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# Effects of OTT services on consumer's willingness to pay for optical fiber broadband connection in Thailand

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## ABSTRACT

Over-the-top (OTT) media and communications services are shifting internet consumption towards the increase of traffic over the internet. Since FTTH provides the highest capacity and speed of the broadband service, this paper attempts to examine the impact of OTT services to consumers to subscribe FTTH as an efficient off-load option from mobile broadband. Main research questions are whether and how OTT services affect and drive consumers to adopt optical fiber broadband. It uses fuzzy data to derive consumer's willingness to pay (WTP) for optical fiber broadband connection. The results of the study indicate that movie over internet service as an OTT service drives people to adopt and be willing to pay more for FTTH connection. The paper also discusses the policy implication on the promotion of optical fiber broadband adoption in Thailand.

Keywords: Optical fiber, Willingness to pay, OTT services, Fuzzy data

## 1. Introduction

Over-the-top (OTT) media and communications services such as Youtube, Netflix and Skype are changing consumer's internet consumption behavior. For instance, the huge amount of video content online shows significant changes. Around 30 hours of video was uploaded to YouTube every minute in 2011 while an estimation by ERICSSON (2016) indicates that it is more than 300 hours every minute today. In addition, behaviors of viewers are shifting towards services that are easy to use and respond well to their needs. These shifts motivate the development of cross-platform access to video content (ERICSSON, 2015).

For Internet service providers (ISP), there is a strong impact on their traditional telecommunications revenues and traffic over the Internet (Seixas, 2015; Baldry, et al., 2015). While consuming a lot of bandwidth, however, it is no doubt that the emergence of OTT services stimulates penetration of the internet (Knoben, 2014).

The main research question of this paper is how OTT services affect consumer's demand optical fiber broadband connection. It uses willingness to pay as an indicator of consumer's utility of satisfaction to their preference on FTTH connection. First, it finds out what kind of OTT services, as well as demographic variables such as age, income, living area and education, affect consumer's decision in subscribing optical fiber broadband connection. Second, it examines consumer's willingness to pay for optical fiber broadband connection influenced by OTT services.

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This study takes Thailand as a target since optical fiber broadband adoption is still in an early stage for the countrywide. The penetration per household was only 30.24% and penetration per population was only 9.26% in 2015. Almost 99% of fixed line internet in Thailand are broadband. The majority, 67% technological share, of broadband internet access is Digital Subscriber Line (DSL). Only some central business district areas access fixed broadband via fiber optic cables, Fiber-to-the-Premise (FTTP) (National Broadcasting and Telecommunication Commission, 2015).

Broadband diffusion in Thailand has been concentrated in urban areas and has relied on mobile rather than fixed access. Mobile broadband penetration per population has reached 87% as of the third quarter of year 2015 (National Broadcasting and Telecommunication Commission, 2015). Assuming mobile broadband as a basement of connection, this paper attempts to examine the impact of OTT services to consumers to subscribe FTTH as an efficient off-load option since the FTTH provides the highest capacity and speed of the broadband service.

Fuzzy data are used to derive consumer's willingness to pay for optical fiber broadband connection influenced by OTT services. Instead of choosing one single answer or a certain range of the answer as in traditional survey, respondents can express the degree of their feelings by using membership function to truly reflect their range of willingness to pay (Lin, et al., 2016).

The willingness to pay can reveal the preference of non-adopters' demand on broadband adoption (Carare, et al., 2015). The marginal effect of OTT services from this study contributes to the expansion of the optical fiber broadband market. The policy implication is also discussed to shed light on the promotion of optical fiber broadband adoption in Thailand.

## 2. Over-the-Top

Mnakri (2015) ITU experts, defines OTT (Over-The-Top) services as applications and services such as social networks, search engines, amateur video aggregation sites which ride on operators' networks offering their services over the internet.

The Body of European Regulators for Electronic Communications (BEREC) (2016) explains OTT services as "*content, a service or an application that is provided to the end user over the public Internet*". Godlovitch, et al. (2015), in a paper for European Parliament, define Over-the-Top as online services which could substitute to some degree for traditional media and telecom services.

