Enhanced Quality of Experience through IVR Mashup to Access Same Service Multiple Operator Services

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Abstract. On one hand a telephone voice call has become an easy and a convenient means to inquire, seek information or book services and on other hand any frequently required service by the masses, like Taxi usually has multiple service operators. While each of these service operators provide the same type of service to the end user, their access points are different and require the end user to choose a priori which service operator to call. The Quality of Experience (QoE) faces major shortcomings in such a Same Service Multiple Operator (SSMO) scenario in terms of (a) long hold times (b) no way the user can connect to the the service operator who can provide him/her, the service he/she needs, fastest. Unlike a web portal or a web mashup, there is no way for the user to comparatively and simultaneously check the offerings from SSMO and choose the best among them. In this paper, we propose an interface which enables an enhanced QoE in a SSMO scenario while using the telephone channel which is achieved through a IVR Mashup [1].

Keywords: Mashup, Hold time, Telequeues, Call Center

1 INTRODUCTION

Services like Radio-Cabs, Travel Portals, Movie-show Bookings, local Yellow Pages search etc are becoming popular and users still prefer to be serviced through a telephone call. Statistics shows that 80% of a firm's customer interaction is through call centers [2]. At the same time any popularly used service, say Taxi-on-call, usually has multiple service operators. Though these different service operators provide the same type of service to the end user, the end user has to call a different service number to make use of the service of that particular service operator. This essentially means even if the end user does not have a preferred service operator, to be serviced, they have to choose a priori a particular service operator. Consider a simple scenario of two different service operators say SP A and SP B who provide the same service. At a given time t assume that the service operator SP A is able to provide the required service while SP B is not. Let us look at the scenario where a user who wants to avail of the service (has no preference for SP A or SP B) calls up SP B. Since SP B can not provide the required service, the user ends the call with SP B and next calls SP A and avails of the service. In sum total the QoE of the user is poor even though SP A was able to provide the service. The QoE is poor because of wasted telephone calls (calls SP B and then SP A) and time (time taken to find SP B is not available and then time taken to actually ask for services of SP A). If there was a way of knowing a priori that the service was available with SP A and not with SP B then the user would have called SP A and completed the transaction with a better QoE. This paper proposes a system that enables richer QoE in terms of both time and naturalness.

2 TYPICAL SCENARIO

When a user calls any service over the telephone, the call is answered by a live agent or by an automated IVR (Interactive Voice Response) system. Invariably, in either situation, the caller is put on hold by playing some music. After a certain hold time, the caller is able to interact with the service operator (can talk to the agent/IVR) and is able to make the service request. In many cases the caller request may not be served in a single call to a service operator; for reasons like operator could not provide with the requested service or the caller wants to get information from another similar but different service operators and then make a decision. The caller has to the dial the next service operator where the user may be put to hold again and the cycle repeats and this is very inconvenient if the number of the service operators is large. Figure 1 illustrates a timeline describing a typical scenario where a user needs a service and has the option of obtaining this service from multiple operators. As shown in Figure 1, when the user calls a service operator, the user is put on hold, until the service operator (in most cases a human agent) is able to service the user request. The user then dials the next service operator only after the previous call is complete; and the wait cycle repeats. Thus the user gains access to the service only after being put on wait by each of the operators and additionally there is an interaction time (speaking to the human agent of the service operators) until finally served by a particular service operator. During the wait times usually some music or advertisement promotions are played, which are as it is today irrelevant and most of the times frustrating to the caller; even in the most optimistic scenario when the user is required to call only a single service operator. This unproductive wait time often degrades the overall QoE and hampers the simplicity and ease of using the telephone services.

In such a scenario, using a telephone call, there is no way the user can connect to the operator which can service the user fastest or first. Unlike a web portal or a web mashup, there is no way for the user to check the offerings from different service operators and choose the best among them using a telephone call. As seen in the example scenario the QoE is poor and the user in a worst case scenario may be left with no information even though there are several operators for

