Improved Fuzzy Logic Controller for a Global Mobile Telecommunication Network

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Abstract - *The inadequacy in call admission management is observed as one of the known limiting factors affecting the performance of the network, resulting in to increase in call drop rate, congestion, and high traffic intensity. The research work applied the mechanism of the Handoff Queue-based Call Admission Control scheme and Fuzzy Logic artificial intelligence to develop an intelligent Call Admission Control for global mobile telecommunication networks. The developed intelligent CAC model is a two-phase fuzzy logic model. Phase one is the Fuzzy policer while Phase two is the Fuzzy Congestion Controller (FCC). The Fuzzy policer intelligently optimizes the delivery of calls and call drop with its fuzzification, inference engine, defuzzification analysis of queue capacity, call mean bit rate and call mean burst rate. These parameters enable it to estimate when new calls comply or violate the threshold at the Base Station. In the second phase of the developed system, the Fuzzy congestion controller optimizes the system resources by adjusting the handoff queue capacity for variations in the relative mobility of calls in the buffer and available free channels in the base station. The comparison of the system throughput of the proposed system, and existing congestion control systems shows that the proposed system outperformed the existing Call Admission Control models. It minimizes call drop rate probability and provides a significant reduction of cell loss due to congestion and buffer overflow under various network traffic variations.*

***Key Words*: Call admission control, Handoff queue, Fuzzy congestion controller, Network traffic, Call drop rate, Cell loss**

1.INTRODUCTION

The increase in the number of network subscribers in Nigeria had contributed to [1] continual network poor quality of service because of the lack of adequate facilities used by the network providers. Also, "[2] observed that the proliferation of mobile devices such as mobile phones, smartphones, and tablets and advancement in wireless technologies have led to an increase in demand for Internet services such as voice over Internet protocol (VoIP), video streaming, internet surfing, and online gaming, etc. by users, anywhere and anytime". "Due to the high influx of subscribers, the network performance of Wideband Code Division Multiple Access (WCDMA) systems began to deteriorate ranging from poor network coverage, constant block/drop calls (Poor call initialization and Handover), call/network congestion, and poor internet services [1]". "Mobile Networks are faced with limited wireless resources with high mobility of users during communication, resulting in increased handoffs between calls [3]". These factors result in unsatisfactory network utility due to poor admission control and inadequate resource reservation. "To reduce the high call drop rate, delay response and traffic congestion require an efficient call admission approach [3]".

In addition, the management of network resources is a major problem in the cellular communication industry. A series of research reviews had been done on network congestion control, network resource management, an approach to minimize call drop rate and optimized network resources for a better quality of service. "The introduction of call admission control scheme provides a dependable approach to achieve optimal resource management in lieu of limited wireless resource availability. Call admission control algorithms are important for wireless networks not only for providing the expected Quality of Service (QoS) requirements to mobile users, but also to maintain network consistency and prevent congestion [3][4]". However, the issue of uncertainties in network performance and variations that occurs at different intervals has been discussed in recent studies such as [3][1]. The attempt made was promising, further approaches to efficiently address these issues will be unveiled in this paper.

Hence, this paper provides an efficient call admission control mechanisms with Fuzzy logic an artificial intelligence method and handoff queue model to address the challenges of network congestion and resource management. The expected outcome provides an improved algorithm to maximize user capacity, reduce traffic congestion and maintain good quality of service.

2. LITERATURE REVIEW

[3] presented "efficient call admission control algorithm for mobility management in LTE networks". "The work developed an intelligent technique to manage and regulate the incoming calls and handoff calls in the Long-Term Evolution (LTE) networks using Fuzzy Logic based call

admission control. The results of the system were used to compare with fuzzy and non-fuzzy techniques, using parameters such as drop calls, average length queue and size of the queue to evaluate the drop call probability. The outcome shows a significant improvement in the network performance resulting in low call drop probability [3]". [5] proposed "Call Admission Control (CAC) optimization in 5G in downlink Single-Cell MISO System. The work provided a solution to the problems of CAC in 5G network for two categories of services such as enhanced Mobile Broadband (eMBB) and ultra-Reliable Low Latency Communications (URLLC)". They used Sequential Convex Programming (SCP) to find a suboptimal solution to the problem. [1] presented fuzzy logic implementation for enhanced WCDMA network using selected KPIs. In the work, empirical and analytic methods were used for the system analysis. Empirical analyses were conducted on two designated networks which are MTN and AIRTEL observed with high network traffic to evaluate their network performances using the selected KPIs [1].

