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Optimized Queue Length Schema Implementation for 3g/4g Mobile Data Network

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Abstract*: During Jan 2016 India Mobile subscribers count crossed one billion and the estimated subscribers during 2017-2022 will be more than 299.9 million. Mobile devices with 3G/4G feature phones are now incorporated with prime specifications and optimized software to handle increased usage of mobile subscribers. The queue length problem arises due to the huge demand of web accessing and file transfers from several resources through several independent devices at the same time. This paper focuses on optimization of queue length for maximize the utilization of data communication on mobile data networks.
Keywords: Queue length, Mobile data, Congestion, Optimization, Waiting time.

I. INTRODUCTION

The most common network protocol used on the internet is the Transmission Control Protocol, or TCP. TCP uses a "congestion window" to determine how many packets it can send at one time [1]. The larger the congestion window size, the higher the throughput. The TCP "slow start" and "congestion avoidance" algorithms determine the size of the congestion window [2]. The For each socket there is a default value for the buffer size, which programs can change by using a system library call just before opening the socket. For some operating systems there is also a kernel-enforced maximum buffer size [3]. You can adjust the buffer size for both the sending and receiving ends of the socket. To achieve maximum throughput, it is critical to use optimal TCP socket buffer sizes for the link you are using. If the buffers are too small, the TCP congestion window will never open up fully, so the sender will be throttled. If the buffers are too large, the sender can overrun the receiver, which will cause the receiver to drop packets and the TCP congestion window to shut down [4]. This is more likely to happen if the sending host is faster than the receiving host. An overly large window on the sending side is not a big problem as long as you have excess memory [5].

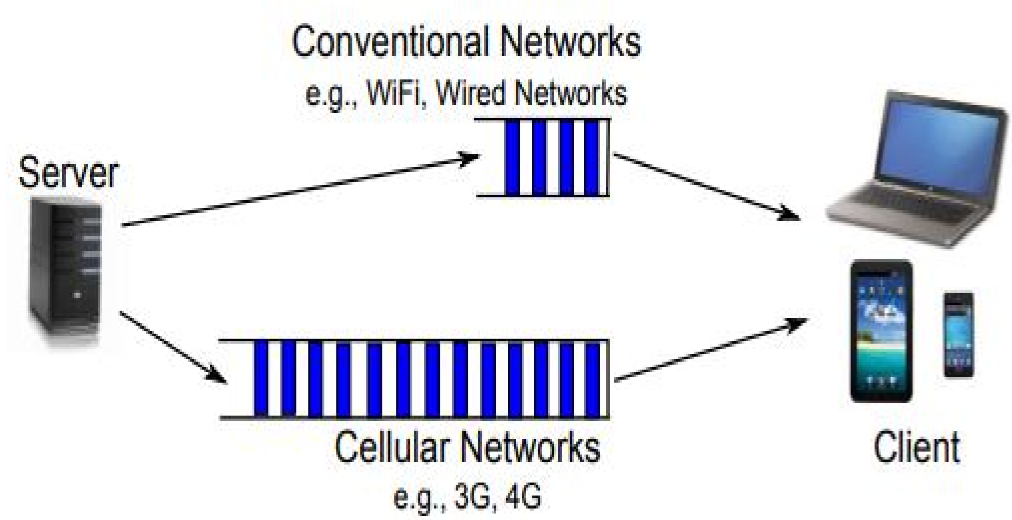

Fig.1:3G/4G-Mobile network data transmission

II. PROPOSED METHODOLOGY

Our proposed methodology focuses on the identification of optimal implementation of TCP buffer setting for different mobile platforms in order to achieve the optimized buffer size for data transmission.

