

Mobile Cloud Convergence in GaaS A Business Model Proposition

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Abstract

The two most important drivers of today's telecommunication market are the development of mobile services and cloud computing. These two trends converge in cloud mobile services what is called cloud gaming. The challenges of delivering mobile cloud applications are not only on the technical side, they also concern the implementation of the accurate business model. The Kusanagi project is an end-to-end infrastructure to deliver Gaming as a Service (GaaS). This paper proposes the construction of a Business Model based on the presentation of a Cloud gaming project intended to evolve with the maturation of the technology and its market.

companies having access to resources otherwise inaccessible and reducing the time-to-market.

In this digital convergence shift, the distribution of multimedia content including videogames not only brings technical challenges due to the lack of common standards. Digitalization has also increased the importance of the business models as observed with the Internet commercialization in the 90s. Amit and Zott [2] pointed out that the central issue of an innovation is the business model as the source of value creation. Often confused with revenue models, the business model also includes the structure of the value network. The purpose of this article is to present Kusanagi, a GaaS solution and the core elements of its business model.

1. Introduction

Following the story of mobile devices, we observed in the last decades an evolution in technologies and their usage. Mobile devices are not only used to communicate. From simple daily applications such as alarm clock to more sophisticated location based services, the mobile phone has become a part of our daily life. From the early 90s Palms and mobile phones, to the today's iPhone and Android, it is clear that data services are gaining over voice in the telecommunication industry and the future points to convergence.

At the same time in these last two decades we have seen a growing inclination to outsource application execution processes in what is commonly known as cloud computing. As for other computing technologies, first adopted by industry, cloud computing is now available for the regular user making thin devices as mobile phones usable platforms for a larger range of applications, including multimedia content. It also allows small and medium business to compete with larger multinational

2. The videogame industry

Taking off on the early 80s (preceded by the adoption acceleration of personal computers), the industry of video games is one of the most profitable and stable industries in the entertainment market, with a 16% of annual growth [1]. In an environment of economic recovery, the videogame segment continues to grow and according to the forecasts this market will reach 80 billion Euros by 2015 where online software and mobile segment are expected to bring almost 40% of the revenues [23].

The console software segment is considered the most lucrative of the industry with an equivalent of 88.90% of the overall value of the market, the other 11.1% correspond to the computer (PC and Mac) games. Despite having higher margins than console games, many publishers stopped doing PC games due to lack of standard platforms, support issues and mainly because of piracy [23].

Online gaming can be described as "A video game that can be played over some form of computer network" [11] and started to be popular with the development of Internet in the nineties with Korea as

the main leader since 1996 with the launch of “the kingdom of the wind”. The concentration of population and dense urban areas facilitated the installation of high speed broadband in this country, one of the reasons why this industry first industrialized in Korea instead of Japan or the United States.

Progressively offline players have shifted to online; social games. Like in other sectors such as music, films and even books, gaming has also an increased tendency to use digital distribution. Nowadays, with the increasing number of households’ internet connection, gaming is also shifting to the online distribution services. The main console manufacturers offer already online services - Playstation Network (Sony), WiiWare (Nintendo), Xbox Live (Microsoft)- where the games can be downloaded to the console’s hard drive. It offers new revenues possibilities but also challenges regarding technology and regulation. Traditionally, this market segment was concentrated on game internet portals; nowadays online access also includes other content than games (music, films, among others) and the access to high quality games through the network [23]. As observed in the last GamesCom, considered as the largest trade fair for interactive games, the mayor tendencies are mobile games, online and browser games to have more immersive game experiences.

3. Cloud computing

Cloud computing can be defined as “a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” [26]. Even if the concept was first introduced by Rammath K. Challapa in 1997 and proposed as a concept by Eric Schmidt (Google’s CEO) in 2004 [20] since 1980s, with the development of the internet, the grid computation concept (distribute computation in different nodes) started to be developed. IBM’s technical white paper, cloud is defined as a virtualization of the resources (platform and services) [4].

