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Cloud TV:
A Techno-Economic Approach in the Emerging Era of the Internet of Things

Georgia Dede, Harokopio University of Athens, Greece
Georgios Loupatatzis, Harokopio University of Athens, Greece
Dimitris Grigoropoulos, Harokopio University of Athens, Greece
Georgios Chatzithanasis, Harokopio University of Athens, Greece
Thomas Kamalakis, Harokopio University of Athens, Greece
Christos Michalakelis, Harokopio University of Athens, Greece
https://orcid.org/0000-0002-4401-5058

ABSTRACT

Cloud TV is a cloud-based live television streaming program or app, allowing the user to watch high definition (HD) TV channels without the requirement of a TV box or aerial but only a stable internet connection. As the number of Cloud TV channels continuously increases, so does the need for a techno-economic evaluation and analysis, which constitutes the aim of this paper. The analysis aims to provide an assessment of the required investment for a new Pay TV operator, using Cloud TV technology in the internet of things (IoT) era. The adopted methodology includes demand forecasting and cash flows calculations and important economic indicators, for a time period of 10 years and different diffusion scenarios. Evaluation of the methodology was based on statistics obtained from one of the larger telecom providers in Greece. Results indicate that investing on Cloud TV technology in Greece is feasible for the technologies of over-the-top (OTT), IPTV, and Smart TV. A sensitivity analysis is also performed, studying the case of a new entry for a Pay TV operator in the local market with emphasis on OTT services, which gains a significant percentage of customers.

KEYWORDS

Cloud TV Technology, IPTV, OTT, Smart TV, Technoeconomic Analysis, Think Analysis

1. INTRODUCTION

Enjoying their second decade of existence, maturing cloud technologies have reformed the expectations and capabilities of the Information and Telecommunication (IT) industry expected to play a crucial role in the new era of the Internet of Things (IoT) (Xfinity, 2017). In the IoT of billion connected devices, the classic distribution networks are migrating in a broadband environment using cloud computing services. The broadcasters and the communication operators who want to offer video services deal with ensuring the live and on-demand video on any device. The operators that want to capitalize this change need a complete television platform based on cloud computing to reduce the time to market and increase their revenues.

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Cloud TV refers to a flexible television option in which customers can take their shows on the go (Xfinity, 2017). Most importantly, TV operators can transition to a public or private cloud at their own pace, and maximize existing investments through a hybrid deployment approach, integrating new, virtualized infrastructure with their current on-premises systems. In contrast to traditional TV channels that would need dedicated equipment and technical stuff, IPTV channels on top of the cloud will enable one simple user to manage many channels without the need for neither dedicated equipments nor technical stuff. In addition, by enabling users to create OTT, TV channels on top of the cloud will make the content more customized for social communities (Xfinity, 2017).An advance in the cloud computing technology facilitates is the creation of media delivery infrastructure along with enabling techniques such as transcoding on the fly. Nowadays, most of the cloud providers adopt pay-as-you-go model, whereby Pay TV operators will pay only for the resources that they use, including storage and traffic communication. A proposed solution (Xfinity, 2017) schedules videos at the same time in the programs, of as many channels as possible, and places the different videos in the same cache servers, in such a way that the number of effective streams created in the network is minimized.

The vastly distributed nature of IoT applications will require additional investments in computational and communication infrastructure. In this context, pay TV operators are expected to invest in Cloud TV, will is expected to play an important role in future smart home networks. The purpose of this paper is to study from a technical and economical point of view the investment of a new TV operator based on Cloud TV technology with focus on OTT services and in addition to the appropriate choice of a Cloud TV provider. In Section 2 the Cloud TV technology is presented, over a number of different platforms, such as Over The Top (OTT), Internet Protocol TV (IPTV) and Smart TV.Section 3 is devoted in the presentation of the analysis of the global and local market, the global and local competition and industry assessment. A techno-economic analysis is also performed, including the demand forecasting, and the cost of the investment, based on a cash-flows approach. Product development for Cloud TV is considered in three areas of IPTV, Smart TV and OTT devices. A sensitivity analysis with different scenarios is performed in Section 4. Conclusions and future directions are presented in the concluding Section 5.

2. CLOUD TV TECHNOLOGY

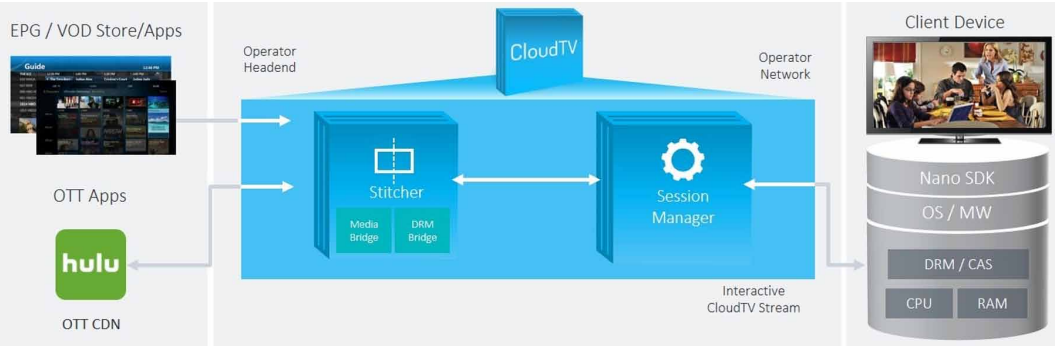
Cloud TV technology provides television subscribers with greater flexibility when accessing live and recorded content. Cloud TV customers can easily stream and download DVR (Digital Video Recorder) shows to any Internet-enabled device. The advanced technology behind cloud TV allows for live in-home streaming and anywhere-access to a personal library of new television series or favorite movies. Cloud TV technology allows television subscribers to stream their saved recordings from anywhere. Innovations in Cloud TV provide an enhanced entertainment experience for the whole family. Any updates or innovations to Cloud TV functionality can be made available to users in real-time. According to different statistics, 85% of the total consumers prefer being recommended, where time-based recommendation engine holds a major part (Xfinity, 2017). From operator's point of view there are also a lot of benefits like important (Key Performance Indicators) KPIs, traffic performance and data analytics regarding customers' behaviour which will be an important tool for CLoud TV. It is possible for Pay TV operators to increase profitability by as much as 30% if they use data analytics across all parts of the organisation, execute well against new-found business insights and then test, iterate and optimise based on the outcomes.

