and also pay extra for the service, the expected revenue was not sufficient to make the project profitable. Other problems were related to create a high volume to cover the marketing costs, which not seemed possible in the short run without a combined effort in the region from both public and private organizations

As a spin off idea from the project, the bank and the supermarket chain launched payment by the mobile phone in the supermarket. The system is working fine (a update of payment terminals in the shop is needed), but is only reaching a very limited number of users. The mobile payment system however has a major competitor in the widespread use of a common Danish debit card system

Dankort[7]. This system has existed for 20 years and has been free to use for the customer. The card has had a huge success with the number of transactions growing every year and a total of 3.3 million cards existed in 2002[8]. It can be used in most shops (102,000 in 2002) and approximately 98% of the transactions were made through electronic terminals.[9] The high diffusion of the card combined with the frequent use i.e. it has become a routine for the customer and the pricing model has made entry for alternative systems very difficult. The mobile payments system probably needs to seek other markets than the larger transactions in shops. The forthcoming introduction of a new upgraded version of the Dankort might however offer some opportunities for mobile payment systems, since the customer has to pay a small fee for every transaction and the existing terminals has to be replaced. The card is also being used to make payments on the fixed line Internet for many pay-as-you-go mobile operators.

5   Platform, content providers and the operators: Mobital and Mobile Gatekeeper

The pricing mechanism set by the operators has limited the number of content providers and m-commerce. The overpriced SMS with logos and ring tones and other services have however been successful, but the high pricing with the major part going to the operator has hampered the competition. These conditions have lead companies to find alternative ways around the operator. Thereby are they adding to the fear of the operators that they would be 'excluded 'from the potential lucrative content market, like happened to many Internet Service Providers (ISP).

Mobital is a small company, founded in 1999. It started with the rationale that WAP was made by web designers and not phones designers. They developed an Internet portal, financed by banner commercials, allowing the customer to create logos and ring tones by use of the fixed line Internet and then download (SMS) them to the mobile phones. The created ring tones and logos also became accessible to others once created. From the beginning the service was free and the company paid the cost of the SMS. The revenues for the operator were only the price of SMS and not the extra charge for the payment. Without commercials the company grew rapidly and costs exploded, which lead the company to put restrictions on access. The user had to sign in and give some personal information. The growth rate stopped for a moment, but continued afterwards. As a result they introduced a point system where the points could be used to pay for logos etc. The point's costs money that are paid by debit/credit cards on the fixed line Internet[10], but there are several ways that the uses can earn point through competitions and it is still cheap compared to overpriced SMS. Gradually the portal expanded the services offered and has grown into a community with chat functions, games etc. Community building has become very important for the company and they are trying to stay in the overlap of community, content and development i.e. not developing technical solutions without relation to both

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[7] The payment with the Dankort can by done by sliding the card through an online terminal in the shop and using a four digit pincode as 'signature' or using a mechanical device or online terminal where the user has to sign on a bill. The cardholder's photo and signature are printed on the card.
[8] There are some restrictions before acquiring a Dankort, e.g. the user must have a bank account, be older than 18 etc. It is possible to have more than one card.
[9] In 2002 the cards was used in approximately 477 million payments. See www.dankort.dk
[10] It is also to pay by the mobile phone, but it is more expensive for the customer.

the content and the community. It also sells user specific commercials (offers) to its customers. It allows different firms to make a targeted advertisement campaign to its users[11].

In two years the company has evolved from portal services to development of mobile IT solutions and multiple related services. They have large share of the young mobile phone users as customers, almost 300,000 users in Denmark and their success have lead to contact with operators who want to buy different software solutions. The success is built on close contact with users, where user demand for services has directed the development. Bypassing the operators is also being used in the introduction of MMS services. By sending the pictures using GPRS data transmission to a network host, place it on the Internet and SMS the receiver a password or a link, then the receiver can decide to download the picture to the mobile phone, using GPRS data transmission. This is much cheaper than a MMS and resolves the possible problem of a receiver not having a MMS enabled phone.

