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Dis-connectivity Parameter based Model for Call Transitions in Dual SIM Mobile

Akash Singh[1], Mrs. Indira Chadar[2],

[1]Deptt. of Computer Science and Engineering, BTIRT, Sagar, (M.P.), 470001, India
[2]Deptt. of Computer Science and Engineering, BTIRT, Sagar, (M.P.), 470001,India

Abstract

Many people are using dual-SIM mobile for a variety of reasons. A common problem observed is the continuity of connectivity of call during communication. Disconnectivity of call affects the market share of an operator. This paper suggests a model based on markov chain to check the relationship between call transitions and call attempts over SIM S_1 *and SIM* S_2 *when congestion and disconnectivity parameter is high or low to complete the call. The assessment reveals that the transitions over SIMs vary at different attempt. Fig 1-4 reveals that the user tries to connect* S_1 *and* S_2 *till attempt 5. Fig 5-8 reveals that the user try to connect SIM* S_1 *till attempt 6 and SIM* S_2 *till attempt 8. When p (high),* p_L *(high),* c_1 *(low),* c_2 *(high) and* d_1 *(high), and when p (low),* p_L *(low),* c_1 *(low),* c_2 *(low),* d_2 *(high), the transition value is very high at attempt 2 over SIM* S_1 *and SIM* S_2*. The graphical Study express the relationship between call transitions and attempts based on Markov chain using Excel tools with varying parameter values.*

Keywords*: Markov chain, Initial probability, Call attempts, Call transitions, Network Service Provider, Transition probability matrix.*

1. Introduction

Call disconnectivity can have an impact on the traffic share between dual-SIM mobile phones. If one SIM experiences frequent call disconnectivity issues, the user may choose to switch to the other SIM for calls, which can result in a shift in traffic share between the two SIMs. This can be especially true if the user has different operators for each SIM. In such cases, if one operator experiences disconnectivity issues, the user may choose to make calls using the other operator's SIM.

Suppose c_1, c_2 are network congestion probabilities and d_1, d_2 are disconnectivity probabilities then according to Chiang and Lin (2014) the quality of service (QoS) is a function of network congestion parameters.

$$QoS = f\ (c_1, c_2)$$

We consider a modified form of this function in light of disconnectivity as

$$QoS = f\ (c_1, c_2, d_1, d_2)$$

Tiwari Kumar Virendra and Shukla D. (2023) produced a cybercrime analysis of two call dimensional effects in internet traffic. The proposed work investigates the effect of different categories crime users on the internet traffic sharing under the markov chain model. Othman et al. (2021) suggested models for internet traffic sharing in computer network. This study suggests two models based on markov chain using three and four access attempts to solve the call blocked problem, Model III perform two attempts and Model IV used three attempts to solve the call blocked problems.. More S. and Shukla D.(2019) submitted a review on internet traffic sharing using Markov Chain Model in Computer Network. This review study discussed various applications of markov chain model. This model is used to study about how the quality of service is obtained and the traffic share is distributed among the operators on the basis of different parameters. Thakur Sanjay and Jain Parag (2013) used a Prediction Model for User's Share Analysis in Dual-sim Environment. Shukla et al. identified the Effects of Disconnectivity Analysis for Congestion Control in Internet Traffic Sharing. Deriving motivation from all these, this paper presents a relationship between call connectivity and call attempts with special reference to the disconnectivity event. A Markov chain model is used to explain the system as user behavior and to derive the mathematical expressions of transition probabilities.

The objective of this paper to study the effects of congestion and disconnectivity probability on the call connectivity with respect to call attempts over the SIM S_1 and SIM S_2 when the congestion and disconnectivity probability is high or low to complete the call.

2. Model and Proposed Methodology

Let S_1 and S_2 be two SIMs in a mobile. User is allowed to choose any of S1 and S_2 based on faith, offers, reputation and quality of service. When he fails to connect any one SIM then shifts to other one. He toggles between two SIMs in n attempts if fails to connect or leaves the connecting process after any attempt. When connects, then faces disconnectivity problem.

Let $\{D^{(n)}, n \geq 0\}$ be a markov chain having transitions over the state space $\{S_1, S_2, Z, L\}$, where

State S_1: The user tries to connect through SIM S_1

State S_2 : The user tries to connect through SIM S_2

State Z : success obtained in call connection

State L: Leaving the connecting process

The $D^{(n)}$ stands for state of random variable D at n^{th} attempt $(n \geq 0)$ by the user. Some underlying assumptions for the proposed model are:

(a) Initially user chooses one of the two SIM, SIM S_1 with probability p and SIM S_2 with probability $(1-p)$.

(b) User has two choices after each failed attempt:-

  (i) Leaves with probability p_L or

  (ii) Moves to the other SIM for a new attempt.

(c) When the call attempt fails through the SIM S_1 the congestion probability is c_1 and fails through the SIM S_2 is c_2.

(d) The connectivity attempts of user between SIMs are on call-by-call basis, which means if the user attempt on S_1 is congested in k^{th} attempt $(k > 0)$ then in $(k+1)^{th}$ attempt user moves to S_2 . If this also fails, user switches to S_1.

(e) Whenever call connects either through SIM S_1 or SIM S_2, we say system reaches to the state of success.

(f) The user can terminate the connecting process to the leave state L at n^{th} attempts with probability p_L either from SIM S_1 or from SIM S_2.

