A Simulator for Reporting Performance Data from Network Element To Network Management System

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Abstract: Now a days, the biggest challenge for Mobile Network Operators is to provide broadband service with high performance.4G(VoLTE) has been developed to meet user requirement by offering high speed data transfer services using IMS network. The key performance indicators (KPI) are used to monitor and optimize mobile network performance in order to provide high quality services using counters. The indicators are standardized by third-generation partnership project(3GPP). Simulators are used in network element so that we can check the capacity of each VM and calculated using counters from element management system to network management system.

Keywords: Key Performance Indicators, Voice over Long Term Evolution, third Generation Partnership Project, IP Multimedia Subsystem.

I. INTRODUCTION

The generation of telecom industry starts from landline, 2G, 3G & 4G to provide communication between one person to another person to exchange their messages and voice data. The technology and methodology differ from generation to generation to give best of best to customers in the daily evolving innovations [1]. In this modern era, 4G is the technology which gives better voice quality and internet speed. So many customers in the market which gives their better quality still peoples go with their own thinking to choose best but all others vendors are started with 2G or 3G then moved 4G services but jio takes very vital role in the market and highest subscribers in India because its start with 4G(LTE) service later it upgrades to 4G(VoLTE) which provides very good voice quality and internet speed. Where two channels are created based on internet protocols one for voice and one for internet [2]. So, the speed distributes equal for voice and internet. Any network which provides very high-quality voice calls then their KPI (Key Performance Indicators) rates are 99.99%. The 4G service is provided by using IMS (IP Multimedia Subsystem) network. Basically, the mobile originating means user entity send request to LTE [3] network it is IP connectivity based network transfer the data to IMS network for facilitating mobile receiver accepts the message that spoken by the user. while the message come across many internal nodes inside IMS network.

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Each and every node provides different counter values are stored in the node and network management system [5]. Based on the intervals values of counter which are specific to cscf (call session control function). It is the first point of contact to IMS network which handles crores of calls on the network with high speed.
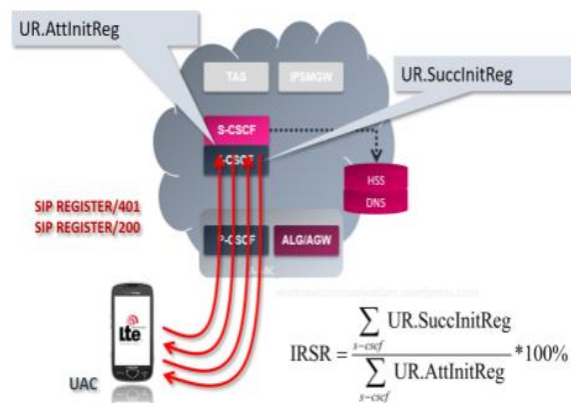

$$IRSR = \frac{\sum_{s-cscf} UR.SuccInitReg}{\sum_{s-cscf} UR.AttInitReg} * 100\%$$

Figure 1: KPI Registration Success Rate Measurements

The speed of the network was calculated by KPI, where KPI stands for key performance indicators there are many KPI across access network and core network. Volte IMS control plane KPI, Packet core 4G network LTE KPI and Radio volte KPI. But in these papers, we are discussing about call session control function KPI which helps easy to understand the network behavior in the network element. All operators are decided which operators to set KPIs for monitoring based on the market situations and network state. The KPIs are based on so many metrices such as accessibility, Retainability, Integrity, availability, utilization, mobility etc.,[6].

KPIs related to speech quality in the core network of IMS are

- RSR-Registration Success Ratio (%)
- CSSR-Call Setup Success Rate (%)
- CST-Call Setup Time (s)
- ACD-Average Call duration (s)
- Mute Rate (%)
- MOS Score
- RTP Packet Loss (%)
- One-way Calls (%)

II. RELATED WORK

Authors Domini, Abhishek [7][8] both made research on KPI optimization for 4G wireless technology which they use LTE network handle multiple nodes to provide better wireless connection for communication. Network element with LTE enhance the radio side and core side.

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Which makes changes in the network element behavior with more performance than previous architecture so KPI rate is good in IMS network, so the updates are made network elements improve the performance of node in network management side.