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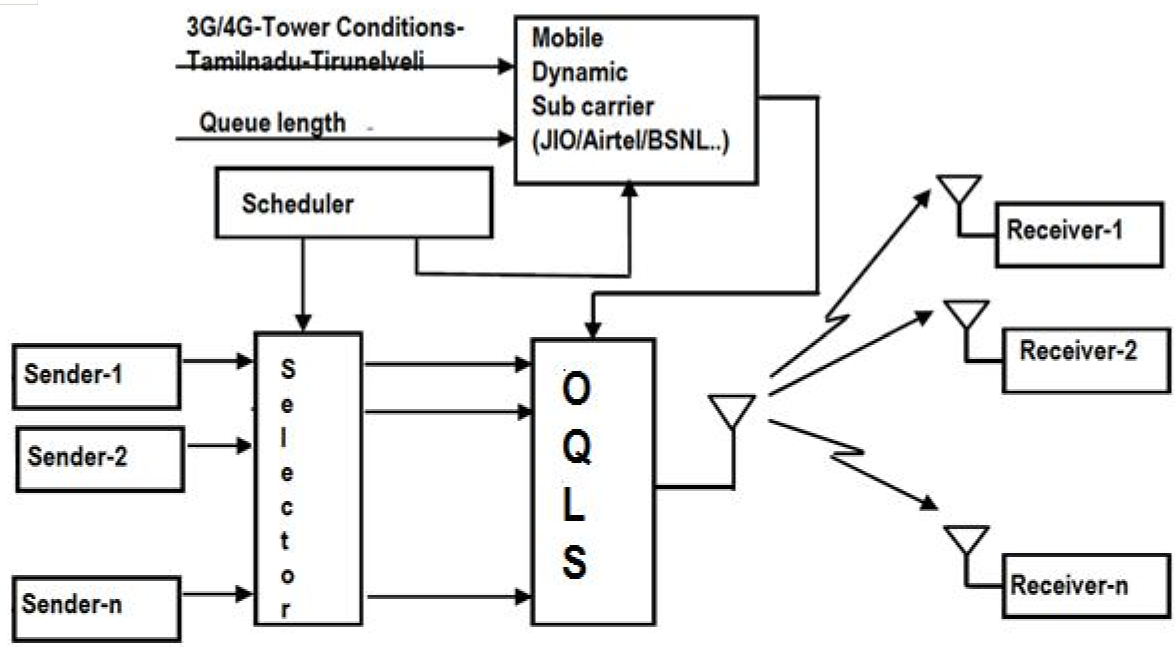

Fig.2: Proposed Optimal Queue Length System schema diagram

The queue length in a Mobile 3G/4G network depends on the delay of packet transmission from the sender to the receiver side. The delay violation in the heavy-traffic scenario can be minimized by shortening the average waiting time. Without loss of generality, most delay violations occur during heavy traffic load, thus we consider it reasonable to formulate optimization problems by exploiting the mean of delays. Denote the sender average arrival bit rate of user *i* as s_i, which is defined to be:

$$s_i=1/L_i \; \mathrm{Lt}_{n \to \infty} \; T_i[n] / n \text{ ----------------------------------(1)}$$

where, $Ti[n]$ represents the total amount of bits arriving during $(0, nLs)$ and Lsis the length of each time slot in Optimized Queue Length System where signaling is time-slotted. We denote$Qi[n]$ as the amount of bits in the queue of user *i* at time *nLs*. Such that

$$Qi= \; \mathrm{Lt} \; \sum_{n=0}^{N-1} Qi[n] / N \text{----------------------------(2)}$$

The scheduler serves user *i* at rate $ri[n]$ during time slot *n*. Let $ai[n]$ denote theamount of arrival bits during time slot *n*, the queue length of user *i* at time $(n+1)LS$,$Qi[n+1]$ can be expressed as,

$Qi[n+1] = Qi[n] - ri[n]Ls + ai[n]$ --------------------(3)

Now defining the objective function

Minimize $Qi[n+1] = Qi[n] - ri[n]Ls + ai[n]$ subject to the constraints,

$Qi[n]>0$,$ri[n]<C$ (Capacity of the scheduler),$L_s>0$ and $ai[n]>0$.

So as to minimize the average waiting of time for sender n+1as *Wn+1 such that,*

$Wn+1 = Qn+1/si$----------------------------------(4)

III. IMPLEMENTATION

The packet variation from the sender to receiver on mobile 3G/4G networks varies on its size as Min, mid and Max with capability of 1024 Bytes, 5120 Bytes and 10240 Bytes in a single transmission unit. The Ls-value and ri value varies with the factor of 100%, 80%, 70%, 50% and X, 2X, 5X and 10X respectively based on JIO/Airtel /BSNL [7] [8] [9] mobile carriers in India Tamilnadu. VOLTE support in JIO contributes more in faster transmission and improved packet handling capability in Tirunelveli District of Tamilnadu, India when compared with Metro city Coimbatore of Tamilnadu, India. The computation implementation strategies are as follows,

Ls Modes- length of each time slot in Optimized Queue Length System, the tabulation is as follows

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Table-I
Computation Table for Ls

Sender Mode	Packet-Size-Mode-Bytes	Ls-Value Msec
Continuous	Min-size	20
	Mid-size	50
	Max-size	100
Frequent	Min-size	16
	Mid-size	40
	Max-size	80
Optimal	Min-size	14
	Mid-size	35
	Max-size	70
Low	Min-size	10
	Mid-size	25
	Max-size	50

The computation of average server service rate schema ri is as follows,

Table-II
Computation Table for ri

Sender Mode	Packet-Size-Mode-Bytes	ri-Value Per Second
Continuous	Min-size	6
	Mid-size	3
	Max-size	2
Frequent	Min-size	12
	Mid-size	6
	Max-size	4
Optimal	Min-size	30
	Mid-size	15
	Max-size	10
Low	Min-size	60
	Mid-size	30
	Max-size	20

IV. RESULTS AND DISCUSSION

Consider the amount of arrival bit as 1000 Bytes/Ms,Qi[n]=1000 and sender arrival rate si=100 without prompting the OQLS schema lead the ri to be the default 5 senders per second and Ls be 10 ms irrespective of the sender type and frequency nature of communication.

