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User Intent-Based Segmentation Analysis for Internet Access Services

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ABSTRACT

The Internet is available for almost all homes in Japan. During the diffusion stage of Internet access services, it was important to construct a model to evaluate the sensitivity for Internet access service attributes and estimate user service choice behavior to consider service sale strategies. However, as the demand for Internet access services reached saturation, the differences in service attributes among service providers became smaller, making it difficult to decide service sale strategies using conventional choice behavior models. Therefore, the purpose of this paper is to establish a method for extracting effective information for service sale strategies by focusing on user intentions and clarifying the differences in future intentions for current carriers or services with observable and unobservable factors concerned with user intention. The authors propose a framework for user intent-based segmentation to understand the current market structure and develop appropriate service sales strategies for each segment.

KEYWORDS

Decision Making, Internet Access Service, Service Strategy, User Intent, User Segmentation

INTRODUCTION

According to the Ministry of Internal Affairs and Communications, Information, and Communications in Japan (2021), the Internet utilization rate (personal) was over 80%. The high-speed fixed-line services, which include optical-fiber and high-speed cable television (CATV) services, are available for almost all homes in Japan. During the period of market expansion for high-speed fixed-line services, promoting the benefits of each service attribute to potential users who were not yet using high-speed Internet access was an important strategy for service providers to increase the number of service subscribers. However, as the demand for fixed-line Internet access becomes saturated and the service specifications offered by each service provider become similar, telecommunications market expansion is becoming more difficult (Hajar et al., 2022). The decision-making factors in users' service preferences become more diverse, making it difficult to promote sales based on characteristics of service attributes of fixed-line services. With the launch of long-term evolution (LTE), broadband wireless access (BWA) (WiMAX), and 5G services, the transmission speed of mobile services has

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improved, and the difference in transmission speed between fixed-line services and wireless services is becoming smaller. As a result, the number of people who use only wireless services is increasing, and the structure of the telecommunications market, which was previously divided into fixed-line and mobile services, is changing. According to the changes in users' needs and usage patterns, there are many methods to access Internet, and telecommunication markets are increasingly complicated and diversified. In some cases, a fixed-line service is the component of information technology (IT) service, and a choice of fixed-line service is a result of choice of IT service. In other cases, a fixed-line service is bundled with a wireless service. There are various types of choice sets, and it is very difficult to define the choice set in Internet-access service choice behavior. It is also difficult to construct common Internet-access service choice models based on the service specifications such as charge and transmission speed. The choice sets and their decision-making factors vary from user to user. It is a very important issue to understand the choice behavior of Internet-services for the related providers including mobile carriers, Internet service providers, Internet access line providers, and contents providers. Under these circumstances, both fixed-line carriers and mobile carriers need to formulate strategies to maximize the continuation rate of existing users and effectively reach users who are considering changing from other carriers. If users are divided into two segments, namely, one consists of users who intend to continue and the other consists of users who do not, the current state of the telecommunications market can be grasped by understanding the characteristics of each segment.

The authors have already proposed the supervised learning models to create differential descriptions of the user segments for Internet access choice behavior. The purpose of this paper is to establish a method for extracting effective information for service sales strategies by focusing on users and clarifying the reasons for the differences in current service choice results and future change intentions among users. Therefore, this paper proposes the framework of user intent-based segmentation analysis that suggests service sales strategy that is suitable for each segment, and presents the evaluation examples of Internet access services.

This paper is organized as follows: First, the authors present the market of Internet access services in Japan; next, the authors review related works, and describe the proposed framework of user intent-based segmentation analysis and supervised learning model they have used in this paper; finally, by using original market survey data, the authors present application examples and conclude.

MARKET OF INTERNET ACCESS SERVICES IN JAPAN

Table 1 indicates the number of high-speed broadband service users as of March 2022 (Ministry of Internal Affairs and Communications, Information, and Communications in Japan, 2022a). The number of high-speed fixed-line users is the total of the number of optical-fiber users and the number of high-speed CATV users. The minimum speed of high-speed CATV services is more than 30Mbps. The number of high-speed wireless users is the total of the number of LTE users, the number of BWA (WiMAX) users, and the number of 5G users. In recent years, the increase in the number of high-speed wireless users in Japan is greater than the increase in the number of high-speed broadband users. Furthermore, not only the means of Internet access services, for example, mobile router or home router which worked by 5G or LTE communication method, but also mobile terminals such as tablets are becoming diversified according to the diversification of the IT service. Table 2 presents the Internet usage rate by devices (Ministry of Internal Affairs and Communications, Information, and Communications in Japan, 2022b). The smartphones exceeded computers by more than 20 points. The usage rate of tablets is also increasing every year, growing to about half the personal computer (PC) usage rate. Therefore, smartphones and tablets are becoming the primary devices used for Internet access.

After the emergence of Covid-19, the volume of download traffic on fixed broadband lines in Japan has increased rapidly (Ministry of Internal Affairs and Communications, Information, and Communications in Japan, 2022c). In Figure 1, the current traffic volume is approximately double

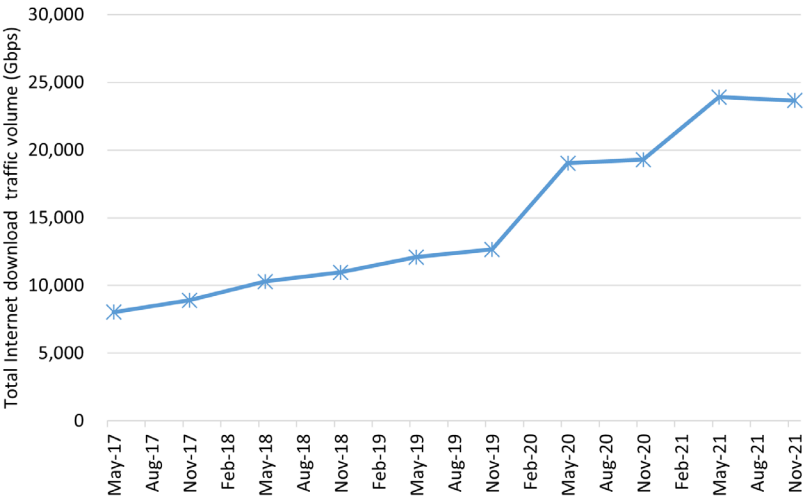
Table 1. Number of High-Speed Broadband Service Users in Japan

Type of services	Number of users (million)
High-speed fixed-line services	41.28
• Optical fiber	36.67
• CATV (down speed: more than 30Mbps)	4.61
High-speed wireless services	263.78
• LTE	139.05
• BWA (WiMAX)	79.71
• 5G	45.02

Table 2. Main Usage Devices for Internet Access Services

Type of devices	2020	2021
Smartphones	68.3%	68.5%
Computers	50.4%	48.1%
Tablets	24.1%	25.1%

Figure 1. The Volume of Download Traffic on Fixed Broadband Lines in Japan



that before Covid-19 emerged. It can be said that there has been a change in the need for and use of fixed lines. On the other hand, home routers have begun to be offered as a new service that allows high-speed Internet access services at home. A home router is a stationary wireless router that requires no installation work, can provide simultaneous connection to more terminals than a mobile router, and can also be connected to a wired LAN with terminals. Since home router users can access the Internet at home in the same way as fixed-line users, it is necessary to monitor trends to see if they will affect the demand for fixed-line services in the future.