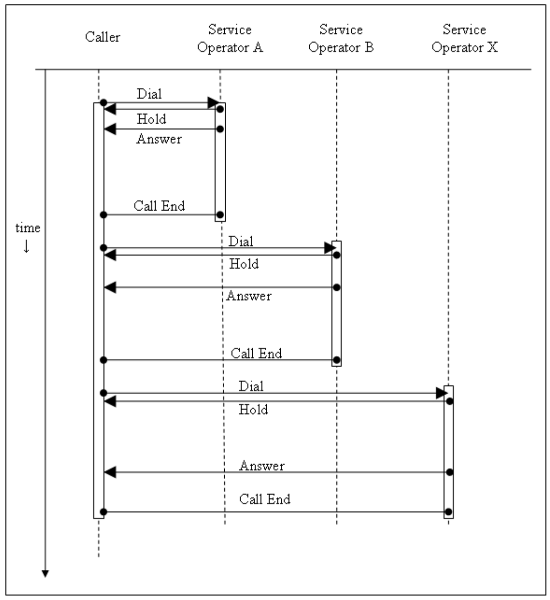

Fig. 1. Timeline describing a typical scenario where a user has to call several same service providing operators to book a service

the service. To summarize, the telephone call service channel faces following shortcomings:

i. Long hold times and no effective use of the hold time. Usually some music or repetitive advertisements are played which are extraneous to the caller.
ii. Inability to connect to the least wait time service operator.
iii. Sequential connection, one after the other, to service operators or sources of information. There is no way to get information from various service operators in the same call.
iv. The user has to speak the same request for service information every time the user talks to the new service operators, a redundant repeat.

Thus even though speaking over a telephone to get a service done is a preferable channel over other channels like website and messaging, it is comparatively less efficient and in the current form does not address the poor QoE. Therefore, there is a need for a system that addresses the shortcomings mentioned above and enables a mashup like interface over the telephone, providing both ease to the access of services and information and also enhances caller experience. Recently there have been systems which have addressed the problem of call hold time. Virtual Queuing [3] allows callers to hangup on long hold times; while keeping a virtual placeholder for the caller, this placeholder is used to call back the users when their turn arrives. Deep Dialing [4] system skips hold time and also skips users having to enter choices from a telephone keypad to reach a particular type of service in an IVR menus and sub menus. It allows a caller to directly reach a particular node in a IVR or directly get connected to the live agent behind an automated IVR. However, [3] and [4] do not provide for a mashup interface, and do not address either the ease to access services from multiple operators, or the ability to connect to the service operator with minimum wait time. The proposed IVR Mashup system addresses these shortcomings.

3 THE MASHUP SERVICE

Figure 2 illustrates the block diagram of the IVR Mashup platform. As depicted in Figure 2 the IVR Mashup is an IVR interface which interacts with the caller on one end and with multiple service operators on the other end. In a typical scenario a user who wishes to use the IVR Mashup service registers on the web with minimal details. The information about the user like his interests, preferences, etc is gathered during this registration and stored in an organized database. When the user wants to make use of the system the user calls the IVR Mashup service. The mashup service answers the user's call and then automatically places simultaneous calls to multiple service operators through the Outbound Dialer system. The mashup platform uses the Call Connection Status Analyzer to monitor the outbound call status. In the meantime it determines for how long and what advertisement (for a set of advertisements) must be played to the user, using the basic details available in the user profile/DB at the time of registration. This helps play targeted or personalized infotainment messages and advertisements to the user. Once connected to a service operator the mashup service handles the call as per the type of mashup service selected by the user. The preference of type of mashup service is marked in the user profile or chosen by the caller after dialing to the mashup service.

Figure 3 illustrates the timeline describing a typical transaction of mashup service. The steps involved in the transaction can be elaborated as follows:

i. The transaction begins when a registered caller dials the Mashup service.
ii. The Mashup service then simultaneously calls different service operators, and waits for them to answer. On the other end it refers to the caller's profile and plays relevant infotainment messages and advertisements.
iii. When a service operator (operator with minimum wait time) answer's the call from the mashup service, the mashup system connects the caller to this service operator. The caller can now directly speak to the service operator agent or IVR.

Additionally, the Mashup service can call and connect only to that service operator which is preferred by the user. The preferred service operator is known from the user's profile. In this scenario the user has to wait for the time that s/he would have to wait even when s/he did not use the mashup service, however since the mashup service plays relevant infotainment messages and advertisements to the user till it gets connected the QoE is enhanced.

