EFFECT OF USER DELAY ON CELLULAR MOBILE COMMUNICATION SYSTEMS

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ABSTRACT

Key data for transmission with mobile communications are voice, FTP And World Wide Web. Different regimes for quality of service (QoS) exist for every with relevancy delay sensitivity. Sharing the provided radio resources essentially supports the characteristics of information classification and associated QoS. Voice End-User Interrupt Protocol (DOVE) was introduced to accommodate each QoS. To support large numbers of voice users, the best-case scenario is that all existing channels are mutual between voice users. In this study, effect of user delay on no-channel availability is shown. A novel scheme of decreasing the probability of no channel availability is presented in this study. It has also been found from the study that the possibility of no channel availability of end-users is reduced drastically (exponentially) compared to the case when shifting the delay in other positions. In this paper, we introduce the steady-state equation of the DOVE (Delay of Voice End User) protocol and solve it. DOVE can significantly reduce the chance of a channel being unavailable by the undetectable time delay of the last voice user. This result is utilized in increasing the enactment of cellular mobile communication.

KEYWORDS - *QoS, DOVE, WWW, FTP, TDMA, No Channel Availability (NCA), GPRS.*

I. INTRODUCTION

A mobile cellular communication system is that the most speedily dynamical technology within the field of telecommunications. The coverage area of the mobile cellular network has been expanded from urban microcell to indoor Pico cell. As the mobile cellular network move towards 5G technology, to fulfill the ever-increasing demand of offered traffic of users in a network, various strategies are taken to support overflow traffic. The main kinds of multimedia data using mobile communication are voice, www, and FTP. To facilitate the largest number of voice users channel availability is badly needed in this regard. One scheme is based only on the delay of the last received acceptable speech unrecognizable time. It is shown in this study that by applying DOVE to the system the probability of no channel availability decreases i.e. channel availability increases which are used in increasing mobile cellular networks performance.

Cellular mobile communication systems have enjoyed dramatic growth over the past twenty-five years everywhere on the planet. Because the range of cellular subscribers will increase, it's an excellent challenge to handle with the restricted resources. The prime indicates things within which a user cannot start a decision as a matter of fact no network resources are obtainable. A free channel must be available in a new call so that undisrupted service is sustained. If an originated call is unsuccessful due to blocking or dropping, it is essential to provide a free channel to the new originated call. To decrease the blocking, an increment of channel availability is needed. Different tricks are existed to support overflow users. In the best case DOVE (Delay of Voice End User) concept to increase the channel availability. The main motivation of this thesis work is that it ensures channel availability by adopting some delay to the last user of the new originating call. It undeniably was solely in late 1983 that the prime business cellular phone system within the U. S. was deployed by Ameritech within the Chicago space. That was the analog facility known as Advanced Mobile Phone Service (AMPS). Today, digital wireless telephone services are on the market throughout the globe and have well surpassed fixed-line telephone services each in terms of accessibility and range of users. In fact, as of March 2010, we've over 4.8 billion mobile subscribers within the world, which is over double the quantity of mounted line subscribers and amounts to a better than hour penetration. The relative adoption of wireless versus fastened lines is even additional dramatic within the developing world. As an example, in India, wireless penetration is over fourfold that of mounted lines. It took but twenty years for mobile subscribers worldwide to grow from zero to over one billion users. This wonderful growth demonstrates not solely the robust need of individuals around the world to attach and have access to info whereas on the move, however additionally the tremendous strides that technology has created in fulfilling and more provision this would like. The developments in RF circuit fabrication advanced digital signal processors and several other shrinking technologies that created it doable to deploy and deliver wireless communication services at the dimension sand scope that we tend to see these days area unit so quite exceptional. Today, we tend to area units at the edge of another major revolution in wireless. While mobile voice telephone drove the past growth of wireless systems and remains the first application, it's profusely clear that wireless information applications can drive its upcoming growth. Within the past twenty years, the web remodeled from being a curious tutorial tool to an essential international info network providing a massive array of services and applications-from social networking to e-mail and e-commerce.