RELATED WORKS

In general, service providers analyze how demand for their services will change in the future and develop service sales strategies. Inoue et al. (2003) proposed a framework for scenario simulation, and using the framework, Nishimatsu et al. (2006) analyzed the market structure and service demand for Internet access services in Japan. Choice modeling (Ben-Akiva & Lerman, 1987; McFadden, 1986) is the most important component of the framework. In the early days of fiber optics penetration in Japan, the choice modeling was also used to evaluate the competitive situation of broadband services (Ida & Sakahira, 2008). Various types of choice models have been developed to analyze user preferences and understand users' choice behavior in the Internet service market and mobile phone market in Japan. For example, as data transmission speeds for wireless services continued to improve, Inoue et al. (2012) analyzed the decision-making factors for changing from fixed-line service to wireless service. As another example, the authors analyzed the relationship between mobile carrier choice and the characteristics of charge menu such as monthly charge, family discount, and availability of iPhone (Inoue et al., 2013; Inoue et al., 2015). In foreign countries, Dagli & Jenkins (2016) analyzed users' decision-making factor for changing 3G to 4G (LTE) by modeling user service choice behavior. Grzybowski & Nicolle (2021) analyzed the impact of changing different operative systems (OS) with the smartphone, and changing iOS to Android was more difficult than changing Android to iOS. Confraria et al. (2017) analyzed the relationship between the menu of wireless service and service choice behavior. Sobolewski & Kopczewski (2017) evaluated the effect on service demand of bundling IP telephony and video distribution services with fixed telecommunication lines. These studies have evaluated how differences in service attribute values among alternative services affect service choice behavior.

However, the current telecommunications market is saturated, and the service specifications offered by various carriers are becoming similar, so the decision factors are diversifying and not limited to service attributes, making it difficult to promote sales by focusing solely on differences in service attributes. Therefore, it is becoming difficult to understand the decision-making factors of users' service choice behavior through sensitivity analysis of service attributes using conventional choice modeling.

In such a competitive market environment, it is more important to retain existing customers and prevent churn than to get new customers, in order to ensure stable profitability. Therefore, numerous studies have been conducted on analyzing customer churn and estimating which customers are likely to churn (Ahn et al., 2020). Now, a large amount of historical data can be obtained from logs and other sources, and machine learning can be applied to this data to estimate the churn probability. Usually, machine learning models are black box and complex. Therefore, it is possible to find users who are likely to churn, but it is difficult to know the reasons for churn. Some studies have analyzed the reasons for churn. By modeling service choice behavior and usage behavior considering user attributes, churn behavior was simulated under a specified scenario with agent-based modeling technology (Flores-Méndez et al., 2018). Another study in the telecommunications industry is the use of two machine learning methods, logistic regression, and logit boost (Jain et al., 2020). A logistic regression method allows to see which explanatory variables contributed to explaining the objective variable, in this case, whether the user already churned or not. By using questionnaire data to prepaid mobile subscribers, Dzivor et al. (2022) analyzed the factors which have affected customer retention in Ghana. To manage customer churn, Pejić Bach et al. (2021) proposed the framework for combining clustering and classification. The authors analyzed the differences of user segmentation based on user intention or user attributes to understand the users' service choice behavior. For example, mobile carrier choice between three major carriers (i.e., NTT docomo, au, and Softbank) and Mobile Virtual Network Operators (MVNO) were analyzed based on the degree of user satisfaction of current service and the differences of important factors of choosing a service (Inoue et al., 2017; Inoue et al., 2019). Users who only used wireless service at home were segmented by whether or not they had used Internet fixed-line access service in the past, and effective information that explains the differences between the segments could be extracted by using logistic regression analysis (Nishimatsu et al., 2019).

Although the service mix is currently expanding, users do not consider all services belonging to the service mix, but rather usually make their choice of service mix based on a part of services that are important to them or that fit their preferences. Therefore, it is important for service providers to understand users' intentions and use them in their service sales strategy. If providers know which services are important for each customer in the service mix, they can segment by homogeneous users and make a choice model for each segment, but it is usually difficult to know which services are important. Also, when overall constraints limit decisions, such as the sum of payments, users must determine a combination of services so as not to exceed the constraints, and the priority of services becomes important. In addition, if users are satisfied with their current service and do not want to change their current usage environment, then churn behavior does not occur and making a choice model itself becomes meaningless. However, it is difficult to understand such internal decision-making factors of users from observable data such as logs.

In order to implement efficient service sales strategies for service mix, it is necessary to clarify the relationship between user intentions, observable attributes (e.g., user attributes and behavioral results), and internal factors (e.g., what users value and their satisfaction with current services). Therefore, in this study, the authors analyzed the differences in intention-based segments using two types of candidate variables that the researchers identified by picking up factors that might influence user intention from user mindset and user attributes, respectively.

FRAMEWORK OF USER INTENT-BASED SEGMENTATION ANALYSIS

As the authors discussed in the previous section, the analysis of user churn behavior in the service mix should include the following considerations:

- Some users determine the service mix by comparing the services they focus on in the service mix with competing services.
- Some users determine the combination of services based on their priorities to satisfy constraints (e.g., the total amount of fee they pay for telecommunications).
- Some users decide on the service mix based on whether or not they can continue to use a particular service.

Since the decision-making factors that lead to the use of services are diversifying, it has become difficult to understand choice behavior using a modeling approach that compares service attributes, as in the conventional choice behavior model. Therefore, the authors adopted segmentation analysis that focuses on strength of continuous intention. In this study, the authors created two user segments: One segment consists of users who have strong intentions to continue with their current carrier and the other segment consists of users who have weak intentions to continue with their current carrier.

The objective of user intent-based segmentation is to understand the differences in user attributes and reasons between two segments, and to obtain useful information to consider service sales strategies.