Then the queue lengthQi[n+1] can be arrived at the following state without any optimization such as,

$Qi[n+1] = Qi[n] - ri[n]\mathrm{Ls} + ai[n]$

$=1000-5*10+1000$

$=1950$

So that by using (4), the average waiting time

$\mathrm{W}n+1 = Qn+1/si$

$=1950/100$

$=19.5$ Ms

Now applying the Optimized Queue Length System schema, we obtain the following variations

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Table-III
Queue length and average waiting time computation table

Sender Mode	Packet-Size-Mode-Bytes	Ls-Value Msec	ri-Value Per Second	*Qi*[*n*+1]	Wn+1
Continuous(100%,X)	Min-size	20	6	1880	18.8
	Mid-size	50	3	1850	18.5
	Max-size	100	2	1800	18.0
Frequent(20%,2X)	Min-size	16	12	1808	18.08
	Mid-size	40	6	1760	17.6
	Max-size	80	4	1680	16.8
Optimal(30%,5X)	Min-size	14	30	1580	15.8
	Mid-size	35	15	1475	14.75
	Max-size	70	10	1300	13.0
Low(50%,10X)	Min-size	10	60	1400	14.0
	Mid-size	25	30	1250	12.5
	Max-size	50	20	1000	10.0

The final Queue length in terms of average waiting time Wn+1 after applying htoptimization ranges from 10Ms to 18.80 Ms with the improvement of 4.7% to 49.78% based on the transmission packet.

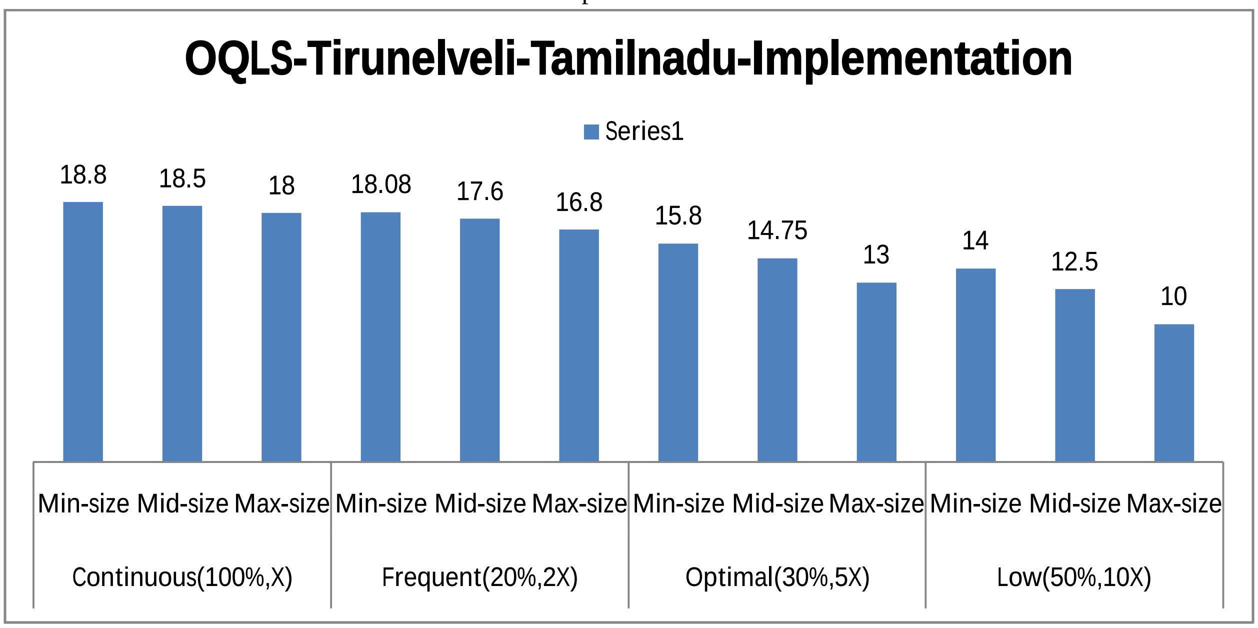

Fig.3: Proposed Optimal Queue Length System Results

V. CONCLUSION

In this paper we focused on the commercial procedural approach incorporated in mobile networks for optimizing the queue length by adjusting the rate of data handling and type of sender from non users to allocating it to the demand users based on the restriction of fair usage policy.

