Operator Roles in Mobile Broadcast

ABSTRACT
Mobile broadcasting is entering a phase of commercial launches worldwide. However, the related value network remains unclear: the markets and the conventional roles of broadcasters, broadcast network operators and cellular operators are becoming intertwined in an unprecedented manner. This paper proposes a generic model for analysing the mobile broadcast value networks. Building on that model and by applying the methods of techno-economic analysis, simulation-based results are presented on the feasibility of selected mobile broadcast value network configurations in the Finnish market.

KEYWORDS
Mobile broadcast, value network, DVB-H, operator roles, techno-economic analysis

1. INTRODUCTION
At present, mobile broadcast technology is being commercially deployed in a number of countries in Europe, Asia, and North America. Looking at digital video broadcasting for handheld devices (DVB-H), eight countries had by 2007 already seen commercial launches and more have followed during 2008. The business environments and selected approaches differ country by country. At the vertical extreme, a single company can assume all functional and business roles needed for providing a mobile broadcast service with pay-TV functionality. At the other end, all or almost all of the roles can be provided by different companies.
country by country. At the vertical extreme, a single company can assume all functional and business roles needed for providing a mobile broadcast service with pay-TV functionality. At the other end, all or almost all of the roles can be provided by different companies. In Finland, the focal point of this study, the distributed roles scenario has been selected. In accordance with an existing mobile broadcast business role terminology (Kivisaari, 2006), Digita Oy acts as network operator and data-cast operator whereas content provision is assumed by Finnish broadcasters. As of December 2007, no active commercial service operators had emerged as the DVB-H service in Finland has been launched with free-to-air broadcasts only.

This paper provides new insights into several aspects of mobile broadcast business. First, a generic model for the mobile broadcast value network is presented. Actual market situations will differ from country to country and case by case, but the granularity of the model is also considered to be applicable outside the Finnish marketplace. The impact of some of the technical characteristics of mobile broadcasting on the business conditions in the emerging mobile broadcast markets is also demonstrated. With significant initial network investments and the diffusion inertia of DVB-H capable handsets, the build-up of the mobile broadcast market takes time. The presented research aims to identify obstacles to successful evolution.

Finally, techno-economic analysis results of selected mobile broadcast pay-TV business scenarios are presented. The main variables in simulations are the availability of free-to-air simulcast content (alongside paid subscriptions), and the selection of roles in the value network by existing companies: broadcasters and/or mobile network operators. Instead of forecasting the exact profitability of a particular scenario, the focus is on comparative analysis between the scenarios, aiming to find the optimal positions of mobile operators and broadcasters, respectively. The selected scenarios that are simulated are not real – at least none of them has been realised yet – but they are based on the actual initial situation in Finland where the only DVB-H network operator license has been given to Digita Oy. According to licence terms, Digita must sell the capacity to other companies (content providers and/or service operators) and hence the vertically integrated model is currently not possible in Finland.

2. BACKGROUND

Digita Oy, a Finnish broadcast network operator, launched its commercial DVB-H network in the capital region around Helsinki and in the cities of Turku and Oulu on 1 December 2006. According to Digita, the initial population coverage of the network is approximately 25% and in the DVB-H license Digita agreed to extend the network to at least 40% population coverage by the end of 2007 (Digita Oy, 2006).

DVB-H capable handsets, namely Nokia N92 and Nokia N77, have been available to Finnish consumers since the spring of 2007. By December 2007, a year after the DVB-H network launch, pay-TV services were not yet available in Finland. Five free-to-air services exist, and uncertainty continues to surround the shape of the mobile-TV value network and the pay-TV business models. This uncertainty creates the motivation for this study. Industry's ability to construct a viable value network around mobile broadcast was perceived as a key factor in delivering compelling services to the consumers, which in turn can fuel the future success of handset vendors, mobile operators and content providers alike. On a broader level, the kind of service convergence that mobile broadcast offers technologically and in a business sense may open possibilities for entirely new business phenomena (Kivisaari and Luukkainen, 2005). It seems that 3G mobile phones with DVB-H receivers will be the first mass-market devices with a capability of receiving digital television content, while having an IP-based return channel well integrated in the same device.