To implement user intent-based segmentation, the authors used the following information:

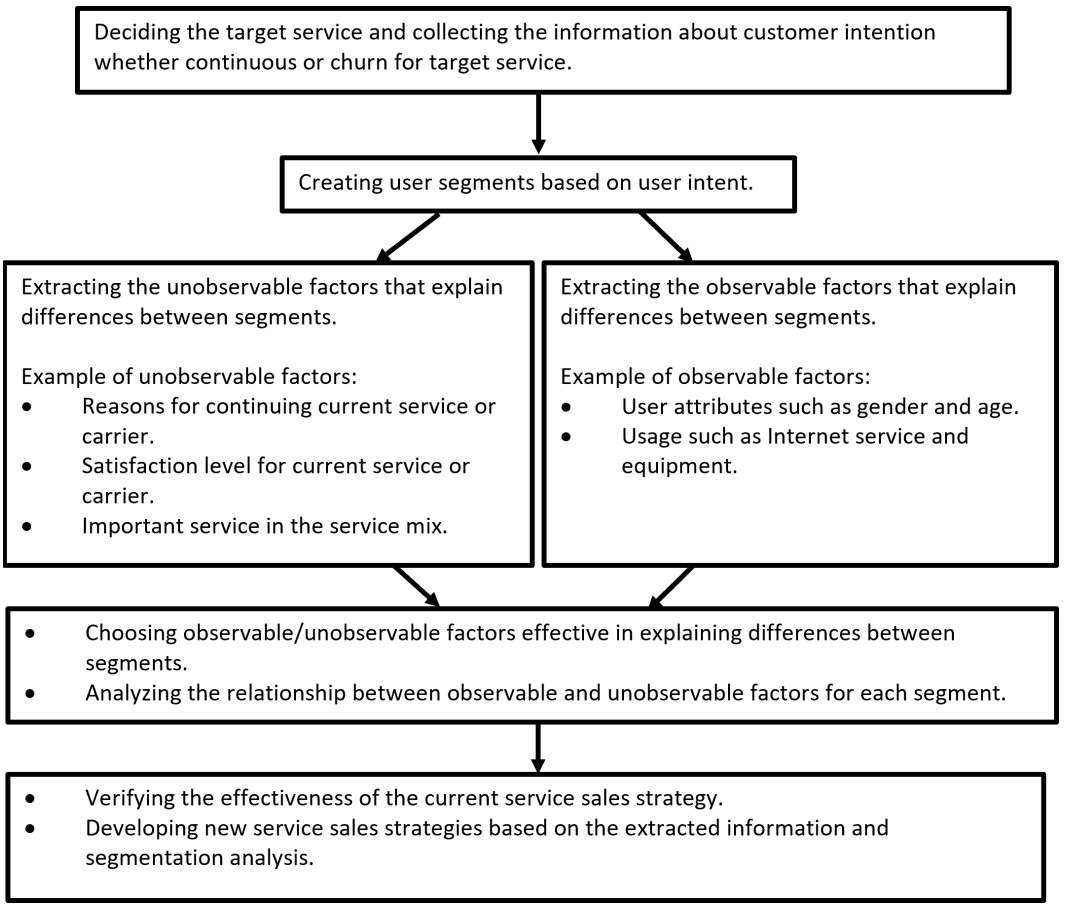
- Customer intention, which means customer's continuous or churn intention for current carrier or service.
- Reasons of customer intention, which represent internal and primary decision-making factors and thinking to the current carrier or service; they are unobserved variables and include:
  - Need for high performance and benefits of the service.
  - Constraints on overall telecommunications service (e.g., payment limits).
  - Service function that cannot be removed.
- User attributes, which are observable variables concerned with users and service usage.

Figure 2 shows the framework of user intent-based segmentation analysis. The authors analyzed the differences between user intent-based segments in terms of unobservable factors, such as the reason for continuing or changing the current carrier (service) by supervised learning model. They also analyzed the differences between these segments in terms of observable factors, such as user attributes. Next, the researchers analyzed the relationship between each segment and observable/unobservable factors. Therefore, service providers can develop service sales strategies for each segment by understanding which users have which choice intentions and for what reasons.

SUPERVISED LEARNING MODEL

User segmentation modeling can be used to create differential descriptions of user segments (Provost & Fawcett, 2013). In this paper, the authors used binominal logistic regression analysis to analyze the differences among user segments. Consider the case of two segments: Segment 0 and segment 1, and Equation 1 calculates the probability P_1 that a user belongs to segment 1. The probability P_0 that a user belongs to segment 0 is equal to $1-P_1$. In Equation 2, the variable x_k represents the explanatory variables, which consist of unobservable factors or observable factors. The variable β_k represents the coefficients of the explanatory variable x_k, and α represents the constant term:

Figure 2. Framework of User Intent-Based Segmentation Analysis



$$P_1 = 1 / \left(1 + \exp\left(-V_1\right)\right) \tag{1}$$

$$V_1 = \alpha + \sum_k \beta_k x_k \tag{2}$$

The authors selected the explanatory variables by using backward elimination method under the condition that the p-value of each variable is less than ρ (e.g., $\rho = 0.1$) in order to identify explanatory variables that were somewhat dominant in explaining segmental differences.

ANALYSIS OF MARKETING SURVEY DATA

The researchers conducted the original survey to analyze the preference for the user choice behavior for Internet access services in December 2020. They collected sample data by using the Web interview system provided by NTT Com Online Marketing Solutions Co. The total number of samples was 1159. The authors carried out the sampling on the basis of the following requirements:

- Business users are excluded.
- The users are limited to decision-makers to choose services and their carriers in their household.
- The mobile users are not only the three mobile-carriers NTT docomo, au by KDDI, and Softbank, but also MVNO users including SIM-free phone users.
- The number of individuals for only-wireless users is collected to be as large as possible.

There is no requirement for samples in relation to demographic factors such as age, gender, area, income, and occupation. Table 3 and Table 4 show the number of individuals in the sample by gender category and age category, respectively.

Table 3. Sample Sizes by Gender Category

Gender	Number of samples	Share
Male	804	69.4%
Female	355	30.6%
Total	1159	100%

Table 4. Sample Sizes by Age Category

Age	Number of samples	Share
20s or below	20	1.7%
30s	99	8.5%
40s	288	24.8%
50s	344	29.7%
60s or above	408	35.2%
Total	1159	100%

To analyze the user preference for Internet access services at home, the authors defined two user segments, namely, fixed-line users (FU) and only-wireless users (WU). FU indicates users of fixed broadband services such as optical-fiber, CATV, and ADSL. FU includes users of both a fixed-line service and a wireless service. WU indicates users of only wireless services at home. The researchers asked FU whether or not they would continue to use fixed-line service in the future and WU whether or not they would continue to use only wireless service. Therefore, based on the results, the authors classified FU and WU into two intent-based segments (defined as level 1 for user intent-based segmentation): Stable users and unstable users (Figure 3), respectively. In these questionnaire data, most of FU and WU were stable users. Since there were few unstable users, the authors focused on both stable FU (SFU) and stable WU (SWU). To analyze the continuous intention for current carrier of SFU, they divided SFU into two segments (defined as level 2 for user intent-based segmentation in Figure 4): A segment of SFU with strong continuous intention for current fixed-line carrier (strong SFU) and a segment of SFU with weak continuous intention for current carrier (weak SFU). The authors divided SWU into two segments as well (Figure 4): A segment of SWU with strong continuous intention for current wireless service (strong SWU) and a segment of SWU with weak continuous intention for current wireless service (weak SWU). Table 5 shows the sample sizes of each segment.