(g) When connected call is suddenly disconnected either of SIM S_1 or SIM S_2 we say it is disconnectivity, it bears SIM S_1 with probability d_1 and SIM S_2 with probability d_2.

(h) While occurring disconnectivity, the return back from success state to SIM $S_i(i = 1,2)$ is based on initial transition from S_i .By disconnectivity the system returns back to the same SIM from where it reaches again to the success state (Z).

(i) If user reach state Z or state L then he cannot leave it, this means the probability transfer to another state is zero and probability remaining in the same state is one.

The transition diagram for model is shown in Fig 1.

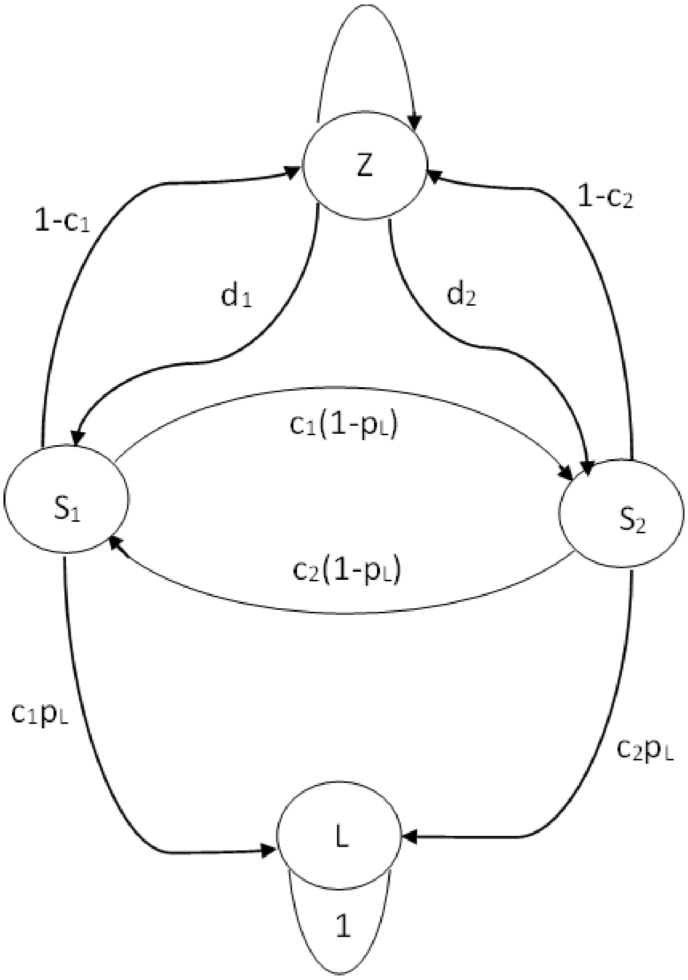

Fig 1 Transition Diagram for Model

3. Transition Probability Matrices

(i) The initial probabilities for user before the first call attempt selecting any one of SIMs are

$$\left.\begin{aligned} P\left[D^{(0)} = S_1\right] &= p \\ P\left[D^{(0)} = S_2\right] &= (1-p) \end{aligned}\right\} \qquad (1)$$

$$P\left[D^{(0)}=Z\right]=0$$

$$P\left[D^{(0)}=L\right]=0$$

(ii) If at $(n-1)^{th}$ attempt call for SIM S_1 is congested, the user may leave the process in the nth attempts.

Therefore, $P\left[D^{(n)}=L \big/ D^{(n-1)}=S_1\right]$ = *P[congested at* S_1 *]. P[leave the process]* $=c_1 p_L$ (2)

Similar for S_2 , $P\left[D^{(n)}=L \big/ D^{(n-1)}=S_2\right]=c_2 p_L$ (3)

(iii) At SIM S_1 in n^{th} attempt call may be made successfully and system reaches to state Z from S_1.This happens only when call does not congest in $(n-1)^{th}$ attempt

$P\left[D^{(n)}=Z \big/ D^{(n-1)}=S_1\right]$ = *P [does not congested at* S_1 *] = 1-*c_1 (4)

Similar for S_2 , $P\left[D^{(n)}=Z \big/ D^{(n-1)}=S_2\right]$ = *1-*c_2 (5)

(iv) If user is congested at SIM S_1 in $(n-1)^{th}$ attempt, does not want leave, then in n^{th} attempt he shifts to SIM S_2.

$P\left[D^{(n)}=S_2 \big/ D^{(n-1)}=S_1\right]$ = *P [congested at* S_1 *] P[does not leave]* = c_1 (1-p$_L$) (6)

Similarly , $P\left[D^{(n)}=S_1 \big/ D^{(n-1)}=S_2\right]$ = c_2 (1-p$_L$) (7)

(v) Disconnectivity occurs when success achieved either through SIM S_1 or SIM S_2. After disconnectivity , user return on SIM S_1 with probability d_1 and on SIM S_2 with d_2.

$$\left.\begin{array}{l} P\left[D^{(n)}=S_1 \big/ D^{(n-1)}=Z\right]=d_1 \\ P\left[D^{(n)}=S_2 \big/ D^{(n-1)}=Z\right]=d_2 \end{array}\right\} \quad (8)$$

Incorporating all, the transition probability matrix is in the form

States

$$\begin{array}{cc|cccc} & & \longleftarrow & X^{(n)} & \longrightarrow & \\ & & S_1 & S_2 & Z & L \\ \hline & S_1 & 0 & c_1(1-p_L) & 1-c_1 & c_1 p_L \\ X^{(n)} & S_2 & c_2(1-p_L) & 0 & 1-c_2 & c_2 p_L \\ & Z & d_1 & d_2 & 1-(d_1+d_2) & 0 \\ & L & 0 & 0 & 0 & 1 \end{array} \quad (9)$$