Despite the technical complexity of an end-to-end mobile broadcast system, it is fair to say that the difficulties facing DVB-H today are predominantly business-related.
did not agree on extra copyright fees planned for DVB-H simulcasts (MINICT, 2006). Finally, in May 2007 the Finnish copyright society Teosto and the two largest commercial broadcasters, MTV and Nelonen, agreed upon a revenue-based deal in which copyright fees for music is based on actual new revenues generated by mobile broadcasting (Teosto, 2007).

3. RESEARCH QUESTIONS AND METHODS

In a mobile broadcast value network the most important business roles are:

1. Content provision (CP): the broadcaster role, aggregation of content programs into tangible packages such as TV or radio channels;
2. Datacast operator (DCO): provision of mobile broadcast platform services (including the Electronic Service Guide generation and control of the Digital Rights Management (DRM) system for pay-TV services), acting as a broadcast capacity intermediary between the broadcast network operator (NO) and the content providers;
3. Network operator (NO): operating the DVB-H broadcast network (holder of a spectrum license);

Companies in the broadcast and cellular industries may be interested in assuming some or all of the aforementioned roles, and because of the number of roles available the business structure can be arranged in many ways. However, it appears that only a subset of all possible value network configurations can prove successful, and for this reason the research question for the techno-economic analysis is formulated as follows: Which of the possible value network configurations would be the most attractive from the point of view of mobile operators and broadcasters, respectively?

Before embarking upon that question, a model for the overall value network is needed so that the relevant business relationships and justified simulation parameters can be found. Hence, Chapter 4 aims to answer the following research question: Which are the business relationships between companies involved in providing an end-to-end mobile broadcast service, and how are these relationships linked to technical interfaces in underlying systems and architectures?

After specifying the generic value network model, the business linkages are formulated in order to facilitate the numerical simulations. What emerge during this process is the dilemma related to starting a new broadcast service with a zero installed base of compatible terminals and no existing DVB-H broadcast network. As will be shown later, mobile broadcast differs from

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**Figure 1: Mobile broadcast operator roles**
many other mobile services due to the substantial incremental investments required in the network building. Furthermore, end-user network effects as presented by Shapiro and Varian (1999) do not exist for mobile broadcast in the same way as in messaging (SMS, MMS) services or voice calls. DVB-H viewers are using a broadcast service in which information typically flows only in one direction. This is in contrast with most other mobile services where it is crucial that other users also have compatible handsets, and where the value of the service for an individual increases as other users also adopt it. However, some indirect network effects exist for mobile broadcast as well. In the long-term, there has to be a sufficient number of users to keep the operating of a DVB-H system economically viable and to create the necessary market demand for good-quality content.

To understand the special nature of the mobile broadcast business and to be able to prepare a balanced simulation model for the analysis, Chapter 5 answers the following research question: Which are the distinct technical characteristics that shape the mobile broadcast business, and how will mobile broadcast differ from other mobile added-value services?

This paper evaluates the mobile broadcast business case in Finland and aims to answer the research questions by applying a techno-economic analysis method supported by expert interviews and a literature study. A generic value network model is identified for mobile broadcast services, related cash flows are quantified, and a number of selected value network configurations is analysed using a Microsoft Excel simulation tool developed by a number of consecutive European research projects, the most recent of which was ECOSYS (ECOSYS, 2007). The analysed scenarios and other inputs for the techno-economic model are based on a literature study, expert interviews, and the contributors’ prior experience and knowledge on network business and mobile broadcast technology. In the semi-structured interviews, expert opinions were gathered from different sides of the value network. The interview questions addressed emerging services, business models and revenue sharing. The interviewees came from Digi TV Plus Oy, Digita Oy, Elisa Oyj, MTV Interactive Oy, Nokia Oyj, SWelcom Oy, Telecommunications Software and Multimedia Laboratory of Helsinki University of Technology, and TeliaSonera Oyj.

