E2E Performance and Fault Analytic of VoIP on HSBB Network

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Abstract— **Voice over IP (VoIP) are offer wide range of benefit. There is include reduction telecom costs, simplify the provisioning of service, wide range as long as have internet access, and ability to deploy new converged application. All provider pursuing the benefits of VoIP must take steps to ensure that their converged network delivers acceptable call quality and non-stop availability. In this paper, we investigate information regarding data integrity, service VoIP performance and fault management in the TM High Speed Broad-Band (HSBB) Network. Multi-vendor and multi technology environment is one of the big challenges for TM to identify, detect or pointed the faulty area. In this study, the main point is generating method on how to calculate performance for VoIP in entire HSBB network. Discuss the key point index (KPI) measurement for analyzed and identify to ensure network in the good condition. Also discuss in how End-to-End (E2E) network monitoring can play an important role in daily monitoring and troubleshooting network fault. The performance of the network is analyzed with active path, routing and traffic flow using measurement of throughput, packet loss, jitter delay, bandwidth and VoIP mean Opinion Score (MOS).**

From VoIP service, customer may experience on delay voice, choppy, echo, robotic sound, and call drop due to network physical error or packet loss. In this study, the method to probing network by active and passive probe will solve and help to manage performance and fault of the VoIP service. Each conversation using VoIP will rated with MOS value which is has 5 categories, bad, poor, fair, good and excellent. From this value, network engineer ease to analyzed QoS of the call and will process the proactive maintenance to solve QoS issue.

I. NOMENCLATURE

VoIP Performance and fault analytic, Mean Opinion Score (MOS) Terminology, ITU-T, Series P.800.1, 2003

II. INTRODUCTION

Telekom Malaysia Berhad (TM) challenged to transform from being a fixed-line incumbent to being an agile and lean operator in a market that is rapidly becoming fiercely competitive. TM was tasked with, by some measures, one of the fastest ever rollouts of a brand new, national network when in September 2008 it signed a public-private- partnership with the government of Malaysia to roll a high- speed broadband (HSBB) network across Malaysia .[1] Unifi is product Service name for HSBB project that offering of High Speed Internet (HSI), Voice Over Broadband (VOBB)/VoIP and Internet-protocol-Television (IPTV) branded HypeTV, which is provided to residential and business customers in Malaysia through an optical core network via Fiber-To-The-Home (FTTH) for individual housing units and Very-High Bit Rate Digital Subscriber Line 2 (VDSL2) for multi-story buildings depending on the customer premises. HSBB network contain two access Technologies with 6 different vendors (Alcatel Lucent, Huawei, Fiberhome, ZTE, D-link, and Alwin) over 2300 Multi-Service Access Node (MSAN) and 750 Optical Line Terminal (OLT) or Passive Optical Network (PON). [2] Each access node connected to the Metro-E network that also have different vendor which is ZTE, Alcatel and Huawei. The core network of TM backbone is using Juniper technology's to cater the high speed backbone with 100Gbps per interfaces with Global connectivity capacity up to 450Gbps. [2]On the application layer, for service IPTV and VOBB, Huawei's Application was used on the separate IPTV network and IP Multimedia subsystem (IMS) network connected directly to the TM's backbone network. All of these become TM's being convergent service provider with currently more than 670K Unifi customers [2].

In the world of telecommunications, integrity of data with complete E2E service and performance measurement is very important by providing measurement information for long-term planning in order to avoid undesirable condition.[3] E2E network can be defined as implies all component from the user access and display devices and sensors to include all level of networking and processing, all associated applications, and all related transport and management service. For voice and video, E2E encompasses network and service from a user and device to end device and for data, E2E is from customer edge (CE) Router (CE-R) to CE-R. Multiple equipment and service is not a stumbling block to service or network provider to monitor E2E network. [4] Research from Leibniz Supercomputing Centre proved the integrated monitoring that single measurement can be combining into an integrated view. E2E Link are formed by combining technologies such as SDH/SONET, native Ethernet or Ethernet over MPLS, where each domain is dependent on data that it can retrieve from the network management system of each network element. In the visualization a view has to be formed by combining E2E link and IP related monitoring data by linking these data in suitable manner. Retrieval of SNMP data from network element are also can contribute the result of active measurements. In this study we discuss in how VoIP service performance can be measured and visualized in E2E environment for fault detection and fast restoration. Correct design and concept must