Authors Ayman and Mohamed [9][10][11] are experimentally proven that new counters give better KPI rate to improve the voice quality by taking action against the network behavior. This paper given the full information about the experimental performance analysis of Volte. Based on this data analysis evaluates by different conditions of radio and volte voice quality in terms of KPIs. Also, they provide basic procedure to carry out performance management of collected data from each or multiple network elements.

Author Pawel Biskupski [12] measure the KPI which user can make and maintain calls by evaluating call initiation and call drop rate (%). Verifying latency delay during a call using latency, jitter metrices. In network elements this proven high KPI rate for high speed voice rate. The special thing of considered research paper are more concentrated on voice drop and migrates to 2G/3G if 4G signal is not able to get in the network those KPI are giving good results.

Author Alessandro, Fabrizio [13] are estimated the network side KPIs and simulated counters using opnet performance measurement tool. which is used simulate different conditions of counter to reach NMS. The hardware implementation used is higher version as compare to above paper so the plenty of counters can send at a time. Where common configuration of node as capacity of 32GB ram, 30GB heap size etc., but in this paper, authors introduce new hardware implantation with 48GB Ram and 42GB heap size, So the counter reach the destination from network level is better measurement.

Author Smita Lonkar and Reddy [14] are did research on voice and video call of volte in core network to performance both should give good quality then end user of the product should be happy and continue the same. So market will always changes its current technology to provide best for users. Here Authors are more concentrated on video and voice call issues in the network. So they created new counter to verify the KPIs values from node to network system which their information gives better quality of volte and voip services for customers.

Author Wasi Ahmad [15] presented paper on LTE technology with problem statement finding difficulty in reaching the customers with good quality is a big task. But later 4G service come up with dashboards with to see exact KPI values in all over the regions. Here used simulator called TSP is integrated into volte to increase the mobile voice accuracy and this changes the business and marketing services. But this is not sufficient to verify voice quality and TSP has some drawbacks in case node hardware specification is not sufficient and developed simulator needs check in new configuration specification node to evaluate the analysis of volte network efficiency.

III. COMPONENTS OF SIMULATOR

This simulator is developed to report performance data from network element to network management system. The component consists to build up of simulator are Kafka, producer, consumer, performance manager and hardware resources.

Producer

Applications set the counter values using the APIs provided by the counter management of the TSP. The producer writes the counters and their values to KAFKA at regular intervals. This interval is fixed at 60 seconds. In case the producer fails to write into KAFKA for any reason, Producer halts any further reading or collection of measurement values until the time Producer is able to write to KAFKA layer successfully. The previously collected measurement values are retained and retried before giving up. Any failure to write to KAFKA is logged. In case Producer goes down for any reason after reading the values from TSP without writing the data to KAFKA, the data will be lost.

KAFKA

Kafka cluster is used as the message bus between counter management, which acts as producer and Processor, which acts as consumer. The VM is primary while the other two VMs are secondary. Only the aggregator on primary VM reads all the incoming messages on the message bus. The messages written to KAFKA can only be deleted by KAFKA after specified timeout. The timeout is configured appropriately to ensure no surge in the memory used.

Performance manager

The PM reads the measurement data from KAFKA at the end of every granularity period. Since the Producer interval is different than the granularity period, the PM collects the multiple instances of same measurement and sum the values of all these instances before sending the values to aggregator. This summation is mandatory for all measurements unless the value received by the aggregator is already an absolute value. After collecting the measurement values from all the VMs, PM Aggregator aggregates the measurements as per defined aggregation rules. The aggregation rules are defined for each counter to specify the appropriate aggregation operations to be performed on the measurement values before sending the value to EMS. The supported aggregation operations are SUM, AVG, MIN and MAX.
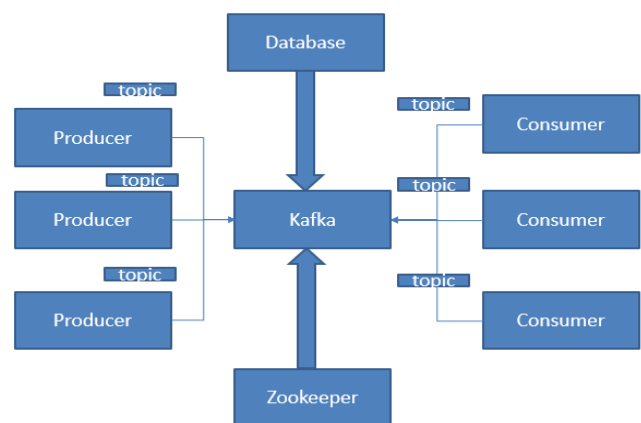

Figure 2: Producer and Consumer communication via topic

The node specific counters, there would exist only one instance of the value. Since the producer interval is different than the time period, there would be more than one value written into KAFKA by the producer. The Processor calculates the value of the counter as described in Aggregation Methodologies.