4. A VALUE NETWORK MODEL FOR THE MOBILE BROADCAST INDUSTRY

Instead of Porterian value chains the mobile broadcast industry structure is modelled, based on the concept of value networks. According to Li & Whalley (2002), “a value network can be seen as a series of intertwined value chains where some nodes are simultaneously involved in more than one value chain.” To construct a value network model that is emerging around DVB-H in Finland, earlier models suggested by Kivisaari (2006), the Digital Terrestrial Television Action Group (DigiTAG) (2005) and the European Broadcasting Union (EBU) (Weck and Wilson, 2006) are applied and extended. The interviewed experts stated their views on the company roles and relationships, and comparative arrangements of several mobile-TV pilots and live networks around the world were studied, building on the work of Braet et al. (2006).

The resulting generic value network model and the associated business roles are described in Table 1 and Figure 2, showing the mapping of different roles and related incoming and outgoing cash flows and content streams. The primary source of money in the value network is the end-user. End-users finance the value network directly and indirectly by handing over money for handsets, paid mobile broadcast services, TV license fees and goods advertised on mobile-TV. The money is then channelled to each player in accordance with their position in the value network, risks taken, and negotiation power.

This model attempts to cover the most relevant roles that tend to vary country by country. For simplicity, some roles are not explicitly shown. For example, the areas of DVB-H broadcast hardware, DVB-H specific handset R&D (and related intellectual property or licensing issues), and application development (electronic service guide (ESG), interactive terminal functions) are intentionally left out. This is because of the assumption that the mobile broadcast industry will be more or less unified, meaning that the majority of mobile broadcast networks and devices will become interoperable. Thus, the model needs to be reworked if the combination of DVB-H and OMA’s Mobile Broadcast Services Enabler Suite BCAST (ESG & service protection and purchase [SPP]) standards do not succeed in gaining a dominant position globally. In that case, according to some of the interviewed experts, the handset manufacturers’ scale economies would not be realised (locally customised broadcast
service platforms and device software would be needed) and as a result the creation of mass markets would suffer globally due to the lack of affordable terminals.

The possible take-up of entirely new applications or service types, enabled by the mobility of users and the capabilities of interactive terminals and software platforms, is not covered in the presented value network model either. This is due to the selected five-year study period: according to many experts, the mobile broadcast business will start with existing broadcast-type content (television and radio services) and the significance of emerging service types will be determined several years from now.

5. MOBILE BROADCAST TECHNICAL CHARACTERISTICS

In October 2007, fewer than ten countries had launched DVB-H services and some 27 countries were running DVB-H trial networks (DVB Project, 2007). However, almost all countries still lack a wide-coverage mobile broadcast network, and the availability of commercially launched DVB-H handsets is limited to a handful of models worldwide. At the same time, the initial network building investment for DVB-H network operators is significant. While sharing the physical layer technology with DVB-T, DVB-H still requires a separate network to be built. DVB-T and DVB-H seldom share multiplexes—although this is technically possible—due to business and signal quality reasons. First, DVB-T networks seldom have leftover capacity that can be given to DVB-H, and second, dividing the