A crucial aspect of assessing Cloud TV as a candidate for future implementation is technological feasibility. While nowadays cloud computing is a given and implements thousands of different use cases, mass market cloud based live TV transmission is still in its infant stage. When it comes to broadcast TV, the main parameters that define technical feasibility are latency and peak traffic capability. Cloud technology does not automatically come with low latency or with high transmission

capacity. Originally designed for best effort Internet traffic and uncritical latency requirements, cloud technology in the past years had to undergo a certain development that made it for the challenges of TV transmission (Zinelaabidine et al., n.d.). A Cloud TV Platform with a general definition is an end-to-end modular cloud-based media manager technology. This provides complete flexibility about how the content is delivered and provides further options to expand streaming services over time for example by adding additional target devices, live editing and social syndication for promotional purposes. An idea of the architecture of a cloud TV platform in the figure 1 is presented below (Zinelaabidine et al., n.d.).

In this paper three alternative technologies for Cloud TV are considered, Smart TV, IPTV and OTT. Smart TV is called the fourth screen coming up with PC, Pad and smartphone. With high market penetration, good configuration and network features, smart TV provides a broader platform for VOD applications. Legacy TV is gradually being replaced by Internet Protocol (IP) connected Smart TV, which offers more advanced computing ability and connectivity and allows users to install and run applications. Smart TV is called the fourth screen coming up with PC, Pad and smartphone. With high market penetration, good configuration and network features, smart TV provides a broader platform for VOD applications (Zinelaabidine et al., n.d.). The remaining problems include storage capacity, scalability, cost and complexity. Meanwhile, the rapidly development of cloud computing technology provides VOD services performance of Smart TV with improved load balance and massive storage capacity (Zinelaabidine et al., n.d.).

Figure 1. A sample of architecture for a cloud TV platform



IPTV is a service that provides television programming and other video content using the TCP/IP protocol suite as opposed to traditional cable or satellite signals. An IPTV system may be used to provide video content over a private network within an enterprise, despite that such implementations are far less common than subscriber-based The purpose of IPTV is to provide a cost-efficient alternative to the traditional TV system, allowing the distribution of different video content to end-users over IP networks and significantly reduce the cost of creating and managing different TV channels. In contrast to the traditional TV channels that would need dedicated equipment and technical stuff, IPTV channels on top of the cloud will enable one simple user to manage many channels without the need for neither dedicated equipment nor technical stuff. Previous studies (Zinelaabidine et al., n.d.) have shown that instead of having guide/user interface functionality in the STBs, it is possible to move this functionality to the cloud.

OTT is a media distribution practice that allows a streaming content provider to distribute audio, video, and other media services directly to the consumer over the internet, via streaming media as a standalone product, bypassing telecommunications, cable or broadcast television service providers

that traditionally act as a controller or distributor of such content. The operators have an aggressive timeline for new service launch, video quality is an important consideration, and there needed to be very low latency. Moreover, the operators want to be able to offer a skinny bundle OTT service at a much lower price. Given these parameters, many cloud TV vendors such as Harmonic and Mirantis partnered to deliver a cloud-native media processing solution on OpenStack that met these requirements, offering quick time to market, high video quality and minimal capital investment.

3. A TECHNOECONOMIC ANALYSIS FOR CLOUD TV

According to market analysis, Cisco predicts (Zinelaabidine et al., n.d.) that consumer internet video traffic will dominate other types of traffic by 2019, taking a massive 80% share of the global market, but add VOD and business consumption to the mix and the figures nudge their way up to the 90% range. Cisco defines 'Internet video' as short-form content (i.e YouTube, Facebook), long-form (i.e. Hulu), Internet-to-TV (i.e Netflix), as well as live-streaming, online rentals and purchases, and webcam views, and estimates that content delivery network traffic will deliver over half of all internet video traffic by 2019. Based on Ericsson (Zinelaabidine et al., n.d.), in 2020 VOD will account for almost half of the total content monitoring time. The penetration of Pay TV in Europe (Zinelaabidine et al., n.d.) will be 60% among the European households and 79% in US.

Around 950,000 clients are now in the Greek market, which represents a 24% of penetration in the country, figures that are similar to those in other Southern states like Spain or Portugal, but considerably lower than the EU average (Zinelaabidine et al., n.d.),with Cosmote TV, Nova and Netflix take the precedence. The great opportunity for the development of pay-TV in Greece, turnaround story betting on the Greek market and the increasing interest in Greece for their content was seen by Netflix and decided to strengthen its presence in Greece, launching its Greek form. The prospect of pay-TV growth is great in the Greek market, as Internet speeds are rising, while overall market shares remain low, although they gallop.

