

# BUSINESS MODELS FOR CONTENT DISTRIBUTION ON MOBILE PEER-TO-PEER NETWORKS

*Tommo Reti, M.Sc. (Tech.)  
Helsinki Institute for Information Technology  
tommo.reti@hiit.fi*

*Mikko Välimäki, LL.M  
Helsinki Institute for Information Technology  
mikko.valimaki@hiit.fi*

## **Abstract**

In this paper we look at business models for mobile peer-to-peer content distribution channel and discuss how different factors such as content type and pricing method affect the choice of business model. We identify and explain in more detail these environmental factors of business models. In effect, we try to find out if there is a profitable content business model that would suit the needs of different actors in the mobile networks of the digital economy.

## **Keywords**

Business Model, Mobile, Peer-to-Peer, Content Distribution, Digital Economy

## **INTRODUCTION**

In this paper we look at business models for a mobile peer-to-peer distribution channel and discuss how different factors such as content type and pricing method affect the choice of a business model. We have previously studied a mobile peer-to-peer news subscription service (Reti et al. 2001) as a business and now aim to expand our experience to other business models.

We assume a future scenario in which the number of advanced mobile terminals will keep on growing globally and users rely on them more and more. This may also lead to users demanding similar kind of applications and media content to their mobile devices as they are used to on their desktops. However, the cost of transmitting high volume content over infrastructure networks like GPRS and UMTS might prove prohibitive to consumers. Fortunately, the emergence of mobile terminals capable of communicating with each other in a peer-to-peer fashion opens up new possibilities for content distribution.

In theory, when the peer-to-peer services on the fixed networks are expanded to the mobile networks they will create a fundamentally new distribution channel for media companies. Any entity could upload a file once and then see it hosted by thousands of potential consumers roaming all over the globe. Those consumers, by offering the file to other peers can subsidize the storage and bandwidth costs of the original distributor by sharing their personal computing resources. In exchange, the consumers might be compensated e.g. with a reduced service cost.

Among the new ways of doing business on the Internet the most attention has been captured by consumer-oriented services such as Amazon.com. Less publicity is given to the way the Internet can be used for business-to-business electronic commerce. We stress that there are new forms of electronic commerce being practiced in many sectors of industry, for business-to-business, business-to-consumer and business-public administrations relationships (Timmers 1999). These forms should be also taken into account when discussing mobile peer-to-peer business models.

This paper is structured as follows: first we structure the research problem in more detail. Then we review past work on business models and discuss the environmental factors of the mobile distribution channel. Finally, we discuss the applicability of different business models to content distribution on mobile peer-to-peer networks.

## **PROBLEM**

The problem we study can be characterized in the following questions. Can media companies control the content distribution process on mobile peer-to-peer networks? If they can, on what assumptions on the content attributes and user behavior can it happen? If they can not, then how can they make any money on content distribution? We try to find out if there is a profitable business model that would suit the needs of media and technology companies both for controlled and uncontrolled content distribution, and especially on mobile peer-to-peer networks, or what parameters should be considered when selecting a business model.

If users freely redistribute the content to each other, then the possibilities for media companies to participate in the distribution business is limited. For example, record companies are seeing their music distributed at unprecedented speeds, but they've lost control of the ability to control and profit from the system. The business model that fits to physical CD record sales simply does not work online. So far, the economic reality is that hardly anyone has made money with content distribution on peer-to-peer networks. On the other hand, there may be some intermediaries who may profit from the context of the content when it is freely distributed in terms similar to open source software.

Our initial assumption is that on mobile peer-to-peer networks the environmental attributes may be such that possibilities for profitable content distribution business exist. However, content type and user behavior may fundamentally differ from the experiences of fixed networks. Our research problem is therefore to identify and explain in more detail these environmental factors of business models.

