Towards a Roadmap for Cloud TV Services in the Internet of Things Era

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Abstract. Cloud TV will play an important role in future pay-TV services and is quickly becoming the next arena for TV content providers. This emphasizes the need for a technology roadmap to address several key issues that may affect the deployment of future Cloud TV services. Taking into account an important blend of social, economic and technological factors, three alternative technologies, Internet Protocol TV, Over the Top and Smart TV have been investigated and ranked using the Analytical Hierarchy Process. The results reveal that OTT seems to take the precedence and security, privacy, accessibility, costs saving and time-to-market are crucial aspects, need to be taken into account.

Keywords: Decision making, Cloud TV, Roadmap, OTT, IPTV, Smart TV.

1 Introduction

Industry 4.0 is expected to deliver significant gains in productivity by assimilating several technological advancements including cloud computing, which will play a crucial role in the era of the Internet-of-Things. The broadcasters and the communication operators who want to offer video services are faced with a daunting task: 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 (Cloud TV) that drastically reduces the time to market and increases the revenues.

Cloud TV offers an effective transition for pay-TV operators who want to invest into the TV industry without much risk. The cloud based model allows companies to test and develop the platform without much expense, ensuring high availability of content and disaster recovery issues. The main objective of this paper is to investigate the cloud based TV services for the case study of Greece, offered by cloud vendors, and examine three alternative technological solutions for Cloud TV, IPTV, OTT and smart TV in order to evaluate the most appropriate solution that a pay TV operator has to follow[1]. This evaluation will help afterwards each operator to design its strategy. Towards this end, the framework of the analytical hierarchy process (AHP) [2] is used as a fundamental part of an effective technology roadmapping,[3]. The importance of the various criteria involved is evaluated and discussed revealing an important blend of economic, social and performance related aspects that may influence the deployment of Cloud TV platforms. The obtained results form a key part of future Cloud TV solutions and implementations both for Greece and for other countries that have not yet deployed Cloud TV solutions as well as a useful guide for Pay TV operators in order to invest on Cloud TV services, which is the current trend for Pay-TV services.

2 Methodology

The hierarchy levels of AHP are presented in Fig1. In order to rate the alternative technologies, one must evaluate the weights of the criteria and the factors. Each expert m ($1 \le m \le M$) compares all possible combinations of C_k by filling out the pairwise

comparison matrix (PWC) $\mathbf{P}^{(m)} = [P_{ij}^{(m)}]$, which signify the importance of C_i compared to C_j based on nine level scale [1].The weights $w_k^{(m)}$ of criterion C_k is calculated with the most widely adopted approach of eigenvalue problem. Assuming that the eigenvalues are ordered so that λ_1 is the largest eigenvalue, then the weight of criterion C_i is estimated by the principal eigenvector $\mathbf{x}_1^{(m)}$ as $wk^{(m)}=x_{1k}{}^{(m)}[\sum_{m=1}^{M} x_{1k}{}^{(m)}x_{1l}]^{-1}$. After all the comparisons have been completed, the average weight w_k for each criterion C_k is calculated. A similar procedure is followed for the estimation of the weights of the factors f_{jk} of each criterion. Finally, the alternatives are pairwise compared according to each factor and for each alternative A_i one obtains the relative scores S_{ijk} under factor F_{jk}. The final ranking priorities A_i of each alternative are evaluated.

$$Ai = \sum_{k=1}^{N} \sum_{j=1}^{J_k} S_{ijk} f_{ijk} w_k$$

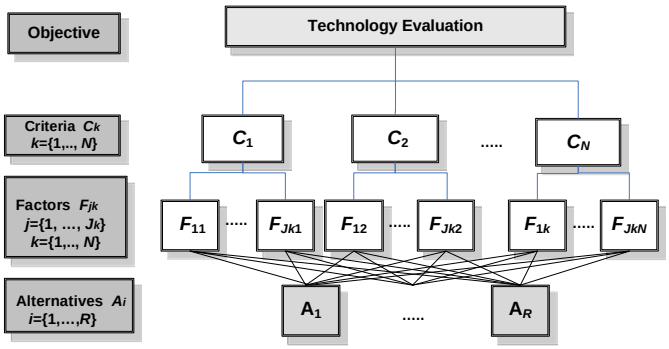

Fig. 1 AHP hierarchical model

3 Results and Discussion

In this section, the results of PWCs for the evaluation of the importance of the criteria and factors that may affect the deployment of Cloud TV are presented in Table I. Sixteen experts, a sufficient number of participants for PWC [4], working in the field of Pay TV, with Computer Science and Electronics and/or Management background have participated in pairwise comparison surveys. |Security seems to take the precedence over the other criteria, emphasizing the need of end users for reliable products since they want to request unceasing services from anywhere and anytime without any kind of malfunction. Reliability criterion has the second highest weight, emphasizing the need to provide reliable, uninterruptible services and also high availability to customers. Reliability of cloud providers builds strong ties between the company and the customer as the uninterruptible service delivery is crucial for the customer experience.