The company has been successful in developing platforms and applications, which has attracted the attention of firms wanting to enter the m-commerce industry, but also from the operators. They are selling platforms to the operators and also to content providers, which could indicate less integration of platforms and applications in the industry. It also is an example of a platform providers not being an operator, which also allows for the content providers to be separated in some degree from the operators.

5.1   Tourism and content

A project in the DDN policy program is Mobile Gatekeeper. The participants are Mobital, an operator, entertainment/content providers and firms from the enabling technologies e.g. Java and data compression techniques. The general purpose of the Mobile Gatekeeper is to enable users to search, process and receive predefined cultural information from any technological platform. For example, prior to a visit in Aalborg/North Jutland, users should be able to retrieve information and define the type of information required via the Internet. During the actual visit to Aalborg/North Jutland, data and information should be available to subsequent processing and use. The project focuses on the use of mobile phones. Much of the information is existing information made by existing non-mobile content providers. The information is being made user specific with easy access focused on events and offers within a given time period. The service is not offering mobile access to existing web pages, but creating user specific content adjusted to the mobile phone. The project and content is thus created with the purpose of keeping and attracting tourists to North Jutland. Access to the content will be free except from the data transmission charge and the financing partly based on commercials e.g. by sending a SMS to some users in an area giving discount to entrance fees in amusement parks etc. The success of this project is still to be seen, but it signals that the platforms and content can be separated.

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[11] As an example is a burger chain that only has very few customers some hours during the afternoon. The campaign is targeted to users of Mobital living in the area that receives an SMS saying: 'show this SMS at the counter and get a discount on a burger'.

6 The operator and the functionalities for the users: Personalized Mobile Broadband Services (PMBS)

Sonofon is the second largest mobile communication service provider in Denmark and was founded in 1991 as a joint venture between GN Great Northern (DEN) and Bell South (US), now owned by Telenor (NOR) and Bell South. Sonofon has participated in the DDN program with a project trying to be in front with personal mobile broadband services in 2001-2002. The other partners in project on PMBS were Nordjyske Medier (a local media company running a radio station, a TV station, newspapers etc.) and AM Production Multimedia (ICT company working with different software solution and production of TV programs etc.). The two latter companies are subsidiaries of the same holding company. The companies were all working on the idea of delivering content to the consumer marked on larger mobile terminals with a high bandwidth. The test was supposed to be using front line technology and creating and testing the future home mobile broadband services. It used newly developed small portable monitors (PDA's and web-pads), which are actually computers operated by the finger touch, combined with state-of-the-art wireless network technology and the control of news and other information to create a strong personalized tool, a family terminal. The project was utilizing the latest facilities for the wireless transmission of large volumes of information like GPRS and FWA[12]. The project was from the beginning technology-driven, but the idea was to include many different kinds of content to the user and introduce a billing system. The content and different services should create a demand-pull for the solution. The technology used should be state of the art and the content plentiful, but already in the early phase of the project, the ambitions were scaled down.

The role of the partners was very clear from the beginning of the project. The operator was to supply a central server, which the test users could sign on with their mobile terminals through the wireless network. The server was running a general PMBS platform. AM Production Multimedia was to connect the systems of content provider with the operator and develop a user-friendly user interface and develop software for presentation of content on the different terminals. The media company and other external partners were to supply the content. The companies made the experiment with technologies and equipment that was very new and had many early service-life failures. The terminals were almost nonexistent even though they were on display from the manufactures. The delivery was delayed and when they arrived they were less capable than promised. The project started in February 2001, but was delayed and the test didn't begin before mid-November 2001. The terminals were Web-pads and PDA's, which were connected to a PMBS server by FWA, GPRS or cable TV[13]. The PDA's are personal terminal compared to the web-pad that could be used by the entire family. In the test families each member of the family had their own personal logon allowing them to personalize the setting and content.

The terminals used a common PMBS interface running on an application server that also was used for security, passwords, personal profiles etc. The platform was combined with applications like video compressing and web-clipping software (removing graphics and adjusting web-pages to the PDA). A

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[12] Fixed Wireless Access is a terrestrial system for radio access in the 4Ghz and the 25Ghz frequency bands. It is the use of wireless technology to replace copper to connect subscribers to the telephone network and the Internet. It consist of a single parabolic antenna in the house connecting the household to the FWA operator.

