

Adapted of full- layered Softswitch network architecture

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Abstract- The performance improvement of Full – layered Softswitch network architecture is presented in this by adding Routing Server (RS) , as a signaling server for searching the routes and the information for the subscribers among the Softswitchs. That can reduce the works of Softswitchs and can decrease the average of the call set up delay. Moreover, we present the analyzing model of Softswitch network by applying the Jackson's theory , and then we study by comparing the capacity of the proposed Softswitch network architecture and of Full-layered architecture of the Xu peng and others. The result is that the proposed network has a better result than Full – layered architecture of Xu peng , both analytical and numerical result.

Keywords - Softswitch, jackson network, full layer Architecture, Queueing Theory, Routing Server

I. INTRODUCTION

In the present time , the non-voice communication and the internet , sends the packet switch , has the important role in the daily life. We find that the packet switch network replaces the circuit switch. In fact, we cannot change the circuit switch to the packet switch because, they are too expensive and we can still use the old device. So, we present the Softswitch network which can support all types of data under the same network and it is popular all over the world. The Softswitch network is composed of the three principal structures: Media Gateway Controller (MGC) , Signaling Gateway (SG) , and Media Gateway (MG). First, Media Gateway Controller connects the different networks, such as H.323, SIP[1] ,MGCP and SS7. Second, Signaling Gateway is the pass way of SS7[2] , is sent by the PSTN network , is transformed for connecting to the IP network . Finally, Media Gateway signals between the PSTN network and IP network, such as the voice, the data, the fax and the video. The Xu Peng's[3] article categorizes three types of the Softswitch networks : Single layer Architecture (SLA), Subscriber Management and Signaling Routing Layered Architecture (SMSRLA) and Fully Layered Architecture (FLA). It analyzes the ability of three Softswitch networks by numerical model for calculating the call set up delay of each network and for comparing which network has least call set up delay . Later on Mr.

Phaithoon Phromsuphorn[4] and others reanalyzes the ability of three Softswitch networks by the mathematical model , in the name of Jackson Network, while Xu Peng does not analyze. The result is more closely by the numerical model but it can save more time and economize. From the study the Softswitch structure which is presented by Xu Peng , we found that the FLA has two layers : the upper layer and the lower layer. The lower layer connects the subscribers within the same Softswitch. The upper layer connects the subscribers in each Softswitch for the best quality. But it is disadvantage is that the call set up delay will increase there are many subscribers. So, in the article, we add the RS for managing the subscribers and routing in the Softswitch network. It appears that we can decrease the call set up delay while there are many subscribers.

II. FULL – LAYERED ARCHITECTURE

A. Full – Layered Architecture (FLA) of Xu Peng and others

Full – Layered Architecture of Xu Peng is divided by two classes, according to the subscribers. The lower class serves to the connect of the subscriber within the same Softswitch. The upper class serves to the connect of the subscribers in each Softswitch. But when there are many connections of the subscribers, the call set up delay will increase as Fig.1

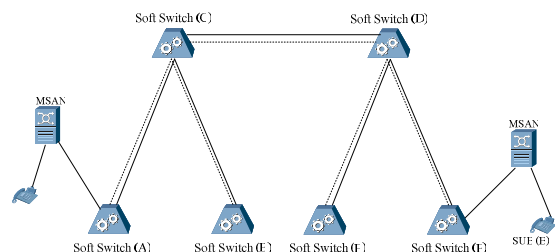


Fig.1 Full – Layered Architecture of Xu Peng and other

B. Adapted Full – Layered Architecture (AFLA)

Adapted Full – Layered Architecture is divided likely the FLA of Xu Peng and other ; that is the lower class connects the subscribers within the same Softswitch, the upper class connects the subscribers in

each Softswitch. But the Routing Server (RS) is add. Its function is the managing the subscribers and routing the information in Softswitch network for decreasing the call set up delay. When there are many subscribers, the RS does not manage the information within the Softswitch, but it will keep the connect of the subscribers within the Softswitch in the format of E.164 (E.164 Number Mapping) followed by IP subnet address. The RS can be used for routing and retransmitting as the Fig.2

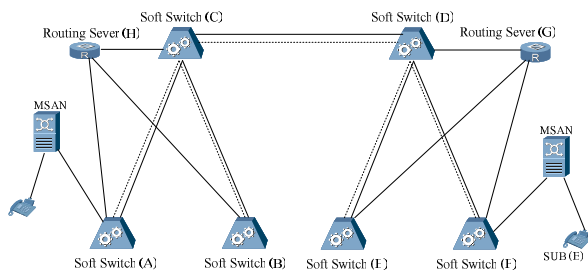


Fig.2 Adapted Full – Layered Architecture

III. ANALYSIS OF THE ABILITY OF THE SOFTSWITCH NETWORK

The functions of Softswitch are divided into a block diagram in Fig.3. The process which controls the call is the call control (CC) ; it is the most important of Softswitch. Another important thing is the Subscriber Management and Routing (SMR). It's functions are the management the information and routing of the subscribers. So, the queuing model in Fig 3 can be presented as Fig.4. As Fig. 4 , the theory of Jackson Network can be used for analyzing the queuing for calculating call set up delay of the Softswitch. The theory of Jackson network which is used for analyzing the queuing model in the open network. It interfaces with the external system.