The Selected KPIs include Receive Signal Level (RXLEV), Call Setup Success Rate (CSSR), Call Drop Rate (CDR) and Call Completion Success Rate (CCSR) [1] was used to evaluate the various performance characteristics of the networks based on the QoS. The results of the empirical analysis of the KPIs from the fieldwork measurements of five (5) geographical locations within Owerri, Nigeria, failed below Nigeria Communication Commission (NCC) threshold. They applied fuzzy logic technique to the system after varying the congestion load characteristics for the different geographical locations using the following parameters: mean bit rate, mean burst rate, network statistics and retain-ability. Their result was promising. [6] proposed an "intelligent fuzzy logic system for network congestion control using Efficient Random Early Detection (FRERED) system". The system improved the fuzzy-Based system in the "Fuzzy Hybrid ERED algorithm, by designing an efficient control mechanism that eliminates the call delay and drops challenges in the network. Their techniques used the queue size, average queue length and delay approximation as input variables in computing the packet drop probability [6]". Their approach produced better results than the existing system.

[7] studied the "Performance Analysis of GSM network in Minna metropolis of Nigeria", the work compared the performance of various KPIs that were used by NCC for rating QoS. The KPIs used are Call Setup Success rate (CSSR), Call Drop Rate (CDR), SDCCH, TCH Congestion Rate". They were of the view that "KPIs that are used to measure Network Performance (N.P) can also be used to measure the network for multiple radio resource management functions such as paging network access, congestion, Call drop, Handover, and power control" [7]. And the most important of the KPIs from operators' perspective includes" Bit Error Rate (BER), Frame Erasure Rate (FER), Bit Error Probability (BER), Received Signal Level (Rx-Level), Received Signal Quality (RxQual) and Means Opinion Score (MOS). The driving test was performed using TEMS Investigation tools. Two different measurement methods were used to collect log files for the performance analysis. They are short calls, which was used to collect accessibility statistic, and long calls used to obtain retain-ability statistic [7]". "The network operators evaluated were named W, X, Y, and Z. The results obtained were used to compare NCC KPIs targets. From the result, it was shown that operator X had the best network quality, followed by W while Y had the worst network quality followed by Z in the area of study" [7]. The result also showed that Y had the best-planned network requiring minimal handover which means 100% handover success rate. The authors further did an in-depth analysis of "W" network, the problem that affects the sites was identified and optimization measures required to resolve the problems were recommended.

Another attempt was made in the work of [8]. The authors proposed "a fuzzy approach for call admission control in LTE networks. Their result was promising as it reduced the number of rejected calls and minimized very low call dropping probability during the busiest hour [8]". But their mechanism did not consider handoff calls and considerable threshold to regulate queue capacity in the Base Station for new incoming calls for the handoff calls initialization and drop calls. These research gaps pointed out will be enhanced with the proposed methods in this work.

[9] in their work on "Quality of service assessment: a case study on performance benchmarking of cellular network operators in Turkey". "They Studied the benchmarking of the cellular network in Ankara, Turkey, by comparing the GSM and UMTS network operators A, B, and C to determine which network renders the best network performance in Ankara". The study was carried out using some selected "KPIs which include CSSR, Call Setup Time (CST), CDR, Speech Quality (SQ) Perceptual Evaluation of Speech Quality (PESQ) and Received Signal level (RxL). End-user perception of service quality was integrated into QoS assessment. They considered the upper-level layer of the ETSI QoS structure which are accessibility and retainability. Accessibility was measured by the number of call attempts (#CA) and successful calls (#SC)" [9].