[13] The web-pad has a large finger touch sensitive screen and has a wireless connection with a base station in the house, which is connected to the Internet via FWA at 1Mb/s. The PDA has a smaller screen and is connected to the mobile communication network via GPRS and has subsequently a wider range.

variety of content and services was collected and added to a PMBS portal, but it was also possible for the users to surf on the Internet. The services, content and application on the PMBS portal was news, sport, weather, traffic, shopping, food recipes, games, calendars, TV-guide, cinema guide, e-mail and a website for searching telephone numbers and addresses etc. The project partners had to develop a lot of the software themselves, since some of the available software was insufficient. They developed an application for gathering of content from many different content providers running on various systems and converting the content from one platform to another platform. In this process they had to secure that user experienced a stabile and quick responding system. The users could access the content on the PMBS portal, but also on the Internet. The users had personal logon and profiles, which allowed them to personalize the settings and have easy access to the preferred content. The personalized content and profiles were created to increase the use of the terminals and create user-friendliness. The use of the terminals was very high in the beginning of the test, but dropped slowly during the period. Especially the users with a large screen terminal were the most active users and the content on the portal was the most used. The web-clipping software was found very useful for accessing content from the PDA's. It was necessary for the entire system to be stabile to create a positive user experience e.g. if a user has some problems with the hardware it seems that the entire system is failing from the user's point of view. The simplicity of the system, interface and applications are very important for the user-friendliness and thus the success. They found that the users had fewer problems with the three buttons web pads compared to the nine buttons PDA. The arrangement and simplicity of the content were also important for the success e.g. the use of web clipping removes most of the conspicuous content (flash, commercials and colors etc) from the Internet web pages, but it enhanced the user experience, since it made it more clear on the small screens. The users liked the mobility of the terminals and the preferred content in the test were news and e-mail.

The project apparently did not have any major impact, but was still considered to be a success. The participants accepted the project to be an exploratory test of a vision, with a focus on gaining experience on the future personalized mobile broadband services. However many problems blurred the test, since even if the technologies and services seemed to exist and were supposed to be working, they were still full of errors and had many limitations. There seems not to be a demand for the PMBS services at present and they didn't find a possible business model. Many of the problems were on the technology side, since it didn't fulfill the user needs and behavior, and a business model missing[14]. The users focused on simplicity, user-friendliness and stability in the network, terminals, content and functionality. These experiences are similar to the general m-commerce experiences and problems. In relation to the daily use and the consumer marked, the users didn't find the terminals and services a 'must have', which set extra requirements for the PMBS services since they have to compete with routines and habits.

The operator has not continued to pursue the PMBS services in its present format, but the cooperation with the content providers and the experiences was considered to be positive. However, to what extent the experiences and the test of personal mobile broadband services have been adopted in the development of activities like m-commerce in the company is uncertain. The content provider and the software developer have used the application allowing them to present content regardless of the receiver device and across platforms in the launch of a new TV channel transmitting mainly local news

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[14]The services were free during the test.

24 hours a day and a free daily newspaper. The application allows them to transport and adjust the content to different media types e.g. newspaper or TV.

7   The content providers and service for the content providers (platforms)

Ericsson (manufacturer), Sonofon (operator), NOVI (science park) and IT-Akademiet (ICT consultancy firm) created MobileContent with the aim of positioning and developing North Denmark as the content center for the mobile Internet. North Jutland is renowned for its manufacturing of hardware for the telecommunications industry. MobileContent wanted to be the environment for focusing on what the mobile phone can be used for. There is quite a leap from producing hardware and content for the Internet to producing content for the mobile Internet, a change that MobileContent wanted to facilitate by making the resources needed available to the firms. The developing work will be carried out by knowledge sharing and collaboration, primarily initiated by establishing fora for this purpose, creating networks, a test and innovative environment, and education. MobileContent wanted to be an international qualification center consisting of firms in the line of IT and mobile technology in North Jutland via a close collaboration with operators, manufacturers of mobile phones and infrastructure as well as content providers.