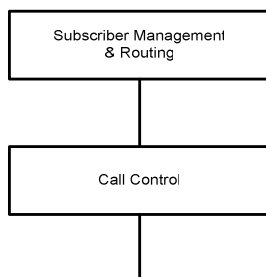


Fig.3 The function block diagram of the Softswitch

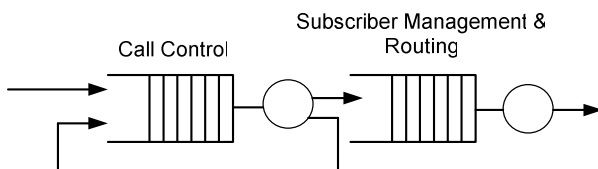


Fig.4 Queuing model of the Softswitch

The incoming data of this network is in the form of Poisson which has only one server [5] as the first equation.

$$I_i = g_i + \sum_{j=1}^m I_i P_{ij} \quad j = 1, 2, 3, \dots, m \quad (1)$$

I_i ; Average incoming rage of all data at node i

g_i ; Average incoming rage of outside data at node i

P_{ij} ; Probability that transfers from node i to node j

The average number of packets which store in nodes of the network can be calculated by the second equation.

$$N = \sum_{i=1}^m \frac{I_i}{m_i + I_i} \quad i = 1, 2, 3, \dots, m \quad (2)$$

N ; Average number of packets store in node of the network

m_i ; Spent time on the routing

The rate of the call set up delay in the time when the packets are in the network or (T) can be calculated by the third equation.

$$T = \frac{\sum_{i=1}^m \frac{I_i}{m_i - I_i}}{\sum_{i=1}^m g_i} \quad i = 1, 2, 3, \dots, m \quad (3)$$

The average of the call control in represent by C and t is the time in the routing for the subscribers. The value of t will increase when the subscribers increase. So, we can indicate $t = f(m)$; m is number of subscribers in one the Softswitch.

1) A ratio of the call requirement in the Softswitch network linearly increase and is relative with the increasing of the number of the connection between the sub subscriber and the Softswitch. We identify t as a ratio of call requirement. So, $t = am$; according to the traffic basic theory of the communication network.[6] a is defined by

$$a = \frac{\text{Traffic Single Subscriber}}{\text{Time Length Average call}}$$

$\text{Traffic SingleSubscriber}$ is the traffic of the subscriber and $\text{TmeLength}_{\text{AverageCall}}$ is an average time for call

2) d is the time delay in the signaling through the IP core

3) M is the all number of subscribers in the network

IV. SIMULATION RESULTS

We do the simulations in two steps.

A Mathematical model

We compare the call set up delay by the mathematical model ; “The theory of Jackson network” , for comparing the call set up delay of two architectures as Fig.5 The result is calculated under condition following.

1) $m = 10^7$ present the direct connection ability of the Softswitch per 10^7 subscribers.

2) $g = 10$, g is a ratio of the call requirement out of network.

3) $c = 0.03s$ present the average of the call control which is 0.03 seconds.

4) $t = fm = am$ present the time average of the call requirement and $a = 4,3 \times 10^{-8}$

5) The call set up delay when the signaling spends while it is on IP core is 0.025 seconds. So, $d = 0.025s$

6) The time average of the Routing server which is in the upper layer of the Softswitch So, $f(M, m) = aM / m$

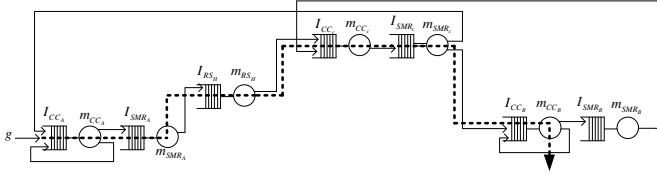


Fig.5 Queuing model of the AFLA network

According to Fig.5 we define

$$I_{CC_A} = g + \frac{I_{CC_A}}{2} + \frac{I_{SMR_C}}{2}, I_{SMR_A} = \frac{I_{CC_A}}{2},$$

$$I_{RS_H} = I_{SMR_A}, I_{CC_C} = I_{RS_H} + I_{SMR_B},$$

$$I_{SMR_C} = I_{CC_C}, I_{CC_B} = \frac{I_{SMR_C}}{2} + \frac{I_{CC_B}}{2}, I_{SMR_B} = \frac{I_{CC_B}}{2}$$