3.1. Cloud computing service models

The essential characteristics of the cloud are on-demand self-service, broad network access. Cloud deployment models are private (operated by

individual organizations), community (operated for organizations with shared interests), public (available to the general public) or hybrid [3]. As shown in figure 1, the three levels of service models offered in the cloud computing are: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).

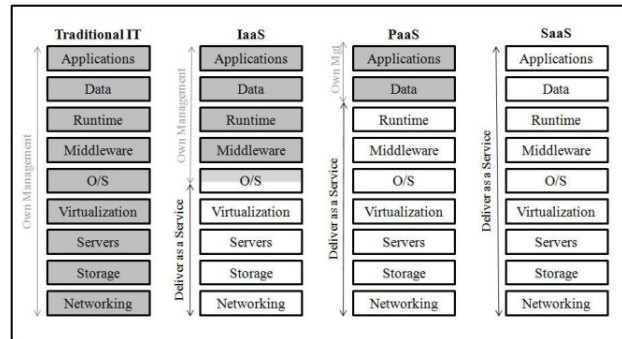


Figure 1. Levels of Cloud Service

IaaS provides basic computing infrastructure of servers, software and network [18] such as IBM, Amazon EC2, Rackspace, among others. PaaS offers application development (partial or complete) that users can access as suite of low-level software as application software, middleware, databases and development tools (Microsoft Azure). SaaS the service delivered include all the IT levels, such as ERM [30]. Salesforce.com is certainly the most popular SaaS provider in the professional sector. Among the particular market, desktop applications like Google Docs are gaining more and more popularity [22].

Beyond the technical definition, cloud computing is a new consumption and delivery model. Cloud-based delivery models are already changing the software market and will transform the service provision. The main attributes of the public cloud services include public internet, pay-as-you-go and self service. SaaS allows end-user applications work on any device by applying pay-per-view basis. Marston et al. [22] include these elements in their cloud computing definition to emphasize this business perspective.

3.2. GaaS

Cloud computing as rendering model for games, offers many advantages for more ubiquitous games (being able to play a same game in different platforms) avoiding the installation time and piracy among others. Even if it is not know directly as “cloud”, remote computing services have been provided for the gaming sectors in different levels.

IaaS, for example, is suitable for independent software vendors (ISV) that cannot afford the infrastructure related to their applications (for example, SAP is collaborating with Amazon). GNI is considered one of the major IaaS providers for online games (e.g. Runes of Magic). From the platform side, World of Warcraft is the most popular PaaS. Other platforms like Photon's Exit Games offer middleware software for the development of high definition games. Motion controllers and stereoscopic 3D have opened a new way of interaction with the game environment. With the digital distribution, companies like Twofish, AMD, and Intel have been interested in developing middleware in the form of SaaS for companies such as Steam or Onlive allowing cross-platform applications. Portability (the possibility to run in different environments or platforms), scalability and flexibility are the three major aspects that middleware has to provide, reducing significantly the cost and wider the market.

The GaaS concept is used generally only for the platforms where big computation capacity is required like console based games. In the last years we have seen diverse several companies like Onlive, Gaikai and G-cluster already starting to commercialize GaaS.

3.3. Remote rendering

In the gaming sector the most important issue is the quality of experience [35] where latency is a key factor of success. Mobile games market had boosted last year mainly due to the development of Smartphones. Recently Sony Ericsson launched its telephone-console (reminder of Nokia's N-cage). When using a mobile device as rendering platform, the two main challenges to overcome is the inherent constraint of a mobile device (size, interaction) and the mobile network. While 3G and 4G networks are significantly adding to available bandwidth and capacity, the fundamental challenges of bandwidth fluctuations, latency and packet loss, will remain [29].

To minimize the latency, one can enhance the remote rendering algorithms. As analyzed in Tizon et al. [32], from the six families that can be distinguished (Graphic commands, 2D pixels, 2D primitives, 3D vectors, Single 3D object, 3D multiple 3D objects), not all are suitable to use for the high requirements of 3D gaming and build a strong pervasive environment; latency being the major problem. Graphic Commands have satisfactory performances in terms of latency but it requires a powerful GPU in the client side [24]. If the rendering solution is split between the client and the server, 3D

vectors extraction is possible if they are extracted and send per object (only once) [28]. As there is no family that can satisfy all the necessities required, the best solution is to mix the approaches [19, 25].