The effect of DOVE on cellular communications in one cell in a GSM/GPRS mobile network, the outcomes from a numerical Matlab coding were matched with results from simulations using OPNET is shown in my target paper. But it requires much calculation time. To establish a worthy agreement with the result of the target paper another paper introduced the DOVE protocol Steady-state equations of Markov chains and solving them. They also presented a beginner's method for estimating the performance of the DOVE protocol. Their anticipated technique can be conceded out in a lesser amount of computer time. Conversely, when estimating the performing of the DOVE protocol, there was one delinquent. They did not consider the other position's delay effect.

In this study, the consequence of user delay on no channel availability is shown. It has also been established from the study that the probability of end-user is reduced drastically (exponentially) compared to the case when shifting the delay in other positions. In this paper, simple and practical equations have been obtainable for computing no channel availability. This effect will be recycled in increasing the presentation of cellular mobile communication.

II. RELATED WORK

There was gradual growth concerning wireless web and also the chance which innumerable users can shortly access e-mail and websites on a wise mobile, PDA, or pager. Case in point, Cahners Instate market research firm forecast that from the year 2000 to the year 2001, worldwide sales will grow from 51 million to 327 million for internet-enabled phones; from 757,000 to 1.3 million for mobile computing machines such as PDAs; and from 950,000 to 2.9 million for two-way pagers [1]. Many types of research have been done on dove [18-19]. According to the report of cellular companies, the current situation is that this figure grows by an average of 150,000 new subscribers every day. As cellular mobile communication system is the most rapidly changing technology in the field of telecommunication. So, performance evaluation is badly needed in this regard. A lot of approaches is going on for performance evaluation. In this study, a simple and practical equation has been offered for computing the no-channel availability. This effect will be used in increasing the enactment of cellular mobile communication.

To the spread of the wireless web and a mixed service with data and voice in cellular mobile communication systems, the micro-browser technology for mobile computing machines and the quality of service (QoS) for wireless communication systems are very significant [3-4]. Developers of the micro-browser technology will face the challenge of improving micro-browser technology while maintaining the small footprint necessary to work with known resource hand-held devices. On the other side of, major types of data for multimedia with mobile communications are voice, WWW, and FTP. Dissimilar regimes for QoS be real for each with mention to delay sensitivity. Distribution available radio supply has been integrally based on the appearances of data types and their related QoS. Consider a mixed service environment with data and voice. These several services can be further categorized in the form of circuit switching, burst or packet switching, and hybrid switching that supports both circuit and packet switching for bandwidth persistence [2]. Hybrid switching has have been considered and in most cases, a partition for data has been proposed [5] [6]. To support the extreme number of voice users, the best situation would be that all available channels are shared between voice users. On the other side of, in cases wherever voice users reside in all available channels, any data obtainable to the system is protected and the mean delay for data becomes high.

Now [7], one common theme relies on delaying the last incoming tolerable voice incorporate a random quantity of your time and exploiting this point to service the accumulated information traffic to stop undue queuing delay in delivering the information traffic is given. However, the delay time has been sometimes shapely as being exponentially distributed. During this paper, the delay is shapely as a uniformly distributed chance variable instead. This theme is extended by delaying over one decision. Performance measures like voice and information block likelihood are planned as operate of last decision delay. Now [8], a simple theme to improve the performance of a mobile cellular network is set by including the delay of a voice user to a new start call through a soccer game called in a real two-dimensional traffic model. In [9], to show the effect of the dove on cellular communications, the authors applied DOVE in one cell of a GSM/GPRS mobile network, consequently, they used N=6 and N=14 as model parameters [10]. The results from a numerical Matlab coding were compared with results from simulations using OPNET. But it requires much calculation time. In [11], the authors used N=6 and N=14 to determine a good agreement with the result. They introduced the steady-state calculations for the Markov method of DOVE protocol and determined them. They gave a simplified technique for evaluating the enactment of the DOVE protocol. Their planned technique is administrated during a less pc time. However, when evaluating the depiction of the DOVE protocol, there was one problem. They did not consider the other position's delay effect. This lesson is showing the impact of user latency when the channel is not available. It also shows in investigations that the probability of end-users can be significantly reduced compared to moving the lag from another location.

III. METHODOLOGY

DOVE means "Delay of the voice end user". It is a protocol that delays the last voice user for an invisible time to the user and decreases the no-channel available probability. The purpose of this task is to determine and analyze the effect of delay placed in different positions of states in the N server loss system. To accomplish the research target four cases are considered, which are shown in Table 1.