## **BACKGROUND**

### **Digital Economy Research**

The term digital economy covers a whole range of processes, mechanisms, and facilities that control, constrain, or support economic activities among different actors operating in a market based on digital transactions. Still, as widely as the term is used today it is lacking a standard definition. For instance, the Better e-Practice project under the European IST program defines digital economy in a rather technical way collecting under the term simply all digital and networking technologies or applications for information and communications.(BEEP)

Another quite typical definition sees digital economy as an economic system that has been evolving with the widespread use of digital technology and, in result, bringing a fundamental change in overall economic activities and also introducing a new socio-political and economic system as information and commerce become digitalized. (Han et al. 2002)

Obviously, the view to digital economy differs according to the field of the observer. By the functional process view, emphasis can be seen on the plug-and-play interoperability and modularity, customer-centricity, friction-free, global supply-chains (Shaw 1999), virtual communities (Rheingold 1993) or world peace (Cairncross 1997). By the social process view, digital economy is hardly anything but a social product, evolving construction - shaped by our collective energies and efforts, interests and innovations, visions and values (Orlikowski 1999). We use our understanding of the term digital economy in the widest possible sense, so that legal and public policy issues are included, in addition to other economic and social aspects of information technology.

### **Business Models**

The unexpected effects of mobile networks and Internet technologies have changed the business environment significantly. New innovations that shape the markets have emerged. (Han et al. 2002) More often the most important innovation is the right business model. For example setting up a new auction site is technically an easy task and will soon be copied all over, but in the end only those sites with a viable revenue-generation or business model will survive the competition. The winners are often those who take advantage of new business models without the prejudice and the critical standards of learned practises. (Christensen 1997)

According to the popular definition of Timmers (Timmers 1999), a business model can be described as architecture for product, service, and information flows, including a description of the various business actors and their roles; and a description of the potential benefits for various business actors; and a description of the sources revenues. Also, a systematic approach to identifying architectures for business models can be based on value-chain deconstruction and reconstruction – that is, identifying value chain elements – and identifying possible ways of integrating information along the value chain.

Timmers has noted that a business model in itself does not yet provide understanding of how it will contribute to realise the business mission of any of the companies who is an actor within the model. Usually it is needed also to know the marketing strategy of the company in order to assess the commercial viability and to answer questions such as: how is competitive advantage being built, what is the positioning, what is the marketing mix, which product-market strategy is followed and so on.

We have collected in the following tables 2, 3 and 4 some popular descriptions of business models as various authors have presented them. In a conclusive table 5 we present our synthesis of the descriptions with the aim of selecting most relevant of them in the light of table 1. We classify these selected business models later in this paper by environmental factors of mobile distribution model.

Table 1. Business model classification by Paul Timmers (Timmers 1999) with an updated example of each.

<b>Name</b>	<b>Function</b>	<b>Example</b>
E-shop	Web marketing with reduced cost, increased sales, and possibly advertising	<a href="http://www.amazon.com/">http://www.amazon.com/</a>
E-procurement	Electronic tendering and procurement of goods and services with reduced costs	<a href="http://www.ariba.com/">http://www.ariba.com/</a>
E-auction	Electronic implementation of the bidding mechanism	<a href="http://www.ebay.com/">http://www.ebay.com/</a>
E-mall	Collection of e-shops under one umbrella, usually enhanced by a common brand	<a href="http://www.e-mall.uk.net/">http://www.e-mall.uk.net/</a>
Third-party marketplace	Web marketing by a third party	<a href="http://www.amazon.com/zshops">http://www.amazon.com/zshops</a>
Virtual communities	Members add their information onto a basic environment provided by the virtual community company	<a href="http://www.amazon.com/community">http://www.amazon.com/community</a>
Value-chain service provider	Specialise on a specific function for the value chain, such as electronic payments or logistics	Couriers such as FedEx and UPS web-based package shipping support
Value-chain integrators	Integrate multiple steps of the value chain, with the potential to exploit the information flow	<a href="http://www.dell.com/">http://www.dell.com/</a>
Collaboration platforms	Provide a set of tools and an information environment for collaboration between enterprises	<a href="http://www.collab.net/">http://www.collab.net/</a>
Information brokerage, trust and other services	Add value to the huge amounts of data available on the open networks	<a href="http://www.google.com/">http://www.google.com/</a>

Table 2. Business models classification by Michael Rappa (Rappa) with selected examples.