The new company examined in this paper, will focus on Broadcasting TV channels and rentals VOD / TV packs/month. The cost of the investment estimated at € 6,000,000 and the staff needed in order to start the company activities estimated at 70 people including the technical staff. The number of TV channels that will provide at startup will be 32-35 channels and will launch 200 VOD assets. According to all the parameters mentioned above the corresponding financial calculations have been made in tables II, III, IV.

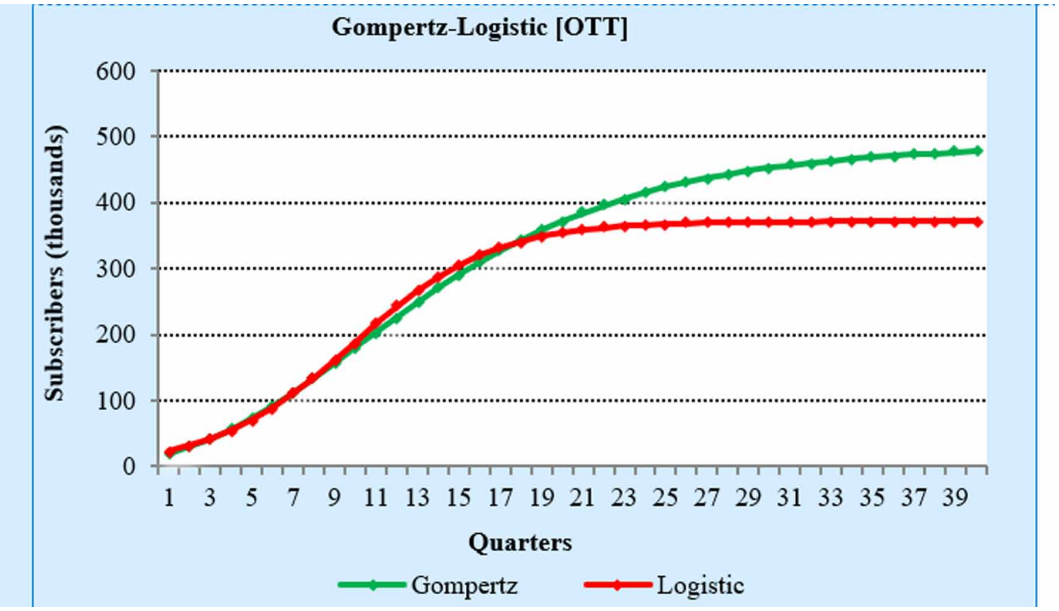
The idea of creating a TV broadcasting company, based on Cloud TV, arose from the need to modernize the traditional broadcasting operations to the technological standards of today's digital world. The goal of this business idea is to enable the customer to access the TV content anytime, anywhere on any device. With the advancement of OTT services, like Netflix and Amazon Prime, and the proliferation of mobile devices as a gateway to access viewers' favorite content the ability to provide a cost-effective, multi-device, service that could appeal to its multilingual audience – and be built for a quick market turnaround – proved complex. Additionally, it was imperative for this TV services to be able to reach new audiences around the world that are not in a position to receive its channels or TV series through traditional TV distribution methods.

3.1 Forecasting Analysis

The present forecasting analysis was based on two of the most aggregate models, the linear Logistic (Zinelaabidine et al., n.d.) and the Gompertz (Zinelaabidine et al., n.d.) to create a range - a zone between which penetration is expected to be recorded. Three years of subscriber statistics have been used and a 10-year forecast (40 quarters) has been made using the two models.

According to the results illustrated in Figure 6 subscribers levels for OTT services range from 370.000 (pessimistic scenario) to 470.000 (optimistic scenario) by the end of the decade. Figure 7 shows that subscribers for IPTV services range between 70.000 and 90.000 by the end of the decade,

Figure 2. Gompertz – Logistic models for OTT subscribers



whereas the subscribers for Smart TV services range between 20.000 and 40.000 (optimistic scenario) by the end of the decade, as shown in Figure 8. Figure 2 shows the Gompertz – Logistic models for OTT subscribers. Figure 3 shows the Gompertz – Logistic models for IPTV subscribers. Figure 4 shows the Gompertz – Logistic models for SMART TV subscribers.