We calculate the call set up delay by

$$T = T_{CC_A} + T_{SMR_A} + T_{RS_H} + T_{CC_C} + T_{SMR_C} + T_{CC_B} + 2d$$

$$T_{CC_A} = \frac{4gC}{g - 4g^2C}, T_{SMR_A} = \frac{2gam}{g - 2g^2am},$$

$$T_{RS_H} = \frac{2gaM}{mg - 2g^2aM}, T_{CC_C} = \frac{2gC}{g - 2g^2C},$$

$$T_{SMR_C} = \frac{2gaM}{mg - 2g^2aM}, T_{CC_B} = \frac{2gC}{g - 2g^2C},$$

$$T = \frac{4gC}{g - 4g^2C} + \frac{2gam}{g - 2g^2am} + \frac{2gaM}{mg - 2g^2aM} + \frac{2gC}{g - 2g^2C} + \frac{2gaM}{mg - 2g^2aM} + \frac{2gC}{g - 2g^2C} + 2d$$

From Fig.6, it presents the comparison the call set up delay of the subscribers between the FLA of Xu Peng and AFLA which adds the Routing Server. From the graph, the X axis represent the call set up delay whose unit is the second and the Y axis represent the number of all subscribers in the Softswitch network. The call set up delay of the AFLA which is represent by $\square$ give the call set up delay less than the FLA network of Xu Peng which is represent by $\triangle$. From Fig.6, when there are subscribers who connect with the Softswitch network are 3.2×10^7 , the call set up delay will more increase because the device in the network fully work both FLA and AFLA.

B Simulation model

We compare the call set up delay by the method of working simulation by the MATLAB Program which is performed in the FLA network of Xu Peng and other and The AFLA network. The traffic which is used in the network is from 1 to 10^7 . The average incoming service time of traffic is in form of Poisson and the average service time of traffic is in form of Exponential. We do 100 experiments by a PC Pentium 4, 2.8 GHz, 512 MByte DRAM for comparing between the process of the FLA network of Xu Peng as flow chart in Fig.7 and the process of the AFLA network as flow chart in Fig.8. The Fig.6 present the comparison the call set up delay of the subscribers between the FLA network of Xu Peng and the AFLA network which the RS is added by the method of working simulation by the MATLAB Program. We find that the AFLA network which is represented by $\square$ gives the call set up delay less than the FLA network of Xu Peng is represented by $\triangle$ as Fig.6

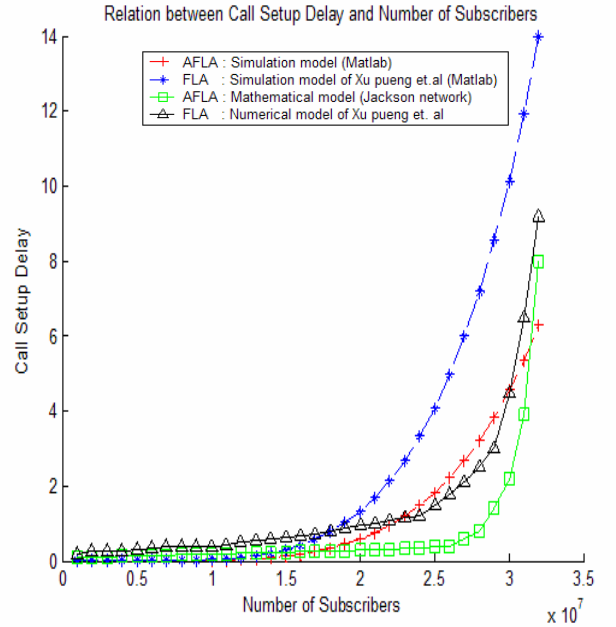


Fig.6 comparison the call set up delay of the subscribers between the FLA and the AFLA

V. THROUGHPUT

$Throughput(T_p)$ means the number of works that the network does in the data sending. The theory of Jackson network defines that N is the numbers of packets that rest in the node of all network. $1 - N$ is the probability of packet that can be sent. So we can calculate $Throughput$ from this equation.

$$Tp = 1 - \frac{N}{I_i}$$

T_p ; $Throughput$ of the network

From Fig9, the comparison $Throughput$ or the number of works that the network does in the data sending between FLA and AFLA is presented. It appears that the AFLA network that is improved, gives $Throughput$ more than FLA network of Xu Peng both the simulation of working

in the Matlab program (—+ AFLA, —* FLA) of the analysis by the theory of Jackson network. (—□ AFLA, —△ FLA) We assume that the AFLA network can send the data better than Xu Peng network.