<b>Name</b>	<b>Function</b>	<b>Example</b>
Brokerage	Bring buyers and sellers together and facilitate transactions	<a href="http://www.ebay.com/">http://www.ebay.com/</a>
Advertising	Web advertising model is an extension of the traditional media broadcast model	<a href="http://www.yahoo.com/">http://www.yahoo.com/</a>
Infomediary	Data about consumers and their consumption habits and producers and their products	<a href="http://www.edmunds.com/">http://www.edmunds.com/</a>
Merchant	Wholesalers and retailers of goods and services.	<a href="http://www.amazon.com/">http://www.amazon.com/</a>
Manufacturer	Manufacturer reaches buyers directly and thereby compresses the distribution channel.	<a href="http://store.apple.com/">http://store.apple.com/</a>
Affiliate	Offers financial incentives to affiliated partner sites	<a href="http://www.amazon.com/associates">http://www.amazon.com/associates</a>
Community	Users have a high investment in both time and emotion in the site	<a href="http://www.imdb.com/">http://www.imdb.com/</a>
Subscription	Users are charged a periodic fee to subscribe to a service	<a href="http://www.economist.com/">http://www.economist.com/</a>
Utility	Based on metering usage, or a "pay as you go" approach.	<a href="http://www.emma.fm/">http://www.emma.fm/</a>

Table 3. Business models by Applegate et al. (Applegate et al. 1999) with example on each.

<b>Name</b>	<b>Function</b>	<b>Example</b>
E-tailer	Product sales (transactional commerce) - selling physical goods	<a href="http://www.amazon.com/">http://www.amazon.com/</a>
E-tailer	Digital goods sales (transactional commerce) – “content” - magazines, music, software, etc	<a href="http://www.amazon.com/ebooks">http://www.amazon.com/ebooks</a>
Advertising-supported	Banner ads sold to generate revenues - usually with free content	<a href="http://www.yahoo.com/">http://www.yahoo.com/</a>
Subscription Fee	Periodic charge for membership or access to content	<a href="http://www.economist.com/">http://www.economist.com/</a>
Commission or transaction (usage) fee	Agent, broker, or intermediary charge	<a href="http://www.ebay.com/">http://www.ebay.com/</a>
Logistics / fulfilment value added	Integrated supply chain	Couriers such as FedEx and UPS web-based package shipping support
Data mining analysis sales	Free content, but sell data about virtual visitors	
Affiliate model	Pay to drive traffic to a site	<a href="http://www.amazon.com/associates">http://www.amazon.com/associates</a>
Community model / expertise database	Subscription or brokerage fee	<a href="http://www.nber.org/">http://www.nber.org/</a>
Utility model	Metered usage (pay per byte or minute)	<a href="http://www.emma.fm/">http://www.emma.fm/</a>

## ENVIRONMENT

### Software and Content

The inexpensive fixed computer network is increasingly important distribution channel for digital content and software, giving greater freedom to update content and change applications with less fear of incompatibilities. Our work does not take account of different distribution media, but sees everything as data. However, we have noted that there are several different issues in software distribution to consider before the software is to a customer. The

customer may have to install the software herself or the software may download over the network and simply execute without an installation step. User-installed software is usually sold for a fixed price like traditional products. This places a premium on selling new releases to maintain a steady revenue stream, especially after a high penetration is reached. (Messerschmitt et al. 2001) If content is text, a video clip or other similar medium a user may need a viewer or other applications before opening data. These aspects may play an important role in selecting the right business model.

### **Mobile Peer-to-Peer Network**

This paper focuses on the mobile peer-to-peer network as the physical environment. The key technical advancement in such networks is to replace some of the communications with the infrastructure network, such as GPRS, with short-range peer-to-peer networks based on e.g. Bluetooth or Wireless LAN. A random terminal accesses the infrastructure network and passes the data to the peer-to-peer network. When used in larger scale in, for instance, a city downtown or a sports arena, wirelessly communicating mobile devices form an ad-hoc peer-to-peer network. Every mobile device receives data from other bypassing users and sends data in return. The data spreads in the mobile network like a virus. The solution saves network bandwidth by distributing most of the data on the edges of the mobile peer-to-peer network. Further, the service provider can introduce additional terminals, or hotspots, whose function is to keep even larger part of the traffic in the peer-to-peer network.

On an advanced mobile peer-to-peer network digital certificates are used to protect the distributed data against modifications. A digital certificate is a signed document in fixed form, which is used for adding descriptive information to objects. Each piece of data is complemented with a validity certificate. The signature in the certificate ensures that a file has not been modified during distribution on the mobile peer-to-peer network. This kind of digital rights management ensures that the content of the service provider is accessible only to legitimate users regardless of where they have received the data from. All the files are encrypted in this system. User needs, for instance, a service contract and a hardware chip to decrypt the files for execution. The chip can be used in any suitable device and it could be lent to another user. The service provider has a useful control over the cryptography keys and certificates accompanying the keys. By defining different kind of expire dates and other rule sets into certificates, the service can be tailored for different kind of users, content channels and price categorizes.