Table 1: Summary of Cases

Cases	Description
Case-1	Analysis of delay in between N-4 and N-3
Case-2	Analysis of delay in between N-3 and N-2
Case-3	Analysis of delay in between N-2 and N-1
Case-4	Analysis of delay in between N-1 and N

The current system uses TDM where Time divisions multiplexing (TDM) delivers a user the occupied channel capacity but distributes the channel usage into time slots (see Figure 10). A typical model of the TDMA system of cellular mobile communications systems is shown in Figure 1.

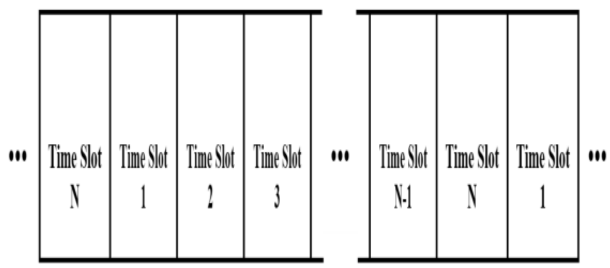

Fig.1. Time Division Multiplexing

The user's traffic is separated into fixed length TDMA slots and then multiplexed into a TDMA frame. The frame is then directed across the channel by radio frequency (RF) carrier modulation. Let each TDMA frame entails of N time slots and this denotes that the TDMA switch can handle N frames at any one time. Voice calls reach according to Poisson method with arrival rate λ_1 [12]. If the switch is already serving N voice calls when a new call arrives, then fresh voice call is lost. If a call is accepted, it lasts for an exponentially random time on average of μ1-1 and then ends. All call duration are independent of each other. Let V (t) be the amount of calls that are being handled by the switch at time t.

The space of state {V (t), t ≥ 0} is {0, 1, 2....., N} and point out the number of voice users that occupy the channels at the same time t. The rate diagram is as displayed in Figure 2. The space of state {V (t), t ≥ 0} is called M/M/N/N, N-server loss system [13]. The limit in sharing of an M/M/N/N model as given in equation 1:

$$P_x = \frac{A^x}{x!} P_0; \quad 0 \le x \le N \qquad \ldots\ldots (1)$$

Where A= $\lambda_1/\mu_1 = \lambda_1 \times 1/\mu_1 = \lambda_1 \times \mu_1$-1 = arrival rate × average call duration, Is the utilization of the server and probability that all servers are idle, the equation of the idle server is given in equation 2.

$$P_0 = \sum_{x=0}^{N} \frac{A^x}{x!} \qquad \ldots.. (2)$$

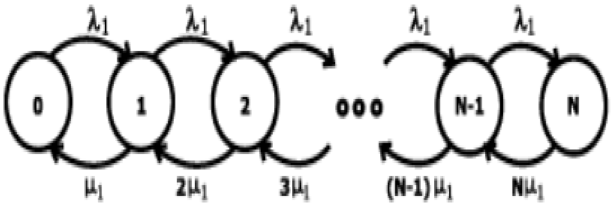

Fig.2. A Rate diagram of N server loss system

The quantity of P_N is important called the possibility of No channel availability. It is the fraction of time that system is full or the section of the time that customers are misplaced in the long run [14,15]

3.1 Delay of Voice End User (DOVE) for Voice Users

Recall the P_N is no channel available possibility and is the portion of the time that system is full. It is implied that the system is saturated with voice users and the mean duration is given in equation 3.

$$mN = (N\mu 1)^{-1} \qquad \ldots.. (3)$$

In general, mN is in the order of many seconds and consequently busty length of queue occurs. Currently, for a system in state N - 1, the next user is given the last available channel [16, 17]. A new protocol called DOVE has been proposed. When the Nth user presents, this call is delayed for an arbitrary time. We redefined that the state-space of {V(t), t ⩾ 0} is {0,1,2,..., N-1, D, N } and represent the number of voice users that reside in the channels at the same time t. Fig. 3 shows the queuing model of DOVE.

