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Applying Call and Event Detail Records to Customer Segmentation and CLV

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ABSTRACT

Acquiring and retaining the most profitable customers is a big concern of a telecommunication operator to perform more targeted marketing therefore business demand and competition between mobile operators is becoming more based on life cycle of customers in the network. In order to improve customer satisfaction and fulfill requirements, several data mining technologies can be used. Many researches have been performed to calculate the customer value without considering the call/event record generated according to service usage while my research suggested analyses to predict value of customer during their life based on CDRs and EDRs that generated in the network. One of the most important data mining technologies in life time value of customers is customer segments. This targeting practice has been proven effectively for mobile telecommunication industry. Most operators evaluate their customers by information like gender that extracted from billing systems. This paper discusses an innovation to link call/even detail record to the customer segmentation and CLV for a telecommunication business. The subscribers categorized in four segments (loyal groups) during the CLV that influenced based on service usage.

I. INTRODUCTION

Mobile operator's competitions and profits are facing great challenges. The high volume of demand and requirements associated with telecommunication services has been changed and customers are demanding daily basis. In order to improve response to customer requirements, several data mining technologies can be used. One of the most important data mining technics is customer clustering analysis to categorize potential customers into distinct groups for implementing company's roadmap and strategy. With the rapid growing marketing business, data mining technology is indicate more important role in the demands of analyzing and utilizing the large scale information gathered from enterprise data warehouse especially large amount call detailed record of mobile subscribers. Dynamic information about customer's behavior is required to segment and personalize products and services along with business strategy and planning. This paper is an initiative because almost always customer segmentation in telecommunication business is only based on personal (static) information such as age, gender and address from a repository rather than from their actual (dynamic) behavior. Furthermore, one of the key purposes of customer segmentation and CLV is customer retention to increase the loyalty and avoid churn volume. This paper focused on proposing a customer segmentation and CLV based on dynamic data from call/even data records.

II. RESEARCH METHODOLOGY

This study is designed to discover the application of call and event detail records associated with service usage by subscribers. I'm going to demonstrate that CLV and customer segmentation will be best identified for a telecommunication business by applying call/event detail records than personal information extracted from a repository such as a billing system. There are many clustering method, for example, fuzzy clustering method, system clustering method, dynamic clustering method to be used however in order to evaluate the huge CDR/EDR data, I take K-means clustering because it generates a specific number of disjoint and flat (non-hierarchical) clusters. The decision of how many customer segments a company should create is largely dictated by the particular make-up of their customers and the organizations ability to develop and deliver unique segment specific marketing treatments. In my research I will apply CDR/EDR data to customer segmentation and CLV by using K-means as a clustering tool. By considering the bellow steps, we need enterprise hardware and software environment to deal with huge amount of generated CDRs and EDRs but it's advised to select a sample of data to evaluate customer habits and behaviors. Many segmentation algorithms developed in software applications such as SAS and SPSS but to make the model works the following steps advised as the key outcome of my research:

- Collecting CDRs & EDRs (by push or pull mechanism into a data warehouse)
- Selecting different services e.g. GPRS/MMS, voice , SMS and contents e.g. RBT, java Applications
- Selecting key factors as the core items to monitor customer's behavior.
- Applying k-means as a well-known segmentation algorithm.
- Generating a matrix of segments as per each selected factors.
- Using the clustering output for loyalty and customer churn application.

Due to huge volume of data generated by subscribers in telecom and based on best marketing practices, generally mobile operators are comfortable to have as few as five unique segments, while other industries require as many as twenty segments to satisfy their data-driven marketing needs. The number of data in GSM is

a barrier to analysis customer's behavior, so almost there is a limitation to analysis the whole data therefore a dynamic analysis for limited duration based on detail records should be considered and repeated continuously.