BEREC (2016) distinguishes OTT services into three types. First, OTT service that qualifies as an Electronic Communications Service (ECS) including OTT voice with possibility to make calls to the Publicly Available Telephone Service (PATS). Second, OTT service that is not an ECS but potentially competes with an ECS including OTT voice, instant messaging. Last, other OTT services such as E-commerce, video and music streaming.

ITU classifies OTT services by impact on network operators in 3 categories: OTT communications, applications, and video/audio (Mnakri, 2015; Seixas, 2015) while Knoblen (2014) categorizes OTT services in 4 classes by business models. First, OTT Communications such as Skype, WhatsApp, Viber. Second, OTT Media such as Youtube, Netflix, Spotify. Third, Commerce such as Amazon, PayPal, ebay. Last, Social Media such as Facebook, Twitter, Pinterest, Linked in.

In summary, Over-the-Top (OTT) is a delivery of services over the internet which ride on internet service providers' networks grouped into 3 main categories: media, communication, and applications. However, this study focuses only on OTT media and communication which are expected to impact in driving higher bandwidth consumption and creating internet traffic. Adopting definitions from Baldry, et al. (2015), OTT media in this study are referred to streamed video and audio content over the internet while OTT communications are referred to services whose primary applications are communications but use the internet as transport medium.

### **3. Willingness to pay**

Traditional approach relies on choice experiments to analyze consumer's preference on broadband network and estimate the demand for broadband services (Madden & Simpson, 1997; Sunada, et al., 2011). With greater accurate evaluation, number of works involve with respondents' willingness to pay in order to estimate the elasticity of the demand for broadband (Rappoport, et al., 2003; Carare, et al., 2015) and support future broadband infrastructure investments (Jeffcoat, et al., 2012).

Nakamura (2013) uses contingent valuation method in the context of universal service of telecommunication services based on functionality. The paper measures Japanese customer's willingness-to-pay to maintain combinations of five telecommunication services that are considered substitutes.

### **4. Methodology**

This study adopts an empirical approach which is based on the data of consumer's willingness to pay for optical fiber broadband connection. This section presents framework design, method, and survey using in collecting data.

#### *4.1) Framework design*

Many studies have been made on factors influence broadband preference. However, there are still limited works on linking the effect from OTT services to consumer's preference on optical fiber broadband adoption.

The framework of this study was developed mainly based on stated-preference of non-FTTH adopters measured by willingness to pay. Since OTT services increase consumer's demand for bandwidth consumption and FTTH provides highest capacity among network technologies, this study presumes that with consumption of OTT services, consumer will need FTTH and willing to pay more.

Based on relevant literatures, Savage & Waldman (2005) based their stated-preference model on broadband attributes including speed, reliability, always-on, price, and immediate installation service in order to estimate consumer's willingness to pay for high-speed broadband network. However, this study focuses on the impact of OTT services on consumer's willingness to pay for optical fiber broadband. Therefore, the framework of this study includes OTT services as an explanatory variable. Consumer's characteristics and experiences of mobile and fixed-line connection problems are included as control variables.

Carare, et al. (2015) estimates the relationships between demographic and socioeconomic characteristics and willingness to pay for broadband of non-adopters. Moreover, Nakamura (2013) mentions the important of mobile and fixed-line substitutability. This study asks respondents whether the mobile broadband prevents them to adopt optical fiber broadband in order to deepen the understanding on the respondent's preference.

Hence, the framework of this study incorporates with explanatory variable – OTT, control variables – individual characteristic, problem of currently using internet connection experiences, and current use of broadband network.

#### 4.2) Method

This study hypothesized that OTT services and mobile over-use are the main drivers of consumer's demand for optical fiber broadband network. It, first, analyzes factors affecting the experience of reaching upper limit of mobile internet package. The 2<sup>nd</sup> model, then, examine factors influence consumer's willingness to pay for optical fiber broadband connection. The last model attempts to explain consumer's intention to consume movie service through the internet in the next 1 – 3 years.