USER SEGMENTATION ANALYSIS OF STABLE FIXED-LINE USERS

The authors analyzed the differences between strong SFU and weak SFU by two binary logistic regression models. They created the one model by using the reason for continuing current fixed-line service as explanatory variables. They classified the reasons into four categories, which are the need for high performance and benefits of the service, constraints on overall telecommunications service, service functions that cannot be removed, and others, and included 13 alternatives. If the respondent

Figure 3. User Segments Based on Use Intention for Internet Access Services (Level 1)

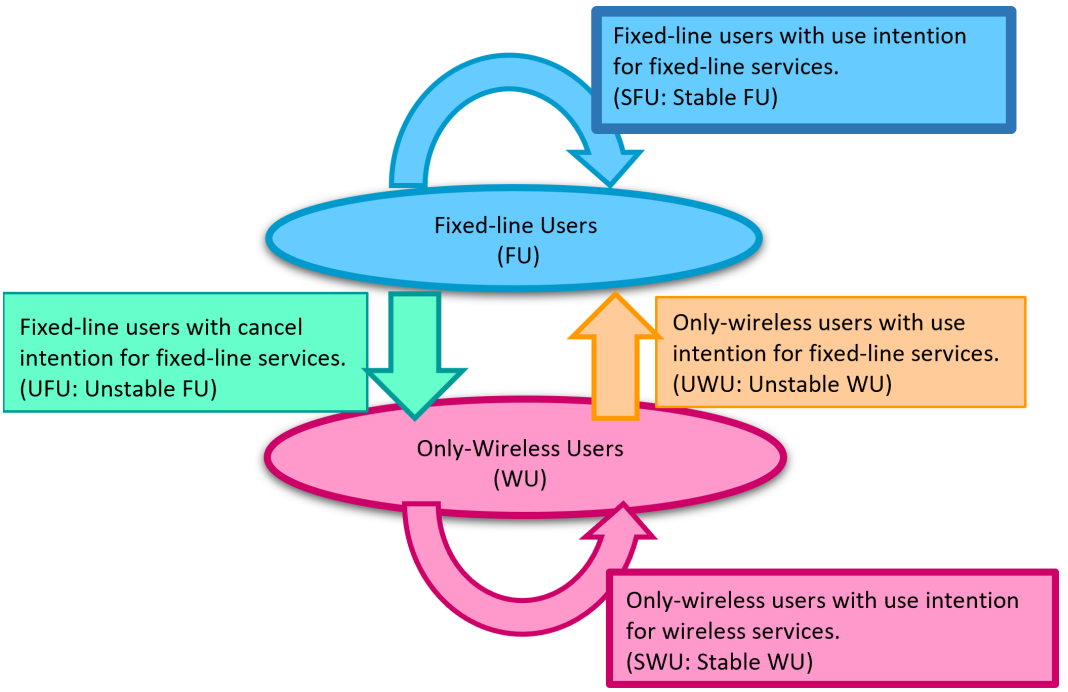
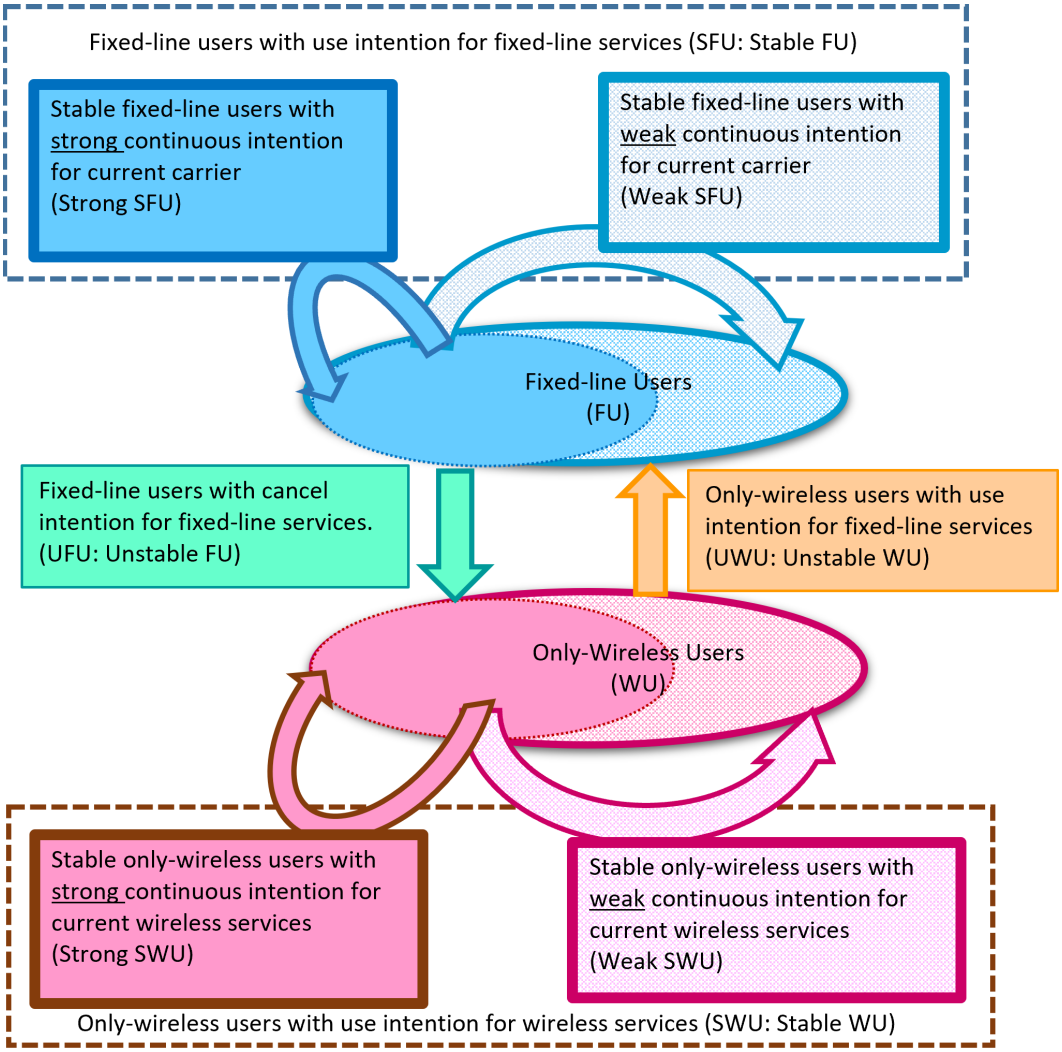