III. PREPARE THE DATA FOR CLUSTERING

I found a set of valuable information to identify core needs in the life time of subscribers based on their call detail record instead of their personal information such as gender, address and income. A Call Detail/Data Record contains at a minimum the following:

- The number making the call (A number)
- The number receiving the call (B number)
- When the call started (date and time)
- How long the call was (duration)
- Call Type e.g. Voice call, SMS, GPRS/MMS
- Balance before & after.
- Location of mobile generator & terminator.
- Incoming and outgoing Voice
- Incoming and outgoing SMS
- Different type of content

In addition to CDRs, I also considered subscribers who are interested in activation or change any services by capturing their record via analyzing EDRs (Event Detail Records). By getting CDRs/EDRs from different sources, we would be able to make sure that customers' behavior captured and we can evaluate what they are interested more and less dynamically. Any call or event from network elements such as IN and MSC will pass through ODS via mediation , so by accessing to the repository of xDRs and defining proper characters ,we build the model of customer segmentation based on call/event detailed record and their value on the network.

IV. CUSTOMER CLV DEFINITION

According to the CDR/EDRs the interests, needs and behavior of subscribers well-defined and distinct with definition of each individual group of customer's behavior and related penetration in percentage:

- Plain Loyal:
  A customer that has always been Active (never went into Dormancy or Churn status).
- Not Dependable:
  A customer has reached the Churn status for the first time. He may in the future either stay in Churn status or return to Active (he will then be labeled 'Loyal under Incentive' from now on until he reaches again and for good the Churn status).
- Fence Seated:
  A customer has moved out of Active situation into Dormancy status for the first time. She/he may either fall into the Churn status, remain Dormant, are become Active again.
- Loyal under Incentive:
  A customer that has moved (once or several time) out of Dormancy or Churn and back into Active status.

Based on the level of loyalty of customers during their life cycle (Fig.1) we really need to keep the plain loyal motivated and also provide proper motivation and package to improve their loyalty.

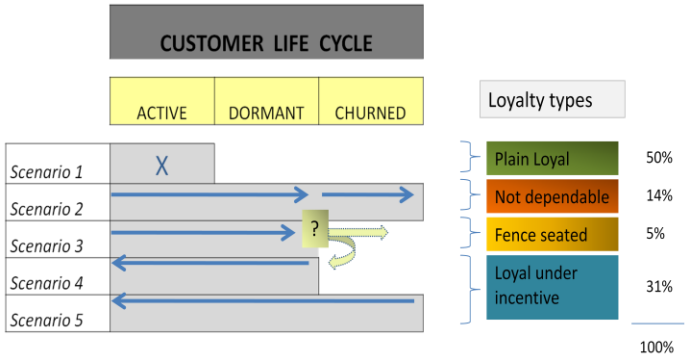

Fig.1 Customer Life Cycle & Loyalty

In order to get a full picture of customer behavior in the network and to realize their interest and also to predict their needs, we will analysis the following two key scenarios in detail based on historical call detail record:

- Which segment he/she falls into and what are the characteristics of this segment including CLV and revenue value to the business.
- What is the risk of this customer to leave the network or remain inactive

V. CUSTOMERS' BEHAVIORAL EVOLUTION

Based on six month historical data from enterprise data warehouse, the statistics report of customers life cycle shows (Fig.2) that more than 50 percent of plain loyal subscribers are significantly decreasing while the other there type of subscribers are not in the same level or even increasing such as loyal under incentive subscribers.

I would like to highlight that due to behavior of subscribers during the selected period of customers' life cycle, we would be in a position to predict that both loyal plain and loyal under incentive subscribers will reach to a single point. In this situation the two various segments will merge to a unique group with population of 40 present of total subscribers. The volume of subscribers (Fig.2) shows that the operator is quite a bit in a safe side at this stage;

however the monitoring of customers behavior shows that we will face high rate of changes in near future.