The company was founded in early 2001 and was soon hit by the crisis in mobile communication. There were plenty firms and persons with ideas related to mobile technologies, but only a few firms who wanted to invest. MobileContent focused on two activities: entrepreneurs and helping existing firms developing their business with mobile technologies. Due to the crisis the company focused mainly on the latter and also found a niche as a network initiator by bringing firms with ideas of m-commerce or content together with firm creating the services. MobileContent has run tests of content on 2.5G and 3G networks, but the slow development of m-commerce and 2.5 and 3G technologies has made the company work with more simple services e.g. using SMS technology. The role of the partners in the project has both been technological, but also as advisors. They are all a part of a business advisory board that evaluates the ideas, after an initial selection by MobileContent. The advisory board selects prospective ideas and begins cooperation with the people behind the idea and helps them with the next steps of developing the idea. The company has thus found a business in servicing and testing possible mobile content companies.

A big problem is that to write content for early generation devices one has to be quite technologically knowledgeable, but technological knowledge may come at the expense of media savvy, so the problem is how to integrate 'style and fashion masters' along with 'technology gurus' – the very different standards for judging are important. This also relates to the problems experienced by the early attempts at m-commerce, which mainly where technology driven. The MobileContent project tries to overcome this problem by allowing content providers to concentrate on the content and support them in creating business models and solving technical problems. The company has been partly financial supported by the DDN policy program, but the company will continue after the end of program. The business plan for the company is targeting a role as an aggregator for mobile technology solutions i.e. platforms and applications. They are already working as an aggregator, where they are selling and implementing applications developed by other companies e.g. E-mail2SMS that makes it possible to

send SMS messages from the normal email program, mobile marketing and terminal management etc. The company is a part of the service infrastructure as displayed in figure 3 and could perhaps get an important role in the development of m-commerce, diversification of the mobile phone platform and mobile technologies by being a kind of a broker and selling standardized product solutions, but this still has to be seen.

8   Diversification of the mobile phone platform and content providers focused on other applications

The high penetration of mobile phones has lead firms to seek in diversification of the mobile phone platform. The mobile phone is integrated in the business, through applications that increase service and minimize costs or support knowledge sharing. These are using the advantages of the mobile phones long reach and 'always on' feature. The functionalities for the user are the main driver, but the target is not the mass marked, but more narrowly defined groups. The market seems to be somehow neglected by operators, but it offers many opportunities.

8.1   The Mobile Employee

Net-Mill[15] was founded in 2001 as a subsidiary of a North Jutland based firm Lyngsø Industry. They wanted to work with the mobile Internet and began making WAP-portals, but there were no market for these, so they diversified into making mobile solutions for logistics. By using a scanner for a GPRS enabled mobile phone and barcodes, they have developed a system for online and mobile time registration, stock control and other logistic related services. The application is browser based and can be used on various mobile devices e.g. laptop, PDA etc. In this case study the focus is however on the solution including a mobile phone. The mother company Lyngsø Industry's main area of activity is logistics solutions for industry, airports, postal and parcel post. The activities of Net-Mill are combining the competencies of logistic solutions and adding the knowledge base of mobile Internet or mobile data communication. The company participates in the DDN program with the project 'The Mobile Employee'. The product is making the working procedures easier for both the company's mobile employees and for its office staff. The traditional, manual time sheets will be replaced with bar codes, and the registrations will automatically be transmitted to the company's financial system, when the employee uses the scanner. Mobile stock management, immediate invoicing and planning are also a part of the system.

It is a problem in the small and medium tradesman firms that the registration of the work is faulty. The tradesman is usually doing all the administrative work regarding specifications of bills etc. in the evenings, which is problematic, since they often only have insufficient handwritten notes to complete the registration work. This is time consuming and the tradesman looses much money on wrongly time registration and on forgetting to put the used spare parts on the bill. Another problem is stock management, since the employee is mobile he has to carry all the spare parts in the van, but it is often a problem that he runs out of certain parts and has to drive back to the firm and get it. Using the system can solve these problems.