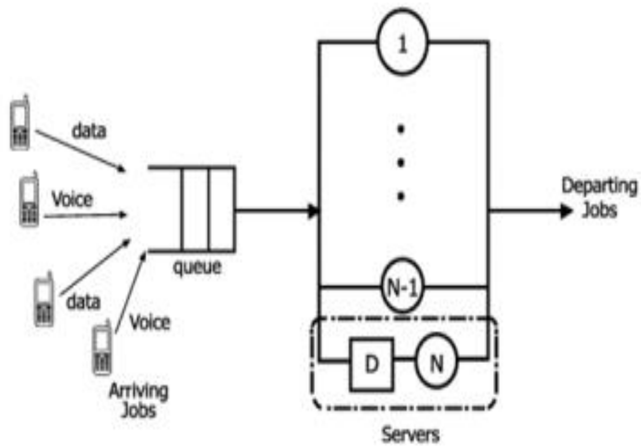

Fig.3. A Model of Exchange with DOVE

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Implementation of delay of voice end-user (DOVE) is direct for mobile networks and would be prompted by a last user triumph condition. Let d (t) be the duration of time that the new call experiences delay before being allowed a channel. In this condition, we can either have that d (t) expires. In which case the delayed voice user is permitted to occupy the channel, or a channel becomes available before the expiration of the d (t), and the voice user is given permission to this other channel. By delaying the Nth user, the duration for which all of the channels are occupied is reduced and the system stays in the state N-1 for a greater proportion of the time.

A recommended Markov chain for the new Protocol is displayed in fig. 13. In fig. 13, $\delta - 1 = d$ and we assume that d (t) is characterized by a negative exponential distribution function with a mean equal to d. Let Px be the probability that the structure is in steady state x, PD be the probability that the structure is in the state D where a voice user is in delay and PN be the probability of no channel available. Here, A= $\lambda_1/\mu_1 = \lambda_1 \times 1/\mu_1 = \lambda_1 \times \mu_1$-1 = arrival rate × average call duration is the utilization of the system, denote the probability of somebody in the system. P0 denote the probability that the system is empty, i.e. no call exists in the system means the possibility of nobody in the system.

Case 1: Analysis of delay in between N-4 and N-3 for the system with N servers

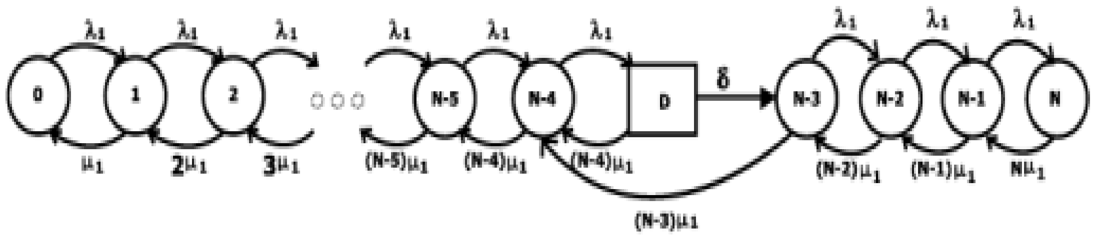

Fig.4. A Transition diagram of case 1 (Delay3)

Having derived, the steady-state calculations for the Markov chain displayed in fig. 4 are presented in fig. 5 (Delay3). Figure 4 shows the transition diagram of case 1 (Delay3)

$$P_x = \frac{A^x}{X!} P_0 \text{; Where } x = 1,2,3,\ldots\ldots,N-4;$$

$$P_D = \frac{A^{N-4}}{(N-4)!} \cdot \frac{\lambda_1}{(\delta+(N-4)\mu_1)} P_0;$$

$$P_{N-3} = \frac{A^{N-3}}{(N-3)!} \cdot \frac{\delta}{(\delta+(N-4)\mu_1)} P_0;$$

$$P_{N-2} = \frac{A^{N-2}}{(N-2)!} \cdot \frac{\delta}{(\delta+(N-4)\mu_1)} P_0;$$

$$P_{N-1} = \frac{A^{N-1}}{(N-1)!} \cdot \frac{\delta}{(\delta+(N-4)\mu_1)} P_0;$$

$$P_N = \frac{A^N}{N!} \cdot \frac{\delta}{(\delta+(N-4)\mu_1)} P_0;$$

Where,

$$P_0 = \left\{ \sum_{X=0}^{N-4} \frac{A^x}{X!} + \frac{A^{N-3}}{(N-3)!} \cdot \frac{N(N-1)(N-2)((N-3)\mu_1 + \delta) + A\delta(N(N-1)+AN+A^2)}{N(N-1)(N-2)(\delta+(N-4)\mu_1)} \right\}^{-1}$$

Fig.5 A steady-state equations for case 1

Px is the probability that the system is in steady-state x, PD is the probability that the system is in the state D, where D is a voice user in delay and PN be the probability of no channel available.