The structure of models are defined as follow:

1<sup>st</sup> model:

$$\text{MobileOverUse} = f(\text{Gender}, \text{Age}, \text{MBmovie}, \text{MBmovieLoad}, \text{MBclip}, \text{MBtv}, \text{MBclipSocial}, \text{MBfbLive}, \text{MBgame}, \text{MBmusicload}, \text{MBvdoCall})$$

2<sup>nd</sup> model:

$$\text{WTP} = f(\text{Gender}, \text{Age}, \text{Income}, \text{Mobile}, \text{Fixed}, \text{MBmovie}, \text{MBmovieLoad}, \text{MBclip}, \text{MBtv}, \text{MBclipSocial}, \text{MBfbLive}, \text{MBmusicLoad}, \text{MBvdoCall}, \text{FixMovie}, \text{FixMovieLoad}, \text{FixClip}, \text{FixTV}, \text{FixClipSocial}, \text{FixFBlive}, \text{FixMusicLoad}, \text{FixVDOcall}, \text{FixGame}, \text{MBprobDisconnect}, \text{MBprobDelay}, \text{MBprobInsta}, \text{MBprobSoundInsta}, \text{FixProbDisonnect}, \text{FixProbDelay}, \text{FixProbInsta}, \text{FixProbSoundInsta}, \text{MBoverUse}, \text{FutureMovie}, \text{FutureTV})$$

This study construct OLS models of a dependent variable calculated by fuzzy number willingness to pay (WTP) of each respondent. It adopts the calculation of scaling for a fuzzy number on R proposed by Lin, et al. (2016) as follows:

for a fuzzy number  $A=[a,b]$ ;

$$\text{Fuzzy number on R} = cx + \frac{\|A\|}{2\ln(e+\|cx\|)}$$

where  $cx$  is a center of the interval

$\|A\|$  is a range of the interval.

3<sup>rd</sup> model:

$$\text{FutureMovie} = f(\text{Gender}, \text{Age}, \text{NowMovieTheater}, \text{NowMovieTVbox}, \text{NowMovieCD}, \text{NowMovieInternet}, \text{SumMovie}, \text{SumMovieLoad}, \text{Mobile}, \text{Fixed})$$

The list of variables that were developed and included in the model is given in Table 1 – 3.

**Table 1.** Description of variables

Variable	Description
WTP (dependent variable)	Willingness to pay calculated by a fuzzy number $[min,max]$ where min = consumer's first answer of willingness to pay max = maximum willingness to pay
MobileOverUse	=1, if the respondent has an experience of reaching upper limit of mobile internet package resulting in the reduction of internet speed; =0, otherwise
FutureMovie	=1, if the respondent intend to watch movie through the internet in the next 1 – 3 years; =0, otherwise
FutureTV	Consumer's intention to watch TV program between television and internet in the next 1 – 3 years, range from 0 to 4 0 indicates their preference in 100% using television 1 indicates a combination of 75% using television and 25% internet 2 indicates a combination of 50% using television and 50% internet 3 indicates a combination of 25% using television and 75% internet 4 indicates that he or she will totally watch movie through the internet
Gender	=1, if the respondent is male; =0, otherwise
Age	Age of the respondent
Income	Monthly income of respondent
Mobile	=1, if the respondent currently mobile broadband; =0, otherwise
Fixed	=1, if the respondent currently fixed broadband; =0, otherwise
MBmovie	Daily time spending of watching movie through mobile internet
MBmovieLoad	Daily time spending of downloading and/or uploading movie through mobile internet
MBclip	Daily time spending of watching VDO clip through mobile internet
MBtv	Daily time spending of watching TV program through mobile internet
MBclipSocial	Daily time spending of watching VDO clip on social network through mobile internet
MBfbLive	Daily time spending of using Facebook Live through mobile internet
MBmusicLoad	Daily time spending of downloading and/or uploading music through mobile internet
MBvdoCall	Daily time spending of making VDO call through mobile internet
MBgame	Daily time spending for mobile game
FixMovie	Daily time spending of watching movie through fixed-line internet
FixMovieLoad	Daily time spending of downloading and/or uploading movie through fixed-line internet
FixClip	Daily time spending of watching VDO clip through fixed-line internet
FixTV	Daily time spending of watching TV program through fixed-line internet
FixClipSocial	Daily time spending of watching VDO clip on social network through fixed-line internet
FixFBlive	Daily time spending of using Facebook Live through mobile internet
FixMusicLoad	Daily time spending of downloading and/or uploading music through fixed-line internet
FixVDOcall	Daily time spending of making VDO call through fixed-line internet
FixGame	Daily time spending for online game through fixed-line internet
SumMovie	Total daily time spending for watching movie through internet
SumMovieLoad	Total daily time spending for downloading and/or uploading movie through internet
MBprobDisconnect	The frequency of experiencing mobile internet disconnection, ranged from 0 to 4