Since the files are spreading freely between users, it is a challenge to ensure that all the users could receive data within a reasonable time frame. Since every certificate includes an ID and the file list is based on these ID's, some unavailable files could be fetched from the centralized network server after some period, after which this peer can inject the material to the mobile peer-to-peer network. User privacy is not at risk in this kind of distribution model. Every user transmits all articles without adding any personal data. Hence, it is not possible to deduce anything from the users own use from the information they transmit. But the service provider might be interested in usage statistics, which would help them develop the service. The design of a suitable solution to implement this requirement without sacrificing privacy is an open question.

## CRITERIA

In this paper we simplify and limit our understanding of business models and distributed content by describing them with a limited selection of parameters as follows. We use parameters to distinct and group the most suitable business models for the mobile peer-to-peer network. The first set of parameters is for categorizing various forms of distributed data and the second is the pricing methods in business models. The suitable cross-section of these two sets is reflected against the selection of business models.

### Content Parameters

One possibility to characterize the mobile peer-to-peer network environment is by the following parameters in table 4.

Table 4. Environmental parameters characterizing a mobile peer-to-peer network.

Parameter Name	Scale		
	Big		Small
File size	Downloadable		Streaming
File transfer method	Strong	Weak	No security
Data security	Public	Group	Personal
Data publicity	Multi-user	Group	Private
Social usage	One physical place		Over net
Usage place	Continues		One timer
Life-cycle	Free		Place dependent
Location	Real-time	Delayed	Off-line
Time scale	Publicly		Privately
Usage publicity	Device Independent		Device dependent
Device dependence	Broadcasting	Group	Individual
Target audience			

### Pricing Method Parameters

We have modified and extended the study of software distribution by Messerschmitt et al. (Messerschmitt et al. 2001) to include the environment of mobile networks and other digital content. This pricing method parameterization is not meant to be exclusive, but to merely give tools to assess the various business models.

Here is how we state the relevant issues on pricing:

- Does the same pricing method apply to all customers, or is there price discrimination for instance? The forms of discrimination could include a price based on an individual customers' value to the service provider or customers' willingness to pay, segmentation of the customer population, or content versioning, in which customers self-select the most attractive price-quality trade-off from among several alternatives.
- Is the price usage dependent? Usage-based pricing requires monitoring and billing of usage, which can be difficult on mobile peer-to-peer network.
- What are the terms and conditions of the sale? Traditional options include paying once, with the right to use indefinitely, leasing for a limited period, paying per use, or subscription arrangements involving periodic payments. These issues of pricing are

sometimes coupled. For example, usage-based or per-use pricing inherently requires periodic billing, a prepayment and debit system, or a pay-before-use infrastructure (such as digital cash).

- What is bundled into the sale? Beyond the content and software itself, options include updates, customer support, and new releases. In the case of mobile network, the bundled sale may include even the mobile terminal itself.
- Who pays? In some cases, it is not the end-user but a third party like an advertiser, who pays the content provider.
- The mobility brings location-based pricing methods like sport results drawn from a wireless hot spot at a stadium during the sporting event or various services when entered to an airport or a shopping mall.
- Indirect sales as infomediary like selling profiles based on user behaviour or acting as brokerage bringing buyers and sellers together and facilitate transactions.
- The nature of the new digital networks has raised the question of alternative ways of paying form such as credits, digi-cash or other network substitute to money. If the amount of received data is monitored, this could be accomplished in a hardware chip. The amount of transferred or send data could be a base for a user reward system that encourages users to act as active supporting nodes on a peer-to-peer network. Users could be credited somehow for their contribution to the community. From one sense, the peer-to-peer network is always indirect selling, because the users are not directly contacted by the service provider. If the file sharing system includes a mechanism to let choosing which files the user accepts to receive or which services she wants to subscribe, the user comes to create a valuable user profile. These profiles could be a subject to selling or further data processing.