be correctly selected on the implementations. For network performance, data collected through intrusive or active testing technique was suitable to measure performance of (Key Point Index) KPI and network analysis.[4] This technique directly injecting test traffic frequently to the network for measure the network performance by using Active Probe. [5] The Probe can estimate of a given KPI at one time from a set of related KPI at other time. Probe can acts as automation agent to inject traffic into network to collect path bandwidth, Throughput, packet Loss, Delay, Jitter and Bit Error Rate. Data can be collected by using ICMP test, SNMP and speed test. To ensure the networks are reliable, Active Probe must inject traffic frequently, for example every 30 minutes or every one hour to calculate and compare measurement result whether it's below or above threshold. The alarm must be pop up in monitoring centre if one of the network parts reading in below threshold. VoIP Quality of Services (QoS) is suitable to collect through non-intrusive measurement technique or Passive Probe. It is because services carried UDP/RTP packet and very sensitive to the throughput and bandwidth. [10] By the way QOS measurement must be not interrupted by the test packet. Passive-Probe acting likes the Man-in-The-Middle server. It's collecting the data packet or signal by T connection that can mirror the traffic from one network element to another network element. All data that receive from passive probe will be analyzed and store onto database.[6] For voice service, quality can be affected by noise, distortion, too high or low signal volume, echo, gaps in speech and variety of other problems. [7]Voice QOS can be measured by Mean Opinion Score (MOS) that measure by three basic categories. It is Listening quality (MOS-LQ), conversation quality (MOS-CQ) and transmission quality(R factor or R-CQ). [9]MOS rated the quality of series from RTP data from database using opinion scale ranging from 1 to 5. This is bad, poor, fair, good and excellent.

A. E2E Topology

Figure 1: HSBB service path Layout E2E Topology

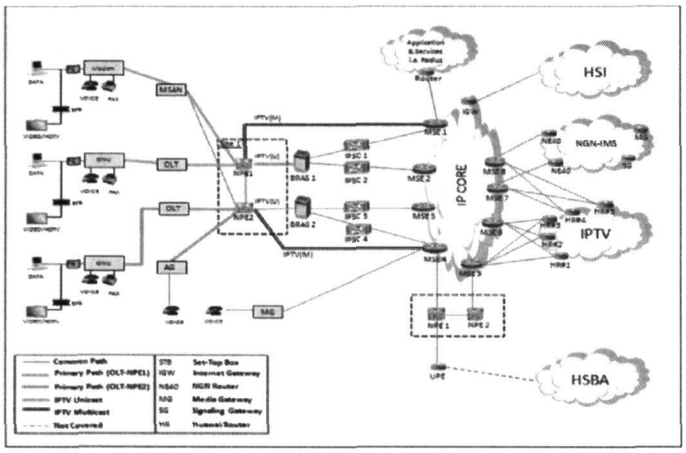


Figure 1: Shows the E2E network diagram of the HSBB network. In this diagram, its can divided by three path of network layer. There is Access layer, Core layer and Application layer. The access layer is catering from user Base-terminal-Unit (BTU) until MSAN/OLT and Access Gateway (AG). BTU is directly connected to the user equipment for triple-play-service, which are Internet, IPTV and VoIP. From VoIP line, customer can connect to telephone, fax, POS terminal (Credit card Machine), alarm monitoring and PBX. . For the Core layer, its consider as Metro-E (NPE), BRAS and IPCore. NGN-IMS is the application network layer for VoIP service. Next Generation Network (NGN) contains telephony switching equipment, for example SoftSwitch, Media Gateway and Signalling gateway. IP Multimedia-subsystem (IMS) functions like a brain of database for the service application layer of the VoIP. In this network, multiple protocols are used to connect each element to traverse all voice signalling packet. For example SIP, and SIP-T, Diameter, H.248, DHCP, M3UA, IUA and ISUP. For Media packet was carried UDP/RTP that contain multiple codec converter in SDP like G.711 μ law and α law, G.729, T.38 and so on.