4. Methodology

4.1. The business model approach

There is not general consensus about the definition of a Business Model. Nevertheless, even if the elements vary from one definition to another, the most representatives used in the literature [8, 21, 31] include four interrelated components: the description of the business value proposition (service), the technology (service platform), the value chain and the source of revenues (revenue model) [6, 17]. These components correspond to the STOF model [5], following Bouwman's definition of the Business Model as a *"blueprint for a service to be delivered, describing the service definition and the intended value for target group, the sources of revenue, and providing an architecture for the service delivery, including a description for the resources required, and the organizational and financial arrangements between the involved business actors, including a description of their roles and the division of the costs and revenues over the business actors"*. The four dimensions of the business model will be defined by:

- **Service:** description of intended value, delivered value, expected value, perceived value
- **Technology:** description of the technical architecture, service platforms, devices, applications
- **Organization:** description of the actors, roles, interactions, strategies and goals, value activities.
- **Finance:** description of investment sources, cost sources, revenue sources, risk sources and pricing

As technology converges, business models become more complex to define. This complexity lies in the changes of the actors in the value chain and their interactions. Digital distribution for example, eliminates the need of the retailer, replacing it by the service provider and the platform hosting. As for any computer related system, the advances on technology made business models evolve as the technology matures. Being a growing technology, little empirical research has been done concerning SaaS business models [27, 7]. The emergence of online and mobile games shift the videogame market structure allowing new ways of doing business [11].

4.2. In-debt interviews

Semi-structured interviews were conducted from October 2010 to May 2011. In order to choose the participant that better help us to gather the information needed to our research [10], the interviewees appertain to three categories: developers, telecommunication operators and experts.

As the Kusanagi solution aims to render High Definition games, all the French developers corresponding to that category were contacted. With a response rate of 15%, 9 developers accepted to respond to the interview. The four experts correspond to an independent game consultant, the head of Game and Digital Entertainment & Consumer Electronics Practice at IDATE and two professors; one specialized in network deployment and the other in mobile applications. Finally, the operators that were contacted correspond to the two mayor operators (fix and mobile) in France (65% of market share). Respondents were lead to talk about their activity, their position in the value chain and the future of videogames and cloud computing.

4.3. Beta test

A beta test of the platform was conducted from February to March 2011 in the THD platform (<http://www.portailthd.fr>). A total of 53 test users were recruited to test the platform. Most of the tester

live in the Paris region and ages varies from 18 to 54 years old (due to legal reasons, users must have more than 18 years old). Testers were invited to play with an adventure game: Jack Keane; from different platforms, at different times. Once the trial period was over, users were asked to give their impressions and describe their attitude towards the service, the questions were adapted from the TRA (Theory of Reasoned Action, [13]).

5. Kusanagi

The solutions presented above use different rendering technologies but to this moment, they only propose as render device the computer and the television (with the operator set-top box or own console). A complete cloud gaming solution should be able to be delivered in more thin clients such as tablets and Smart-phones since the calculation are done on the server. Kusanagi project is an end-to-end infrastructure (Figure 2) to develop, publish and play High-Definition 2D and 3D Real-Time Networked Multimedia Content, whose purpose is to enable end user devices to run applications requiring a high performance computation to run.