3.1 Summary of Literature Review

The work of [6] proposed an intelligent fuzzy logic system for network congestion control using Efficient Random Early Detection (FRERED) system. Though their work outsmarts the existing fuzzy hybrid ERED system, their model failed to minimize calls drop rate in the buffer which leads to network congestion. The application of handoff queue model would have produced better results. Also, the work of [1] presented "fuzzy logic implementation for enhanced WCDMA network using selected KPIs. In the work, empirical and analytic methods were used for the system analysis [1]" Their result was promising but they did not consider variations of network congestion in the buffer and the level of its effect on the system. Though they used variables such as negative and positive of the "network statistics" which is not sufficient to determine congestion of call waiting for free cells to be initiated.

Therefore, the proposed system in this paper developed a hybrid model of handoff mechanism and queue model to produce an efficient model to improve the quality of service for global mobile telecommunication network using fuzzy logic artificial intelligence.

3. RESEARCH METHODOLOGY

This work adopted Object-Oriented Analysis and Design (OOAD) methodology for the development of the proposed system. It developed an efficient Call Admission Control mechanism using the integration of Queuing and Handoff model with Fuzzy logic artificial intelligence model. The developed intelligent CAC model is a two-phase fuzzy logic model.

Phase one is the Fuzzy policer while Phase two is the Fuzzy Congestion Controller (FCC). The Fuzzy policer intelligently optimizes the delivery of calls and call drop with its fuzzification, inference engine, defuzzification analysis of queue capacity, call mean bit rate and call mean burst rate. These parameters enable it to estimate when new calls comply or violate the threshold at the Base Station.

In the second phase of the developed system, the Fuzzy congestion controller optimizes the system resources by adjusting the handoff queue capacity concerning variations in the relative mobility of calls in the buffer and available free channels in the base station. It outputs the queue capacity which is received as input to Fuzzy policer the first phase of the developed system. The handoff queue model manages undelivered calls on the mobile station by using released cells in the Base stations (BS) to connect the calls waiting for free channels. The mechanism of the Handoff queue depends on the threshold parameter specified to manage the queue capacity. Hance, the developed system has an efficient mechanism of passing or dropping calls to stabilizes network Quality of Service (QoS) and control congestion uncertainties in the network.

The architecture of the proposed fuzzy logic traffic controller is presented in fig 1.

The components of the proposed system's architecture are as follow:

i. Fuzzy Congestion Controller: Fuzzy congestion controller (FCC) handles the calls channeled in the buffer to prevent network congestion in the Base state. Before the waiting calls in the buffer are assigned to new free cells, the FCC manages the calls in the buffer by their Available guard channel, Relative mobility to intelligently optimize the "Queue capacity" in the buffer using fuzzy logic model. The output of the process is used to direct the Fuzzy policer that manages the call complies in the base station. This mechanism ensures that the system is congestion free.

ii. Handover Mechanism: the developed system uses handover method to manage the drop calls using the mechanism of Available Guard Channel, Relative Mobility, and Queue Capacity for the transfer of cells to different and initialize its connections.