<table>
<thead>
<tr>
<th>Role name</th>
<th>Role description</th>
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<tbody>
<tr>
<td>End-user</td>
<td>Consumes mobile broadcast services and pays for them directly or indirectly.</td>
</tr>
<tr>
<td>Network Operator, NO</td>
<td>DVB-H frequency licence owner, operates the DVB-H network and IP multicast network carrying content streams to the transmitter sites.</td>
</tr>
<tr>
<td>Datacast Operator, DCO</td>
<td>Performs the central management of a technical mobile broadcast platform and provisions the content providers with broadcast capacity (obtained from NO).</td>
</tr>
<tr>
<td>Content Provider, CP</td>
<td>The broadcaster – runs one or more mobile-TV or radio channels by creating the content in-house or by buying it from content aggregators/creators.</td>
</tr>
<tr>
<td>Content creator / owner</td>
<td>Produces the original content or otherwise is the holder of related IPRs.</td>
</tr>
<tr>
<td>Service Operator, SO</td>
<td>The rights issuer – accepts purchase requests, sends related Digital Rights Management (DRM) rights to mobile terminals, and creates billing records.</td>
</tr>
<tr>
<td>Mobile service operator</td>
<td>Provides cellular services – has a billing relationship with mobile subscribers.</td>
</tr>
<tr>
<td>Mobile network operator</td>
<td>Operates a cellular network and sells capacity to mobile service operators and MVNOs.</td>
</tr>
<tr>
<td>DRM trust model provider</td>
<td>Certifies the robustness of the DRM implementation of terminals and rights issuing servers.</td>
</tr>
<tr>
<td>Handset manufacturer</td>
<td>Manufactures DVB-H handsets and sells them to retailers.</td>
</tr>
<tr>
<td>TV fee collector</td>
<td>Collects TV fees from end-users possessing a television receiver.</td>
</tr>
<tr>
<td>Collecting society (also known as the copyright society)</td>
<td>Collects payments for the usage of copyrighted music on behalf of the copyright owners.</td>
</tr>
<tr>
<td>Advertiser</td>
<td>Pays for advertising on TV or radio and/or sponsors content creation.</td>
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Table 1: Key roles in the mobile broadcast value network
capacity of a DVB-T modulator (in 64QAM mode) to high priority (for mobiles) and low priority (for set-top-boxes) parts will not deliver comparable reception reliability to dedicated DVB-H networks. In dedicated DVB-H networks the physical parameters and error correction levels can be optimised for mobile reliability (Faria et al., 2006) instead of maximising fixed reception capacity, delivering better end-user experiences for the mobile services.

**According to interviewed experts**, the total amount of transmitters and gap fillers needed for very good outdoor and reasonably good indoor coverage for DVB-H would be approximately at a logarithmic midpoint between the number of traditional broadcast sites and the number of cellular base stations. Although the broadcast masts and suitable cellular sites can provide significant parts of the needed infrastructure as a legacy, the deployment of IP encapsulators, communication links, DVB-H transmitters and repeaters leads to a substantial investment. To justify this investment, network operators have to be able to start selling that capacity from the start, even when the diffusion of handsets has barely started. The Finnish DVB-H network operator, Digita, has addressed this issue by announcing a DVB-H capacity pricing schema for nationwide mobile television channels which indicates discounted prices for the initial stages and gradual price increases towards the longer-term price levels. The original pricing schema announced by Digita is shown in table 2. In April 2007 Digita released an updated pricing list which includes prices also for unencrypted DVB-H television services and radio services (Digita, 2007a).

**Due to the same** basic reason (DVB-H handset diffusion inertia), similar pricing evolution can be recognised and anticipated on the content provider (CP) and service operator (SO) side as well. In May 2007, the two largest commercial TV broadcasters in Finland, MTV and Nelonen, started to broadcast their main TV channels over DVB-H as free clear-to-air services. In addition, two television channels (The Voice and Elisa TV) and one radio channel (Voice Radio) are being broadcast. All services are free for end-users; encryption is not used and rights issuing servers do not exist, meaning that the role of a mobile broadcast service operator is yet to be introduced on the Finnish market. Nokia Mobile Broadcast Solution (Nokia Corporation, 2007a), Digita’s mobile broadcast server platform of choice, supports broadcast stream encryption and pay-TV functionality, but these features are currently not used.