Figure 4. User Segments Based on Use Intention for Internet Access Services (Level 2)



chose an alternative, its explanatory variable took a value of 1, otherwise it took a value of 0. The reasons the researchers classified into each category are the following:

- Need for high performance and benefits of the service:
  - I need data transmission speed of fixed-line services.
  - I need stable communications quality of fixed-line services.
  - I would like to use fixed-charge service with no usage limitation.
  - I would like to use terminals via LAN cable.
  - I need the stable environment that plural people can use at the same time from multiple terminals.
- Constraints on overall telecommunications service (e.g., payment limits):
  - I can use fixed-line services very cheaply, if I use bundle service with smart phones.
  - I would like to use mobile terminals via a Wi-Fi router connected to fixed-line services at home.
  - I do not feel burdened to pay for fixed-line service.

Table 5. Sample Sizes by User Segment of Internet Access Service

User segment	User intent-based segmentation (level 1)	User intent-based segmentation (level 2)	Number of samples	
FU	With use intention for fixed-line services (SFU)	With strong intention for continuing current fixed-line carrier (strong SFU)	347	669
		With weak intention for continuing current fixed-line carrier (weak SFU)	322	
	With cancel intention for fixed-line services (unstable FU [UFU])	---	10	
WU	With use intention for fixed-line services (unstable WU [UWU])	---	21	
	With use intention for wireless services (SWU)	With strong intention for continuing current wireless service (strong SWU)	378	459
		With weak intention for continuing current wireless service (weak SWU)	81	

- Service function that cannot be removed:
  - I would like to continue to use fixed-line telephone service.
  - I would like to continue to use homepages and storage services provided by current provider.
- Others:
  - I feel uneasy that I use only wireless services.
  - I get tired of cancel the current service.
  - I have no reason to cancel fixed-line services.

Table 6 shows the response rate for each reason. The authors constructed model SFU-1, which used these reasons as candidate of explanatory variables, to classify strong SFU and weak SFU. They also constructed model SFU-2 to classify strong SFU and weak SFU by using user attributes, the feature of Internet usage, and the demographic in Table 7, as candidate of explanatory variables. The user attribute is a dummy variable that takes a value of 1 if the respondent fits the target user attribute and 0 otherwise.

Then, strong SFU is defined as segment 1, and weak SFU is defined as segment 0. The authors expressed the probability P_1 that a user belongs to strong SFU by Equation 1. In this paper, the parameter ρ took the value of 0.1. Table 8 and Table 9 show the estimation results of model SFU-1 and model SFU-2, respectively. The symbols "**" and "*" indicate the significant levels of variables for the estimated model. The symbol "**" means that the p-value is less than 0.01, while the symbol "*" means that the p-value is less than 0.05. Usually, the coefficients of the model can be estimated by using maximum likelihood estimation. In this paper, the authors used the estimator BellCurve for Excel by Social Survey Research Information Co. Ltd. to calculate the coefficients.

From Table 8, a user who chose "I do not feel burdened to pay for fixed-line service" considers the benefits of fixed-line services to be worth the charge and are not related to the overall constraints of telecommunication services. Besides, the odds ratio indicates that such a user is 2.717 times more likely to be strong SFU than a user who did not choose. A user who chose "I would like to continue to use homepages and storage services provided by current provider" is likely to need homepage and storage services and cannot remove these services. This user is 1.8493 times more likely to be strong SFU than a user who does not have service function that cannot be removed. A user who chose "I need stable communications quality of fixed-line services" needs high performance network and is likely to be strong SFU. Moreover, a user who chose "I would like to use mobile terminals via a Wi-Fi

Table 6. Percentage of Responses Regarding Reasons for Continuing Fixed Line Services

Name of user attributes	Total of SFU	Segment 0 (weak SFU)	Segment 1 (strong SFU)
User of IP phone provided by carriers	54.9%	52.2%	57.3%
User of IP phone additional services provided by carriers	9.9%	7.5%	12.1%
User of video streaming services provided by carriers	7.6%	4.3%	10.7%
User who rents mobile equipment from carriers	8.4%	6.8%	9.8%
User of e-mail services provided by carriers	9.3%	6.2%	12.1%
User of security service provided by carriers	9.9%	7.1%	12.4%
SNS user	50.4%	50.6%	50.1%
User of free video streaming services	58.9%	58.7%	59.1%
User of paid video streaming services	22.1%	18.9%	25.1%
User of free music distribution services	17.8%	20.2%	15.6%
User of paid music distribution services	8.2%	8.4%	8.1%
User of online game	14.2%	14.6%	13.8%
User of online storage service	12.7%	12.1%	13.3%
Transmission speed of fixed-line service is 1Gbps or above.	20.2%	16.5%	23.6%
Fixed-line service is bundled with smart phones.	27.7%	23.0%	32.0%
Contract period is more than 1 year, but less than 3 years.	14.6%	17.4%	12.1%
Contract period is more than 3 years, but less than 5 years.	17.8%	15.5%	19.9%
Contract period is 5 years or above.	59.2%	59.0%	59.4%
Male	73.1%	68.9%	76.9%
40s	20.2%	23.6%	17.0%
50s	30.0%	32.3%	28.0%
60s or above	43.6%	36.6%	50.1%
Tablet user	22.6%	21.7%	23.3%
MVNO user	25.6%	29.5%	21.9%
The number of Internet users in same household equals 1.	25.0%	27.6%	22.5%
The number of Internet users in same household equals 2.	39.2%	37.6%	40.6%
The number of devices connected to the Internet is at least 3.	70.9%	66.1%	75.2%
The mobile devices are connected to Wi-Fi almost or always.	73.1%	71.1%	74.9%
Annual income is more than 4 million, but less than 8 million.	22.9%	21.7%	23.9%
Annual income is 8 million yen or above.	26.2%	28.0%	24.5%

router connected to fixed-line services at home" is more likely to want to save on total communication charges due to payment restrictions for communication services, and is also likely to be strong SFU. Conversely, a user who chose "I get tired of cancel the current service" is considered to be less engaged with current carrier and is 3.418 times more likely to be weak SFU than a user who did not choose.