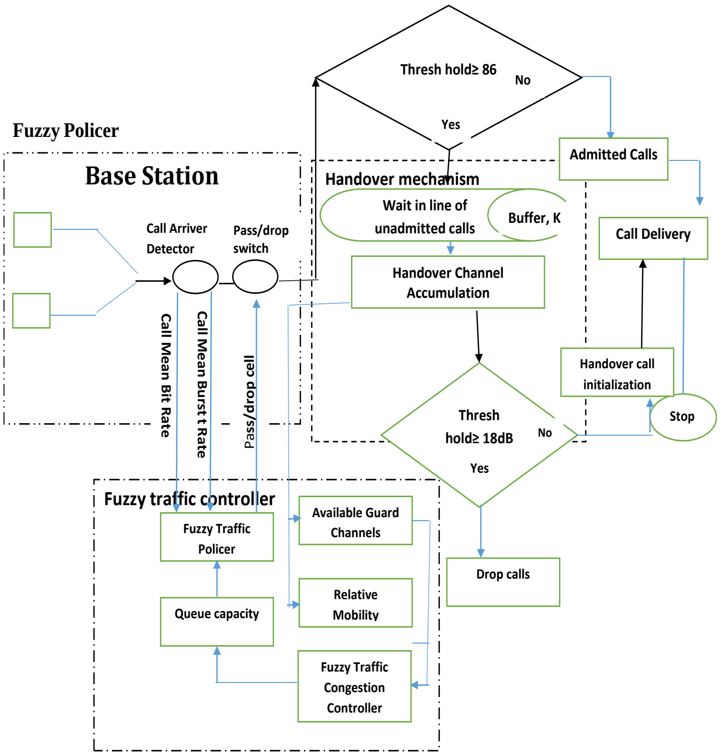

Fig-1 Architecture of the proposed system.

iii. Call Arrival Detector: The call arrival detection is the parameter that detects the call mean bit rate and the call mean burst rate. These parameters are input in the Fuzzy Policer to optimize the call capacity in the Base station. This ensures that all incoming calls are complied with or do not exceed the number of calls that are supposed to be delivered. The calls that are not connected are queued up in the buffer.

iv. Pass/Drop Switch: The reason for the extension is to provide the Fuzzy policer (FP) with more information thus helping it in making more accurate decisions on passing or dropping cells.

v. Fuzzy Police: The intelligence mechanisms of Fuzzy Policer in the Base Station enhanced the management of the capacity of the queue model. It used the parameters: mean bit rate, mean burst rate, and queue capacity from the Fuzzy Controller to determine the call drop rate at the Base station. This implies that if the queue capacity in the base station is exceeded the system will drop or move calls in the buffer to prevent congestion.

The fuzzy policer controls the overall network of the system. It efficiently manages call delivery without dropping the calls by channeling undelivered calls to the queue in the buffer, awaiting a free channel to connect them. Also, it communicates with the queue capacity output from the Fuzzy controller in the buffer for an efficient decision on whether to pass or drop new incoming calls in the Base Station.

3.1 Activity Diagram of the proposed system

The Activity diagram of the proposed system is shown in Figure 3.4

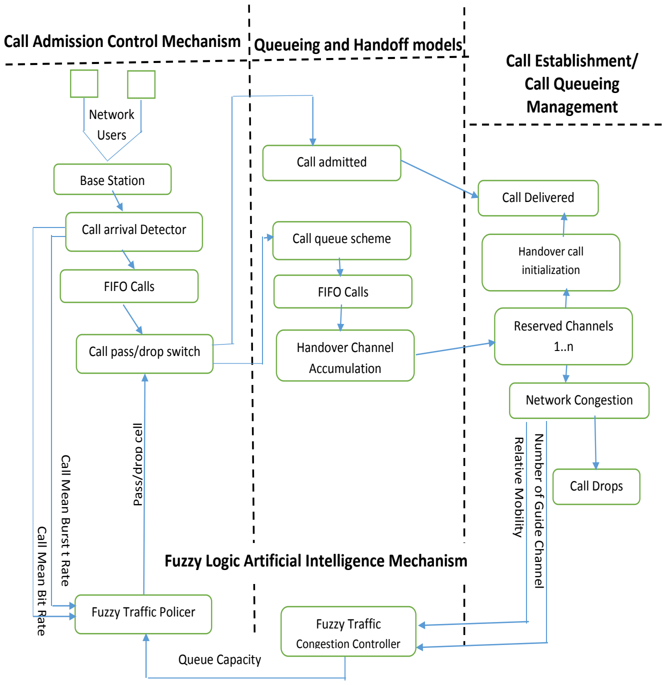

Fig-2. Activity diagram.

The activity diagram shows the system connectivity components. The Fuzzy Policer (FP) continuously evaluate the compliance/violation levels of the queue capacity in the Base Station. Thereby it sent the call drop rate and call completion success rates values to the pass/drop switch. The switch would either pass or drop and call completion success rates fractions of the cells in the memory based on the values of the drop rate.