4. Transition Probabilities

In n^{th} attempt the probabilities of ultimate state are derived in the following theorem

Theorem 4.1: If the user makes attempt between SIM S_1 and SIM S_2 , then the n^{th} step transitions probability could be obtained as

$$P[D^{(2n)} = S_1] = p[(c_1c_2)^n(1-p_L)^{2n} + (c_1c_2)^{n-1}(1-p_L)^{2(n-1)}(1-c_1)d_1]$$

$$P[D^{(2n+1)} = S_1] = (1-p)c_2[(c_1c_2)^n(1-p_L)^{2n+1} + (c_1c_2)^{n-1}(1-p_L)^{2n-1}(1-c_1)d_1]$$

$$P[D^{(2n)} = S_2] = (1-p)[(c_1c_2)^n(1-p_L)^{2n} + (c_1c_2)^{n-1}(1-p_L)^{2(n-1)}(1-c_2)d_2]$$

$$P[D^{(2n+1)} = S_2] = pc_1[(c_1c_2)^n(1-p_L)^{2n+1} + (c_1c_2)^{n-1}(1-p_L)^{2n-1}(1-c_2)d_2]$$

Proof: At $n = 0$, we have

$P[D^{(0)} = S_1] = p$; $P[D^{(0)} = S_2] = (1-p)$, the start may either from SIM S_1 and SIM S_2 , and we have:

For n = 1,

$$P\left[D^{(1)} = S_1\right] = P\left[D^{(0)} = S_2\right]P\left[D^{(1)} = S_1 \big/ D^{(0)} = S_2\right] = (1-p)c_2(1-p_L)$$

$$P\left[D^{(1)} = S_2\right] = P\left[D^{(0)} = S_1\right]P\left[D^{(1)} = S_2 \big/ D^{(0)} = S_1\right] = pc_1(1-p_L)$$

$$P\left[D^{(1)} = Z\right]_{S_1} = P\left[D^{(0)} = S_1\right]P\left[D^{(1)} = Z \big/ D^{(0)} = S_1\right] = p(1-c_1)$$

$$P\left[D^{(1)} = Z\right]_{S_2} = P\left[D^{(0)} = S_2\right]P\left[D^{(1)} = Z \big/ D^{(0)} = S_2\right] = (1-p)(1-c_2)$$

For n = 2,

$$P\left[D^{(2)} = S_1\right] = P\left[D^{(1)} = S_2\right]P\left[D^{(2)} = S_1 \big/ D^{(1)} = S_2\right] + P\left[D^{(1)} = Z\right]_{S_1} P\left[D^{(2)} = S_1 \big/ D^{(1)} = Z\right]$$

$$= p[c_1c_2(1-p_L)^2 + (1-c_1)d_1]$$

$$P\left[D^{(2)} = S_2\right] = P\left[D^{(1)} = S_1\right]P\left[D^{(2)} = S_2 \big/ D^{(1)} = S_1\right] + P\left[D^{(1)} = Z\right]_{S_2} P\left[D^{(2)} = S_2 \big/ D^{(1)} = Z\right]$$

$$= (1-p)[c_1c_2(1-p_L)^2 + (1-c_2)d_2]$$

$$P\left[D^{(2)} = Z\right]_{S_1} = P\left[D^{(1)} = S_1\right]P\left[D^{(2)} = Z \big/ D^{(1)} = S_1\right] = (1-p)c_2(1-p_L)(1-c_1)$$

$$P\left[D^{(2)} = S_2\right] = P\left[D^{(1)} = S_1\right]P\left[D^{(2)} = S_2 \big/ D^{(1)} = S_1\right] = (1-p)c_1c_2(1-p_L)^2$$

$$P\left[D^{(2)}=Z\right]_{S_2}=P\left[D^{(1)}=S_2\right]P\left[D^{(2)}=Z\middle/D^{(1)}=S_2\right]=pc_1(1-p_L)(1-c_2)$$

$$P\left[D^{(2)}=S_1\right]=P\left[D^{(1)}=S_2\right]P\left[D^{(2)}=S_1\middle/D^{(1)}=S_2\right]=pc_1c_2(1-p_L)^2$$

For n = 3,

$$P\left[D^{(3)}=S_1\right]=P\left[D^{(2)}=S_2\right]P\left[D^{(3)}=S_1\middle/D^{(2)}=S_2\right]+P\left[D^{(2)}=Z\right]_{S_1}P\left[D^{(3)}=S_1\middle/D^{(2)}=Z\right]$$

$$=(1-p)c_2(1-p_L)[c_1c_2(1-p_L)^2+(1-c_1)d_1]$$

$$P\left[D^{(3)}=S_2\right]=P\left[D^{(2)}=S_1\right]P\left[D^{(3)}=S_2\middle/D^{(2)}=S_1\right]+P\left[D^{(2)}=Z\right]_{S_2}P\left[D^{(3)}=S_2\middle/D^{(2)}=Z\right]$$

$$=pc_1(1-p_L)[c_1c_2(1-p_L)^2+(1-c_2)d_2]$$

$$P\left[D^{(3)}=Z\right]_{S_1}=P\left[D^{(2)}=S_1\right]P\left[D^{(3)}=Z\middle/D^{(2)}=S_1\right]=pc_1c_2(1-p_L)^2(1-c_1)$$