Figure 2: Detail NGN-IMS network

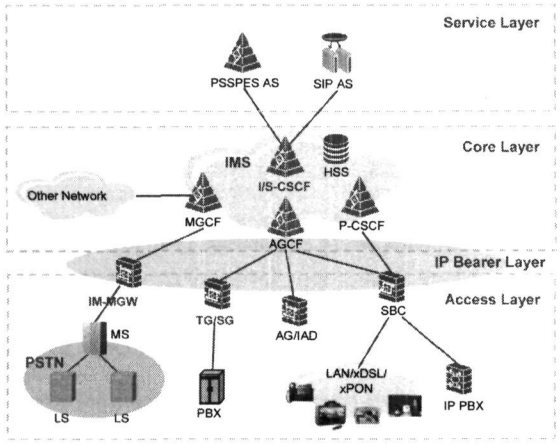


Figure 2: shows the detail NGN-IMS Network. Its divided by 4 layers, which is Access, IP Bearer, Core layer and Service layer. These networks only forward, receive, control and manage signaling and media packet to deliver VoIP service.

B. KPI

Table 1: VoIP KPI for performance and fault analytic

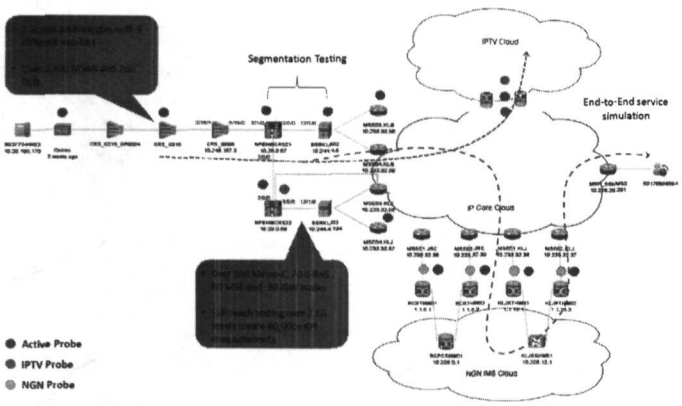
No	KPI	VoIP	User View		
			Call Centre	NOC	Regional Engineer
1	Latency (Every segment)	√	√	√	√
2	Packet loss (Every segment)	√	√	√	√
3	Jitter (Every segment)	√	√	√	√
4	Interface Utilization	√		√	
5	CPU utilization	√		√	
6	Memory utilization	√		√	
7	Video Mean Opinion Score (V-MOS)	√	√	√	√

8	Mean Opinion Score (MOS/R-factor)	√	√	√	√

C. Probe

In this study, two type of probe are used to indicate data to analyst. Active probe will inject intrusive data by service testing frequently to the network. For example, the probe will automate self testing for every 2 hours and will produce report of network conditions and update the database. The end user will refer and get latest from data-base for latest result by Probe testing. Meanwhile the passive Probe is acting like Man-in-The-Middle by mirroring traffic to capture all data and analyst data. It does require to the Voice service to ensure every conversation are achieve above MOS threshold. In this design, Passive probe are suitable locate in NGN-IMS network. Thus Active probe are suitable to locate in Access and Core layer.

Figure 3: Sample Active and Passive probe



D. Mean Opinion Score

Table 2: Mean Opinion Score (MOS)

Mean Opinion Score (MOS)		
MOS	Quality	Impairment
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying

E. Result

F. Discussion

G. Units

H. Abbreviations and Acronyms

I. Math and Equations

III. Appendix.

IV. Acknowledgment

V. References

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VI. Biographies