Case 2: Analysis of delay in between N-3 and N-2 for the system with N servers (Delay2). Fig. 6 presents the transition diagram of case 2 (Delay2).

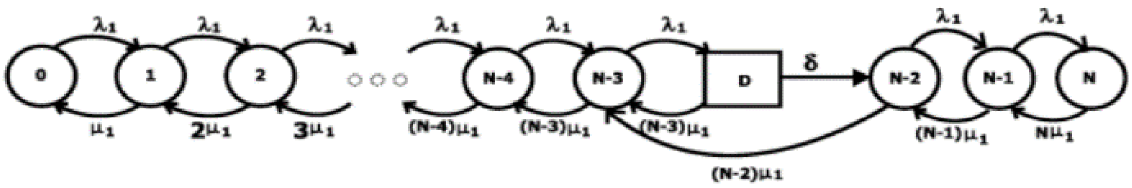

Fig.6. A Transition diagram of case 2 (Delay2)

Having derived, the steady-state calculations for the Markov Chain shown in fig. 6 is obtained in fig. 7.

$$P_x = \frac{A^x}{X!} P_0 \text{ ; Where } x = 1,2,3,\ldots\ldots,N-3;$$

$$P_D = \frac{A^{N-3}}{(N-3)!} \cdot \frac{\lambda_1}{(\delta+(N-3)\mu_1)} P_0 ;$$

$$P_{N-2} = \frac{A^{N-2}}{(N-2)!} \cdot \frac{\delta}{(\delta+(N-3)\mu_1)} P_0 ;$$

$$P_{N-1} = \frac{A^{N-1}}{(N-1)!} \cdot \frac{\delta}{(\delta+(N-3)\mu_1)} P_0 ;$$

$$P_N = \frac{A^N}{N!} \cdot \frac{\delta}{(\delta+(N-3)\mu_1)} P_0 ;$$

Where,

$$P_0 = \left\{ \sum_{X=0}^{N-3} \frac{A^x}{X!} + \frac{A^{N-2}}{(N-2)!} \cdot \frac{N(N-1)((N-2)\mu_1 + \delta) + A\delta(N+A)}{N(N-1)(\delta+(N-3)\mu_1)} \right\}^{-1}$$

Fig.7 A steady-state equations for case 2

Case 3: Analysis of delay in between N-2 and N-1 for the system with N servers (Delay1). Fig. 8 describes the transition diagram of case 3 (Delay1).

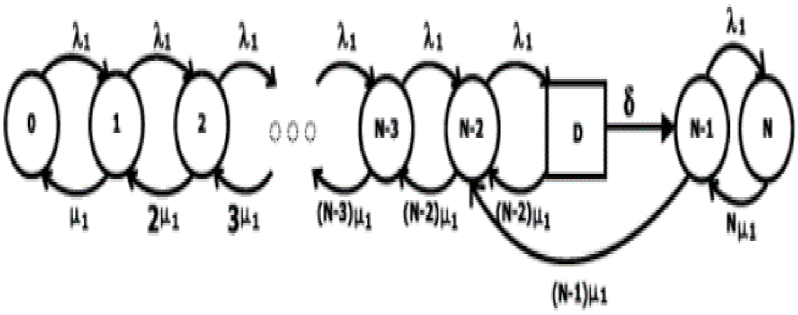

Fig.8 Transition diagram of case 3 (Delay1)

The steady-state calculations for the Markov chain of fig. 8 are followed in fig. 9.