### Business Model Selection

To focus our criteria further, we need to classify and select certain business models for further analysis. Within the scope of this paper we need to select such representatives from the business model tables that most closely reflect the parameters of the introduced mobile peer-to-peer network.

Table 4. Selection of business models for further classification.

<b>Our notation</b>	<b>Timmers</b>	<b>Rappa</b>	<b>Applegate et al.</b>
Auction	E-Auction	Brokerage	Commission fee
Advertising	-	Advertising	Advertising-supported
Merchant	E-Shop	Merchant	E-Tailer
Information brokerage	Information brokerage	Infomediary	-
Pay-per-use	-	Utility	Utility model
Subscription	-	Subscription	Subscription fee
Community	Virtual communities, collaboration tools	Community	Community model

## SOLUTION

### Suitable Content on the Mobile Peer-to-Peer Network

On a mobile peer-to-peer network, file size needs to be relatively bigger than the accompanying certificate files to justify the transfer traffic. The certificate should be a minor addition to the overall file size. The nature of the mobile peer-to-peer network makes streaming data impossible. Meetings of the peers are assumed to be random and short. As described, a very high level of data security can be achieved on the network by using encryption and digital certificates.

This distribution channel is suitable for broadcasting type of media that is wanted to spread as widely as possible or among a big user group. The channel is not for distributing to a targeted single user. The more the sent encrypted files differ, the more the system needs keys and the key management may become a serious bottleneck if the files are personalized to users. So, the information is more public.

Since each mobile terminal is a private representative of its user and an analog to a watch or similar wearable, the usage is normally private and happens privately, even the small monitor sizes limit the usage to a person or to two people at most. However, mobility gives the receiver the freedom to execute the content anywhere, but still, at one physical place at a time where the terminal. This is important, since our environment presumes the device to be the trusted hardware and the enabler for decryption.

Referring to a table previously presented in the criteria chapter, we can now fill in the parameters for the mobile peer-to-peer network.

Table 6. Parameters characterizing a mobile peer-to-peer network.

Parameter Name	Scale		
File size	<b>Big</b>		Small
File transfer method	<b>Downloadable</b>		Streaming
Data security	<b>Strong</b>	Weak	No security
Data publicity	<b>Public</b>	<b>Group</b>	Personal
Social usage	Multi-user	Group	<b>Private</b>
Usage place	<b>One physical place</b>		Over net
Life-cycle	<b>Continues</b>		<b>One timer</b>
Location	<b>Free</b>		<b>Place dependent</b>
Time scale	Real-time	Delayed	<b>Off-line</b>
Usage publicity	Publicly		<b>Privately</b>
Device dependence	Device Independent		<b>Device dependent</b>
Target audience	<b>Broadcasting</b>	<b>Group</b>	Individual

### Suitable Pricing Model on the Mobile Peer-to-Peer Network

Traditional usage-independent pricing models based on hosts or users supported become less appropriate on the mobile peer-to-peer network. Instead, pricing should move to usage-based subscription models. Such pricing methods require infrastructure support for transparent, efficient, and auditable billing against delivered services. (Messerschmitt et al. 2001)

If we take a look at the pricing methods found in the criteria chapter, we could place them to eight categories, as presented in the table 5.

Table 7. Pricing method parameters.

Parameter Name	Scale		
	Pricing	Price discrimination	
Usage dependent pricing	Usage monitored		Not monitored
Conditions of sale	Per use	Periodic	Continuous
Bundled pricing	Bundled		No bundled
The source of payment	The third party		User
Location dependent pricing	Location monitored		Not monitored
Indirect sales	Indirect sales		No indirect sales
The form of payment	Credits etc. also		Money