$$P\left[D^{(3)}=S_2\right]=P\left[D^{21)}=S_1\right]P\left[D^{(3)}=S_2\middle/D^{(2)}=S_1\right]=pc_1^{\,2}c_2(1-p_L)^3$$

$$P\left[D^{(3)}=Z\right]_{S_2}=P\left[D^{(2)}=S_2\right]P\left[D^{(3)}=Z\middle/D^{(2)}=S_2\right]=(1-p)c_1c_2(1-p_L)^2(1-c_2)$$

$$P\left[D^{(3)}=S_1\right]=P\left[D^{(2)}=S_2\right]P\left[D^{(3)}=S_1\middle/D^{(2)}=S_2\right]=(1-p)c_1c_2^{\,2}(1-p_L)^3$$

For n = 4

$$P\left[D^{(4)}=S_1\right]=P\left[D^{(3)}=S_2\right]P\left[D^{(4)}=S_1\middle/D^{(3)}=S_2\right]+P\left[D^{(3)}=Z\right]_{S_1}P\left[D^{(4)}=S_1\middle/D^{(3)}=Z\right]$$

$$=pc_1c_2(1-p_L)^2[c_1c_2(1-p_L)^2+(1-c_1)d_1]$$

$$P\left[D^{(4)}=S_2\right]=P\left[D^{(3)}=S_1\right]P\left[D^{(4)}=S_2\middle/D^{(3)}=S_1\right]+P\left[D^{(3)}=Z\right]_{S_2}P\left[D^{(4)}=S_2\middle/D^{(3)}=Z\right]$$

$$=(1-p)c_1c_2(1-p_L)^2[c_1c_2(1-p_L)^2+(1-c_2)d_2]$$

On continuation in similar way, the theorem exits.

Results

This section discusses the graphical comparison of the user call transitions between S_1 (SIM S_1) and S_2 (SIM S_2) using Excel application as shown in the figures (1-8). Parameters p, p_L, c_1, c_2,d_1 and d_2 are selected to compare SIM S_1 and SIM S_2 using various values once with high numbers and once with low numbers and these numbers were selected randomly.

Figures (1-8), shows user call transitions over the SIM S_1 and SIM S_2 at 10 attempts using Model.

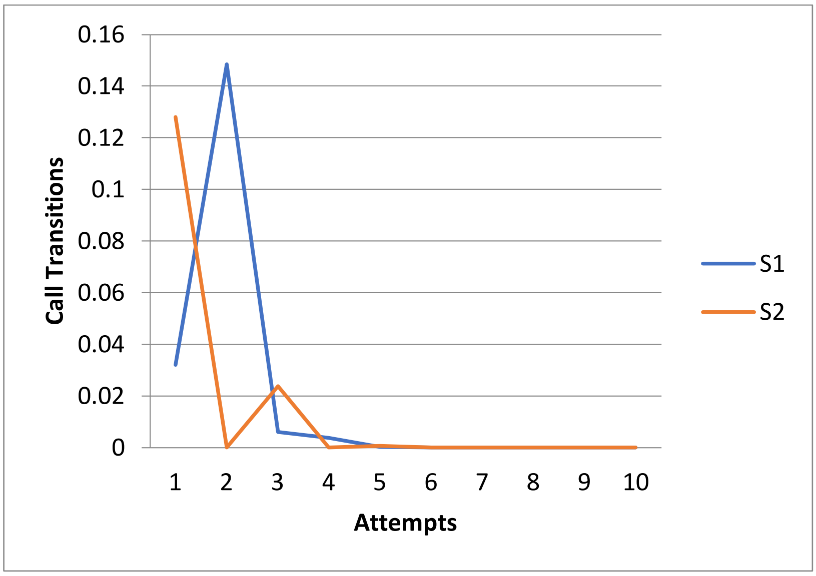

Fig. 1 (p = 0.8, p_L= 0.8, c_1= 0.8,c_2 = 0.8,d_1= 0.8, d_2= 0.8)

Fig. 1 shows the relation between the call transition and call attempts for S_1 (SIM S_1) and S_2 (SIM S_2) when p (high), p_L (high), c_1 (high), c_2 (high), d_1 (high) and d_2 (high). The user call transitions over SIM S_1 is rapidly increases between attempt 1 and 2. After attempt 2 call transitions is gradually decreases and stops after attempt 5. The transition over S_2 is fluctuating between odd and even attempts then stop after attempt 5.