$$P_x = \frac{A^x}{X!} P_0 \text{; Where } x = 1,2,3,\ldots\ldots,N-2;$$

$$P_D = \frac{A^{N-2}}{(N-2)!} \cdot \frac{\lambda_1}{(\delta+(N-2)\mu_1)} P_0;$$

$$P_{N-1} = \frac{A^{N-1}}{(N-1)!} \cdot \frac{\delta}{(\delta+(N-2)\mu_1)} P_0;$$

$$P_N = \frac{A^N}{N!} \cdot \frac{\delta}{(\delta+(N-2)\mu_1)} P_0;$$

Where,

$$P_0 = \left\{ \sum_{X=0}^{N-2} \frac{A^x}{X!} + \frac{A^{N-1}}{(N-1)!} \cdot \frac{N\left((N-1)\mu_1+\delta\right)+A\delta}{N(\delta+(N-2)\mu_1)} \right\}^{-1}$$

Fig.9 A steady-state equations for case 3

Case 4: Analysis of delay in between N-1 and N for the system with N servers (DOVE). Fig. 20 presents the transition diagram of case 4 (DOVE).

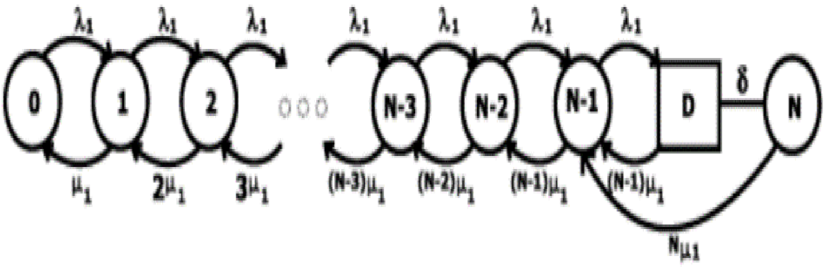

Fig.10 A Transition diagram of delay case 4 (DOVE)

The steady-state calculations for the Markov Chain of fig. 10 is illustrated in fig. 11. The flow diagram to solve the cases is displayed in figure 12

$$P_x = \frac{A^x}{X!} P_0 \text{; Where } x = 1,2,3,\ldots\ldots,N-1;$$

$$P_D = \frac{A^{N-1}}{(N-1)!} \cdot \frac{\lambda_1}{(\delta+(N-1)\mu_1)} P_0;$$

$$P_N = \frac{A^N}{N!} \cdot \frac{\delta}{(\delta+(N-1)\mu_1)} P_0;$$

Where,

$$P_0 = \left\{ \sum_{X=0}^{N-1} \frac{A^x}{X!} + \frac{A^N(N\mu_1+\delta)}{N!(\delta+(N-1)\mu_1)} \right\}^{-1}$$