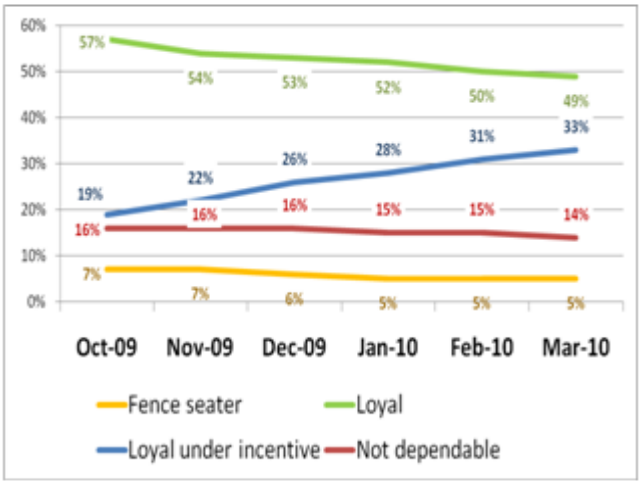

Fig.2 Customer Life Cycle

All the subscribers are active in the network till their status will be changed to dormant and churned status. As soon as they become a dormant subscriber, the risk will be remained to leave the network and churn. The highest challenge is related to the fence seated group because they have potential capacity to change their status into loyal incentive in a very optimistic view or they will leave the network for ever (pessimistic).Besides the total number of subscribers in each segment, we need to more focus on the detailed information and track the dynamic behavior of subscribers in each group and find a proper answer for the following questions:

- What happened to the 'Fence Seated' customers?
- What happened to the 'Not Dependable' customers?
- What happened to the 'Loyal' customers?
- Where do each ''Loyalty type' sit and what strategy to apply?

Distinguish between groups, is the key milestone to make distinguish promotion and motivation for each individual groups. By the same way, marketing managements can design more suitable marketing strategy. The behavior of Fence Seated subscribers shows that all the existing promotions and various tariff plan have not any impact on this group, so as per detailed graph (Fig.3) after one month only 41% of this subscribers remained in the same situation while the 60% divided into two equal parts and joint into "Not dependable" and " Loyal under inventive" groups. It's so interesting that the after about four month the loyal under incentive (66%) group members increased to double compare to the Not dependable (33.5%) group members.