The cell arrival detector checks the mean bit rate and mean-burst length of the incoming traffic from an already connected user. The two-parameter measurements serve as input to the fuzzy policer including the buffer state of network accepted from Fuzzy congestion controller that represents the congestion state of the network based on the inference engine decision on analyzing the "Number of guide channels" and "Relative Mobility" of queue length in the buffer (queue register). However, the output decision from the fuzzy policer will then signal to the pass/drop switch. The proposed fuzzy traffic controller' aim is to simultaneously monitor the Mean rate and reject bursts while preventing and relieving congestion.

3.2 Algorithm

Step one: Arrival of calls from the users at the base station;

Step two: Call arrival detector generates call mean bit rate and call burst rate from call users request for fuzzy policer's analysis

Step three: Pass/drop switch pass calls based on the thresh hold ≤86dB or send unadmitted calls to the buffer if thresh hold ≥86dB

Step four: Handover mechanism analyzes unadmitted calls within the buffer While the admitted calls are delivered,

Step five: Handover Channel Accumulation takes decision about assigning free cell to deliver calls if (threshold ≤18) in the buffer otherwise Calls are drop if (threshold ≥ 18)

Step Six: Handover Initialization assigns free cell to waiting calls in the buffer and initializes it delivery

Step Seven: Handover Channel Accumulation determine and sends reports (Available Guard Channel and Relative Mobility of Queue lengths) of the state of the network in the buffer (queue register) to Fuzzy Congestion Controller.

Step Eight: Fuzzy Congestion Controller intelligently analyzes the state of the network in the buffer and outputs condition of the queue capacity, which is sent to Fuzzy Policer for further analysis

Step Nine: Fuzzy Policer determines the state of call burst rate, call mean bit rate and queue capacity (Buffer) to control congestion occurrence in the system by deciding call drop and pass in the base station.

Step Ten: Determine system throughput

Step Eleven: GOTO: step one

Table -1: Twenty-six rule structure for the Fuzzy Policer (FP)

Rule	A_1	A_2	QC	CDP	Rule	A_1	A_2	QC	CDP	Rule	A_1	A_2	QC
1	C	C	empty	P	10	V	C	empty	P	19	SC	C	Medium
2	C	C	low	P	11	V	SC	low	P	20	SC	C	moderate
3	C	C	Very low	P	12	V	V	Very low	D	21	SC	C	Full
4	C	SC	empty	P	13	V	C	medium	D	22	SC	SC	Full
5	C	V	low	D	14	V	SC	moderate	D	23	SC	V	Full
6	SC	C	Very low	P	15	C	C	moderate	P	24	V	C	moderate
7	SC	SC	low	P	16	C	SC	Full	B	25	V	SC	Medium
8	SC	SC	Very low	P	17	C	SC	Medium	P	26	V	V	Medium
9	SC	V	Very low	B	18	C	V	Full	D				

where A1 = Call Mean Bit Rate, A2 = Call Mean Burst Rate, CDP = Call Drop Prob, C = comply, SC = Sort of Comply, V= Violate, P = Pass, D = drop.

Table .1 presented the proposed twenty-six rules used to developed intelligent call admission control system. The rule base is constructed on the basis of knowledge from studying various literatures on Call Admission control system.
The Twenty-six rules are presented" as follows:

1. If (Mean-Bit-Rate is Comply) and (Mean-Burst-Rate is Comply) and (Buffer-Queue-Capacity is empty) then (Call-Drop-Prob is P).
2. If (Mean-Bit-Rate is Comply) and (Mean-Burst-Rate is Comply) and (Buffer-Queue-Capacity is Low) then (Call-Drop-Prob is P).
3. If (Mean-Bit-Rate is Comply) and (Mean-Burst-Rate is Comply) and (Buffer-Queue-Capacity is VeryLow) then (Call-Drop-Prob is P)
4. If (Mean-Bit-Rate is Comply) and (Mean-Burst-Rate is Sort-of-Comply) and (Buffer-Queue-Capacity is empty) then (Call-Drop-Prob is P)
5. If (Mean-Bit-Rate is Comply) and (Mean-Burst-Rate is Violate) and (Buffer-Queue-Capacity is Low) then (Call-Drop-Prob is D)
6. If (Mean-Bit-Rate is Sort-of-Comply) and (Mean-Burst-Rate is Comply) and (Buffer-Queue-Capacity is VeryLow) then (Call-Drop-Prob is P)
7. If (Mean-Bit-Rate is Sort-of-Comply) and (Mean-Burst-Rate is Sort-of-Comply) and (Buffer-Queue-Capacity is Low) then (Call-Drop-Prob is P)

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.
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26. If (Accessible-Channel is High) and (Relative-Mobility is Fast) then (Queue-Capacity is Medium)

Table-2: Fuzzy logic rules for congestion control in the Buffer.