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[15] http://www.denmobilemedarbejder.dk/dmm/index.jsp

The product consists of a mobile telephone with a small bar code scanner attached. The scanner is developed by a L.M. Ericsson spinoff in Sweden and was originally designed for the consumer market. It can easily be attached to the mobile phone. The mobile phone is running on the GPRS network, which allows the user to be always online. The idea of using a barcode scanner for logistics is well known, but the systems are quite expensive and the new scanner attached to the mobile phone has several advantages since it is online, cheap and mobile. The mobile scanner is not limited by the memory of the scanner, which is a problem with traditional handheld scanners, since it is online it 'knows' the entire list of commodities. The mobile phone is logged on to a server at Net-Mill, which is connected with different actors depending on the wanted service. It can be connected with the computer system at the firm, the warehouse, and the wholesale supplier.

Net-Mill has developed the platform and the database, but they are also developing the applications. The platform is the most important part of the system since different applications can be added depending on the user need. The main issue is user friendliness and the system is kept as simple as possible. The platform is fixed, but the content can be changed between different business segments e.g. carpenter, plumber, but also within the segment i.e. the master and the apprentice and according to the access device i.e. desk top or mobile. Using a scanner whenever a task is done or a spare part used, collects data. The data is automatically continuously transferred to a server where the data is computed and presented in a browser program for the user. When the user verifies the data, it is automatically transferred to the firms financial system. Since the application is browser based, all users with an Internet connection, username and a password have access to the application. The application is build up in various modules that cover different user needs, which also allow the firm to put together the needed modules to an individual system. When the system is online it is possible to adjust the individuals units to the individual user in the company. User-friendliness and user adjustment is very important for the success. If the system is not easy and seems complicated, then the user will stop using it or loose productivity as a result the application is adjusted and the users don't see the same on the screen. This feature is important since the screen size on the mobile phone is very limited and the user don't want to be confused by functions and options not needed in the daily work. The system is flexible and can be adjusted, if the user needs a more complicated system.

The platform is flexible and can be adjusted to different industries, but the first application has been targeted at the small tradesman firms. They have cooperated with a large wholesale of metal products company. The cooperation has been focused on the small or medium plumber firms that are customers in the wholesale company. The system has been tested on some of the experienced and demanding customers, who want to have their vans organized and stock control. The wholesale company is contributing with industry experience and customers. After the test period the wholesale firm are going to sell a standard package of the system to their customers. They can install the system and modify it for the customer. Many of these are small firms that can use a standard solution.

The main idea behind the system is using barcodes and data management to organize the work for the plumber. Barcodes has been added to all the work functions and the user just have to scan the barcode, add a number or some comments if needed and verify the action. When the plumber leaves the home/firm he scans a barcode named 'start' from a list where the work functions are specified. The mobile phone displays the selected work function and he controls the time and press verify. When he reaches the customer he scans the barcode 'beginning work' and verifies. All this information is

now stored in the system and at home in the firm they always can see where the worker is. The worker is not under constant surveillance since it is only possible for the boss to see what the worker has registered after the worker has verified the bill. If the job takes longer than expected it is possible to warn the last customer that day or reschedule etc. The system requires some reorganizing in the plumbers van, since the equipment and spare parts etc. has to be in order. A barcode is attached to the different boxes with parts (they also have a book with all the barcodes) and when the plumber uses a spare part he scans the barcode and it is registered in the system. A possible problem could be the response time on system because if the worker has to wait on a slow system he would stop using it, but the response time is very quick (approximately one second). The user doesn't necessarily have to scan the individual parts during the work, but can also do it afterwards. When the job is finished the employee either scans the barcode for finished job and he can see the total work time and the used parts, which he has to verify or add changes. It is now possible to get the bill faxed to the customer or let the customer verify the bill on spot. The system can be integrated with the firms existing financial system. The collected data can be processed in different ways depending on who is connected to the system. The worker can later on sit at home at the computer and control the work of the day and the manager or the financial department can control the number of work hours and use it for calculating wages. If the system is integrated with the wholesale supplier it is possible to keep control of the part used and stock in the van, and order new supplies if needed.

Several different applications can be added to the platform. Their first customers are in the plumbing business, but they are developing new applications for other business e.g. carpenters and lately for a large producer and distributor of alcohol. The system is on the market, and the direct competitors are few, because of the complexity of the platform. Many of the competitors are focusing on single markets with very narrow solutions that are not online.