Figure 3. Gompertz – Logistic models for IPTV subscribers

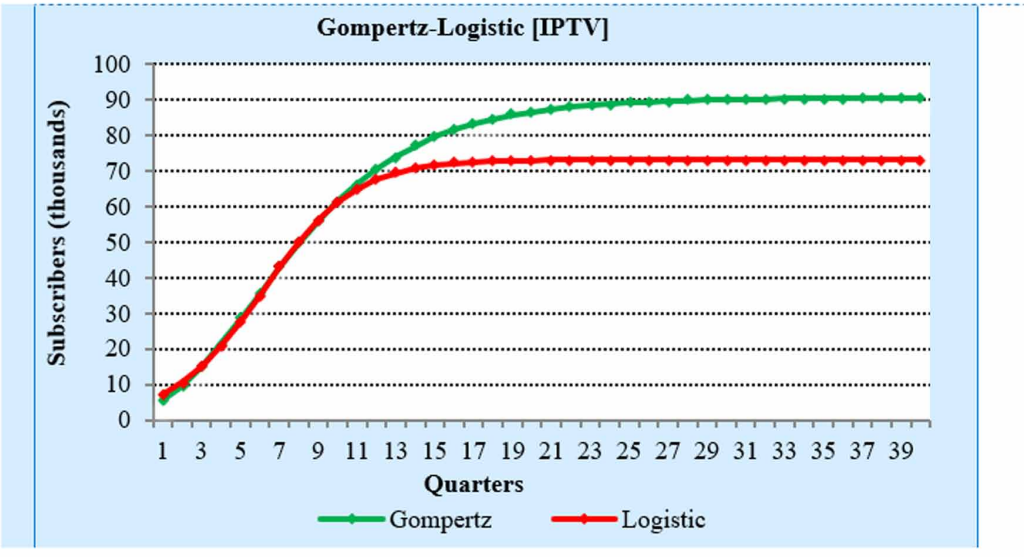
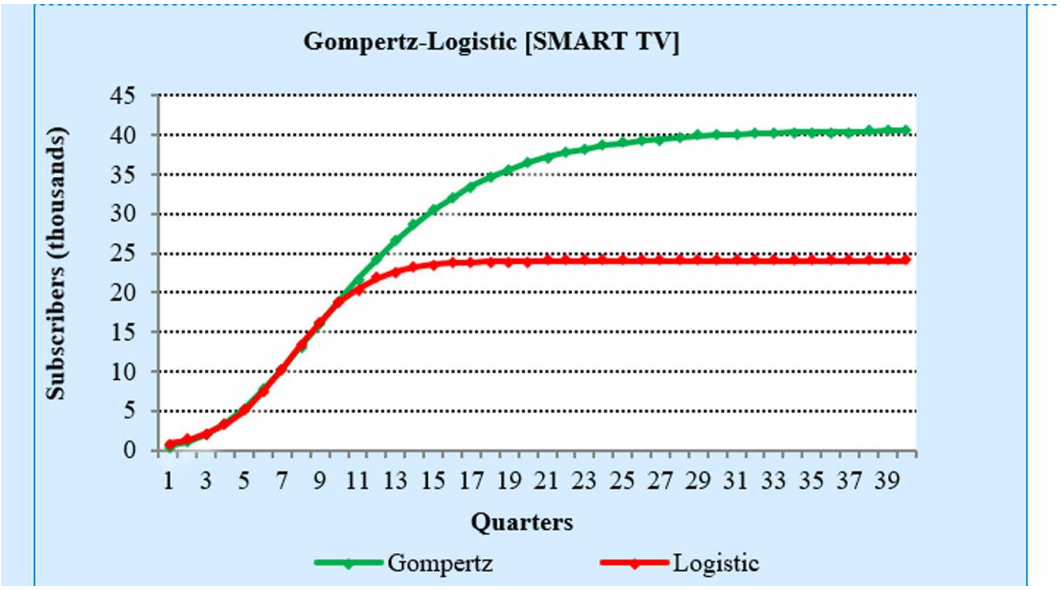


Figure 4. Gompertz – Logistic models for SMART TV subscribers



3.2 Pricing

Pricing and cash flows correspond to one of the most important steps of the technoeconomic analysis, since it affects the success of the investment and the viability of the organization (Kalantonis et al., 2019). The offered services will be television services through an IPTV custom device that will be built exclusively for this purpose. Also, TV services will be provided as an OTT service, where subscribers will be able to watch TV content up to 3 devices at the same time. Finally, there will be an additional option which will be the Smart TV application. The company plans to establish collaboration with major smart TV companies, such as Samsung and LG. Therefore, customers will have three bundles / packages to choose according to their needs: IPTV Pack, OTT Pack and SmartTV Pack. In each case there will be the corresponding sub packets such as the Family Pack, the Sports Pack and the Full Pack. Costing of the services will be based on the fully distributed cost (FDC) approach, according to which a percentage of fixed common costs and a percentage of group costs that are not directly related (eg, company advertising) are assigned to the service. Pricing will be based on the penetration pricing model, offering high quality of services at a low price. Table 1 shows the packs for technology.

Table 1. Packs for each technology

Technology Packs	Price(€)	Cost(€)
OTT Pack	16	6
IPTV Pack	16	8
Smart TV Pack	15	5
VOD	3	2

Table 2. Expenditure analysis

	Expenditure Analysis (thousands €)										
	Start	**Years**									
Cost Category	0	1	2	3	4	5	6	7	8	9	10
Cloud Vendor [PaaS, SaaS,IaaS,App,SLAs]	1.580	0	0	0	0	0	0	0	0	0	0
CDNs	100	0	0	0	0	0	0	0	0	0	0
Linear Channels costs	750	750	750	750	750	750	750	750	750	750	750
Inhouse channels costs	700	0	0	0	0	0	0	0	0	0	0
Salaries	60	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260	1.260
Marketing	500	400	400	400	400	400	400	400	400	400	400
Rental of building facilities	-	0	0	0	0	0	0	0	0	0	0
Maintenance of production equipment	200	0	0	0	0	0	0	0	0	0	0
Movements	-	20	20	20	20	20	20	20	20	20	20
Expenditure to third parties	30	20	20	20	20	20	20	20	20	20	20
Other expenses	60	10	10	10	10	10	10	10	10	10	10
Total annual fixed operating costs	3.980	2.460	2.460	2.460	2.460	2.460	2.460	2.460	2.460	2.460	2.460
Total expenditure (operating costs & investments)	4.380	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490	2.490

3.3. Implementation Cost

The basic Fixed Operating Expenses are the cost for the Cloud vendor, CDNs, Linear Channels and Marketing for the construction period, as shown in Table 2.

The Cloud Video platform expenses required for the construction period are calculated and presented in Table 3. Services are divided into 3 categories. Frontend Services, Backend Services, and other services needed to build the platform. The total cost for cloud vendor in the construction period is 1.580.000 €

3.4 Cash Flows

The Cash Flows for 10 years of sales for optimistic (Gompertz) and pessimistic (Logistic) scenarios are presented in the below Figure 5. Table 4 shows economic indicators.