<table>
<thead>
<tr>
<th>Nationwide</th>
<th>Population Coverage</th>
<th>Population</th>
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<tbody>
<tr>
<td>DVB-T Ch.</td>
<td>€ / Month / Ch.</td>
<td>€ / Month / Ch. / Person</td>
</tr>
<tr>
<td>Coverage [%]</td>
<td>100 %</td>
<td>0.047</td>
</tr>
<tr>
<td>Nationwide digital TV</td>
<td>5 200 000</td>
<td>245 000</td>
</tr>
<tr>
<td>DVB-H Ch.</td>
<td>Population Coverage</td>
<td>Population</td>
</tr>
<tr>
<td>Coverage [%]</td>
<td>€ / Month / Ch.</td>
<td>€ / Month / Ch. / Person</td>
</tr>
<tr>
<td>First 4 months</td>
<td>25 %</td>
<td>5 900</td>
</tr>
<tr>
<td>Next 9 months</td>
<td>32 %</td>
<td>19 700</td>
</tr>
<tr>
<td>Jan 2008 onwards</td>
<td>40 %</td>
<td>39 400</td>
</tr>
<tr>
<td>DVB-H</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handset diffusion</td>
<td>Handset adopters</td>
<td></td>
</tr>
<tr>
<td>[% of population]</td>
<td>€ / Month / Ch.</td>
<td>€ / Month / Ch. / Person</td>
</tr>
<tr>
<td>10 000</td>
<td>0 %</td>
<td>19 700</td>
</tr>
<tr>
<td>100 000</td>
<td>2 %</td>
<td>39 400</td>
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<tr>
<td>500 000</td>
<td>10 %</td>
<td>39 400</td>
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<tr>
<td>1 000 000</td>
<td>19 %</td>
<td>39 400</td>
</tr>
</tbody>
</table>

Table 2: DVB-H and DVB-T capacity pricing in Finland with per-viewer calculations based on prices announced by Digita Oy. The nationwide DVB-T service price is an example; actual pricing depends on selected DVB-T service bitrates (Digita, 2007b).
Broadcasting is by nature a mass-market service, and it typically responds very significantly to economies of scale. According to expert interviews and latest market developments in Finland, it appears that when the scale economies are not yet realised – during the ramp-up stages of the mobile broadcast market – both network capacity pricing and end-user service pricing may be adjusted so that they encourage service adoption by content provider companies and handset users. However, the way in which the mobile broadcast business is structured can have a big impact on the service adoption speed. A chicken-and-egg phenomenon may occur when service operators do not want to invest in setting up pay-TV services or buying capacity if there are not enough potential users (handset owners). Simultaneously, end-users may not want to buy handsets if there is not a big enough variety of available content.

A further issue concerns the competition between mobile broadcast standards. Even after selecting the radio technology (DVB-H, MediaFLO, DMB etc.) many choices are to be made by the handset vendors, mobile broadcast system suppliers and service operators. These choices include the electronic service guide standard and mechanisms for service protection and purchase. Both for ESG and SPP the broadcasting industry, lead by the DVB organisation, has its own proposals and the mobile industry (handset vendors, mobile operators etc.) have their own, although much cooperation is taking place as well. Table 3 lists the ESG and SPP standards proposed by Digital Video Broadcasting (DVB) and the Open Mobile Alliance (OMA) organisations.

<table>
<thead>
<tr>
<th></th>
<th>OMA</th>
<th>DVB</th>
</tr>
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<tbody>
<tr>
<td>ESG</td>
<td>OMA BCAST ESG</td>
<td>DVB IPDC ESG (formerly CBMS ESG)</td>
</tr>
<tr>
<td>SPP</td>
<td>OMA BCAST DRM Profile</td>
<td>Open Security Framework (DVB SPP Annex A)</td>
</tr>
<tr>
<td></td>
<td>OMA BCAST Smartcard Profile</td>
<td>18Crypt (DVB SPP Annex B)</td>
</tr>
</tbody>
</table>

Table 3: Electronic Service Guide (ESG) and Service Protection and Purchase (SPP) standards proposed by Open Mobile Alliance (OMA) and DVB organization, respectively. Note that OMA BCAST DRM Profile and 18Crypt are practically identical as SPP solutions (Nokia Corporation, 2007b).