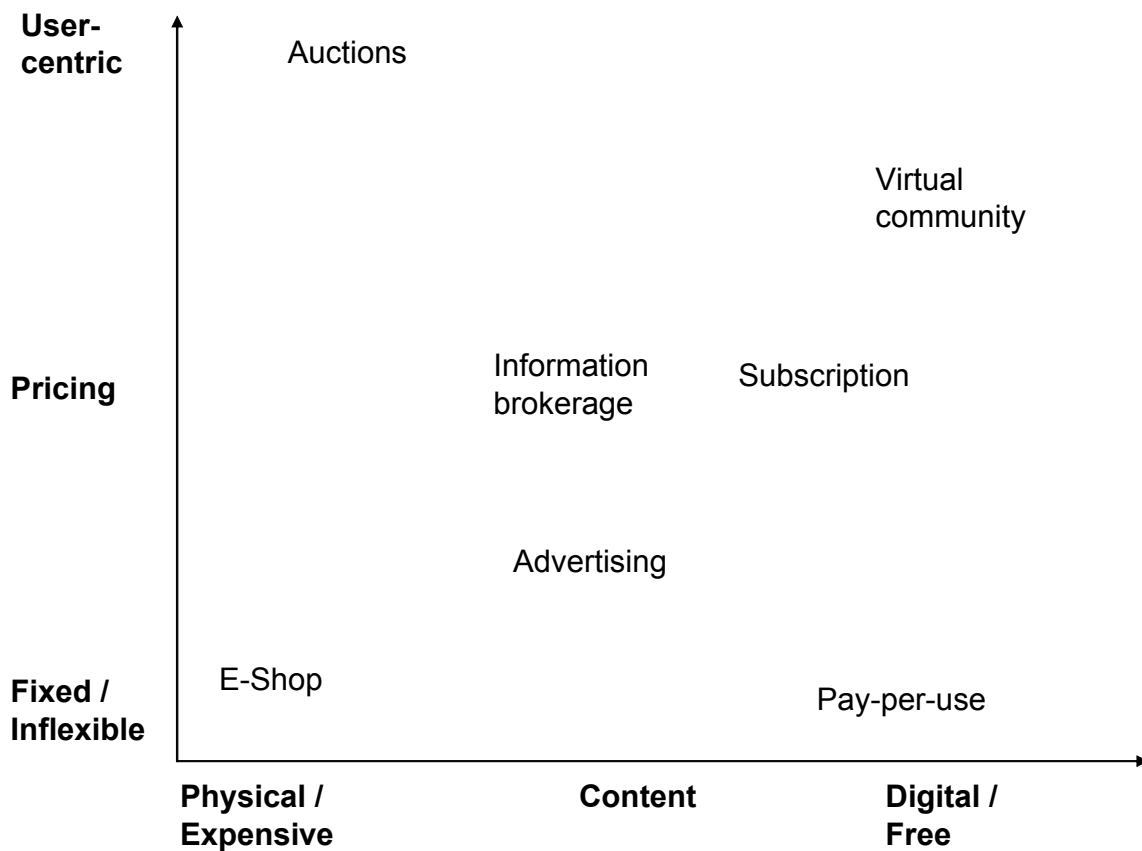
Roughly put, the further on the left the pricing method of the business model is, the more modern and more suitable it is for the mobile peer-to-peer network. We also notice that the monitoring brings more versatility to selection of different kind of pricing methods and therefore gives freedom to select a business model.

### Classifying Business Models

Finally, we can use the developed parameters to classify and characterize the selected business models. It should be emphasized that there are numerous ways to classify and structure the business models depending on the selected parameters and other environmental attributes.

In Figure 1 we present one possible approach. There, content is illustrated in the horizontal axis and pricing on the vertical axis. Physical / expensive can be characterized as content that is costly to produce and depends on the physical context. Digital / free can be characterized as cheap to produce and more informational content. User-centric pricing is more flexible and content-independent than fixed / inflexible. In this figure, with the selected parameters and after our personal judgements, the more top-right corner the business model is placed, the more suitable it would be at the mobile peer-to-peer network.

Figure 1. Classification of selected business models by pricing and content parameters



## CONCLUSIONS AND FUTURE WORK

In this paper we presented a way to assess suitability of business models and digital content to the mobile peer-to-peer network by self-created parameterisation. Using this parameterisation we pointed out the specific parameters the business models should possess to fit in to the environment of mobile peer-to-peer network.

We didn't pick the best business model for the introduced mobile peer-to-peer network, because we see that the business models introduced in previous work are not comparable with each other and they do not represent the same abstract levels from the data distribution point of view. For instance, auction is hardly data distribution and pay-per-use and subscription are two pricing methods, not business models.

The continuous development of the markets and the technology virtually guarantees that this paper has not captured the possibilities beyond a limited vision based on what is obvious or predictable today. There are numerous possibilities, most of which are still unknown. While research on other analogous business models may offer many useful insights, we feel that the fundamentals of the possibilities of the mobile peer-to-peer distribution channel for content business is still not even conceptualized.

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