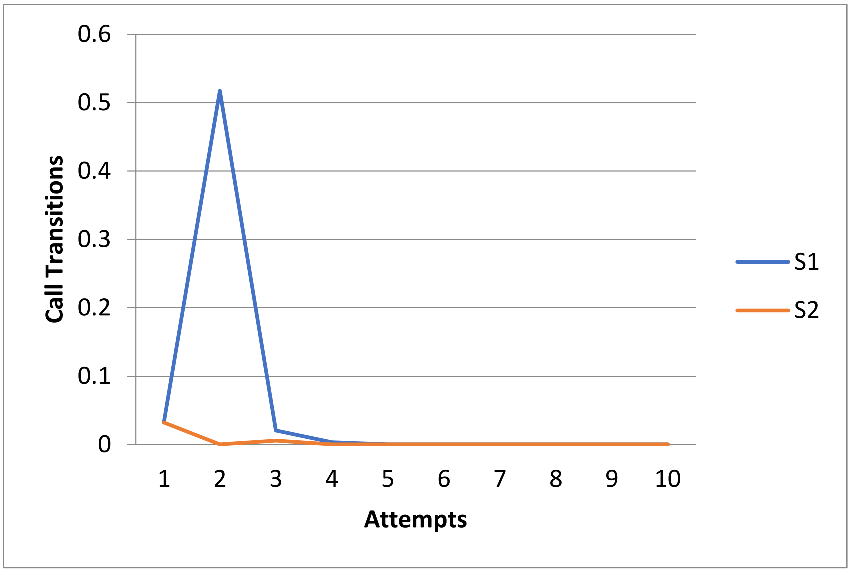

Fig. 2 (p = 0.8, p_L= 0.8, c_1= 0.2, c_2 = 0.8, d_1= 0.8, d_2= 0.8)

Fig. 2 shows the relation between the call transition and call attempts for S1 (SIM S1) and S2 (SIM S2) when p (high), pL (high), c1 (low), c2 (high), d1 (high) and d2 (high). Figure shows the transitions over S1 are rapidly increases from attempt 1 to attempt 2. After attempt 3 transitions are gradually decreases and stop after attempt 5. The transition over S2 is fluctuating between odd and even attempts then stop after attempt 3.

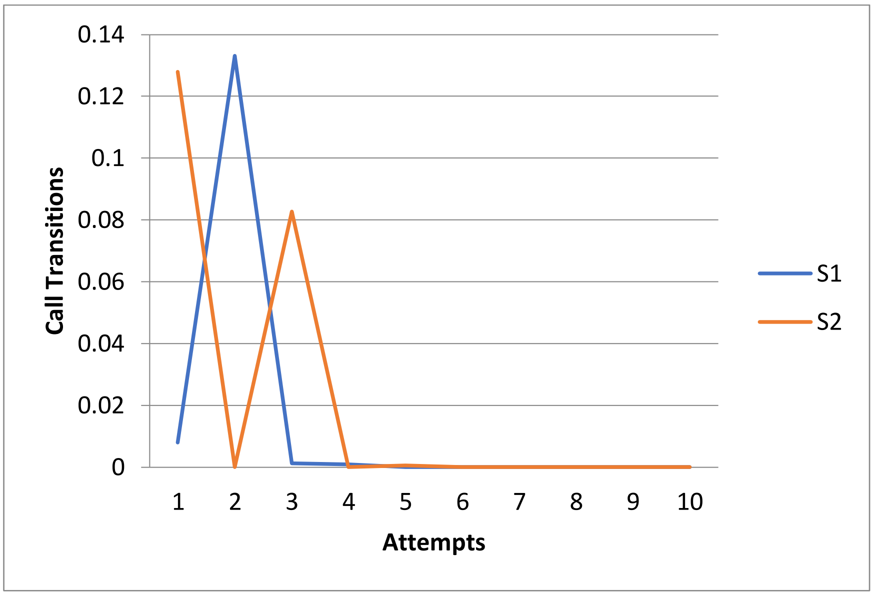

Fig. 3 ($p = 0.8$, $p_L= 0.8$, $c_1= 0.8$, $c_2 = 0.2$, $d_1= 0.8$, $d_2= 0.8$)

Fig. 3 shows the comparison when p (high), p_L (high), c_1 (high), c_2 (low), d_1 (high) and d_2 (high). The transition over S_1 is increases from attempt 1 to attempt 2 then transition is rapidly decreases and stop after attempt 4. The transition over S_2 is fluctuating with small variations and stop after attempt 5.

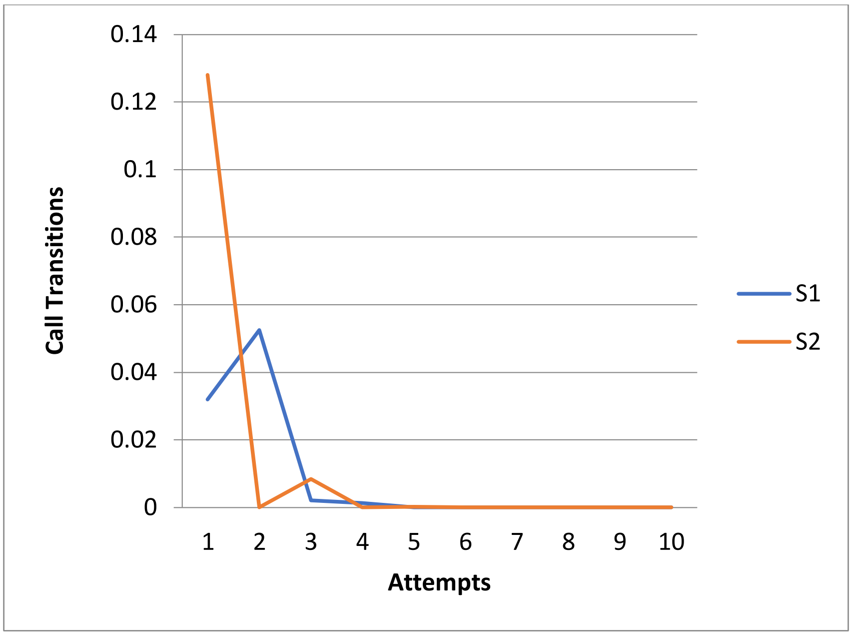

Fig. 4 ($p = 0.8$, $p_L= 0.8$, $c_1= 0.8$, $c_2 = 0.8$, $d_1= 0.2$, $d_2= 0.2$)

Fig. 4 shows the comparison between S_1 and S_2 when p (high), p_L (high), c_1 (high), c_2 (high), d_1 (low) and d_2 (low). It is clear from figure that transition over S_1 is slightly increases from attempt 1 to attempt 2 then slightly decreases and stop after attempt 4. Over S_2, the call transition is rapidly fluctuating and stop after attempt 5.