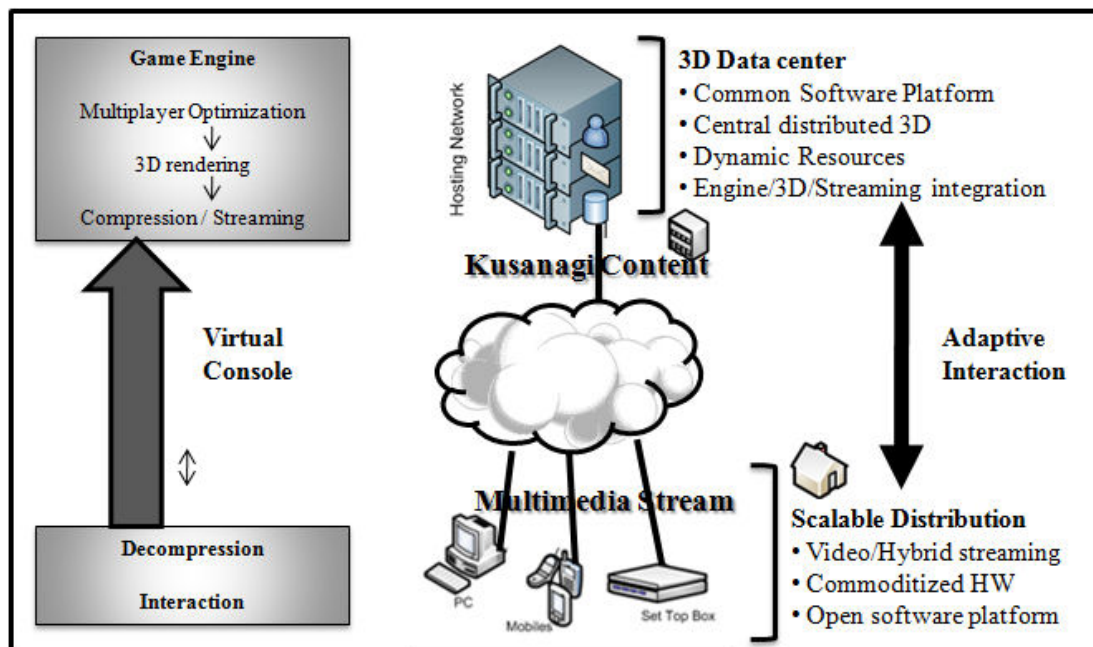


Figure 2. Kusanagi framework

5.1. Service domain

The service Kusanagi proposes in to offer the possibility to play high definition games in any device (no matter its computing capacity). At this moment, Kusanagi is able to run high quality graphics in mobile devices as shown in figure 3.



Figure 3. Kusanagi running on mobile device

Even if all users were enthusiasts of the platform, the more hard core gamers (more than 3 hours of gaming per day) agreed that they prefer to use their computer (in some cases build by themselves) than any other device. It is to believe that this kind of infrastructure is more suitable for casual to medium players. Concerning the attitude regarding this type of rendering solution, the results indicate that in a 92% users have a positive attitude towards Kusanagi and are willing to adopt it once it will be available. Among the reasons given to use a platform like Kusanagi the portability and cost stand out, followed by the enlargement of the market target. The platforms that will most likely be used by this kind of service would be the Television and the Mobile Phone.

Concerning the developers, despite the positive attitude towards the platform to distribute their own games, some of the respondents were concern about the value proposition. As for the console delivery, developers wished to have the assurance that the quality of experience would be the same in every device.

5.2. Technology domain

To ensure the quality of experience, Kusanagi searches to maximize the output on high bandwidth and low latency networks. As today's streaming is mainly focused on video-like images, one of the biggest challenges is the real-time interaction required in videogames. Kusanagi's architecture is using the 2D pixel approach and its components are the Kusanagi application, the lobby server and the MPEG client. The requests are sent to the Lobby that manages the application.

5.3. Organization domain

The value network determine how the firm interacts with the other members of the value chain described as a complex system of suppliers, distributors and partners [9]. The actors and their role were identified by the different respondents and are presented as follows:

- **Developer and publisher:** The developers are the game creators. Usually the developer designs the game and does a master (software product) that is sold to the editor for further publishing and distribution. The developer creates or licenses content as his core business. Publishers are usually the major economic actors in the value chain due to their capacity to manage large budgets. This controlling position can affect directly the developers that are very dependant of the publisher and it is said that it reduces creativity process but at the same time, it gives more security because the risk is taken by the publishers. Developers have mitigated opinions about publishers, half of them prefer to work bias them (investment and security), while the other half would prefer to choose the delivery channel. In that case, cloud computing represent for these producers a more direct way to reach the final consumer. In the network chain, developers and publishers are put in the same level as the creation partnership can be done with either of these two entities.
- **Enabler:** The role of the enabler is to allow (enable) the production of the game. Middleware is dedicated software aimed to the execution of the following tasks: 3D visualization, video decompression, among others. Kusanagi can be considered as a middleware solution. Game enablers had broadened their scope including other platforms like mobiles phones, tablets, among others. This diversification had permitted to small independent developers to focus on newer (less expensive) platforms such as iPhone

or Facebook. Commented by the respondents, the major trend on the sector is to produce more immersive game experiences and heighten the realism. Middleware must allow the cross-platform.

- **Hosting:** Kusanagi is the responsible of the rendering and therefore is the one choosing where the service will be hosted, this activity must be transparent for the customer as it is determine by the cloud computing logic.
- **Mobile network operator:** the mobile operator will be the carrier. Respondents' preoccupations about cloud gaming concern the mobile operator

and its ability to supply a sufficient bandwidth to deliver GaaS.

- **Access Interface:** In a first place, Kusanagi was thought to be access by an Internet browser (running also in mobile devices), but for the majority of the respondent considered that as for any other game o mobile application it is suitable that the user is able to access to the game via an app store.
- **End user device:** Finally, Kusanagi solution must run in any mobile device.

The proposed interaction between the different participants is show in Figure 4.

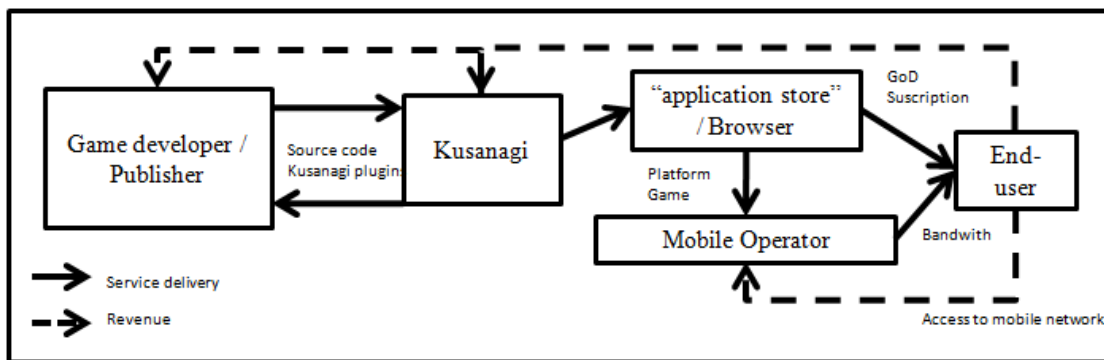


Figure 4. Kusanagi BM position

5.4. Financial domain

The revenue models considered can be divided in two categories: using an application store as suggested by the respondents or by accessing a mobile website. In the two cases, Kusanagi will be the interface between the developer/publisher and the end user. The flow of the revenues will go from the user to Kusanagi and from Kusanagi to the developer/publisher. The participation will be settled as a percentage of the sell value to be defined with the developer. This schema is the more suitable for the developers as they don't deal with the AAA (Accounting, Authentication and Authorization) and allow them to remain close to the customer (with just one intermediary). The costs can be absorbed by the different actors.

Concerning the pricing, as it concern the launching time, it is recommended to give free trials as the users become familiar with the service. Monthly fees can only be interesting when the game base growths. Once the service popularity increases, other revenue means can be contemplated.

5. Discussion

Even if some of the respondents (the third part of the studios) were skeptical about the concept of cloud gaming, the general opinion (from the other developers, experts and beta testers) was very favorable about the project. While the multinational companies (Ubisoft for example) is interest in cloud gaming in order to broad their market penetration, the smaller independent studios sees it as viable way to reach the customer without dealing with the publishers even if the main motivation to have a publisher relies on the financing.