Variable	Description
MBprobDelay	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing mobile internet delay, ranged from 0 to 4
MBprobInsta	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing unstable video quality on mobile internet, ranged from 0 to 4
MBprobSoundInsta	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing unstable voice quality on mobile internet, ranged from 0 to 4
FixProbDisconnect	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing fixed-line internet disconnection, ranged from 0 to 4
FixProbDelay	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing fixed-line internet delay, ranged from 0 to 4
FixProbInsta	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing unstable video quality on fixed-line internet, ranged from 0 to 4
FixProbSoundInsta	0=No problem at all; 1=A few acceptable problems; 2=Frequent acceptable problems; 3=Many problems to be complained; 4=Severe problems to switch operator. The frequency of experiencing unstable voice quality on fixed-line internet, ranged from 0 to 4
NowMovieTheater	=1, if the respondent currently watching movie in theater; =0, otherwise
NowMovieTVbox	=1, if the respondent currently watching movie through pay TV; =0, otherwise
NowMovieCD	=1, if the respondent currently watching movie from CD; =0, otherwise
NowMovieInternet	=1, if the respondent currently watching movie through internet; =0, otherwise

#### 4.3) Survey

The questionnaire consists of the following four parts:

- Part 1: User's profile
- Part 2: Telecommunications service experiences
- Part 3: OTT services consumption
- Part 4: Consumer's preference of optical fiber broadband network and willingness to pay

The details of each part in the questionnaire are described below.

##### *Part 1: User's profile*

The questionnaire in Part 1 consists of a user's profile indicating gender, age, education, occupation, monthly income, and monthly expenditure.

##### *Part 2: Telecommunications service experiences*

This part aims at collecting data of current use of internet connection and connection problems experience. Current use of the internet consists of mobile and fixed broadband. Connection problems include connection drop, upload/download delay, unstable video quality during media watching, and sound or video distortion during VDO call. It also includes the problem of the reduction of internet speed due to reaching the upper limit of the use of internet on mobile broadband.

#### *Part 3: OTT services consumption*

Daily time spend in using OTT services including OTT media and OTT communication are collected in this part. OTT media consist of movie watching and download, TV program on demand, video clip watching, download and upload, Facebook Live download and upload, music download and upload. OTT communication consists of Video call services through Facetime, Skype, LINE, and Facebook.

This part also identifies current and expected within 3 years of consumption channel. For OTT media – TV program on demand, respondents indicate their consumption channel between television and internet scaling 0 to 4. 0 indicates their preference in using only television while 4 indicates preference in using only internet. For other OTT media and OTT communication services, respondents indicate their consumption channel between mobile and fixed connection scaling 0 to 4. 0 indicates that they totally prefer for using only mobile while 4 indicates preference in using only fixed network.

#### *Part 4: Consumer's preference of optical fiber broadband network and willingness to pay*

After explaining optical fiber broadband network capacities, the respondents are required to make decisions whether they want to subscribe FTTH or not. For those who have intention to adopt, they are asked their willingness to pay. Those who are not using fixed network, the first answer is considered as a minimum of willingness to pay while those who are currently using fixed broadband, their current monthly price is used as the minimum. With an increment of THB50 (approximately USD1.5), respondents are asked until they stop their willingness to pay. Then, the last price is recorded as a maximum of willingness to pay.

## **5. Results**

An interview based questionnaire was carried out during July 2016. Excluding questionnaires which were not completely answered, effective 482 respondents were obtained. However, data utilized for examining the influence of OTT services on consumer's willingness to pay for optical fiber broadband connection includes 472 respondent excluding 10 current FTTH users.