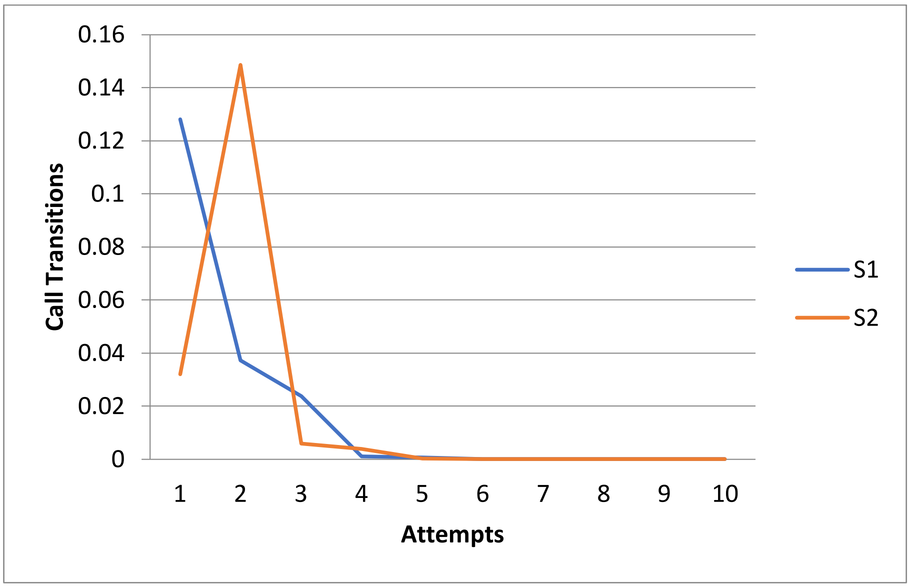

Fig. 5 ($p = 0.2$, $p_L = 0.2$, $c_1 = 0.2$, $c_2 = 0.2$, $d_1 = 0.2$, $d_2 = 0.2$)

Fig. 5 shows the comparison between S_1 and S_2 when p (low), p_L (low), c_1 (low), c_2 (low), d_1 (low) and d_2 (low). Figure shows that the call transition over SIM S_1 gently decreases and stop after attempt 5. Over SIM S_2, the call transition is increases from attempt 1 to 2. After then start decreasing steadily and stop after attempt 5.

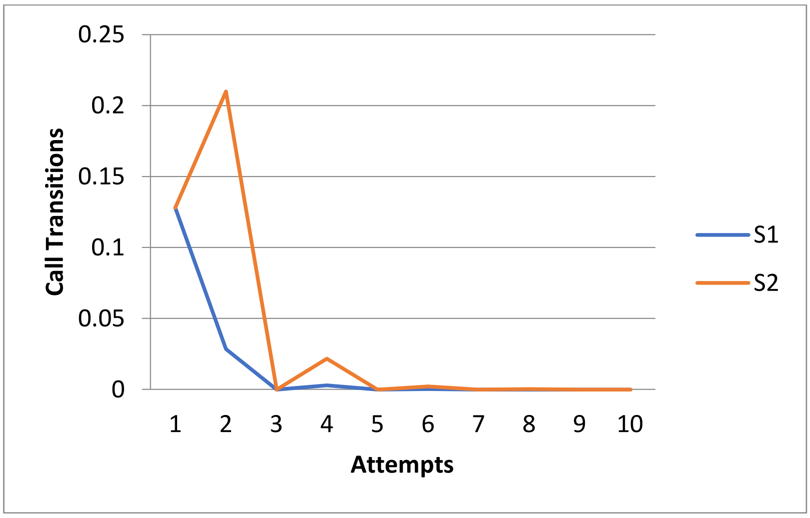

Fig. 6 ($p = 0.2$, $p_L = 0.2$, $c_1 = 0.8$, $c_2 = 0.2$, $d_1 = 0.2$, $d_2 = 0.2$)

Fig. 6 shows the comparison between S1 and S2 when p (low), pL (low), c1 (high), c2 (low), d1 (low) and d2 (low).The call transitions over SIM S1 is decreases from attempt 1 to attempt 2 then fluctuate and stops after attempt 6 but over SIM S2 call transition is increases from attempt 1 to attempt 2 then fluctuate and stops after attempt 8.