Table 1. Criteria and Factors

Criteria-factors		Description	Weight
C1 Flexibility (11,83%)			
F_{11}	Interoperability	Interoperability between the different platforms	53,70%
F_{12}	Portability	Portability of services to cover a wide range from different mobile devices.	21,06%
F_{13}	Scalability	Supports a wide range of TV channels.	25,24%
C2 Usability (7,87%)			

F_{21}	Accessibility	Supports highest degree of access to their clients.	42,97%
F_{22}	Content Control	Controls the TV content to the customer.	25,52%
F_{23}	TV Software App	The usability of the application that end-users experience.	31,50%
		C3 Economic Issues (10,01%)	
F_{31}	Pricing Model	The pricing model followed by each cloud TV provider.	34,47%
F_{32}	Costs saving	Stated in the contract the resources and requirements from client's side. (Capex/ Opex).	36,45%
F_{33}	Time-to-market	The time-to-market plan that cloud vendors promise.	29,08%
		C4 Security (31,13%)	
F_{41}	Protection	The security offered by the cloud TV vendors in relation to their infrastructure.	41,11%
F_{42}	IT Compliance	Customer must consider the security policies of providers	17,85%
F_{43}	Data Security	Applicant cloud providers should explicitly state the encryption method used.	41,03%
		C5 Performance (15,98%)	
F_{51}	Latency	Providers determine the latency to be present in broadcast of live TV programs.	50,91%
F_{52}	Software	Performance of software tools for Transcoding, Encoding/Decoding, Ingestion	28,01%
F_{53}	Hardware	Technical characteristics of equipment.	21,09%
		C6 Reliability (23,18%)	
F_{61}	SLAs	Indicate the availability of vendors, response time in the event of problems occurs.	36,21%
F_{62}	Availability	Availability of TV channels, VOD content, Smart TV applications, extra features	41,77%
F_{63}	Service Management	Providers should be trustworthy, supervise and control the television services.	22,02%

Regarding Flexibility, experts seem to be more concerned about the interoperability. Concerning Usability, accessibility seems to take the precedence and as far as economic are concerned, cost saving has the highest importance emphasizing its role as a motivation for potential investment. Regarding Performance, the experts seem to be more concerned about the latency rather than hardware or software factors. Software has rated as more important than hardware, as this is a little more considerable according to the performance of software tools that used to provide Transcoding, Encoding/Decoding, Ingestion of TV assets and linear TV Channels. Considering Reliability, availability is the most important factor since it is the great goal of vendors to provide any kind of variable content anywhere and anytime.

Figure (a), (b) presents the relative scores of alternatives for each factor and the final ranking, respectively. The scenario rating with highest importance is OTT highly rated in almost all the factors. OTT devices support flexibility, portability, functionality, rapid upgrading and adaptability to new trends and applications. OTT technology also offers low latency, content and personal data security, great usability and high performance by having 4K Ultra High Definition players installed. In addition, OTT is considered to be the most affordable solution by helping the pay-TV company to save money and increase revenue by improving cash flows. IPTV is not expected to have any more penetration to the market, assumed as a legacy technology. Although Smart TV is ranked third, it is considered as a technology of the future, because the factories of major television manufacturers have spent a lot of time to research and development (R&D) for internet connectivity and optimization of TV processors to provide as many applications as possible, including pay-TV software Apps.

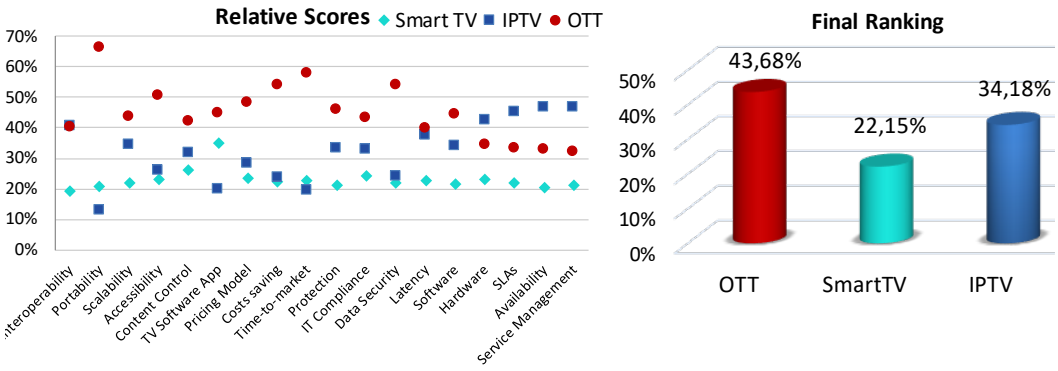

Fig. 2 (a) Relative Scores, (b) Final Ranking

4 Conclusion

In this paper the evaluation of the potential of three technological alternatives OTT, Smart TV and IPTV for Cloud TV implementation for pay-TV business strategy, has been carried out for the case study of Greece. The results focus on security, data protection, accessibility, costs saving and time-to-market but are also indicative for the rest of the factors. OTT takes the precedence, IPTV is ranked second, while Smart TV is considered as a longer term alternative. The growing penetration of portable devices in addition with the predictions and estimation of high video traffic through internet can motivate the OTT application in pay-TV market. Furthermore, R&D are going to improve all these functionalities and optimize new features and applications that can be supported from OTT technology providing great customer experience. This paper implements and verifies an open and transparent roadmapping model for Cloud TV investment, emphasizing on crucial interdisciplinary aspects of cloud operation The obtained results form a key part of future Cloud TV solutions and implementations both for Greece and other countries that have not yet deployed Cloud TV solutions.

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