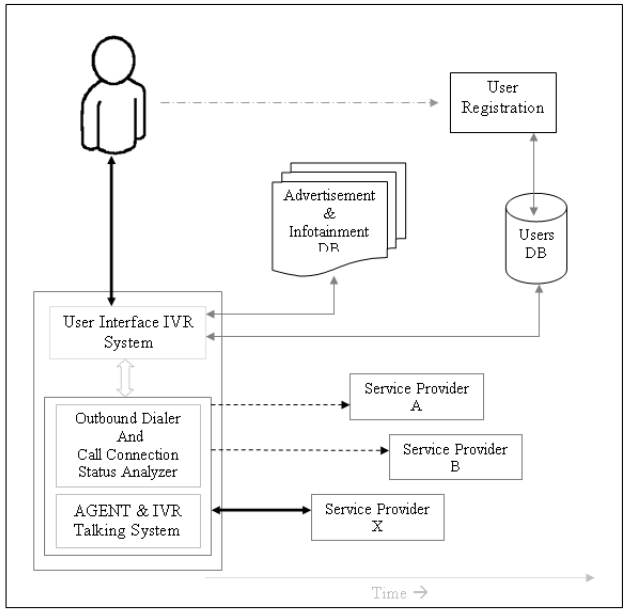

Fig. 2. Block diagram of the proposed IVR Mashup platform

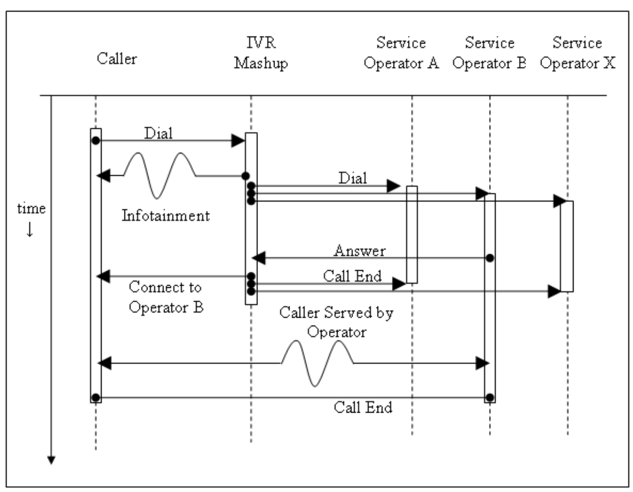

Fig. 3. Timeline describing a typical transaction completed by the mashup service by connecting the caller to the immediate available service operator

The IVR mashup service can also serve like a web mashup and provide service from all the service operators in the same call. The mashup service talks to the service operators after the wait period using advanced Automatic Speech Recognition and Text to Speech software. The mashup service is capable of talking simultaneously to more than one service operator. The mashup service then provides the answers to the user's request as and when it completes a transaction with a service operator or provides an update of information together at the end. It is also possible for the mashup service to complete the call with the service operators and later call the user and furnish the service details.

4 Mashup Service Analysis

4.1 Minimum Wait Advantage

The Mashup service discussed has a clear advantage of connecting the user to the service operator which can answer him first. As shown in Figure 4, for the purpose of analysis, let us consider a caller has the option to make use of any of the three available service providers, say A,B,C. Let $p(A)$, $p(B)$, $p(C)$ be the probabilities that the caller calls service operators A, B, C respectively. Let WA, WB and WC be the average waiting time faced by any caller calling the service operators A, B and C respectively. In the absence of the mashup service the caller has to wait (hold) for a time

$$t = p(A)WA + p(B)WB + p(C)WC \tag{1}$$

which is average probable and could be more. While use of the mashup connect service, the caller gets connected to the first available service operator. Hence the wait time is

$$t = min\{p(A)WA, p(B)WB, p(C)WC\} \tag{2}$$

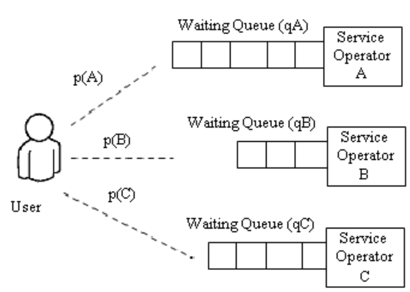

Fig. 4. Analysis of Minimum Wait Advantage

To understand this better, consider the Erlang C queuing model as described in [5]. Using this model, the probability that a caller has to wait in the queue when s/he calls a service operator with N agents is given as:

$$C(N,R) = 1 - \frac{\sum_{m=0}^{N-1}(R^m/m!)}{\sum_{m=0}^{N-1}(R^m/m!) + (R^N/N!)(1/(1-R/N))} \tag{3}$$