Fig.11 A steady-state equations for case 4

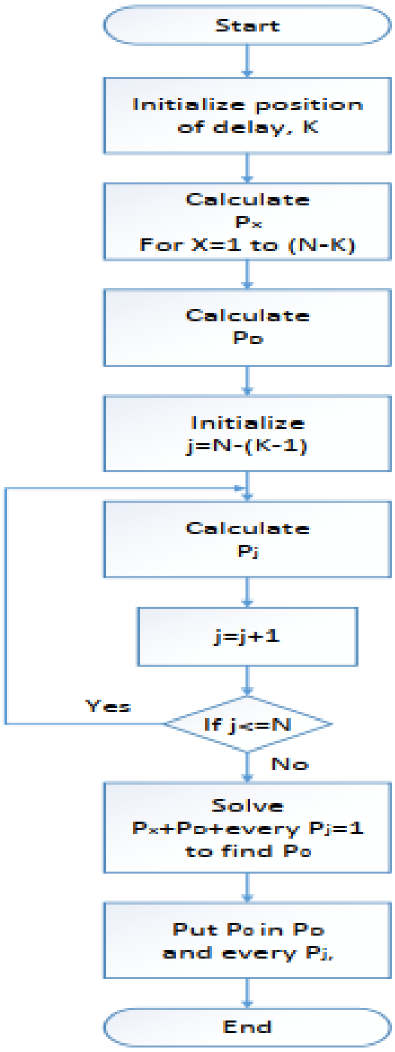

Fig.12 Flow Chart of Algorithm to solve the cases

IV. RESULTS

Matlab Modeler R2017a is used for doing the simulation. Matlab Models the system behavior by each event in the system effectively. It offers more structures than any other simulator in exercise. It has a dynamic development environment with a rich feature that supports both distributed systems and the modeling of communication networks. It has large and user-friendly documentation to guide users. Matlab results are flexibly interpretable and have comprehensive tools to support display, plot, and analysis time series, histograms, probability, parametric curves, and confidence intervals. No channel availability (NCA) concerning delay for the four cases is presented in fig. 13.We used, N=6, μ_1-1=120s, λ_1= 63.17, A= $\lambda_1/\mu_1 = \lambda_1 \times 1/\ \mu_1 = \lambda_1 \times\ \mu_1$-1 = arrival rate × average call duration = 7.5804e+03, P0 =3.7008e-21 It is shown that when d is increased the probability of no channel available of delay1, delay2 and delay3 for data has little effect which is negligible for last values of N. On the other side of, if delay is applied only for the last user (DOVE), it is shown that when d is increased the probability of no channel available for data has an important decrement particularly for large values of N. It has been found from the study that the probability of no channel availability of end-user is drastically reduced (exponentially) compared to the other cases. The combined result of four cases for N=6 is depicted in fig. 14 and the effect of delay on no channel available probability for N=6 is shown in Table 2.

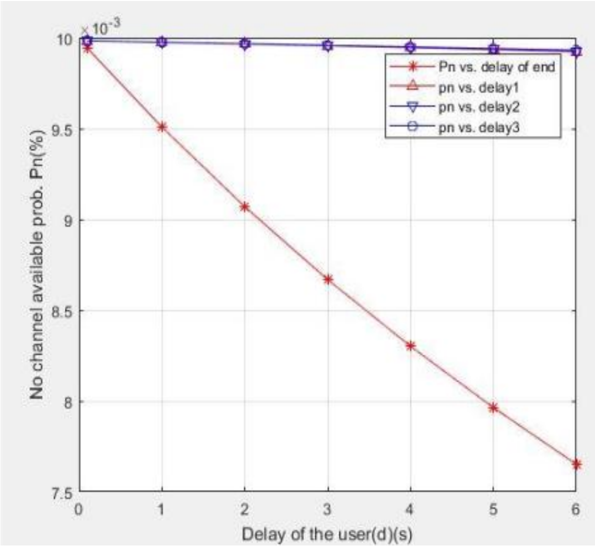

Fig.13 No channel available probability for delay

Table 2: NCA distribution for N=6

Delay of the user(d)(s)	NCA probability for the Delay3	NCA probability for the Delay2	NCA probability for the Delay1	NCA probability for the DOVE
1	0.0100	0.0100	0.0100	0.0095
2	0.0100	0.0100	0.0100	0.0091
3	0.0100	0.0100	0.0100	0.0087
4	0.0100	0.0099	0.0099	0.0083
5	0.0099	0.0099	0.0099	0.0080
6	0.0099	0.0099	0.0099	0.0077

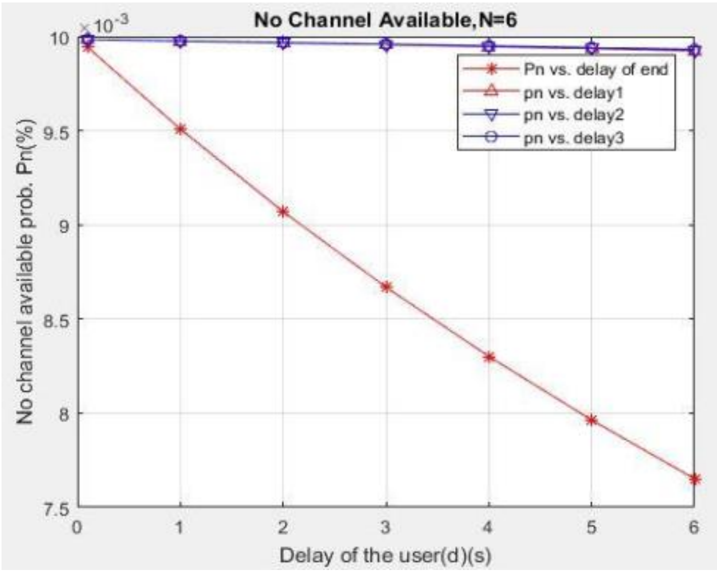

Fig.14 No channel available probability for N=6

The combined result of four cases for N=14 is presented in fig. 15 and the effect of delay on no channel available probability for N=14 is shown in Table 3.