ESG defines how content schedules, metadata and purchasable items (such as pay-TV channel packages or pay-per-view programs) are presented to the handsets. SPP defines how the purchase requests, encryption keystreams (broadcast), and delivery of DRM rights objects, are implemented. Hence, the developments in the ESG and SPP standardisation and the choices made by manufacturers and operators are crucial for the future of mobile broadcast business worldwide. Competing standards could fragment the markets, delaying the formation of scale economies, and making it more difficult to reach profitability in all levels. Handset vendors would lack scale economies if different regions selected different standards, or they would have to support many standards simultaneously, both cases possibly leading to more expensive handsets. This would in turn affect the speed of handset adoption, affecting the time frame in which scale economies would start working for regional broadcaster companies and service operators – and consequently for the DVB-H network operators as well.

A chicken-and-egg phenomenon may occur when service operators do not want to invest in setting up pay-TV services or buying capacity if there are not enough potential users (handset owners). Simultaneously, end-users may not want to buy handsets if there is not a big enough variety of available content.

According to an expert interview in October 2007, the global marketplace seems finally to be moving towards a common set of standards. OMA BCAST ESG and corresponding SPP solutions (DRM Profile, and later also Smartcard Profile) enjoy a wide support today, also in companies that earlier backed the DVB IPDC ESG standard. The combination of DVB-H, OMA BCAST ESG and the OMA BCAST SmartCard SPP seems especially popular among decision makers in mobile network operator companies in many countries.
All in all, the aforementioned technical challenges are currently having an effect on the speed of the mobile broadcast market creation, but what separates mobile broadcast most from other mobile value-added services is its industry-mixing nature. What is taking place is a collision of broadcast and mobile industries, two very established but fundamentally different businesses. This creates new possibilities – brought by convergence in the end-user functionality – but also friction in setting up the rules of the game, and possibly some strategic chicken-and-egg situations.

What separates mobile broadcast most from other mobile value-added services is its industry-mixing nature. What is taking place is a collision of broadcast and mobile industries, two very established but fundamentally different businesses.

6. TECHNO-ECONOMIC ANALYSIS
The business case of mobile broadcast is a moving target, with many uncertain and variable input parameters. A study period of around five years is chosen, from April 2007 to the end of 2011, which is considered as a reasonable period for making penetration forecasts and enabling practical conclusions to be drawn about the comparative profitability of the analysed scenarios.

A. SERVICE OPERATOR SCENARIOS
For the techno-economic analysis, the regulatory and market situation in Finland is used as a starting point. In Finland, a single DVB-H license has been granted to Digita Oy, which acts as a pure network operator, selling network capacity to service operators. Digita is not allowed to act as a service operator, and its DVB-H capacity pricing must be non-discriminatory and cost-oriented, which is to say, transparent, the same for all buyers and based on true costs plus a fair and reasonable profit margin. The license conditions also restrict the maximum amount of capacity sold to one player to 33% of the total to enable a healthy market (one party cannot buy the whole capacity and resell it at a higher price).

Whereas the network operator and datacast operator roles are determined by regulation to belong to Digita Oy, the service operator role is possible for virtually any interested company. Two major groups of companies are particularly interesting: established broadcasters (of traditional television) and mobile operators.

If mobile network operators (MNOs or mobile virtual network operators – MVNOs) assume the service operator role, they can either decide to buy the required network capacity (channels) and TV programming by themselves (take the content provider role), or resell other content providers’ TV channels and channel bundles. On the other hand, if a broadcaster decides to become a service operator, it can either outsource its pay-TV billing to mobile service operators, or handle pay-TV billing in-house using alternative methods.

Based on the discussion above, and applying the work of Kivisaari (2006), DigiTAG (2005), and the EBU (Weck and Wilson, 2006), seven different scenarios for analysis are constructed:

1. MNO approach (MNO as CP, SO, and content aggregator)
2. MVNO approach (MVNO as CP, SO, and content aggregator)
3. Broadcaster approach with outsourced billing (broadcaster as CP & SO, billing outsourced to a MNO/ MVNO)
4. Broadcaster approach with in-house pay-TV billing (broadcaster as CP & SO, in-house billing)
5. Pay-TV broadcaster with outsourced billing (broadcaster as CP & SO, like Scenario 3, but with only pay-TV channels)
6. Co-operation approach, MNO with broadcasters (broadcasters as CP, MNO as SO)
7. Co-operation approach, MVNO with broadcasters (broadcasters as CP, MVNO as SO)
Each of the seven scenarios is modelled and analysed separately under the assumption that simulcasts (i.e. simultaneous transmissions of the ordinary television programs over the DVB-H network) are either free or have to be separately paid for by the end-user.