3.5 Break-Even Point

Break-even point is the exact amount of sales (turnover) that an enterprise covers its entire costs, fixed and variable, making no profit or loss. This concept is an important subject of study and goes into the sphere of sales analysis of a business. According to this method, the relationship between a business's variable costs, fixed costs of a business and its sales is defined as follows: Sales revenue = Fixed cost + Variable costs + Net profit. The sales revenue of a business depends on the product of the units sold and their price, fixed costs are not changed, and we have assumed above that the variable costs are proportional to the output of the units sold, the above equation is:

$$P.X = F + AV.X$$

Table 3. Cloud TV video platform investment

Cloud TV Video Platform Investment (thousands €)	
Backend	
Online platform	600
Integration Services	350
Transcoding-Ingestion	50
COTS (commercial off-the-shelf)	30
Subtotal 1	1.130
FrontEnd	
UI/UX Design	50
iOS Apps	40
Android Apps	40
Web App	50
Samsung SmartTV UP	70
Android STB Client	100
Subtotal 2	350
Other costs	
IT cost for provising	50
Recommendation Engine	20
Analytics	30
Subtotal 3	100
Total	1.580

Where,

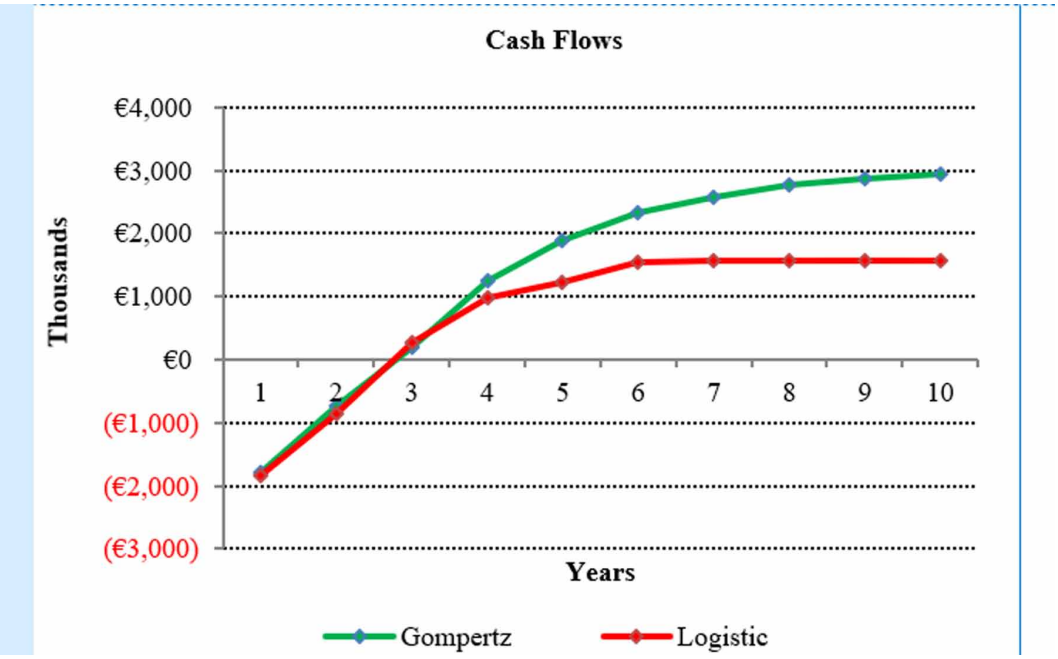
P = The selling price of the product
X = Requested quantity of the product sold
F = Fixed production costs
AV = variable cost per unit of product
P.X - AV.X = F =>
X(P - AV) = F =>
X = F/(P - AV)

where, P - AV are fixed unit costs (fixed unit cost = unit sales price - variable unit cost).

In Table 5 the break-even point (number of subscribers) is calculated for the different products.

According to the evaluation results, break-even point for OTT is appeared after 2 years of sales and 159.900 subscribers, for IPTV after 3,5 years of sales and 76.875 subscribers, for Smart TV after 2,5 years of sales and 17.220 subscriber and for VOD there is no break-even point for the first 10 years of sales. The OTT break-even point is graphically illustrated in Figure. 10 and Figure.11, since this is the most valuable technology for Pay TV operator to invest using the cloud. Figure 6 shows the break even point for Gompertz model (OTT). Figure 7 shows the break even point for the Logistic model (OTT).

Figure 5. Cash Flows



4. SENSITIVITY ANALYSIS

In this section a further sensitivity analysis is presented, taking into account the launch of a new similar service from a new operator in this specific local market. Based on this scenario there is a need of calculation and examination of potential customer database reduction and the migration to the new Pay TV operator. This scenario which includes only the reduction of OTT subscribers that is the most valuable product and the new trend of Pay TV market, will trigger the operator to examine all the costs and the model pricing of products in order to reduce or avoid the loss of profits. The most probably assumption is the 10% loss of subscribers who will decide to choose the new competitor's TV platform. As a counter measure company has to reduce the price for OTT Pack from 16€ to 14€ in order to keep stable the percentage of reduction regarding to customer database. According to this hypothesis all the respective values such as Break Event Point, Payback Period and all the economic indicators are going to change. In the below figures are presented the Break Even Point, Payback Period and the values of the most significant economic indicators according the specific scenario. The mathematical model we used is Gompertz. Figure 8 shows the break even point OTT/ 1st scenario -10% for OTT subscribers. Figure 9 shows the cash Flows for OTT / scenario -10%. Table 6 displays Economic indicators / 1st scenario scenario -10% for OTT subscribers.