Since the system requires a higher level of organization in the daily work of the user and also of the equipment in the van it is not all tradesmen who can use the system and get productivity gains. The user needs to be willing to adopt the changes in the work routine. Test of the system have however shown that the users consider it to be an advantage in the daily work and user-friendly. The system however has some disadvantages or limitations when it is necessary to fill out more complex documents, that are easier completed with a ball pen. The solution has been to include an electronic pen together with the mobile phone in the system. The pen recognizes the document and the individual boxes, and is transmitting all the registrations electronically via the mobile phone the server. The pen is still functioning as a ball pen and the worker can immediately see the result of the physical paper. The pen also allows for the customer to sign for packages that automatically becomes electronic registered.

8.2   Remote monitoring of cardiac patients

Modern health services seek to put resources to efficient use. A field of focus within the health services could be the improvement of existing methods of diagnosing and treatment. Today diagnosing and treatment is often performed during hospitalization. With such days of admission being a heavy burden of cost to the health budget, it is found attractive to assess the scope of moving treatment from the hospitals into the patients' homes. The general purpose of the project is to establish a new telemed-

icine method of examination of cardiac patients to reduce the demand for hospital bed-days, to bring down the costs of the health sector and, in some cases, to optimize the treatment of the patient. The project includes design and development of an intelligent and reliant mobile teleelectrocardiography system for patients with hearth rhythm disturbances using mobile phones with GPRS and Bluetooth technology. By using Bluetooth and GPRS the patient becomes mobile and there is no installation and no need for a visit by a technician. The Bluetooth technology is safe by encryption and the frequency hopping is limiting possible interference and increasing stability and security. The aim is to build a telemedicine system for the continuous wireless transmission of cardiological signals from the patient's home to the Cardiological Department of the Hospital of Aalborg. This prevents or cuts down admissions and the number of bed-days, and the effect from the treatment can be assessed under the conditions normally experienced by the patient. The patient will probably experience a better quality of life, since it reduces uncertainty and the number of hospital days, and improve the treatment. Likewise has the existing treatment system a two-month waiting time and further delays in the processing of results etc.

The participants are L.M. Ericsson (mobile phone manufacturer), Sonofon (operator), Danica Biomedical (manufacturer of electrocardiogram (ECG) equipment, which recently was acquired by General Electric), the Hospital of Aalborg and the County of North Jutland. L.M. Ericsson deliver the mobile communication technology and owns the software platform and the research, development and design, Danica Biomedical implements the module in their ECG equipment and is also doing the integration and design with regard to the ECG processes. The hospital is testing the equipment and the role of the operator is to provide a stabile and reliant GPRS mobile communication connection, which is crucial for the success of the project. If the connection is not stabile it will effect the reading of the signals, but more importantly giving the patient a feeling of it is not working probably and is not as secure as staying at the hospital, which will make the project a failure. This has set some technical requirements to the operator and giving the operator the opportunity to test the network with an advanced user.

The traditional treatment method of patients with heart rhythm disturbances has been monitoring with short-range telemetry in the hospital for two to five days. The continuous monitoring is important due to the registration of tendencies to pause in the hearth beat, too high or low average hearth rhythm in a minute, warnings of virulent hearth rhythm disturbances and short-term very fast hearth rhythm frequencies. The treatment is rhythm-regulating medication. The hospitalisation procedure requires many resources and it can take many days to determine the appropriate treatment i.e. medicine. The effect of the medicine has however proven to be affected by the patient's activity level[16], which makes correct medication problematic, since it is only possible to monitor the patient in a non-active position at the hospital. The remote monitoring gives the opportunity to evaluate the effect of the medicine in daily live activities and ensure the long time effectiveness of the treatment. The quality of the treatment improves by monitoring of the effect of the medicine, but also the length of the continuous monitoring. The known technology for outpatient treatment is recording with a tape recorder, and mailing the tape to the doctor. The doctor analyses the recorded heartbeat and prescribe medicine

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[16] The medicine is very effective for patients with a low activity level, which is the situation in the hospital, but during activity the effect is more uncertain. When the patient leaves the hospital and return to the daily life the activity level rises, which effects the medication.

or put the patient in hospital. If the patient has to be put in hospital is has to go to the administration that contacts the patient. The process is very time consuming, error related and has a long response time. There are also competing systems using the mobile phone, however these are not online, but only recording for a few seconds at the time and then transmitting the recording to the hospital.