1	If Accessible Channels is Precisely Less and Relative Mobility is Slow **T**hen Queue Capacity is High
2	If Accessible Channels is Less and Relative Mobility is Slow **T**hen Queue Capacity is Medium
3	If Accessible Channels is medium and Relative Mobility is Slow **T**hen Queue Capacity is Moderate
4	If Accessible Channels is High and Relative Mobility is Slow **T**hen Queue Capacity is Low
5	If Accessible Channels is Very High and Relative Mobility is Slow **T**hen Queue Capacity is Low
6	If Accessible Channels is Very Less and Relative Mobility is Very Slow **T**hen Queue Capacity is Medium
7	If Accessible Channels is Less and Relative Mobility is Very Slow Then Queue Capacity is Low
8	If Accessible Channels is Medium and Relative Mobility is Very Slow Then Queue Capacity is Low
9	If Accessible Channels is High and Relative Mobility is Very Slow Then Queue Capacity is Very Low
10	If Accessible Channels is Very High and Relative Mobility is Very Slow **T**hen Queue Capacity is Low
11	If Accessible Channels is Very Less and Relative Mobility is Moderate **T**hen Queue Capacity is Very High
12	If Accessible Channels is Less and Relative Mobility is Moderate **T**hen Queue Capacity is Medium
13	If Accessible Channels is Medium and Relative Mobility is Moderate **T**hen Queue Capacity is Medium
14	If Accessible Channels is High and Relative Mobility is Moderate **T**hen Queue Capacity is Low
15	If Accessible Channels is Very High and Relative Mobility is Moderate **T**hen Queue Capacity is Low
16	If Accessible Channels is Very Less and Relative Mobility is Considerable **T**hen Queue Capacity is Very High
17	If Accessible Channels is Less and Relative Mobility is Considerable **T**hen Queue Capacity is High
18	If Accessible Channels is Medium and Relative Mobility is Considerable **T**hen Queue Capacity is High
19	If Accessible Channels is High and Relative Mobility is Considerable **T**hen Queue Capacity is Moderate
20	If Accessible Channels is Very High and Relative Mobility is Considerable **T**hen Queue Capacity is High
21	If Accessible Channels is Very Less and Relative Mobility is Very Fast **T**hen Queue Capacity is Very High
22	If Accessible Channels is Less and Relative Mobility is Very Fast **T**hen Queue Capacity is Very High
23	If Accessible Channels is Medium and Relative Mobility is Very Fast **T**hen Queue Capacity is High
24	If Accessible Channels is High and Relative Mobility is Very Fast **T**hen Queue Capacity is High
25	If Accessible Channels is Very High and Relative Mobility is Very Fast **T**hen Queue Capacity is Medium
26	If Accessible Channels is Very Less and Relative Mobility is Fast **T**hen Queue Capacity is Very High
27	If Accessible Channels is Less and Relative Mobility is Fast **T**hen Queue Capacity is High

28	If Accessible Channels is Medium and Relative Mobility is Fast **Then** Queue Capacity is High
29	If Accessible Channels is High and Relative Mobility is Fast **Then** Queue Capacity is Medium
30	If Accessible Channels Very is High and Relative Mobility is Fast **Then** Queue Capacity is Medium

The input/output specifications are described in Table-3.