As observed, comparing Table 4 and Table 6, the IRR has been reduced from 43% to 19% and the Payback Period has been increased from 2,04 to 3,65 years. However the investment is still valuable for a new Pay TV operator.

Extending the 1st scenario with a 10% reduction rate to OTT subscribers we proceeded to a 2nd scenario where the new company have 10% reduction rate to OTT subscribers and 40% reduction rate to IPTV subscribers. The target is to reduce costs, as STBs have a fairly high cost per provider compared to OTT and Smart TV applications so the marketing strategy focus on the sales for OTT and Smart TV products. This makes new calculations based on the Gompertz mathematical model for the corresponding parameters.

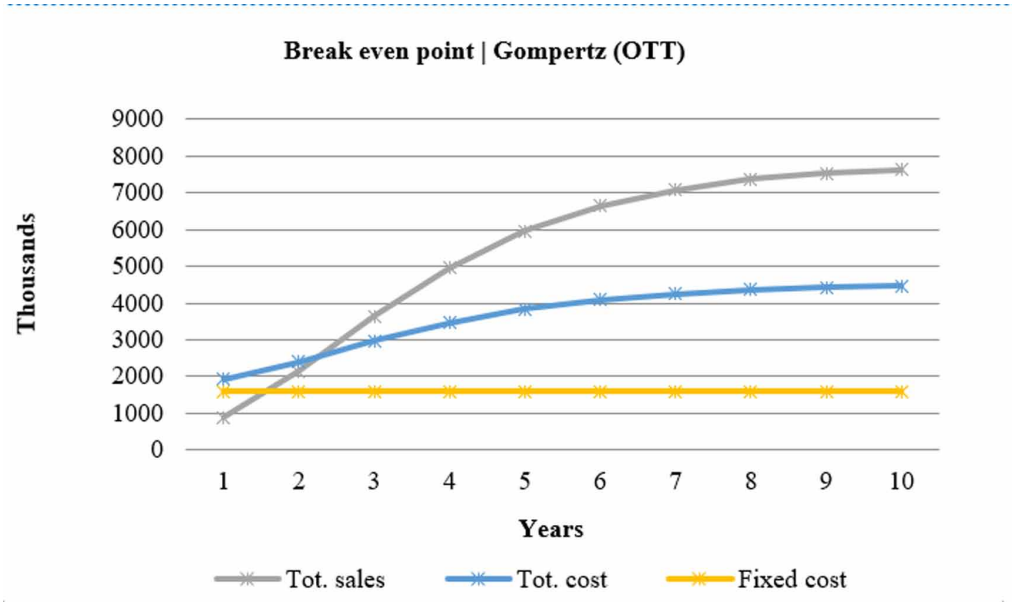
Table 4. Economic indicators

		Years									
Indicators of 10 years		1	2	3	4	5	6	7	8	9	10
HPR (Holding Period Return)	Total	HPR1	HPR2	HPR3	HPR4	HPR5	HPR6	HPR7	HPR8	HPR9	HPR10
Optimistic scenario	2,40	0,28	0,11	-0,04	-0,21	-0,31	-0,39	-0,43	-0,46	-0,48	-0,49
Pessimistic scenario	1,32	0,29	0,13	-0,05	-0,17	-0,21	-0,26	-0,26	-0,26	-0,26	-0,26
HPY (Holding Period Yield)		HPY1	HPY2	HPY3	HPY4	HPY5	HPY6	HPY7	HPY8	HPY9	HPY10
Optimistic scenario	1,40	-0,72	-0,89	-1,04	-1,21	-1,31	-1,39	-1,43	-1,46	-1,48	-1,49
Pessimistic scenario	0,32	-0,71	-0,87	-1,05	-1,17	-1,21	-1,26	-1,26	-1,26	-1,26	-1,26
Yearly HPR (Holding Period Return)											
Optimistic scenario		1,10									
Pessimistic scenario		1,03									
GM (Geometric Mean)											
Optimistic scenario		-0,67									
Pessimistic scenario		-0,73									
E(r) (Expected Return)											
Optimistic scenario		0,21									
Pessimistic scenario		0,18									
σ (Risk)		Σ									
Optimistic scenario		0,58									
Pessimistic scenario		0,42									
PV (Present Value)											
Optimistic scenario		4.643.280									
Pessimistic scenario		2.330.233									
NPV (Net Present Value)											
Optimistic scenario		9.023.280									
Pessimistic scenario		6.710.233									
FV (Future Value)											
Optimistic scenario		12.043.473									
Pessimistic scenario		6.044.025									
IRR (Internal Rate of Return)											
Optimistic scenario		0,43									
Pessimistic scenario		0,31									
Payback Period											
Optimistic scenario		2,04									
Pessimistic scenario		3,82									

Table 5. Break Even Point for different products

		Break Even Point	
X=F/(P-AV)	X=	159.900	Packs OTT
X=F/(P-AV)	X=	76.875	Packs IPTV
X=F/(P-AV)	X=	17.220	Packs SmartTV
X=F/(P-AV)	X=	73.800	VODs

Figure 6. Break even point for Gompertz model (OTT)



According to this hypothesis all the respective values such as Break Event Point, Payback Period and all the economic indicators are going to change. The following figures present, the Payback Period and the values of the most significant economic indicators according this 2nd scenario. The break even point for the OTT subscribers is the same and there is no change.(see figure 8) Figure 10 shows Cash Flows for 2nd scenario (-10% for OTT subscribers and -40% for IPTV subscribers). TABLE 7 shows Economic indicators / 2nd scenario -10% OTT, -40% IPTV).