$$R = \frac{\lambda}{\mu} \tag{4}$$

where λ is the call arrival rate and μ is the service rate. And the probability that the caller has to wait for time t is given as:

$$P(>t) = C(N,R) * e^{-(N\mu-\lambda)t} \tag{5}$$

Consider a service operator SP1 having 100 agents ($N = 100$), call service time of 10 minutes ($\mu = 1/10$) and average call arrival rate of 9.9 calls per minute. Consider another service operator SP2 having same number of agents and call service time, but average call arrival rate that is 90% of that of SP1. Using (1) to (5) we can plot the probability of waiting for time t and compare these for any caller trying to call service operators SP1 or SP2 directly and callers using mashup service. This is illustrated in the graph in Figure 5.

As shown in Figure 5, for a caller particularly calling SP2 the probability of waiting greater than time t is lesser than that for a caller particularly calling SP1. However, for a non mashup user, who can arbitarily call SP1 or SP2, the average probability of waiting is greater than that of SP2 (the service operator having minimum probability of waiting in this case). It must be noted that in a practical situation the service operator with minimum wait time is not known to a caller (non mashup user) and also it may not be the same service opeartor which has minimum wait time throughout. For a mashup user, since the mashup service ensures to connect the user to the service opeartor with least wait time, the probability of waiting is always minimum and equal to that of service operator having minimum probability of waiting (SP2 in this case). Therefore, the graph of the probability of waiting for the mashup user overlaps that of SP2.

Similarly, using the Erlang C queing model in [5] the average wait time for any caller in the queue is given as:

$$Tq = \frac{C(N,R)}{(N\mu - \lambda)} \tag{6}$$

The average waiting time can be plotted as a function of the call arrival rate (λ). Figure 6 shows a graph that compares the average wait time for callers trying to call service operators SP1 or SP2 directly and callers using mashup service, at different arrival rates. (Average call arrival rate for SP2 is 90% of that of SP1.)

As shown in Figure 6, for a caller particularly calling SP2 the average waiting time is lesser than that for a caller particularly calling SP1. However, for a non mashup user, who can arbitarily call SP1 or SP2, the average waiting time is

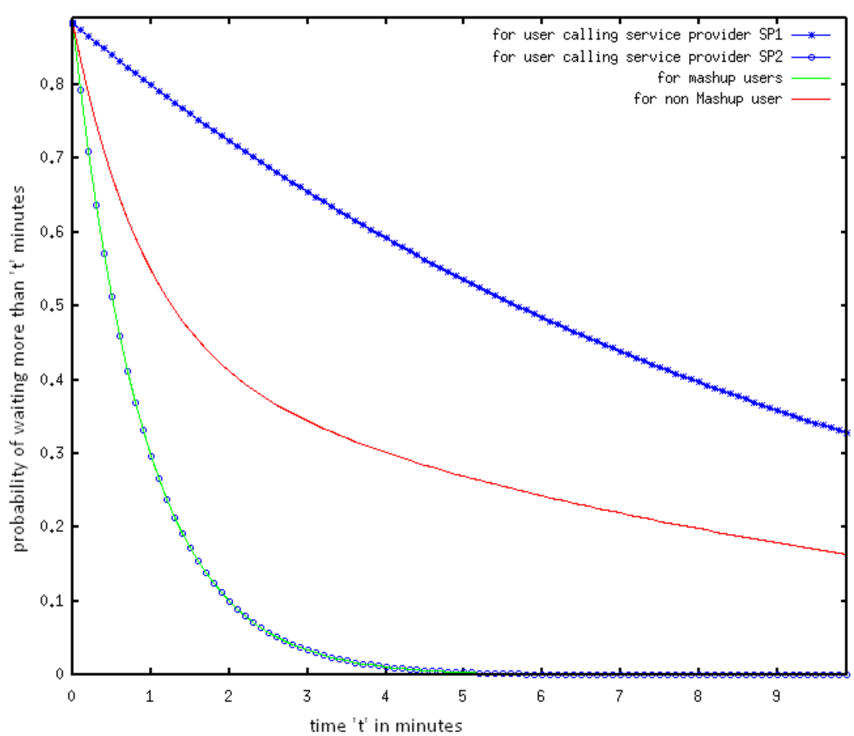

Fig. 5. Graph of probability of waiting greater than time t

greater than that of SP2 (least waiting time in this case). For a mashup user, the average waiting time is minimum and equal to least waiting time (given by SP2 in this case). Therefore, the graph of waiting time for the mashup user overlaps that provided by SP2.