**B. TECHNOCO-MONOMIC MODEL**

Figure 3 illustrates the logic of the techno-economic model used to calculate the economic results for the different scenarios. For presentation reasons, the figure has been somewhat simplified from the actual structure of the simulation model; for a more detailed description of the model, see Autio (2007). Some of the input parameters (e.g. DVB-H handset penetration) in the model are the same for all the scenarios, whereas some (e.g. service operator market share) differ between scenarios.

Three forecasts, optimistic, average and pessimistic are made for DVB-H handset penetration. The optimistic scenario is based on the assumption that penetration of DVB-H capable handsets will grow at the same pace as the penetration of camera phones in 2001–2005. This scenario forecasts an S-shaped growth curve with 50% penetration for DVB-H handsets at the end of 2011. Average and pessimistic scenarios assume 24% and 12% penetration at the end of 2011, respectively.

Together with the service operator market share, the handset penetration forecast gives an upper boundary for the number of mobile broadcast subscribers. A market share of 30% is assumed for a MNO, 10% for a MVNO, and 50% for a broadcaster type of service operator. Whereas mobile operators are serving only their own customers, a broadcaster is assumed to sell its services to customers of many mobile operators.

As the demand for mobile broadcast services is still very uncertain, the simulations are run for a relatively wide range of price / quantity combinations. Three different service bundles or channel packages (bronze, silver and gold) are assumed to be offered, each providing additional channels over the previous one at a higher price. Based on this demand model, the number of subscribers and the revenues from channel packages can be
calculated. The number of subscribers is also used for calculating revenues from advertising (available only to broadcasters) and complementary services (handset sales, short term Pay-TV content).

In the model, the costs comprise purely of different types of operational expenditure (OPEX) elements. Capital expenditures (CAPEX) do not exist, as access to required network elements is assumed to be acquired by leasing. The number of subscribers affects the charging and billing costs as well as the TV programming costs. The number of offered TV channels affects both the TV programming costs as well as the DVB-H network capacity costs. Other costs taken into account in the model include marketing, customer care and service management (personnel) costs. For a more detailed description of the model, as well as numeric values of the key input parameters, see Autio (2007).

C. SIMULATION RESULTS

After constructing the model and setting the ranges of variation for the input parameters (based on the calculations, expert opinions and literature studies on recent mobile broadcast pilots), a number of simulations are run. More specifically, a Monte Carlo simulation method with 1000 simulation runs has been used for each of the seven scenarios, separately for the two simulcast options (free / not free) and three handset penetration forecast options (optimistic, neutral, pessimistic), resulting in $7 \times 2 \times 3 = 42$ calculation cases.

Results of the simulations are shown in figures 4 through 7. In the diagrams, the thick bars represent the mean net present value (NPV) of the calculation case, and the error bars present the extremes of NPV, i.e. the best and worst cases. Regardless of the scenario, best outcomes generally occur when the simulated service demand is high, service pricing is closest to optimal, and operating costs are low.

![Figure 4: Results for mobile operator and co-operation approaches when simulcasts are free](image-url)
Figure 5: Results for mobile operator and co-operation approaches when simulcasts are not free.

Figure 6: Results for broadcaster approaches when simulcasts are free.

Figure 7: Results for broadcaster approaches when simulcasts are not free.
Overall, the results show that for a MNO, the cooperation approach is the least risky, since broadcasters bear the major risks: capacity and programming costs. However, profit potential of the cooperation model is limited. The cooperation model seems to be only slightly affected by simulcasts being free or not.