From Table 9, a strong SFU was likely to use optional services such as video streaming services and IP phone additional services provided by current carrier. The sign of 1Gbps or above transmission

Table 7. Percentage of Each User Attribute for SFU

Reasons for continuing to use fixed-line services	Total of SFU	Segment 0 (weak SFU)	Segment 1 (strong SFU)
I need data transmission speed of fixed-line services.	38.4%	32.9%	43.5%
I would like to use mobile terminals via a Wi-Fi router connected to fixed-line services at home.	30.3%	23.9%	36.3%
I can use fixed-line services very cheaply if I use bundle service with smart phones.	11.7%	10.6%	12.7%
I need stable communications quality of fixed-line services.	27.7%	19.3%	35.4%
I would like to use terminals via LAN cable.	10.9%	7.8%	13.8%
I would like to use fixed-charge service with no usage limitation.	16.1%	12.4%	19.6%
I would like to continue to use fixed-line telephone service.	17.9%	13.4%	22.2%
I would like to continue to use homepages and storage services provided by current provider.	6.4%	3.7%	8.9%
I need the stable environment that plural people can use at the same time from multiple terminals.	10.2%	8.1%	12.1%
I do not feel burdened to pay for fixed-line service.	6.6%	3.1%	9.8%
I feel uneasy that I use only wireless services.	11.5%	9.9%	13.0%
I get tired of cancel the current service.	12.4%	18.9%	6.3%
I have no reason to cancel fixed-line services.	19.1%	23.0%	15.6%

Table 8. Estimation Result of Model SFU-1

Explanatory variable		Estimated coefficient	P value		Odds ratio
d1	I do not feel burdened to pay for fixed-line service.	0.9995	0.0097	**	2.7170
d2	I would like to continue to use homepages and storage services provided by current provider.	0.6148	0.0941		1.8493
d3	I need stable communications quality of fixed-line services.	0.6047	0.0017	**	1.8307
d4	I would like to use mobile terminals via a Wi-Fi router connected to fixed-line services at home.	0.3599	0.0490	*	1.4332
d5	I get tired of cancel the current service.	-1.2291	$P < 0.001$	**	0.2926
Constant		-0.1462	0.1738		0.8640

speed and that of fixed and mobile bundle service were both positive, which represents both service attributes are effective for continuous use intention for current carrier. A strong SFU was also likely to be characterized by being in their 50s or older, 3 or more devices were connected to the Internet, and using paid video streaming services. A weak SFU tends to use free or paid music services. Since music distribution services are provided by over the top providers (e.g., Amazon and Apple) and require less bandwidth than video streaming services, they are not expected to have much impact on the carrier's continuous intention. The authors considered that the current fixed-line service meets the needs of strong SFU, so it is important to maintain a good relationship with strong SFU continuously. On the other hand, weak SFU have low engagement with current carrier and need to work on communicating the benefits to weak SFU of continuing their current services. By using an

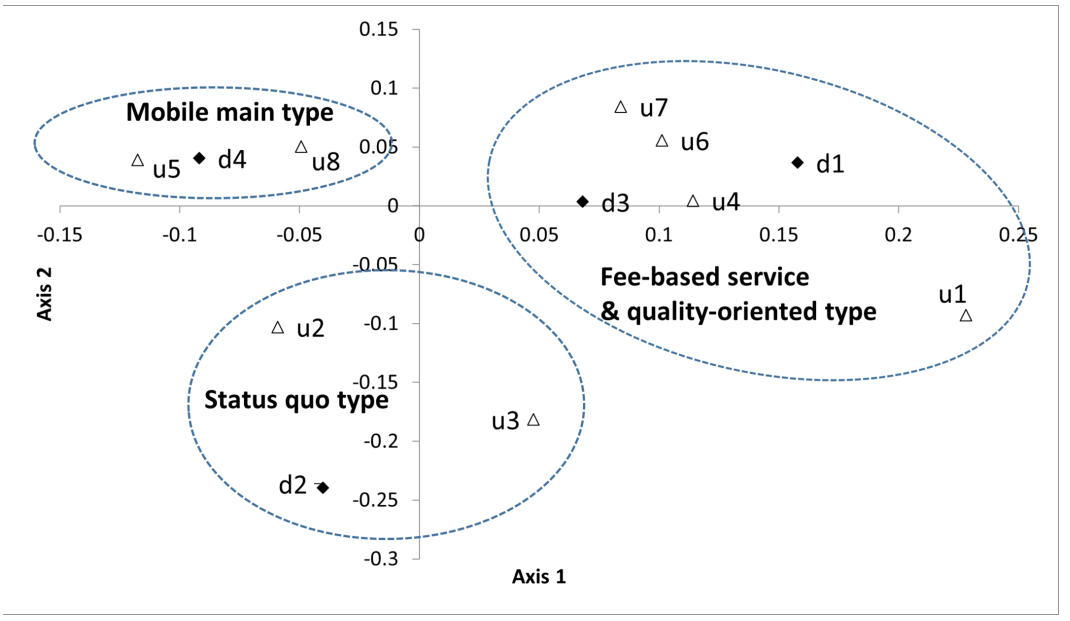
Table 9. Estimation Result of Model SFU-2

Explanatory variable		Estimated coefficient	P value		Odds ratio
u1	User of video streaming services provided by carriers	0.9022	0.0109	*	2.4650
u2	60s or above	0.8678	P < 0.001	**	2.3818
u3	User of IP phone additional services provided by carriers	0.5513	0.0531		1.7355
u4	User of paid video streaming services	0.5170	0.0294	*	1.6771
u5	Fixed-line service is bundled with smart phones	0.5010	0.0079	**	1.6504
u6	Transmission speed of fixed-line service is 1Gbps or above.	0.4873	0.0237	*	1.6279
u7	50s	0.3903	0.0752		1.4774
u8	The number of devices connected to the Internet is at least 3.	0.3648	0.0468	*	1.4402
u9	Contract period is more than 1 year but less than 3 years.	-0.5180	0.0276	*	0.5957
u10	User of free music distribution services	-0.5599	0.0156	*	0.5713
u11	User of paid music distribution services	-0.6603	0.0695		0.5167
Constant		-0.9114	P < 0.001	**	0.4020

intent-based segmentation model, it is possible to describe segmented user profiling from various perspectives, such as decision factors and user attributes.

Then, the authors extracted data concerned with four explanatory variables which have positive coefficient sign (Table 8) (described as Group 1) and eight explanatory variables which have positive coefficient sign (Table 9) (described as Group 2) from questionnaire data. Next, the authors conducted cross-tabulation for Group 1 and Group 2; Figure 5 shows the results of applying the dual scale method to the tabulated data. The researchers interpreted axis 1 as indicating whether fixed

Figure 5. Results of Dual Scale Method



or mobile services were more important in continuous use of Internet access line services, and axis 2 as indicating whether the factors considered when continuing Internet access service are the line service itself or whether optional services are included. The authors categorized those who intend to continue using current fixed-line carriers into three types: Mobile main type, status quo type, and fee-based service & quality-oriented type. For each of the three types, the authors estimated the probability of being classified as a strong SFU when variables included in the dotted circle took a value of 1 and those not included took a value of 0, respectively. Figure 6 shows that the probability that fee-based service & quality-oriented type users were strong SFU was about 0.8. Similarly, the probability of being strong SFU for users of the status quo type was about 0.6, and the probability of being strong SFU for users of the mobile main type was about 0.5. These indicated that there were differences among the types.