The remote monitoring of cardiological works by using small electrodes placed on the patient's chest to register the hearth beat. This information is transmitted online to the mobile phone via Bluetooth signals and sent via a GPRS network to a server at the hospital. The system registers information on the hearth rhythm, blood pressure and the amount of oxygen in the blood. The hospital personnel analyse the data and remotely monitor the patient's condition. The patient put on the electrodes themselves, gets the medicine and the monitoring can begin. The doctor confers with the patient over a telephone and a health visitor visits the patient occasionally. The system is still being tested, but it is estimated that 50% of the patients can be monitored from home with the new system. The medico electric monitoring system is an existing system that has been technological improved by using the mobile phone and thus been giving a much longer range and has become more flexible.

As a numerical example on the possible effects, the hospital serves approximately 200,000 people and has 900 cardiological patients with hearth rhythm disturbances hospitalized every year[17] in two to five days. The average costs is approximately 400 € per patient per day and they estimate that half can be kept at home. The hospitalisation days per patient can be reduced (expected 1.5 days on average) and scaled to the entire country the savings will be considerable even with the extra costs taken into consideration (e.g. mobile communication, mobile phones etc.). The technique could also be applied for other monitoring of hearth beat situations e.g. to transfer ECG data from ambulances to the cardiology department.

9 Key actors who can move or block the process of fusion

In m-commerce we find several key actors that, in the current market situation can play a crucial role in the process of fusion and development of the market:

- The operators seems to be the main key actor since they have the 'control' of the contact with the users

- The price structure created by the operators is blocking entrants from enter the market

- The role of demand in the understanding the opportunities and the services offered by the new technology solutions

- The financial system can block the process by hindering the mobile payment system, since they have the control of a well functioning payment system

- The non network operators can move the process by increased interaction with content providers

- The handset producers through the interoperability of the mobile platforms and technological development

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[17] Approximately 40% of the cardiological patients in the hospital are caused by hearth rhythm disturbances.

10 Interaction between actors

From the case studies be find the following interaction between the actors. The interactions is collected in an interaction matrix, see table 1.

Table 1 Interaction and power between the actors matrix

	Interaction with technology providers	Interaction with technology users	Interaction with technology co-developers
Larger size/power than the other party	**Feature Request** (I.e. a supply contract) **The digital Mall** with small IT service providers	**Independent design of the technology** (taking into account feedback from selected users, or including as many features as possible) **The digital Mall** with focus groups **PMBS** with test users **Mobital** with users **Net-Mill** with buyers of their applications and test users	**Definition of interface specifications** (with which other developers of other components of the platform have to comply) **PMBS** with content providers
Equal size/power as the other party	**Joint definition of features** (provision of feedback for technological design). **Mobile Content** with operators and hardware suppliers **Mobile Gatekeeper** with content providers	**Joint Definition of features** (maybe through a partnership or inside a standard setting forum). **Mobile Content** with content providers and customers	**Joint development of the technology** (possibly inside a standard setting organization). **The digital Mall:** the bank with the operator
Smaller size/power than the other party	**"Off-the-shelf" purchase of the technology** **Remote Monitoring** with the operator **Mobile Gatekeeper** with an operator **PMBS** with terminal providers **Net-Mill** with hardware suppliers	**Feature Implementation.** **Net-Mill** with large wholesale companies **Remote Monitoring** with the hospital	**Compliance with interface specifications** (defined by other co-developers). **Remote Monitoring** with hardware supplier

Source: Structure adopted from García and Steinmueller (2003)

The operators seem to be the central node in the interaction matrix. They are engaged in cooperation in most of the case studies, which seems reasonable since they have the contact with the user, but this picture might be a bit misleading since the case studies all are participants in the DDN ICT policy program and all the projects started in 2001, when the operators still were quite open for cooperation. The continued crisis in the mobile communication industry, however, has lead the operators to focus on the core business. The DDN policy program encouraged the applicants to cooperate with several partners, which might have increased the participation of the local based operator. The operators seem to have to most to gain from m-commerce, depending on their role in the m-commerce value chain, but they seem reluctant to change their business models and allow other firms into the market by letting go some of their control of the customers.