The potential for creating value is higher in the MNO approach, but with a higher risk as well. Here, the simulcasts are in a more important role; being able to bundle simulcasts and pay-TV channels together into a channel package can, therefore, be considered as a potential value driver for mobile operators. If simulcasts are free, the profitability of the MNO approach weakens considerably.

In general, for an MVNO, the business case seems worse. Due to the smaller market share, acting as a broadcaster and buying capacity is not likely to be profitable. In the simulations, a slight chance of positive net present value (NPV) for the investment was present only if simulcasts were not free.

The wide spread in the results for broadcaster scenarios implies that there is a high risk associated with buying DVB-H capacity and programming for the channel packages. The models are clearly very sensitive to the number of handset adopters and to the market demand for pay-TV channel packages.

The direct broadcaster approach seems to be slightly more attractive than the indirect one, especially if simulcasts are free. This is due to the high costs of mobile billing compared to alternative methods, such as credit card transactions over the Internet. This indicates a possible conflict of interest between mobile operators and broadcasters, although bypassing mobile operators completely, might prove difficult in reality. The finding is also in line with Braet et al. (2006), according to whom the revenue sharing schemes might turn out to be suboptimal for content aggregators, which neither own spectrum nor have direct customer ownership.

The pure pay-TV broadcaster approach seems to be very difficult, especially if simulcasts (offered by other players) are free. Market demand might not support buying large amounts of capacity for pay-TV channels.

7. CONCLUSIONS

The presented simulation results tentatively support the prevailing expectations among some experts: DVB-H in its initial stages does not seem a gold mine in Finland – a large country with a small and sparse population. It seems that too many players are willing to share the future revenues. This is noted in reference to the debate between broadcasters and IPR stakeholders (copyright societies) concerning the right to simulcast DVB-T content over DVB-H.

From the simulated scenarios, the cooperation approach seems the most lucrative for mobile operators, but broadcasters might want to bypass them as a sales channel. Thus, it can be concluded that possibilities for viable business do exist, but at the same time the partially conflicting interests of mobile operators and broadcasters may hinder a swift formation of a working business model. In addition, the market window for DVB-H seems to be limited by the emerging all-IP technology that will gradually bring video streaming into mainstream. Therefore, the stakeholders of DVB-H might improve their business case by speeding up DVB-H adoption through accelerated investment in DVB-H coverage and bundled handsets. This is finally becoming possible due to growing consensus over the ESG and SPP standards among terminal manufacturers and mobile network operators.

Overall, the presented results, however, may be too pessimistic to be generalised, due to the fact that Finland is one of the most sparsely populated countries in Europe, making the broadcast business investments relatively large and scale economies more difficult to achieve. Mobile-TV is based on the bundling of two independent access technologies (cellular and broadcast), which leads to complex technical and business linkages. Some of this complexity could be eliminated with a fully integrated vertical industry structure, but Finland has chosen the distributed horizontal structure. This choice in Finland is based on the logic that a sparsely populated market cannot provide critical mass for more than one DVB-H network and that service competition is needed to maintain fruitful innovation. The profitability challenges in the presented scenarios support the policy choices made in Finland although the final success is not obvious.
8. FUTURE WORK

During the writing of this paper, several interesting questions emerged that remain as challenges for future academic work and practical business problem solving. First, a fundamental comparison should be made on totally vertical mobile broadcast business cases and the distributed models, in which different roles (content provider, service operator, datacast operator and DVB-H network operator) have been assigned to separate companies. In other words, does it make a difference to have several separate but simultaneous profit margin goals – set by different companies in the distributed model – or to have one integrated business engine, that of the vertically integrated operator? In contrast to the scenarios elaborated in this article, the vertically integrated operator would also be responsible of the DVB-H network building efforts.

Another issue to be studied would be end-user sensitivity to mobile television service pricing. Mobile television, quite logically, is not an essential service, but it can become a nice-to-have service for millions. How should this be taken into account when setting price tags for mobile-TV channel bundles and programs? 

REFERENCES

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