A low frequency and low size data sender can achieve much higher throughput although setting it too large may cause lesser delay and transmissionup gradation. In summary, flat transmission without OQLS has performance issues in both throughput and delay. In small mobile networks, the static setting of ri and Ls may be too large and cause unnecessarily long end-to-end latency. On the other hand, it may be too small in large mobile networks and suffer from significant throughput degradation.

But they trigger excessive packets in flight and result in unnecessarily long Round Trip Time. The proposed Optimization Queue length System offers a 49.78 % gain in network load when compared with 2 out of 3users share the remaining non used packet of remaining user strategy for implementing optimized queue length technique .In future we will focus on tuning the hardware and software components of mobile devices to increase the buffer size based queue length optimization implementation.

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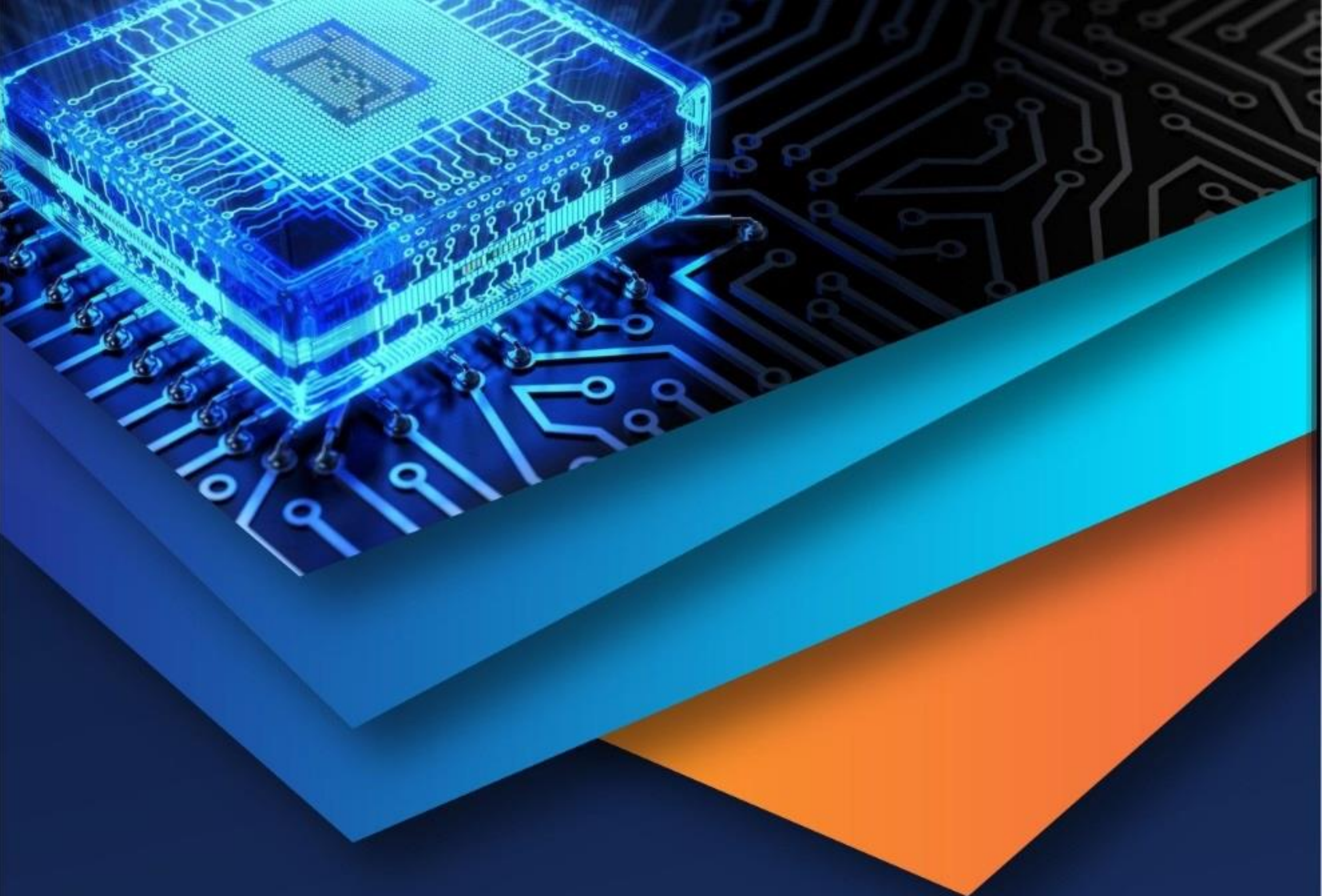

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