STABLE FIXED-LINE USERS' INTENTION ANALYSIS OF HOME ROUTER

Currently, carriers are beginning to offer Internet access services using home routers, which offer the same ease of use as fixed-line Internet access services and can be used immediately without the need for line installation. Table 10 presents the results of a cross-tabulation of the intention to continue using the current fixed-line service and the intention to use a home router in the future. Since there is no significant difference between strong SFU and weak SFU in terms of the percentage of home router usage intention, the authors determined that the segment separated by intention to use a home router is a segment divided from a different perspective than the segment separated by intention to continue using a fixed line. Therefore, the authors segmented the entire SFU by whether they intended to use a home router or not and constructed another user segmentation model (i.e., model SFU-3) to explain the differences

Figure 6. Estimated Probability That Each Type of User Belongs to SFU

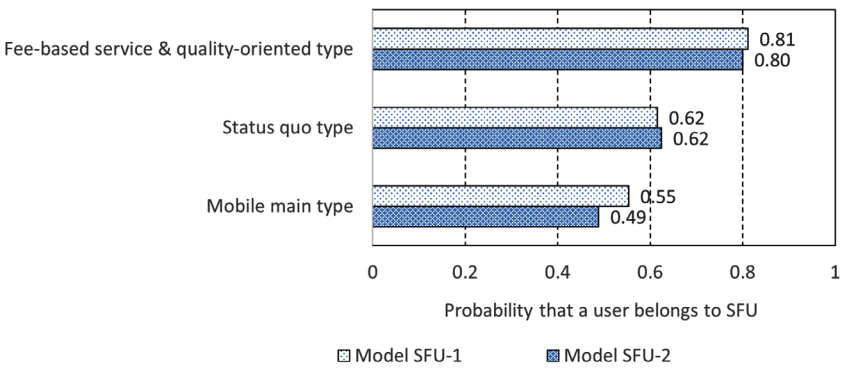


Table 10. Future Use Intention of Home Router for SFU

	Segment 0 (users with no intention of using a home router)	Segment 1 (users who intend to use a home router)	Total	Rate of segment 1
Weak SFU	293	29	322	9.0%
Strong SFU	306	41	347	11.8%
SFU	599	70	669	10.5%

between segments in terms of user attributes. Table 6 shows the candidates of explanatory variables, and Table 11 reports the results of estimated model. From Table 11, part of online game users, free video streaming users, and video streaming users provided by carriers tend to consider using home router. It is necessary to ensure stable communication quality for users who use various services to be satisfied with their home routers. Although the number of samples with the intention to use home routers is small, they tend to use a variety of services. It is necessary to monitor future trends to see if the user attributes of home router users will change from the characteristics extracted in this analysis in response to increasingly diversified IT services in the future.

USER SEGMENTATION ANALYSIS OF STABLE ONLY-WIRELESS USERS

The authors also analyzed the differences between strong SWU and weak SWU by two binary logistic regression models. They created the one model by using the reason for continuing to use only mobile service as explanatory variables. They classified the reasons into four categories, which are convenience compared to fixed-line service, constraints on overall telecommunications service, intention to use one service to handle everything, rather than multiple services, and others, and included 13 alternatives. If the respondent chose an alternative, its explanatory variable took a value of 1, otherwise it took a value of 0. The reasons the authors classified into each category are the following:

- Convenience compared to fixed-line service:
  - I can use the home routers as the same usage as fixed-line services.
  - Mobile communication speeds have been found to be sufficient.
  - I can access the Internet by using tethering function of a smartphone or mobile phone without using a fixed-line service.
  - Cables and router to use fixed-line service are obstacle.
  - I'm using a tablet or other device at home that does not require a LAN cable connection.
- Constraints on overall telecommunications service (e.g., payment limits):
  - I would like to reduce communications cost.
  - The low-priced and fixed-charge services which can transmit more than 20G packets are available.

Table 11. Estimation Results Regarding Use Intention of Home Router (Model SFU-3)

Explanatory variable	Estimated coefficient	P value		Odds ratio
Annual income is more than 4 million, but less than 8 million.	1.2311	P < 0.001	**	3.4249
The mobile devices are connected to Wi-Fi almost or always.	1.0521	0.0097	**	2.8635
User of video streaming services provided by carriers	1.0003	0.0220	*	2.7191
User of online game	0.9486	0.0064	**	2.5821
Tablet user	0.7901	0.0072	**	2.2035
User of free video streaming services	0.7153	0.0246	*	2.0447
User of paid video streaming services	-0.7563	0.0382	*	0.4694
50s	-0.7828	0.0139	*	0.4571
60s	-1.8025	P < 0.001	**	0.1649
Constant	-3.7112	P < 0.001	**	0.0244

- Intention to use one service to handle everything, rather than multiple services:
  - I usually use PC or tablet with LTE or WiMAX service both in home and outside.
  - The Internet user is alone in my house.
- Others:
  - I do not need for high-speed internet access services.
  - Fixed-line telephone service is not necessary.
  - I think that the fixed-line service is unnecessary.
  - It is a hassle to contract a fixed line.

Table 12 shows the response rate for each reason. The authors constructed model SWU-1, which used these reasons as candidate of explanatory variables, to classify strong SWU and weak SWU. The authors also constructed model SWU-2 to classify strong SWU and weak SWU by using user attributes, the feature of Internet usage, and the demographic (Table 13), as candidate of explanatory variables. The user attribute is a dummy variable that takes a value of 1 if the respondent fits the target user attribute and 0 otherwise. Here, strong SWU is defined as segment 1, and weak SWU is defined as segment 0. The authors expressed the probability P_1 that a user belongs to strong SWU by Equation 1. The parameter ρ also took the value of 0.1. Table 14 and Table 15 show the estimation results of model SWU-1 and model SWU-2, respectively.