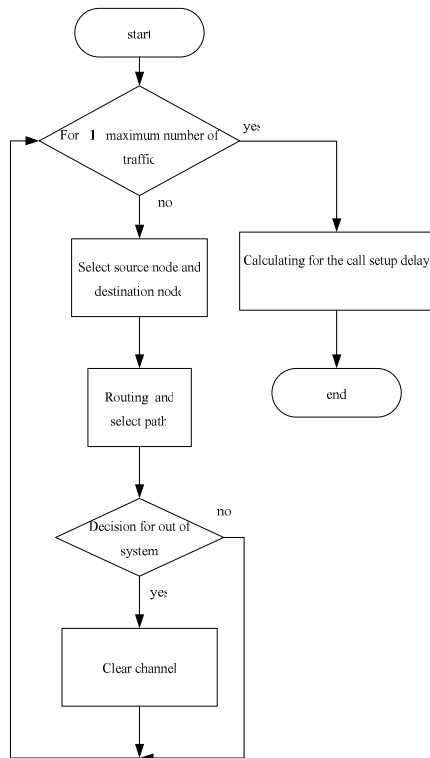


Fig.7 Flow chart working of the FLA network

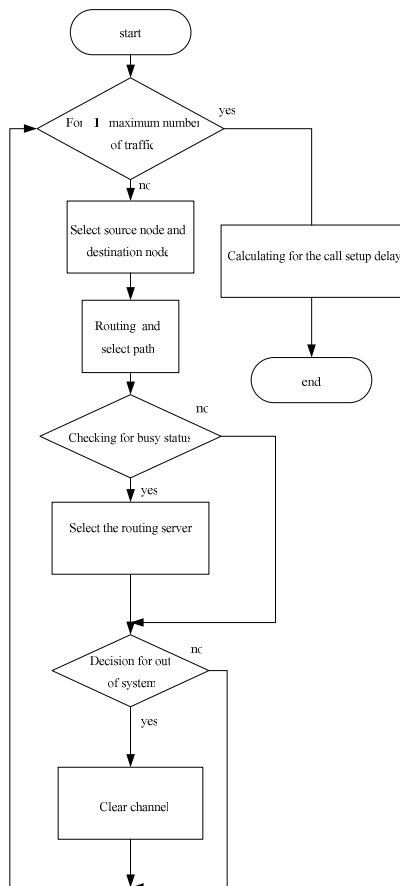


Fig.8 Flow chart working of the AFLA network

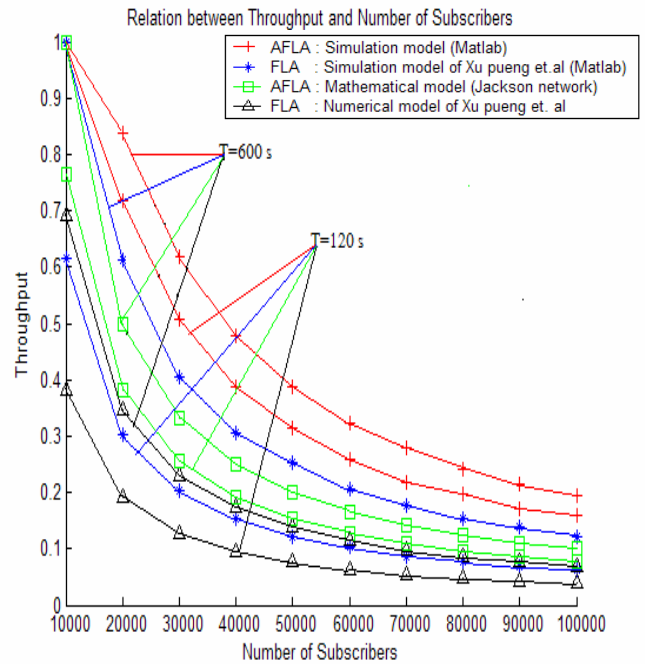


Fig.9 Comparison Throughput between FLA and AFLA

VI. CONCLUSION

From the experiment, we assume that the call set up delay of the FLA network of Xu Peng is more than the AFLA network. It present that the adding the RS makes the better sending data among the Softswitches within the network, so the time of signaling within the network is decreased very much. However, the result of call set up delay presented Fig.6 is closely when there are the subscribers less than 1.5×10^7 and it will be changed when the traffic increased because the value in the distribution model of traffic input and service may be not satisfy.

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