Thus it can be observed from Figures 5 and 6 that the probability of waiting greater time t, as well as the average waiting time for a mashup user is minimum when compared to a non mashup user. In the worst case scenario where the waiting times for all service operators is same, the IVR mashup service gives the advantage of enhanced QoE as discussed in the next section.

4.2 Enhanced Quality of Experience

The Telephone Mashup service provides an overall enhanced QoE. The factors enhancing QoE are:

i. Minimum wait time to connect to a service operator.
ii. The wait is not boring because the caller gets to listen to something that is appealing to his/her personal interests.
iii. It allows user to speak personalized and natural voice requests.
iv. User can get information from multiple service operators in a single call.

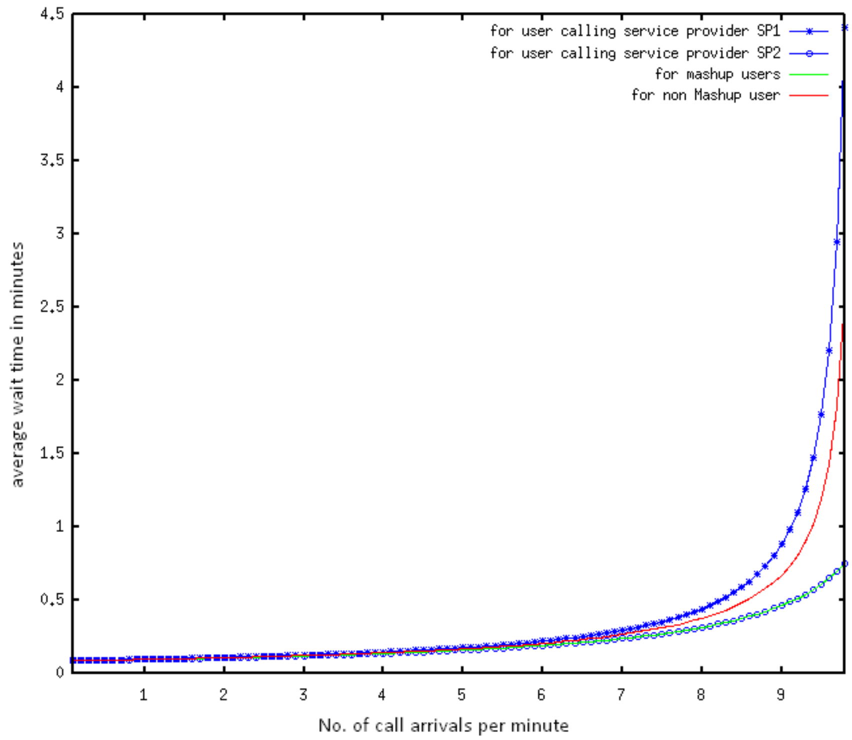

Fig. 6. Average waiting time for different call arrival rates

4.3 Effect on Call Center Queues

The primary function of the IVR Mashup service is to call a service operator and wait in the queue of the call center (of the service operator) on behalf of the caller. Different scenarios of the Mashup service have a different effect on the call center queues. For cases where the IVR Mashup calls the service operator preferred by the user, it is same as the caller calling and waiting in the queue, and hence the queue remains unaffected. In other case where the mashup service connects to the fastest answering service operator, the mashup service calls multiple service operators and stays in the queue of the respective call centers. However, once the call is connected to a service operator (the operator with minimum wait time) the mashup service disconnects calls to remaining service operators, thus clearing places in their queues. Hence, even though the queues appear to be increasing, it actually is reducing at the same time. When the Mashup service calls multiple service operators and stays in the queue of the respective call centers, and talks to each of the service operators, it increases the queue length, but the waiting is still done by the Mashup service thus increasing the QoE.

5 CONCLUSION

Even though a telephone voice call is highly popular, for booking services and getting information about services, it faces major shortcomings like long hold times and inability to get information from multiple service operators in the same call. There is an express need to develop a platform which can integrate services offered by different service operators, through the telephone channel, to enhance QoE. The proposed IVR Mashup solution is a step towards that. The advantage of such a system is that a caller not only spends less time to enable a transaction but also gets a better calling experience.

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