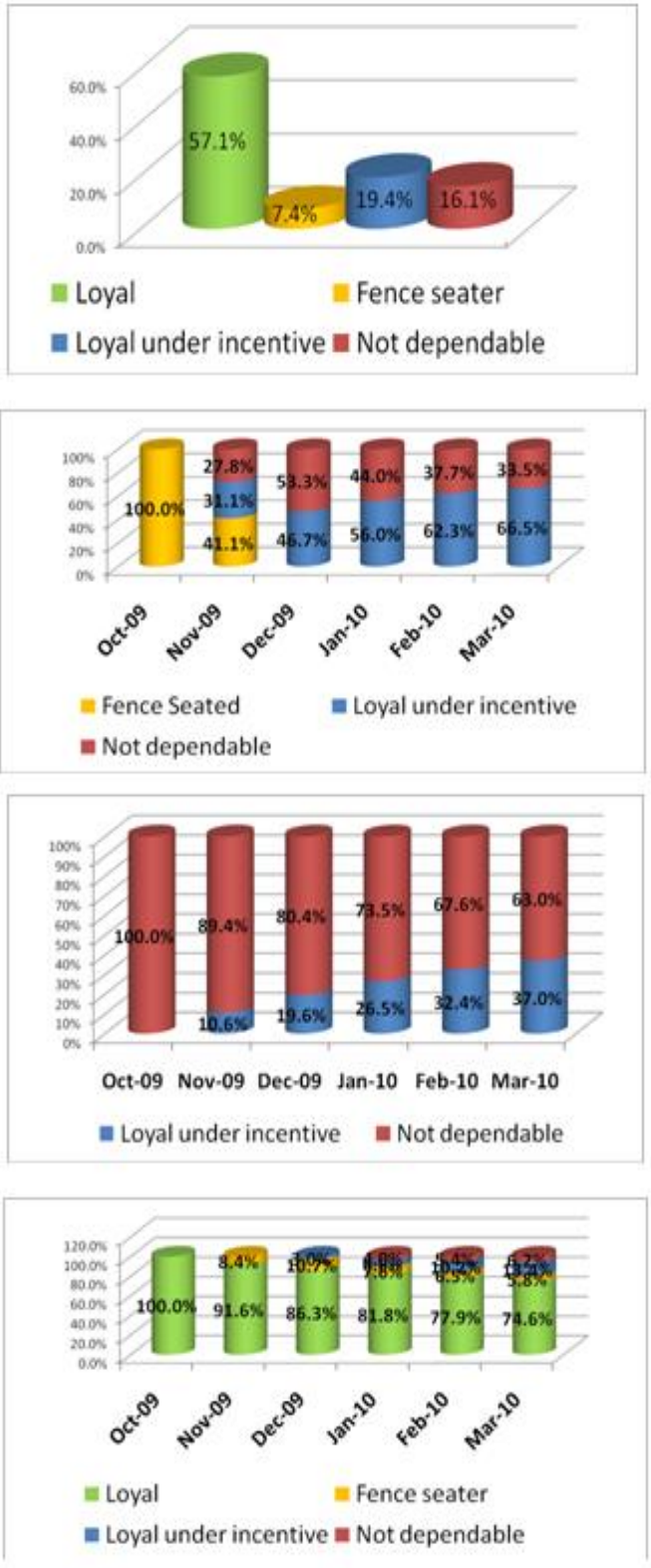

Fig.3 Detailed Behavior of Customer Life Cycle & Loyalty

By focusing on not dependable subscribers which are 16% of total subscribers, it's illustrated that only 10% of these people moved to loyal under incentive while the rate of movement increased up to 37% after four month. I would like to highlight that not dependable staff only moved to loyal under incentive group and not to any other group. This is a good message to keep continue and boos the existing marketing plan to increase the number of loyal under incentive staff at the first step. The goal is to make a plan to have specific motivation to move three segments into the plain loyal group. The selected period of subscribers' life cycle is totally in a green status as more than half out of total subscribers is plain total. There is a big risk of churning to other operators because during the last six month the trend of loyal subscribers is not fluctuated and decreased to 49% that shows 8 % drop down to other groups. Besides not dependable and fence seated groups, the two other loyal groups have high rate of upward (Loyal under Incentive from 19% to 33%) and downward (Plain Loyal from 57% to 49%) changes.

VI. WHAT STRATEGY TO APPLY?

Any operator required to build strong and profitable customer relationships with solutions that increase average revenue per user, reduce subscriber churn and enhance brand loyalty. In order to utilize the best criteria, two important parameters selected to identify level of loyalty based on monthly recharge and active on net (AON) for each segment of subscribers. The propagation of subscribers and the location of each loyalty type will lead the business to make an adequate plan, so based on two mentioned items we mapped (Fig.4) four loyalty groups into a matrix of duration (10 to 16 month) and recharge (from 60$ to 100$) monthly basis. The margin for AON is 13month and the recharge is 80$ monthly basis. It means that if a subscriber is active more that 13 month on network, then its ether plain or under incentive loyal subscribers depend on the volume of recharge per month. By the same way if they are less that 13 month active on network then they are either fence seated or Not dependent, so it shows that we need development plan to keep them more active on net by offering new packages as motivations. As mentioned the boundary for monthly revenue is 80$, so it's quite important that even the subscribers who charge more than specified range (80$) they are not loyal. In addition to mentioned parameters to identify behaviors and level of loyalty, we need to consider the service usage and also the dependency or relation between services as part of cross functional management to improve customer segmentation. After we recognized the location of loyal subscribers, it's time to plan the right strategy for each specific segment. The size and the status of each loyal group have been illustrated in the Fig.4 based on their monthly recharge and active time on the network. Both fence seated and not dependable subscribers have less size than other two groups and they stayed around 12 month on the network as an active subscriber, while fence seated staff pied more than boundary. On the other hand, two plain and under incentive loyal groups are almost 15 month active on the net with different monthly recharge payment. It's clearly advised to motivate the loyal under incentive subscribers to buy more vouchers (for prepaid) or bill payment (postpaid) as the right strategy to make then plain loyal as they are 33% of all subscribers. As a general concern and risk, we might loss the entire 14% of not dependable subscribers if they refuse to do payment. By considering the size of each loyal group , the average revenue per user and the location of group in the matrix (Fig.4) , at least we would be able to initiated a strategic plan because sometime it's very costly to motivate this group than put more effort and cost on the loyal under incentive or fence seated groups to make them plain loyal on the network, so depend on the constraints such as budget , priority and the number of subscribers in each group, management will be able to make a decision accordingly.