Table -3: Fuzzy Linguistic variables Input/output specifications

	Inputs					Outputs	
Congestion Control Mechanisms	Handoff input Mechanism			Queue Model Mechanism			
Parameter	Relative Mobility	Available guide Channel	Queue Capacity	Mean Burst Rate	Mean Burst Rate.	Queue Capacity	Term set T(c)
Linguistic Variable	"Very Slow, Slow, Moderate, Considerable, Fast, Very Fast"	"Very Less, Less, Medium, High, Very High"	"Very Low, Low, Moderate, Medium, High, Very High"	"Comply, Sort of Comply, violate".	"Comply, Sort of Comply, violate"	"Very Low, Low, Moderate, Medium, High, Very High"	"Drop, Between Pass &Drop, Pass"

Table-3 describes the congestion control mechanisms parameters and its linguistic variables used in the analysis of the proposed system.

3.3 Mathematical Models for Handoff Queueing

The Mathematical models for "handoff queueing for New call blocking probability (Bn) and Blocking probability Bhandoff handover requirement [10]" are given as follow:

i. New call blocking probability (Bn)

i.

$$B_n = \sum_{i=1}^{C+U_H} p(i, U_N) \quad (1)$$

Where "C represents the limited amount of code channels accessible in the channel pool. Most cases each channel reserves w channels wholly for management of queue issues. U_N represents Queue capacity in the Based Station N. P(q) represents the steady state probability" (Ravi & Sanjiv,2012).

i. Blocking probability $B_{handoff}$ as given in equation

$$B_{handoff} = \sum_{k=0}^{U_N} P(C + U_H, k)$$

$$(Ravi\ \&\ Sanjiv, 2012) \quad (2)$$

Where U_H represents Queue Capacity in the Mobile Station H.

3.4 Member Functions

There are several types of membership functions such as triangular waveform, trapezoidal waveform, Gaussian waveform, bell-shaped waveform, sigmoidal waveform and S-curve waveform. Since this work is a real-time operation that involves significant dynamic variation within a short period, triangular and trapezoidal waveform is utilized. The "proposed Fuzzy Congestion Controller (FCC) also uses the max-min inference method for the inference engine and Tsukamoto's Defuzzification. The membership functions for call mean burst rate and mean bit rate is shown in Fig-3.

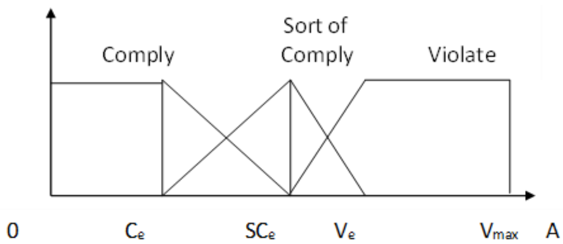

Fig-3: illustrates the membership functions for call mean burst rate and mean bit rate

The Membership functions for call drop rate is shown in Fig-4

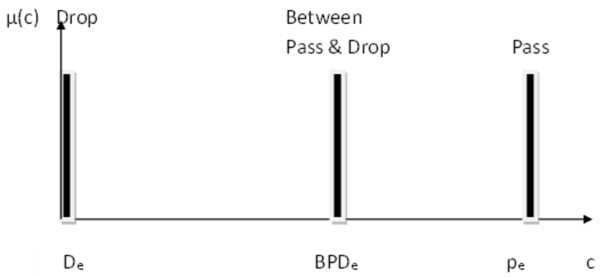

Fig-4: The membership functions for Call drop rate

"De, BPDe, Pe represents the drop rate imposed on the cells. De would be set to 0 for the total drop of all cells, BPDe to a value within [0,1] but closer to 1 for dropping a fraction of the cells, and Pe is set to 1 for passing all cells. The FP decides on the drop rate c, according to the set of linguistic variables of parameters Al and A2, state of the network y generated by the Fuzzy Congestion Control (FCC), and a set of built-in fuzzy control rules".