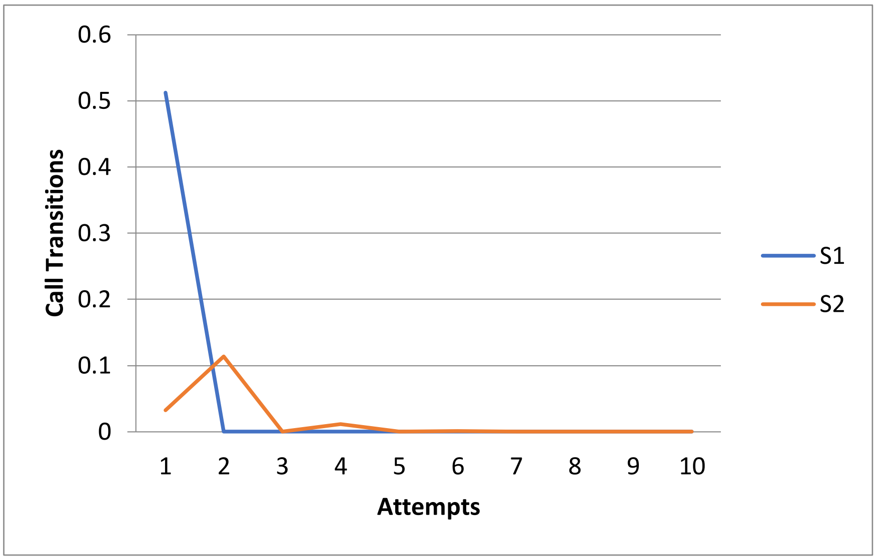

Fig. 7 ($p = 0.2$, $p_L = 0.2$, $c_1 = 0.2$, $c_2 = 0.8$, $d_1 = 0.2$, $d_2 = 0.2$)

Fig. 7 shows the comparison between S_1 and S_2 when p (low), p_L (low), c_1 (low), c_2 (high), d_1 (low) and d_2 (low), the transition is rapidly increases at high level at attempt 1 then stop over SIM S_1. The transitions is rapidly increases from attempt 1 to attempt 2 then rapidly fluctuate and stop after attempt 8 over SIM S_2.

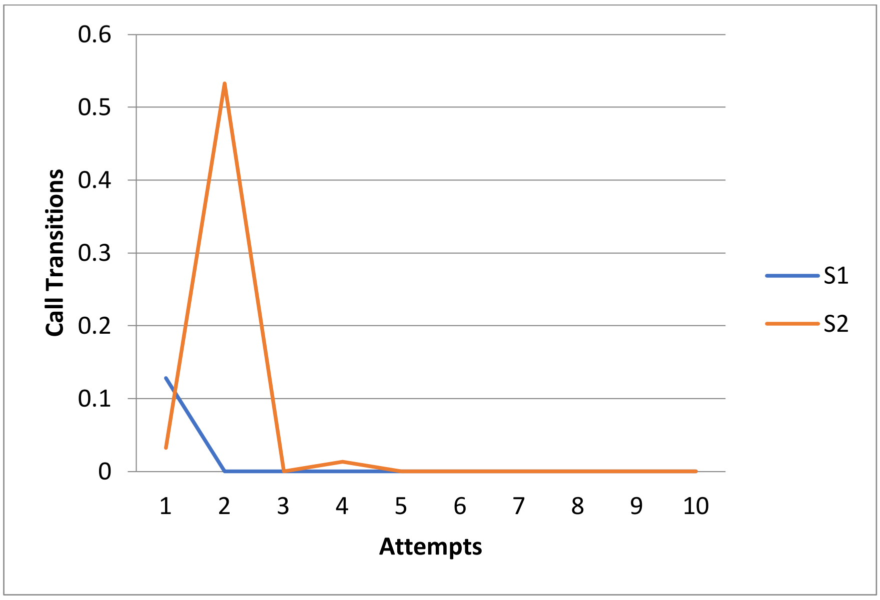

Fig. 8 ($p = 0.2$, $p_L = 0.2$, $c_1 = 0.2$, $c_2 = 0.2$, $d_1 = 0.8$, $d_2 = 0.8$)

Fig. 8 shows the comparison between S1 and S2 when p (low), pL (low), c1 (low), c1 (low), c2 (low), d1 (high) and d2 (high). The transition is rapidly increases at low level at attempt 1 and stop over SIM S1. The transitions is rapidly increases form low level to high level form attempt 1 to attempt 2 then fluttered and stops after attempt 6 over SIM S2.

Table 1: Call Transition over SIM S_1

Attempt	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
when p=high $p_{L=}$ high, c_1= high,c_2 = high $d_{1=}$ high, d_2 = high	Increase	Increase	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
when p=high $p_{L=}$ high, c_1= low,c_2 = high $d_{1=}$ high, d_2 = high	Increase	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop
when p=high $p_{L=}$ high, c_1= high,c_2 = low $d_{1=}$ high, d_2 = high	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop	stop
when p=high $p_{L=}$ high, c_1= high,c_2 = high $d_{1=}$ low, d_2 = low	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop	stop
when p = low $p_{L=}$ low, c_1= low,c_2 = low $d_{1=}$ low, d_2 = low	Decrease	Decrease	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
when p = low $p_{L=}$ low, c_1= high, c_2 = low $d_{1=}$ low, d_2 = low	Decrease	Decrease	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop
when p = low $p_{L=}$ low, c_1= low, c_2 = high $d_{1=}$ low, d_2 = low	Increase at high level	stop	stop	stop	stop	stop	stop	stop	stop	stop
when p = low $p_{L=}$ low, c_1= low, c_2 = low $d_{1=}$ high, d_2 = high	Increase at low level	stop	stop	stop	stop	stop	stop	stop	stop	stop