IV. IMPLEMENTATION

The general procedure to implement simulator in network element as follows:

- First required software and library application needs to be installed in the node. As any IDE can be used for development using java programming. Then which counter needs to verify present in the node. And classify the measurement type according to core network components.
- Creation of unique topic name for all VM in network for communication purpose to send and request counter as each component.
- The communication between each node is carried out by topic name using kafka broker. It has two parts such that producer and consumer. Producer write the data to specific topic and consumer request the counter for same topic.
- For each producer and consumer dedicated ports are configured in network element for send data to network management system.
- Developed simulator put it in the network element where it is executed their VM counters and voice call counter which come across all node to network system.
- The counter has many different categories based on the type it will generate the value and values are reported for every internal values. If interval is less than counter time taken to destination will also be less Based on this criteria simulator is designed it will report all types and intervals.
- The counter values will report to NMS GUI their all values stored in the xls format. These file is very large and plenty of counters are reported.
- Segregate the counter based on KPI type and plot a graph against classified counter versus time taken to reach NMS.
- The result shows that below graph represent RSR counter incrementing in all the interval and there is significant time taken to NMS in microsecond this shows voice related KPIs are increment in all interval type. In real time there should be multiple nodes are connected to NMS and report their counter info for respected KPI to show how is behaving in the IMS network.
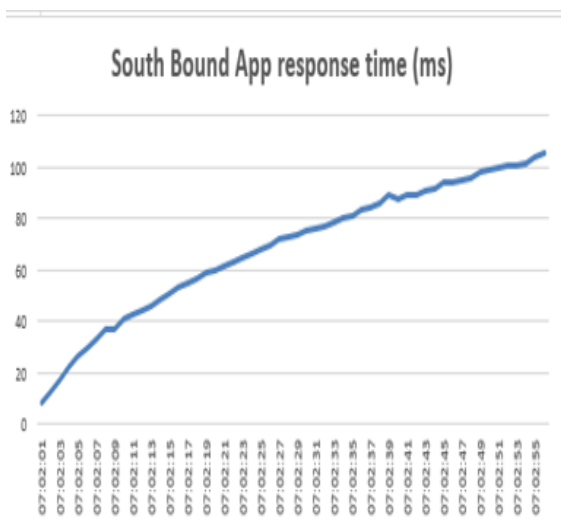

Figure 3: Graph plotted against number of counter simulated time at node level (micro second) vs counter reaches to network management system (milli second).

V. CONCLUSION

In the paper, we proposed new simulator for reporting performance data from network element to IMS network with the support of some new counter to verify voice quality. Also, we have found out the trendlines with the high correlation that are described by the help of the graphs. It is observed that VoLTE provides high voice quality, excellent network performance. Hence network reliability can be achieved by activating various VoLTE related counter features in network.

FUTURE ENHANCEMENT

The collected data is stored in database operators and their analysis on comparison of actual values with the numbers from the past (ex - to compare registration success rate with the data from yesterday, previous week, previous month). The values can be also used as feeds for artificial intelligence systems providing decision making support.

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Manjunath K Gowda pursuing MTech in Information Technology branch in RV College of Engineering, Bengaluru. Working as an intern in Nokia Solutions and Network pvt lmt company, Bengaluru. Working for AT & T, Verizon clients to deliver 4G/5G feature to customers. And also working for Information Science and Engineering department as Student Placement Co-Ordinator for RVCE placement cell.
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5.Resource Person for "IoT Application development" for M.Tech students of Mechanical department, RVCE held on 08/03/19.
6.Resource Person for "IoT Application development using Nodemcu ESP8266" for BCA students of National college, 10th Jan 2019, Jayanagar.
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