"The output is the membership function for the term set T(c) which are Drop (D), between Pass & Drop (BPD) and Pass (P). Uncertainty in the network system may result to drop calls, calls between pass & drop, and pass all calls. The value for Drop (D) calls will be set to zero for the total drop of all calls, and BPD set to a value within [0, 1] but closer to 1 for dropping a fraction of cells, and passing all calls set to 1". The simulated parameters are represented in Table -4

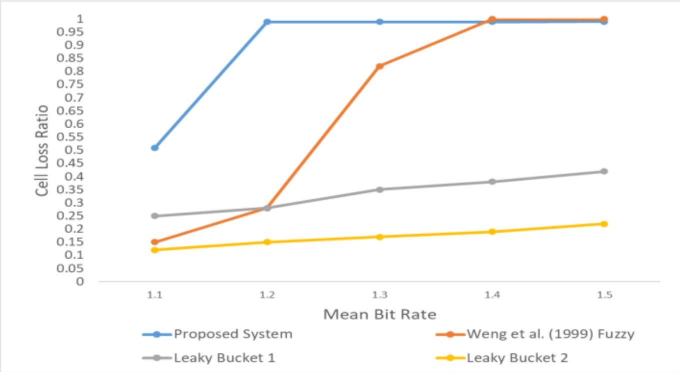

Fig-8: Graphical comparison of the cell loss ratios of the developed system, [12] existing fuzzy and leaky bucket congestion control.

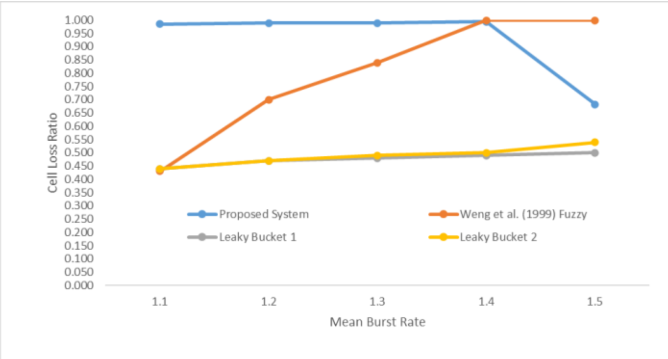

Fig-9: Graphical representation of the comparison of the call loss ratio of the proposed system, and existing fuzzy, leaky bucket congestion control with respect to Call Mean Burst Rate.

4.1 Discussion

The proposed fuzzy policer and fuzzy congestion control were developed using MATLAB R2018a version. From Fig-7, the comparison of the rate of call delivery (system throughput) of the proposed system, and existing congestion control systems shows that the proposed system outperformed [11] and [1] Call Admission Control models. These demonstrated that the proposed system minimized call drop rate more than the existing systems, it processes a given amount of call delivery efficiently.

Moreover, from Fig-8 the comparison of the call loss ratio of the proposed system, and the existing systems shows that the proposed system also outperformed [12] fuzzy logic and leaky bucket congestion control models. Furthermore, from Fig-9, the comparison of the cell loss ratio of the proposed system, and existing fuzzy, leaky bucket congestion control with respect to Call Mean Burst Rate shows that proposed system produced a better result than the existing systems. However, the simulation results confirm that the developed system is more efficient on reduction of cell loss caused by congestion and buffer overflow in various network variations. Whenever congestion occurs in the system the developed intelligent congestion control rules from FCC signals the Fuzzy Policer to reduce its current rate of calls delivery, by optimizing the queue capacity (state of the network in the buffer) with the mean bit and burst rate of the linguistic variables of the incoming calls and determine the appropriate decision to take under such network uncertainties. When the network is congestion free the transmission/cell rate will be restored to its original values. Thereby enhancing the performance of the system throughput.

3. CONCLUSIONS

The research work successfully developed an improved fuzzy logic controller for a global mobile telecommunication network. It applied the mechanism of Handoff queue-based Call Admission Control (CAC) scheme and Fuzzy Logic artificial intelligence to developed an intelligent network congestion controller for global mobile telecommunication network.

The proposed system is very efficient to provide efficient quality of service by intelligently analyzing the dynamic of complex user call network activities, in the mobile networks base station. It uses Fuzzy logic handoff mechanism to ensure that the unadmitted calls are not dropped but assigns to free available cells for efficient delivery and moreover ensures that incoming calls are properly managed to minimize call dropping and prevents congestion in the network.

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