10.1 Interaction with technology providers

- Many of projects interact with the operators, but the operators are the most powerful. The operators have the control and the interaction is often about using the network to test applications.

- In remote monitoring of cardiological patients the role of the operator is to provide a stabile GPRS mobile communication connection, which is crucial for the success of the project. If the connection is not stabile it will effect the reading of the signals, but more importantly giving the patient a feeling of it is not working probably and is not as secure as staying at the hospital, which will make the project a failure. This has set some technical requirements to the operator and giving the operator the opportunity to test the network and also worked as an advanced user. The purchase of technology can however still be characterised as 'off-the-shelf'.

- In PMBS, the operator Sonofon tested personal mobile broadband services on new terminals e.g. web pads, but the interaction was off-the-shelf purchase of technology.

- Net-Mill has in their project used a small scanner added to the mobile phone invented by a L.M. Ericsson spinoff. Even though the Net-Mill used the scanner in a new way, the co-operation and technological feedback has been limited.

10.2 Interaction with technology users

- The interaction with technology users have been quite widespread both in size/power and extent of interaction

- PMBS has run tests on broadband services with specific test users.

- Mobital has used their intensive contact and interaction with ordinary users and lead users to guide their technological development and business models.

- Remote monitoring of cardiac patients and Net-Mill have effectively cooperated with potential users in the development phase of the product and service. This contact has been very important for the companies

10.3 Interaction with technology co-developers

- Interaction with technology co-developers have to some extent been used, mainly in more specific areas e.g. in PMBS it was important to develop a platform for content presentation regardless of the users receiver device and across platforms.

11 Discussion

M-commerce seems to be moving out of the 'research lab' and into the market. Many of the new applications are however not directly m-commerce in the sense of buying via the mobile phone, but diversification of the mobile platform. While we are waiting for m-commerce, the use of and penetra-

tion of mobile phones keeps increasing. The mobile phones are becoming more technologically advanced in terms of colour screens, higher speed, cameras, higher speed and memory etc. The operators are also introducing new 3G mobile technologies, with high bandwidth allowing more advanced services, with more or less success, but the m-commerce is still lacking. The process has mainly been technology driven, where user education and social shaping of technology have been neglected. This is closely related to the extent of integration of infrastructure, platforms and applications and the role and power of the actors in the industry.

Two of the initial hurdles in m-commerce seem to be business models and payment systems. Before it becomes commerce, some kind of payment or money transaction is needed, except from sponsored service. This payment can take various forms either on the monthly telephone bill to the operator, subscription fees, direct mobile payment etc., but the payment for the services or goods are still unsolved questions of how much, who and how? Other problems in the development of the m-commerce industry relates to the combination of the different actors and the extent of integration between infrastructure, platforms and applications. Especially within the m-commerce service infrastructure is the extent of integration between platforms and application unsettled. The control of and access to the users are creating unsolved problems, since all the actors: operators, non-network operators and manufactures of mobile phones, financial organisations, content- and platform providers, retailers, users and regulatory bodies are connected to each other. The operators are still controlling the access to the customers and are not willing to allow others into the market by creating business models that allow the content provider to offer services that are priced to attract a larger market. A common mobile payment system is also missing, mainly due to disagreement between the operators and the financial system. While these problems are unsolved, m-commerce is only evolving very slowly and new entrants and existing firms are working on systems bypassing the operators.

The m-commerce is however in spite of all these problems still evolving very slowly through more simple applications based on the SMS technology (ring tones, logos etc), but also in combination with Internet based solutions. Diversification of the mobile platform can also play an important role in the development of m-commerce by creating successful application and platform, and educating the users. A future killer application can maybe be found in this area, but it seems doubtful that m-commerce will become successful without an enhanced effort to increase interaction between the actors in the industry and further 'education' of the potential users.

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