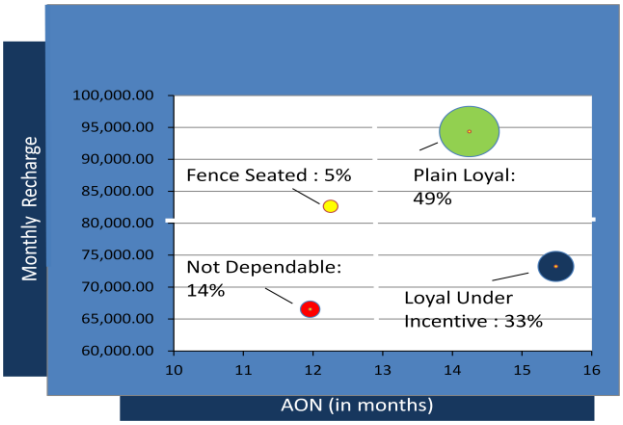

Fig.4 Loyalty segments based on their monthly recharge

VII. DELINEATE 'CUSTOMER LIFE VALUE'

The CLV defined as the sum of the revenues gained from company's customers over the lifetime of transactions after the deduction of the total cost of attracting, selling, and servicing customers, taking into account the time value of money .In order to identify the value that each type of customers can bring into the picture, the value of mentioned subscribers in one month calculated as following:

Table.1 Customer Life Value for each loyal group (Monthly Revenue * No. months)

SEGMENT	Size	Individual CLV	Estimated CLV of the Base
Fence seated	5%	*1,012*	*1,518,549,415*
Plain Loyal	49%	*1,343*	*19,755,580,218*

Loyal under incentive	32%	***1,134***	***11,228,482,296***
Not dependable	14%	***795***	***3,342,027,906***

As identified earlier and shows in the Table.1 the statistic report proved that the Loyal under Incentive customers have 32% of total subscribers and the prediction of the net profit is 1,134 which is less than Plain Loyal customers with 49% population and 1,343 CLV as the highest net profit segment of customers. The interesting highlighted point is that the higher CLV of a segment (Fence Seated) compare to a bigger segment of customers which is 14% clearly shows a group of subscribers with three time smaller population generated 78% more as generated 1,012 net profit. As a conclusion we should not relay on prediction and assumption because the CLV is dynamic and might be differ due to the customers are using. Similarly, the size of segment and the prediction of the net profit of each individual don't have direct relation to anticipate and judge that the higher volume of customers in each segment can generate the higher profit per individual. Although the number of subscribers in each segment will help to predict the profit but still there is no guarantee to estimate until unless we get the information regarding the different services and package they are consuming in the network. This lead us to extract the service usage information for different segment of subscribers which is align with cross selling approach across the network products and series.

VIII. EXTRACT CROSS-SELLING VALUE

The definition of Cross-selling and value generated in the customer life time is selling new products to a customer who has made other purchases earlier.in telecommunication the cross-selling will reduce the churn and keep subscribers as loyal as possible. Unlike the acquiring of new subscribers, it involves either the revenue increase from existing subscribers or it can disturb the relation between service provider and the customer. The validly and quality of customer segmentation in a dynamic process that will help to decrease the risk of negative impact of cross-selling and associated value gained from individual segments.

In order to evaluate the service usage impact during subscriber life time and its value, the majority of services listed and a matrix illustrated in Table.2 to come up with customer's behavior associated with various services.

- Voice
- SMS (Short Messaging Service)
- GPRS (General Packet Radio Service)
- WOW (service usage more than the airtime amount of the recharge in a defined time period)
- RBT (Ring Back Tone)
- Content based services
- MMS (Multimedia Messaging Service)
- Roaming

The matrix describes how two services related to each other. For instance there is a likelihood of 87% for a customer to use both voice and SMS, a likelihood of 43% to use both voice and GPRS. Although the SMS usage is not popular in most of the countries and operators, the matrix shows that the subscribers are interested in short message usage after making call.