Table 14 indicates that users who responded that "Cables and routers to use fixed-line phone service are in the way" do not feel the need for a wired line, but rather want the convenience of being able to use the service anywhere and the ease of management; besides, the odds ratio indicates that such users are 3.6538 times more likely to be strong SWU than users who did not choose this reason. A user who chose "Mobile communication speeds have been found to be sufficient" is likely to satisfied with transmission speed of current mobile service. This user is 1.9062 times more likely to be strong

Table 12. Percentage of Responses Regarding Reasons for Continuing to Use Only Mobile Service at Home

Reasons for continuing only mobile service	Total of SWU	Segment 0 (weak SWU)	Segment1 (strong SWU)
I can use the home routers as the same usage as fixed-line services.	9.8%	8.6%	10.1%
Mobile communication speeds have been found to be sufficient.	45.8%	35.8%	47.9%
The low-priced and fixed-charge services which can transmit more than 20G packets are available.	8.5%	14.8%	7.1%
I usually use PC or tablet with LTE or WiMAX service both in home and outside.	12.4%	19.8%	10.8%
I'm using a tablet or other device at home that does not require a LAN cable connection.	5.2%	11.1%	4.0%
I can access the Internet by using tethering function of a smartphone or mobile phone without using a fixed-line service.	8.7%	13.6%	7.7%
I do not need for high-speed internet access services.	8.5%	11.1%	7.9%
I would like to reduce communications costs.	22.9%	32.1%	20.9%
Fixed-line telephone service is not necessary.	12.0%	12.3%	11.9%
I think that the fixed-line service is unnecessary.	6.3%	3.7%	6.9%
The Internet user is alone in my house.	9.4%	14.8%	8.2%
It is a hassle to contract a fixed line.	7.4%	9.9%	6.9%
Cables and router to use fixed-line service are obstacle.	8.5%	3.7%	9.5%

Table 13. Percentage of Each User Attribute for SWU

Name of user attributes	Total of SWU	Segment 0 (weak SWU)	Segment 1 (strong SWU)
SNS user	52.3%	54.3%	51.9%
User of free video streaming services	60.1%	69.1%	58.2%
User of paid video streaming services	14.4%	18.5%	13.5%
User of free music distribution services	18.5%	23.5%	17.5%
User of paid music distribution services	5.0%	4.9%	5.0%
User of online game	14.4%	23.5%	12.4%
User of online storage service	11.1%	14.8%	10.3%
Users accessing the Internet at home with a mobile phone directly	55.6%	48.1%	57.1%
Users accessing the Internet at home with a mobile router	29.4%	35.8%	28.0%
Users accessing the Internet at home with a home router	13.3%	12.3%	13.5%
Male	63.2%	65.4%	62.7%
40s	30.9%	29.6%	31.2%
50s	28.5%	23.5%	29.6%
60s or above	24.0%	24.7%	23.8%
Tablet user	19.8%	25.9%	18.5%
MVNO user	36.2%	44.4%	34.4%
The number of Internet users in same household equals 1.	42.3%	40.7%	42.6%
The number of Internet users in same household equals 2.	36.6%	32.1%	37.6%
The number of devices connected to the Internet is at least 3.	46.2%	53.1%	44.7%
Monthly mobile phone charge for the entire household is 10,000 yen or more.	75.8%	86.4%	73.5%
Payment limit for mobile monthly charge is 5,000 yen or above.	75.6%	76.5%	75.4%
Annual income is more than 4 million, but less than 8 million.	23.1%	25.9%	22.5%
Annual income is 8 million yen or above.	22.0%	23.5%	21.7%

Table 14. Estimation Result of Model SWU-1

Explanatory variable		Estimated coefficient	P value		Odds ratio
d6	Cables and router to use fixed-line service are obstacle.	1.2958	0.0406	*	3.6538
d7	Mobile communication speeds have been found to be sufficient.	0.6451	0.0134	*	1.9062
d8	The low-priced and fixed-charge services which can transmit more than 20G packets are available.	-0.7853	0.0398	*	0.4560
d9	I'm using a tablet or other device at home that does not require a LAN cable connection.	-1.2233	0.0081	**	0.2942
Constant		1.3586	$P < 0.001$	**	3.8908

Table 15. Estimation Result of Model SWU-2

Explanatory variable		Estimated coefficient	P value		Odds ratio
u12	Payment limit for mobile monthly charge is 5,000 yen or above.	0.7783	0.0440	*	2.1778
u13	MVNO user	-0.5632	0.0306	*	0.5694
u14	User of online game	-0.6847	0.0276	*	0.5042
u15	Monthly mobile phone charge for the entire household is 10,000 yen or more.	-1.4988	0.0012	**	0.2234
Constant		2.4964	P < 0.001	**	12.1392

SWU than a user who does not choose this reason. A user who chose "The low-priced and fixed-charge services which can transmit more than 20G packets are available" needs a certain amount of packets while paying less, is 2.193 times more likely to be weak SWU, and is likely to churn current service if another lower-cost and higher-capacity charge plan is available. Moreover, a user who chose "I'm using a tablet or other device at home that does not require a LAN cable connection" wants the convenience of being able to use the service anywhere and the ease of management, is also likely to be weak SWU, and is about 3.4 times more likely to be weak SWU than a user who did not choose.

From Table 15, the authors extracted the characteristics of the weak SWU as mobile monthly usage of 10,000 yen or more for the entire household, use of online games, and use of MVNO. They extracted the high monthly mobile service payment limit as a characteristic of the strong SWU, suggesting that, while weak SWU have a strong preference for low prices, they also have a need to use more packets, not limited to online game use. Higher available packet capacity and lower prices are areas where competition among carriers is likely to continue. Although the sample size of weak SWU was small for this survey, future service trends and their impact need to be carefully monitored.

Furthermore, among the characteristics of users in weak SWU, users who want to use large amounts of packets, use their mobile phones for online games, and whose total family mobile phone usage exceeds 10,000 yen could be recommended for a fixed-line service, although more detailed understanding of their intentions is needed.

CONCLUSION

The service mix is currently being expanded, and, as the combination of services becomes more complex, users' decision-making factors when choosing services are also becoming increasingly diverse. Service providers have to keep existing customers and to get new customers, and need the methodology of developing service sales strategies according to such complex market conditions. Therefore, it is important to understand the differences between users who intend to continue current carriers or services and those who intend to change them. In this paper, the authors proposed the framework of user intent-based segmentation analysis and showed that the framework can extract efficient information explaining the differences between two segments of users with strong and weak intentions to continue with their current carriers or services, using unobservable variables and observable variables collected from questionnaire data. The framework also showed that logistic regression analysis can be used to construct an intent-based segmentation model. In order to implement efficient service sales strategies for service mix, it is necessary to clarify the relationship between user intentions and not only observable user attributes and behavioral results, but also internal factors such as what users value and their satisfaction with current services. To analyze these relationships, the authors used questionnaire data, in this paper. However, in order to respond to the dynamically changing telecommunications market, a mechanism for collecting users' internal data is a future

problem, such as collecting observable data in real time and inferring users' internal information or collecting users' internal information from service users on a regular basis.

The total amount of fixed-line traffic has been growing after Covid-19. On the other hand, the service using 5G technology will be expanded, and performance differences between fixed-line services and wireless services will become small. With these changes, some fixed line services and wireless services will be combined as a new service and the service will be diversified. Therefore, the authors plan to develop the proposed framework into a method adapted to new services and work on adapting it to services that require real-time decisions.

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