As observed, comparing Table IV, Table VI and Table VII, the IRR has been reduced from 43% to 12% and the Payback Period has been increased from 2,04 to 4,31 years. However, the investment is still valuable despite the shrinking customer base and this is a proof that OTT services via Cloud technology will be the state of the art in Pay TV market compared to IPTV STBs or Smart TV services.

5. CONCLUSION

Taking into account the current economic situation in the local and global market, competition (due to innovation) and the estimated response to the public, a techno-economic analysis of a Pay

Figure 7. Break even point for Logistic model (OTT)

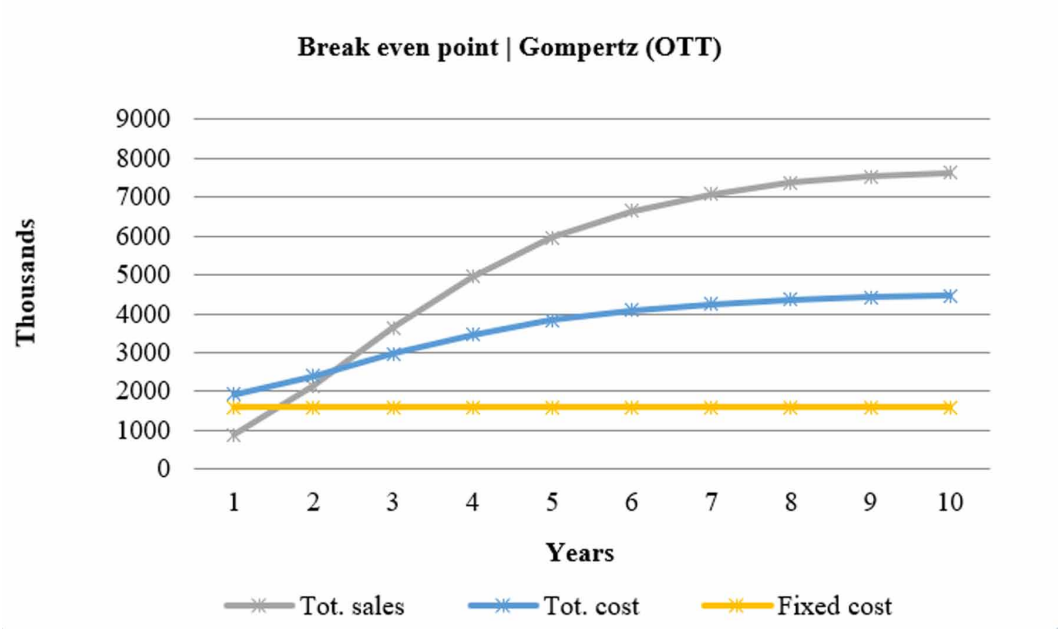


Figure 8. Break even point OTT/ 1st scenario -10% for OTT subscribers

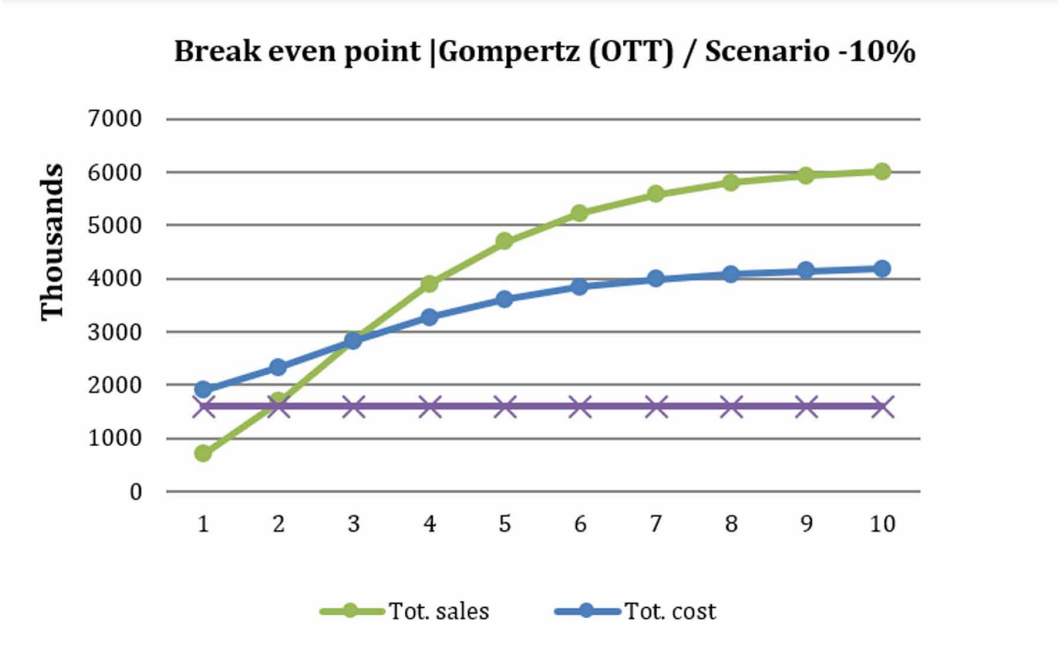


Figure 9. Cash Flows for OTT / scenario -10%

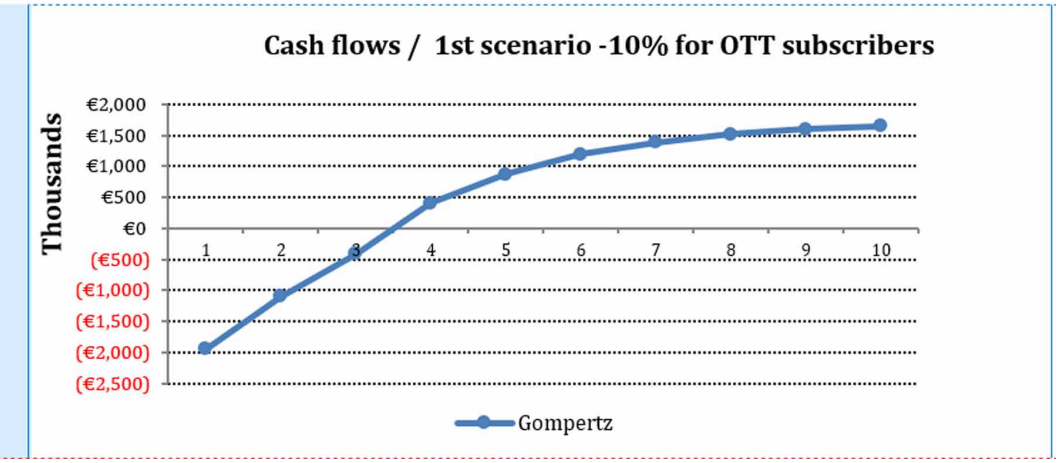


Table 6. Economic indicators / 1st scenario scenario -10% for OTT subscribers

PV (Present Value)	1.126.565 €
NPV (Net Present Value)	5.506.565 €
FV (Future Value)	2.922.020 €
IRR (Internal Rate of Return)	19%
Payback Period	3,65

Figure 10. Cash Flows for 2nd scenario (-10% for OTT subscribers and -40% for IPTV subscribers)

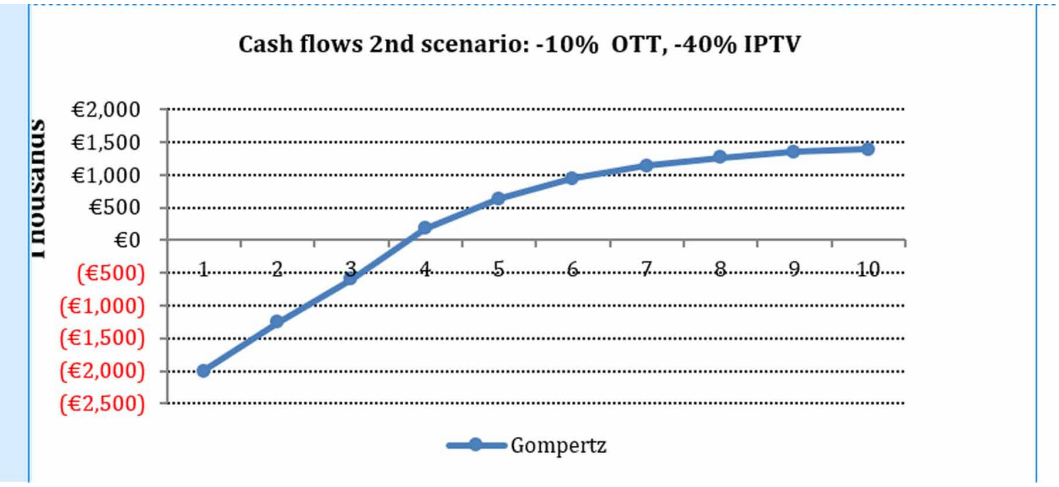


Table 7. Economic indicators / 2nd scenario -10% OTT, -40% IPTV)

PV (Present Value)	**263.666 €**
NPV (Net Present Value)	**4.643.666 €**
FV (Future Value)	**683.883 €**
IRR (Internal Rate of Return)	**12%**
Payback Period	**4,31**

TV operator with cloud technology, was carried out and reveals that investing on this technology is worth. The significant further improvement of the key ratios of the financial statements, as well as the net profits that are expected to expand even further in the coming period lay the foundations for a dynamic presence in the sector. Cash flow tends to show a positive trajectory relatively quickly, the break-even point also appears reasonably and the expected return is rather satisfying. Moreover, net operating income in the first two year is negative while in the third year it reaches positive numbers.

This pay-as-you grow model provides a fast time-to-market adaptation with low capital and operational costs and less staff, since cloud provider is responsible almost for the majority of the tasks. The hardware requirements are also limited to indoor operation and monitoring equipment. Taking into account the low penetration in Greece (25%), there is a great opportunity for Pay TV investments. This is in accordance with the new European regulation that obliges broadcasters, since March 2018, to provide content portability. This is an important opportunity for new companies in Pay TV area for widening their targets group and profits. In addition, there are many expectations of the development of TV services from the development and consolidation of 5G in many applications.

Furthermore, and after examine the new entry of a Pay TV operator in the local market, the investment turns out to be still valuable even though there will be loss of subscribers which will cause a significant loss of profits. According to the sensitivity analysis which performed in section IV we observe that the investment is still valuable despite the shrinking customer base. The expected return is 19% in first scenario and 12% in the second scenario. Also the payback period move within a reasonable framework for such an investment in both scenarios.

A topic that requires further research by a technoeconomic perspective as well is the necessity of a proper analysis and the factors needed for a Pay TV operator, is the option to have only OTT services at startup of the company, excluded IPTV services which have high cost for the provider due to the availability of STB to the customerIn that case the initial cost of the investment must be changed.

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