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Table 3: NCA distribution for N=14

Delay of the user(d)(s)	NCA probability for the Delay3	NCA probability for the Delay2	NCA probability for the Delay1	NCA probability for the DOVE
1	0.0098	0.0098	0.0098	0.0088
2	0.0097	0.0097	0.0097	0.0079
3	0.0096	0.0096	0.0096	0.0072
4	0.0095	0.0095	0.0094	0.0066
5	0.0094	0.0093	0.0093	0.0061
6	0.0092	0.0092	0.0092	0.0056

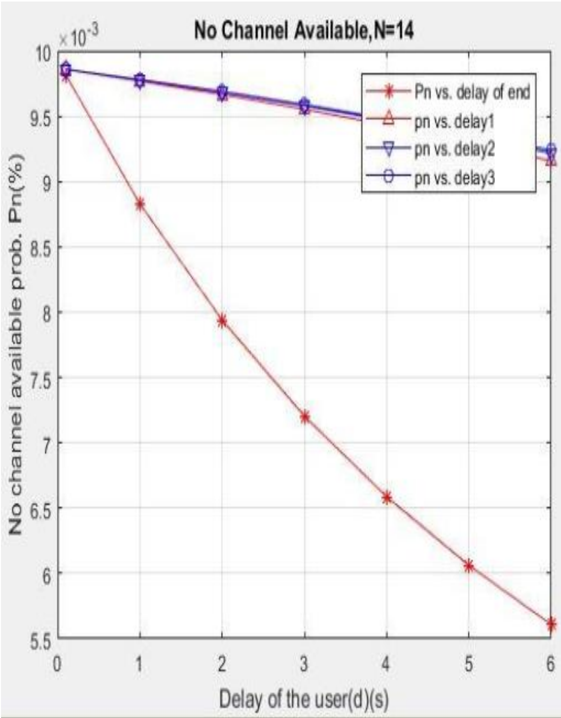

Fig.15 No channel available probability for N=14

In figure 14, we used N=6, μ_1-1=120s, λ_1= 63.17, A= $\lambda_1/\mu_1 = \lambda_1 \times 1/\mu_1 = \lambda_1 \times \mu_1$-1 = arrival rate × average call duration = 7.5804e+03, P0 =3.7008e-21 and in figure 15, we used N=14, μ_1-1=120s, λ_1= 16.39, A= λ_1/μ_1 =1.9668e+03, P0 =6.2252e-36 to demonstrate a worthy promise with the related work. It is shown that when d is increased the probability of no channel available for data has a significant decrement especially for large values of N. It has been establish from the study that the probability of no channel availability of end-user is drastically reduced (exponentially) compared to the other cases. DOVE delays the last voice user for an imperceptible time and when the delay has increased the probability of no channel availability is drastically reduced compared to other delays. It's shown that once the delay is accumulated the chance of no channel availability for information contains an important decrement for big values of N.

V. CONCLUSION

A scheme of reducing the probability of no channel availability is presented in this study. Matlab modeler R2017a is used for doing the simulation. The DOVE protocol for TDMA hybrid switched integrated voice/data on cellular mobile networks is conferred. Every frame may be shared between users for all services, with a voice as circuit-switched traffic with priority and preemption. DOVE delays the last voice user for an imperceptible time and decreases the probability of no channel availability. It has also been found from the study that when the delay is increased the possibility of no channel availability of end-user is reduced drastically (exponentially) compared to the case when shifting the delay in other positions. . In this paper, presenting the steady-state equalities of Delay of Voice End-User (DOVE) protocol and resolving them. This effect will be used in increasing the enactment of cellular mobile communications. It is stressed that the concept of DOVE discussed in this study can be simply implemented in mobile cellular networks to improve channel availability. System. The reason we chose TDMA for all standards is because advanced cellular environments use some important features for the system environment. Each user has a predefined time slot. For future research topics, we need to analyze, when moving from one cell to another, if all the time slots in this cell are full, the user might be disconnected.

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