Table.2 Cross-Selling and Services Penetration

%	Voice	SMS	WOW	GPRS	RBT	F&F	Vitrin - TBS	Vitrin – Monotone	Vitrin - Polytonal	MMS	Roaming
Voice	100%	**87%**	**42%**	**43%**	**16%**	**3%**	**12%**	**0.1%**	**0.03%**	**0.4%**	**0.1%**
SMS	87%	100%%	**39%**	**41%**	**16%**	**3%**	**12%**	**0.1%**	**0.03%**	**0.4%**	**0.1%**
WOW	42%	**39%**	100%	**21%**	**8%**	**2%**	**6%**	**0.1%**	**0.01%**	**0.2%**	**0.03%**
GPRS	43%	**41%**	**21%**	100%	**9%**	**2%**	**7%**	**0.1%**	**0.03%**	**0.3%**	**0.03%**
RBT	16%	**16%**	**8%**	**9%**	100%	**1%**	**4%**	**0.1%**	**0.01%**	**0.12%**	**0.01%**
F&F	3%	**3%**	**2%**	**2%**	**1%**	100%	**1%**	**0.01%**	**0.002%**	**0.04%**	**0.002%**
Vitrin TBS	12%	**12%**	**6%**	**7%**	**4%**	**1%**	100%	**0.1%**	**0.01%**	**0.1%**	**0.01%**
Vitrin	0.1%	**0.1%**	**0.1%**	**0.1%**	**0.1%**	**0.01%**	**0.1%**	100%	**0.01%**	**0.003%**	**0.0001%**

Mono											
Vitrin Pol	0.03%	**0.03%**	**0.01%**	**0.03%**	**0.01%**	**0.002%**	**0.01%**	**0.01%**	100%	**0.002%**	**0.00003%**
MMS	0.4%	**0.4%**	**0.2%**	**0.3%**	**0.1%**	**0.04%**	**0.1%**	**0.003%**	**0.002%**	100%	**0.0003%**
Roam	0.1%	0.1%	0.03%	0.03%	0.01%	0.002%	0.01%	0.0001%	0.00003%	0.0003%	100%

It's also clearly reflected the high usage of a plan that enables subscribers to make call or send SMS, MMS more than the airtime amount of the recharge card through WOW plan in a defined time period. I would like to emphasis that an initiated campaign by considering customer/subscriber life time will generate extensive value even more than GPRS (internet) usage. Same result generated by the mentioned Cross-Selling matrix for the three type of content based services are the least services that customers are willing to use after they joint into the network.

IX. CATEGORIZE REVENUE GENERATED IN CLV

We concentrated on the volume of services used by subscribers and also their participation during customer life cycle without considering the amount they pay via different vouchers (air time) through various channels.

Table.3 Categorized Values

+ +	Greater than 50% ABOVE average
+	Between 25%-50% ABOVE average
Avg	within 25% of average
-	Between 25%-50% BELOW average
- -	Greater than 50% BELOW average

In order to manage the situation and categorize the volume / level of statistic reports, the thresholds provide in Table.3 to have tangible report in five categories with equal thresholds.

Table.4 Revenue generated based on voucher during CLV

		REVENUE			
Penetration	**Services**	**Voucher Revenue**	**Voucher Count**	**Voice Revenue**	**SMS Revenue**
100%	Voice	avg	avg	avg	avg
87%	SMS	avg	avg	avg	avg
0.1%	Roaming	+ +	avg	+ +	+
10%	TBS	+	avg	avg	+ +
0.1%	Monotone	+	+	avg	+ +
0.02%	Poly tone	avg	avg	avg	+
12%	RBT	+	+	+	+ +
0.4%	MMS	+ +	+ +	+ +	+ +
45%	GPRS	avg	avg	avg	+
42%	WOW	+	+	+ +	+
3%	F&F	+	+	+	+ +
	AVERAGE	**88,637**	**4.7**	**56,368**	**16,722**

The amount of money that subscribers paid via voucher (air time) for different services will generate useful information that is hidden in the IN (intelligence network e.g. CS5) data base. It's so interesting that roaming service with around 0.1 present and MMS with 0.4 percent usage in the network are part of most revenue generated services. In addition it (Table.4) shows that the most value extended from customers using Voice, SMS and MMS during their life cycle in the network. The number of vouchers consumed by MMS customers is highest while the average is 4.5 vouchers for charging prepaid accounts. Least but not last, the SMS consumers who are using highest number of services (5 services) are generating highest value and make revenue.

X. CLASSIFYING CHURN PROPAGATION IN CLV

The more loyal subscriber results more revenue, therefore it reduce churn in the life cycle of customers as per Table.5.Except "Plain Loyal" segment of subscribers, the rest have potential churn in the network. The TBS, Poly Tone and MMS services consumed by loyal customers while two of them (TBS & MMS) not even seen by non-dependable customers. According to Table.5 the customers who are active on net for long time are using TBS and F&F more than other services. Moreover , it's amazing to find out that besides roaming the other services consume below average by 33% of subscribers that known as loyal under incentive, so they have enough potential to leave the network because the service threshold of this segment indicated below average service usage during customer life cycle in this group.