The experts agreed in that the future of the Video Games was on the internet and the mobile market. Game industry follows the same dematerialization tendency of the software industry and even the console manufacturer's offer online services (Xbox live for example) with an important success. As mentioned earlier other companies propose already GaaS, as follows we present the STOF analysis of G-Cluster, Gaikai and OnLive.

Table 1. STOF model GaaS examples

G-Cluster	Gaikai	OnLive
History		
Established on 2000, G-cluster business models have evolved from 2005 to 2010 as analyzed by Ojala and Tyrväinen [27]. From IPTV to “gaming on demand”	The company is already established in 12 countries. This company offers the service not only for gaming but to other entertainment software.	First announced in the developer’s conference in 2009 and then launched on 2010. Proposed already in the United States, OnLive plans its expansion to Europe.
Service domain		
GoD service offered through the set-top box	Platform as a promotional channel.	Blockbuster games in the PPV basis.
Technology domain		
Rendering technology installed in the operator’s box.	Remote rendering from Gaikai portal or developer.	Remote rendering directly from OnLive portal or through mini console
Organization domain		
Direct collaboration with telecom operator and developers/publishers	Direct relationship with developer/publisher	Developers/publishers, device manufacturers and operator as investors.
Finance domain		
Payment for the licenses to developer/publisher. Contract with telecom operator (information not available). Service to consumer: charged by operator	Agreement with developer/publisher (information not available). Service to consumer: free	Investments from the actors of the value chain. Service to consumer: Monthly fee or PPG.

The three examples above give us very different approaches adopted to render GaaS. While OnLive proposes a direct service to the end-user and has received an enormous amount of publicity, G-cluster prefers to go through the operator to render the service. This strategy reduces the risk but at the same time the benefits and the direct relation with the end-user. The STOF proposed by Kusanagi is situated between OnLive and G-Cluster. We observe that both companies have a direct relationship and with the developers/publisher, the first using them as investors. Network alliances are difficult to establish but are critical to succeed as relational resources come from interactions [14]. Giving access to the source code or developing the games with the vision of cloud distribution will facilitate the rendering.

When going mobile, the most difficult challenge to overcome is the involvement of different actors depending in the device. This is the reason why the BM model proposed in Kusanagi, let aside the mobile

operator. The end user should be able to choose to access to his game using 3G, WiFi or a network cable (this being the advantage of using cloud gaming). G-cluster chose to make an alliance with the network operator in order to propose the cloud gaming as one of the set-top box, limiting the access of the games to the household.

Concerning the distribution method, it is certain that Apple change the logic of mobile data business with the launch of the app store (followed by the android store). This distribution method allows any developer to create mobile games and sell them via the store. Yet, this model is only suitable for low definition games. The provision via the apple store, for example, allows reaching a larger number of users, using apple devices and already familiar with this platform. The other side of the coin of apple’s model is the hermetic structure. We believe that this is one of the reasons of Onlive’s partnership with HTC. Kusanagi will seek to render the service the easiest possible way to the end-user.

As pointed out by Gummeson [16], users don’t acquire goods or services, but offers that render service. Zott and Amitt [36] highlight the importance of the value proposition and most of all the value creation pointed out earlier by Magretta [21]. As for any other called value added service, the provider can only make the value proposition. People buy perceived value but the customer is active in this value creation [15] and it is the consumer that will determine the value of the product/service [33]. In this Service Dominant Logic [34], Cloud is a very good example of the value co-creation, as the service is co-produce by the device and the network user’s choose.

6. Conclusions and future work

Mobile devices have become the most promising platform for any application due to their new capacities and pervasive services. As mentioned by Dhar and Varshney [12], the mayor challenges in mobile services include technology, suitable platforms and adequate business models.

In the case of Kusanagi, the proposition will consist in offering a pervasive service giving the user the liberty to use the device he chooses and allowing developers to offer their games via an alternative channel. In this paper we show the first sketch of a possible business model for Kusanagi. Further work will include a larger panel of beta tester and a global questionnaire in order to determine the adoption factors (based on diffusion of innovation literature) and a deeper analysis based on SDL.

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