An approach to implementing viable voice over IP (VoIP) service level agreement (SLA) data collection

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Abstract—The use of voice and video data transmission over packet switched networks (PSN) have increased dramatically over recent times. The IP protocols used on these PSN's provide a best effort service with no guarantee on the arrival time and state of the transmitted data. Voice and video over IP based PSN's requires real time network performance with minimum jitter, latency and packet loss. By setting up a SLA the eligible amount of jitter, latency and packet loss can be specified. The necessary data needed to conduct SLA violation detection and monitoring can be extracted from different points in the network. Achievability of realistic SLA violation detection and monitoring differs with these varying data extraction points in the network. This paper investigates the extraction of SLA related data from different extraction points in the network. Investigation will also be performed to create a satisfactory infrastructure to collect and process the required SLA parameters.

Index Terms — Jitter, Latency, Packet Switched Networks, Service Level Agreement and Quality of Service

I. INTRODUCTION

Voice and video transmission over the internet has increased dramatically over the last few years. Companies can conduct real time conferencing over the Internet. The software needed to conduct these sessions (e.g. NetMeeting® and Internet Phone®) is freely available on the Internet and incorporated into the latest operating systems.

Increases in voice and video sending over the Internet are due to increasing data rates achieved on the Internet and the fact that circuit switched networks (CSN's) is rapidly being replaced with PSN's. [1,2]

These IP based PSN's are a best effort service, meaning that there is no guarantee on the time taken to send the data packets to the necessary location and the state of the sent data packets when it reaches the desired location. [3,4]

Each packet transmitted over the PSN has a "time to live" parameter specified in the packet overhead. If the packet takes too long to reach the desired destination it will be deleted [1,2]. It must be remembered that not just the recent call will have packet loss but all the calls in progress will have packet loss when transmission time increases. This creates a poor quality of service (QoS), and as congestion increases more packets will be lost and the network stability will decrease. [4]

Voice and video transmission requires real time performance and a minimum of packet loss and jitter. Increases in network congestion will increase packet loss and jitter, decreasing the real time performance of the video and voice data transmission [5]. By setting up a SLA the eligible amount of jitter, latency and packet loss can be specified. Specified network capabilities could include network availability, permanent virtual circuit (PVC) availability, average roundtrip network delay, average round trip PVC delay, amount of jitter and packets lost for example. [6,7]

The aim of this project is to investigate SLA’s, specifically in the following fields.

- Needed data parameters: The SLA data parameters needed to conduct SLA monitoring and billing should be determined.
- Data extraction points: Different data extraction points within the network should be considered for the SLA data parameter extraction.
- Data format: The necessary data format for the billing infrastructure should be determined. The extracted data needs to be given to the billing infrastructure in the required format for processing.

By answering the above questions, we will determine if the current infrastructure can be manipulated to extract the necessary SLA parameter data, or if a system should be designed to extract and manipulate the necessary SLA parameter data.

II. VOICE OVER PSN’S, QoS AND SLA OVERVIEW

A. Voice over PSN’s

Voice over IP (VoIP) applications meets the challenges of combining legacy voice networks and PSN’s by allowing both
voice and data to be transported over the packet network. Traditional voice signals are digitized, divided up into packets and sent through the network. The receiving terminal receives the packets and reassembles the voice signal.

Transporting voice over these packet networks offers the opportunity for significant financial savings for both the client and the provider. These cost implications is due to the fact that PSN’s utilize its given bandwidth more efficiently [8,9].

Multiple calls can be entertained on a single transmission medium. Decreasing network construction time, construction costs and market entry time.

The advantages of reduced cost and bandwidth savings for VoIP networks are associated with some QoS issues for example.

Delay: Delay causes echo and overlap; some common causes of delay are accumulation delay (algorithm delay), processing delay and network delay.

Jitter: Caused by delays in packet delivery times through the network. Removing jitter can be utilized through lost packet compensation, echo compensation and buffering for example. The network must also be configured and managed to provide minimal delay and jitter enabling a consistent QoS [5].

Packet loss: Packet loss degrades the speech quality considerably. Packet loss is due to packets being dropped at the end of full queues for example.

B. Aim of QoS

The primary goal of QoS is to provide certain communication sessions with a greater priority than others. A communication session can be considered as a combination of source and destination addresses, source and destination socket numbers and the session identifier.

QoS applications must have control over network resources; they must use the network resources more efficiently and be adaptable. QoS can be subdivided into three parts each incorporating an aspect of the whole QoS process in the network.

• QoS identification and marketing techniques.

If a higher priority or preferential needs to be applied to a certain communication session, the communication session must firstly be identified.

Priority settings seen only within the router like priority and custom queuing for example are used to identify the packets on a per hop basis. If the priority needs to be visible in the entire network the precedence bits within the IP packet are set making the packet priority visible within the entire network [1].

• Single network element QoS.

Video and voice data sent over the packet networks are usually bursty and the required speed exceeds the speed of the link. Question that needs to be answered is;

What should the router do with the excess packets?
Must a FIFO (first in first out) approach be taken?
Should the excess packets be discarded [5]?