The results of this study will illustrate the effect of OTT services on consumer's willingness to pay for FTTH connection. Coefficients from independent variables are interpreted as an increase in THB amount consumers are willing to pay influenced by each one unit increase in the significant continuous variable or the event of significant discrete variable occurring.

The result from the first model indicates that respondents who spend a more time on mobile game have 15% higher possibility to reach upper limit of their mobile internet package. Therefore, the study excludes "mobile game" from the second model in order to avoid the multicollinearity.



The result from the second model, the WTP model, suggests that movie, as an OTT service, as well as instability of fixed-line connection and mobile over-use positively influence consumer's willingness to pay. People who spend 1 hour more on movie through mobile internet are willing to pay THB26.31 (USD0.76) more for FTTH connection. The more frequency in experiencing the instability of fixed-line network induces THB68.97 (USD2.00) of consumer's willingness to pay while the experience of reaching upper limit of mobile internet package also makes people want to pay THB72.28 (USD2.09) more. In addition, older respondents are willing to pay THB2.9 (USD0.08) more than younger. Interestingly, current mobile broadband users are willing to pay THB169.55 (USD4.89) more than those who are not.

**Table 2.** Reasons for FTTH non-adoption

Reasons	Percentage of respondents who do not choose FTTH
1. Not use internet so often	9.36
2. Current fixed-line technology is enough	40.85
3. Wi-fi offload is enough	44.68
4. Current mobile technology is enough	58.30
5. Willing to pay more for mobile	3.40

To make an understanding of the influence of movie OTT service, this study applies the third model. An additional analysis from the model indicates that people who are watching movie through internet, TV box, and CD today as well as current fixed-line users are more likely to watch movie through internet in the next 1 – 3 years.

## 6. Discussion and Implication

The results of this study imply that movie over internet service is the only OTT service that directly drives consumers to pay for optical fiber broadband network. It can be said that movie over internet service can directly contribute to the revenue of optical fiber broadband operators.

Moreover, the limitation of high-speed mobile broadband and problem of unstable video quality are also important factors that directly drives people's willingness to pay for FTTH. This result in lines with the finding from Savage & Waldman (2005) that reliability of internet connection is one of the important functions for high-speed internet users. In addition, mobile game is an important factor of experiencing the reduction of internet speed due to reaching upper limit of mobile internet package. It implies that mobile game OTT service indirectly induces consumer's willingness to pay for optical fiber broadband connection. However, optical fiber broadband will not be fully penetrated countrywide in the near future since more than half of consumers prefer mobile network. For policy makers, the results imply that policy makers should support in optical fiber investment as both means of fiber-to-the-home and advanced mobile network backbone.

## 7. Conclusion

Over-the-top (OTT) services are changing internet consumption behavior and drive demand for bandwidth and speed internet connection. Assuming mobile network as a basement of internet access, this study examine the influence of OTT services to consumer's willingness to pay for optical fiber broadband connection.

The data utilized in the analysis were retrieved from interview based questionnaire of FTTH non-adopters in Thailand. Respondents were allow to express their willingness to pay for optical fiber broadband connection in a range in order to truly reflect their willingness and flexibility. It applied fuzzy number transformation to real number incorporated with center and range for using in WTP regression model.

The results of the study indicate that OTT services have both direct and indirect impact to consumer's willingness to pay for FTTH connection. OTT movie services directly increases people's willingness to pay for FTTH while OTT mobile game indirectly influences. Mobile games drive internet consumption to reach upper limit of mobile internet package which further induces consumer's willingness to pay for FTTH connection as well as consumers who experiences unstable video quality on fixed-line. However, more than half of consumers prefer mobile network to fixed-line in using OTT applications and services. Therefore, it can be predict that with the emergence of OTT media, optical fiber broadband will not be fully penetrated in the near future even if it is available countrywide.

The implications of this study suggest that movie over internet services directly contribute to the revenue of optical fiber broadband operators. There is also a need of policy support in optical fiber investment as both means of fiber-to-the-home and advanced mobile network backbone in order to meet people's demand influenced by OTT applications and services.

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