Table.5 Input from Churn during specific CLV

Services	Avg AON (in months)	'Plain Loyal'	'Loyal Under Incentive' (dormancy)	'Fence seated'	'Not Dependable' (churn)
Voice	avg	avg	avg	avg	avg
SMS	avg	avg	(-)	(-)	avg
Roaming	avg	avg	(+)	+ +	- -
TBS	(+)	+ +	(-)	- -	- -
Monotone	avg	(+)	(-)	(-)	(-)
Poly tone	avg	+ +	- -	+ +	(-)
RBT	avg	(+)	(-)	(-)	(-)
MMS	avg	+ +	- -	(-)	- -
GPRS	avg	(+)	(-)	(-)	(-)
WOW	avg	(+)	(-)	avg	(-)
F&F	(+)	(+)	(-)	(-)	(-)
AVERAGE	**14.5**	**49%**	**33%**	**5%**	**14%**

According to the model presented in the Fing.9 the visibility of churn based on level of participation and service attraction is a sign that will be changed dynamically and can't be extended over CLV or to any other telecommunication companies.

XI. IDENTIFYING SEGMENTATION AND CLV

The value of identified segments by considering service usage during CLV has been exposed in Table.6

Table.6 Identify Customer Segmentation

SERVICE	Cluster1	Cluster2	Cluster3	Cluster4	Cluster5	Cluster6	Cluster7	Cluster8	Cluster9	Cluster10
Voice	avg	avg	avg	avg	avg	avg	avg	avg	avg	avg
SMS	avg	avg	avg	avg	avg	- -	avg	- -	avg	avg
Roaming	+ +	+ +	-	(+)	+ +	avg	+ +	- -	- -	avg
TBS	avg	-	avg	(+)	-	- -	avg	- -	- -	(+)
Monotone	avg	- -	avg	+ +	-	- -	(+)	- -	- -	(+)
Poly tone	(+)	-	avg	(+)	-	- -	+ +	- -	- -	(+)
RBT	(+)	- -	avg	+ +	+ +	- -	avg	- -	- -	avg
MMS	avg	+ +	-	+ +	+ +	- -	(+)	- -	- -	(+)
GPRS	avg	-	avg	(+)	avg	-	avg	- -	- -	avg
WOW	avg	- -	-	+ +	avg	- -	avg	- -	- -	(+)
F&F	avg	avg	-	+ +	- -	- -	avg	- -	- -	(+)
AVERAGE	**1%**	**2%**	**39%**	**17%**	**3%**	**8%**	**3%**	**3%**	**4%**	**21%**

The highest number of customers is belong to cluster No.3 with 39% and also average service usage in most services and the next volume of customer are cluster 10 and cluster 4 with 21% and 17% which both are almost equal to cluster 3 with 38% of total number of subscribers in the network that makes revenue through consuming various services. Besides multimedia and content based services, voice and SMS are popular in all clusters within 25% of average usage. The behavior of customers:

Customer segmentation provides a model to categorize the value generated by various groups of customers and their level of participation to generate value from each individual service.

XII. CONCLUSION

Many researches attempt to improve customer satisfaction by developing a comprehensive customer segmentation model to gain highest profitability by analyzing CLV. The mobile telecommunication marketplace is highly competitive, so telecommunication companies often need to design distinguishable marketing strategy based on different behavior of their subscribers in order to improve their marketing results and revenue. Call and Event Detail Records is introduced as a key success factor to describe customer behavior in this paper since it has valid and dynamic information than a billing system. It is clearly demonstrated that clustering analysis based on call and event details records will give more enriched information than other analysis for anticipating the business roadmap. This innovation proposed how effectively can apply CDR/EDR data to customer segmentation, customer life cycle; loyalty, churn and cross-selling by considering the past contribution, potential value, and churn probability at the same time. Three perspectives on customer value (current value, potential value, and customer loyalty) assist marketing managers in identifying customer's segmentation with more balanced viewpoints. After identification of subscriber's behavior and loyal groups, it's feasible and possible to put customer clusters in place and make an applicable strategic plan for each group to achieve highest customer satisfaction along with maximum revenue for telecommunication industries.

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