Table 2: Call Transition over SIM S_2

Attempt	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
when p = high p_L= high, c_1= high,c_2 = high d_1 = high, d_2 = high	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop
when p=high p_L= high, c_1= low,c_2 = high d_1 = high, d_2 = high	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop	stop	stop
when p=high p_L= high, c_1= high,c_2 = low d_1 = high, d_2 = high	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop
when p=high p_L= high, c_1= high,c_2 = high d_1 = low, d_2 = low	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop	stop
when p = low p_L = low, c_1= low,c_2 = low d_1 = low, d_2 = low	Increase	Increase	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
when p = low p_L = low, c_1= high, c_2 = low d_1 = low, d_2 = low	Increase	Increase	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop
when p = low p_L = low, c_1= low, c_2 = high d_1 = low, d_2 = low	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop
when p = low p_L = low, c_1= low, c_2 = low d_1 = high, d_2 = high	Increase at low level	Increase at low level	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop

Table 3: Comparison of Call Transition over SIM S_1 and SIM S_2

Attempt		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
when p = high p_L = high, c_1 = high,c_2 = high d_1 = high, d_2 = high	S1	Increase	Increase	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
	S2	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop
when p=high p_L= high, c_1 = low,c_2 = high d_1 = high, d_2 = high	S1	Increase	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop
	S2	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop	Fluctuate	Fluctuate
when p=high p_L= high, c_1 = high,c_2 = low d_1 = high, d_2 = high	S1	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop	stop
	S2	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop
when p=high p_L= high, c_1 = high,c_2 = high d_1 = low, d_2 = low	S1	Increase	Increase	Decrease	Decrease	stop	stop	stop	stop	stop	stop
	S2	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop	stop	stop
when p = low p_L = low, c_1 = low,c_2 = low d_1 = low, d_2 = low	S1	Decrease	Decrease	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
	S2	Increase	Increase	Decrease	Decrease	Decrease	stop	stop	stop	stop	stop
when p = low p_L = low, c_1 = high, c_2 = low d_1 = low, d_2 = low	S1	Decrease	Decrease	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop
	S2	Increase	Increase	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop
when p = low p_L = low, c_1 = low, c_2 = high d_1 = low, d_2 = low	S1	Increase at high level	stop	stop	stop	stop	stop	stop	stop	stop	stop
	S2	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop
when p = low p_L = low, c_1 = low, c_2 = low d_1 = high, d_2 = high	S1	Increase at low level	stop	stop	stop	stop	stop	stop	stop	stop	stop
	S2	Increase at low level	Increase at low level	Fluctuate	Fluctuate	Fluctuate	Fluctuate	stop	stop	stop	stop

4. Conclusion

Fig 1- 4, reveals that when p (high), p_L (high), c_1 (high), c_2 (high) and d_1 (high), the user try to connect S_1 till attempt 5 and call transitions are decreases after attempt 2 from high level. When p (high), p_L (high), c_1 (low), c_2 (high), d_1 (high) the user try to connect SIM S_1 till attempt 5 and call transitions are decreases after attempt 2 from higher level. When p (high), p_L (high), c_1 (high), c_2 (low), d_1 (high) the user try to connect SIM S_1 till attempt 3 and call transitions are decreases after attempt 2 from high level. When p (high), p_L (high), c_1 (high), c_2 (high), d_1 (low), the user try to connect SIM S_1 till attempt 3 and transitions value are decreases.

Similarly, Fig 1- 4, reveals that When p (high), p_L (high), c_1 (high), c_2 (high), d_1 (high), the user try to connect SIM S_2 till attempt 5 and call transitions are fluctuate till attempt 5 then stop. When p (high), p_L (high), c_1 (low), c_2 (high), d_1 (high) the user try to connect SIM S_2 till attempt 2 and call transitions are fluctuate till attempt 2 then stop. When p (high), p_L (high), c_1 (high), c_2 (low), d_1 (high) the user try to connect SIM S_2 till attempt 5 and call transitions are fluctuate till attempt 5 then stop. When p (high), p_L (high), c_1 (high), c_2 (high), d_1 (low), the user try to connect SIM S_2 till attempt 5 and call transitions are fluctuate till attempt 5 then stop.

Fig 5- 8, reveals that when p (low), pL (low), c1 (low), c2 (low), d1 (low) the user try to connect SIM S1 till attempt 5 and call transitions are decreases. When p (low), pL (low), c1 (high), c2 (low), d1 (low) the user try to connect SIM S1 till attempt 6 and call transitions are fluctuate. When p (low), pL (low), c1 (low), c2 (high), d1 (low) and when p (low), pL (low), c1 (low), c2 (low), d1 (high) the user try to connect SIM S1 till attempt 1 and stop or leave the connectivity process.

Similarly, Fig 5- 8, reveals that, when p (low), pL (low), c1 (low), c2 (low), d2 (low) the user try to connect SIM S2 till attempt 5 and call transitions are decreases after attempt 2 from high level. When p (low), pL (low), c1 (high), c2 (low), d2 (low) and when p (low), pL (low), c1 (low), c2 (high), d2 (low) the user try to connect SIM S2 till attempt 8 and call transitions are fluctuate after attempt 2 from high level. When p (low), pL (low), c1 (low), c2 (low), d2 (high) the user try to connect SIM S2 till attempt 6 and call transitions are fluctuate after attempt 2 from higher level.

Overall, when p (high), pL (high), c1 (high), c2 (high) and d1 (high), and when p (low), pL (low), c1 (low), c2 (low), d2 (low) the call transitions over SIM S1 and SIM S2 are equal at attempt 1 to 10.When p (high), pL (high), c1 (high), c2 (high) and d2 (high), and when p (low), pL (low), c1 (low), c2 (low), d1 (low) the call transitions over SIM S1 and SIM S2 are equal at attempt 1 to 10.

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