Techniques used in this situation include priority queuing, custom queuing and weighted queuing for example. Another approach is to try and stop the queue from filling up or to drop packets with a lower priority first before packets with a higher priority are dropped. This technique is called weighted early random select and is also used for the above problem [1].

Another method within the single network element is the compression of the amount of overhead contained in a packet. A large low priority packet could also be divided up into smaller packets and then interwoven between higher priority packets before sending.

• QoS policy, management and accounting functions to control and administer end-to-end traffic across the network.

Setting of precedence bits within the IP packet and routing to specific traffic engineered paths may be used to obtain a specific QoS through the network. Care should be taken that setting precedence bits within the IP packets should not be confused with routing packets based on configured policies. The network should be managed to uphold a certain QoS agreed upon within the SLA.

C. Service level agreements

The implementation of SLA's could be divided up into three different parts.

• Planning and calculating the necessary requirements for the SLA needed on the network.
• Monitoring of the network to see if the current SLA levels are being met.
• Troubleshooting and correction when the SLA levels aren't being met.

These three steps must be integrated for long term and short-term goals. The short-term goal is to implement troubleshooting techniques to ensure that the network is currently ensuring desirable services. The long-term goal however is to create or set up a network that will uphold these SLA specifications.
Why are SLA's important?

International companies use the PSN's to send crucial business data and they need the data to be delivered in a consistent and reliable manner. SLA's makes sure that this crucial business data is delivered in a reliable and consistent manner. As stated earlier real time voice and video requires certain bandwidths. These bandwidths can be obtained and guaranteed through setting up a SLA.

Service level agreements compel service providers to perform to a specific level of expertise. Service providers could suffer financial implications if they can't uphold the networks SLA parameters. This encouraged some service providers to design networks with SLA parameters exceeding the client's required SLA parameters, reducing their chances of client-based penalties.

1) SLA data extraction points

Different measurement extraction points include end-to-end (from the customer premise location) or just within the network (switch-to-switch). In a switch-to-switch implementation the end portion is ignored (user to switch), taking measurements in this fashion is not accurate because the user to switch network part has a profound impact on the network performance (see figure 1) [1].

![Figure 1 End-to-end and switch-to-switch measurement](image)

2) Basic components of PSN SLA's

SLA’s covering individual components allow less downtime than those covering entire networks. Due to the fact that the total network downtime consists of the underlying network elements downtimes. PSN SLA’s contains a number of key network system parameters, above and beyond typical signaling network system parameters. Typical signaling parameters may cover the network as a whole; in contrast SLA’s depends on the networks importance to a business and as stated allows less downtime than those covering entire networks.

PSN's SLA parameters include the following:

- Network availability
- (Permanent virtual circuit) PVC availability
- Average round trip network delay
- Average round trip PVC delay
- Effective PVC throughput
- Mean time to respond
- Mean time to repair or restore the fault [6,7]

As is clear, several SLA parameters depend on human responses to problems and thus can only be determined from the appropriate trouble reporting systems and not the network.

3) VoIP and multimedia SLA parameters

Parameters for SLA’s covering individual components like VoIP and multimedia can be extracted form their transmission protocol headers (H.323 and SIP) in an end-to-end topology [10].

H.323 is part of a family of ITU-T recommendations called H.32X that provides multimedia communications services over a variety of networks [6]. It specifies the components, protocols and procedures providing multimedia communications over PSN's. H.323 can be applied to carry audio only (IP telephony), audio and video (video telephony), audio and data and audio, video and data. The H.323 standard specifies four types of components, which when networked together provide point-to-point and point-to-multimedia communication services.

H.323 extractable parameters include the following:

- Caller IP address
- Destination IP address
- Master or slave determination
- Total packets lost
- Maximum delay
- Type of data (video, audio)
- Total size of transmission
- Amount of jitter

These parameters obtainable from the H.323 protocol headers could enable the monitoring and billing of SLA's [10].

III. H.323 Protocol Overview

H.323 also provides info on possible access points for collecting these parameters:

1. Terminals: An H.323 terminal can be any stand-alone device running an H.323 multimedia application. It can support audio communications and optional video
or data communications.

2. **Gateways**: A H.323 gateway provides connectivity between an H.323 network and a non-H.323 network.

3. **Gatekeepers**: Gatekeepers provide addressing, authorization and authentication of terminals and gateways, bandwidth management, accounting, billing and charging.

4. **Multipoint control units (MCU’s)**: MCU’s provide support for conferences of three or more H.323 terminals participating in the conference. Support includes coder/decoder (CODEC) determination for example [11].

IV. **CONCLUSION**

Available network extraction points for SLA parameters, and the effect on the SLA monitoring from these extraction points have been identified. Typical SLA parameter data needed for extraction has also been investigated. Leading us to the conclusion that SLA implementation must be done in conjunction with network source and system data, and trouble and repair system data. Thus a forth-flowing study has to be done into the applicable Telkom SA Ltd. information sources and systems in the light of international practices of SLA creation.

REFERENCES