SS7 ROUTING LOGIC TO SUPPORT LOAD-SHARING AND RELIABILITY OF SCCP MESSAGES USING ROUTES OF HETEROGENEOUS LINK TYPES

SRINIVASA RAJU KASIRAJU

Research Scholar - ECE, Jawaharlal Nehru Technological University (JNTU), Hyderabad, India-500072

E-mail: srinivasa.kasiraju@gmail.com

ABSTRACT

This paper provides logic to overcome the standard SS7 load-sharing algorithms for SCCP messages. Logic provides flexibility to support load-sharing non- 2^n links within a link-set. Logic also takes into consideration typical service providers' SS7 signaling network with network elements supporting different or mix of SS7 link types such as 64kbps low-speed link and 2mbps high-speed links.

Keywords: *Common channel signaling (CCS), Signaling system 7 (SS7), Message transfer part (MTP), Signaling connection control part (SCCP),Signaling Link Selector (SLS), Signaling Link Code (SLC), Message Signaling Unit (MSU) Intelligent Network (IN), low speed link (LSL), High speed link (HSL), link-set, route, route-set, load-sharing, algorithm*

1. INTRODUCTION

Worldwide mobile telephony has shown exponential growth during last few years. Apart from basic and supplementary services, service providers are always in pursuit for increasing mobile penetration, customer satisfaction and newer means of revenue generation. Value added services such as roaming, international roaming, intelligent network services, SMS etc., are significant contributor. These services are SCCP based and are bandwidth intensive for SS7 signaling links. Growing need for these SCCP based messages prompted for considerable dependency on high-speed signaling links (HSL) from existing low-speed signaling links (LSL).

If deployed with route-set for combinations of HSL and LSL link-set dependent routes, standard SS7 load-sharing algorithm would affect adversely the link loading of LSL link-sets. Thus, in network planning the general practice is be to make use for either HSL or LSL link-set and not a mix while defining load-sharing route-sets and under-utilize with routing inefficiency. Standard SS7 load-sharing algorithm is based on 4-bit SLS for ITU and thus does not support using more than two link-sets in a combined link-set with a total of 16 links. It is thus desirable to support all provisioned links in a link-set while supporting more than two link-sets in a route-set for effective routing and network planning.

This paper describes a SLS and routing determination to support MTP load-sharing for SCCP user messages with any or all possibilities mentioned below a. through c.

a. Non- 2^n links within a link-set.

b. Route-set with mix of LSL and HSL link-sets.

c. Eight (8) routes within a route-set.

2. STEPS AND PROCEDURE

SS7 routing logic to support load-sharing and reliability of SCCP messages using routes of heterogeneous link types includes the following major steps :

a. Procedures for relative link weight.

b. Procedures for relative weight for routes in route-set for specific destination.

c. Route identification procedures

d. Link identification within link-set.

Procedure for relative link weight : In Signaling point (SP) or Signaling transfer point (STP) attribute link-set type plays a significant role for determination of link weight. Average MSU size can help determine the weight to be used based on the link type i.e., LSL, ITU-HSL and ATM-HSL. For the purpose of this paper an average MSU size of 150 octets is considered.

a. If link type is not varying across the link-sets defined for routes in the route-set each available link will use weight = 1, i.e., equal weight.

b. Else if, any link-set using type = LSL the weightage table for LSL, ITU-HSL and ATM-HSL will used, for example each active link of type LSL = 1, ITU-HSL = 16, ATM-HSL =22 weights will be used.

c. Else weightage table for ITU-HSL and ATM-HSL will be used for example for each active link ITU-HSL = 2, ATM-HSL = 3 weights will be used.

Next step is accumulation of link weights of all links in each link-set of the route-set defined as routes.

Procedure for relative weight of link-set defined as routes of a route-set : Based on the accumulated weights of links of link-set compute relative absolute weight of link-set of a route-set using following steps:

a. Reference : Set link-set with least weight as reference.

b. Division : Divide and round-off accumulated weight of each link-set with accumulated weight of reference link-set.

c. Addition : Add thus computed relative weights of each link-set in route-set and compute the total weight of route-set.

d. Compute : Compute the next 2^n value (modulo_2) to represent total weight of route-set say, ***route_set_modulo_2*** value.

e. Check : If total weight of route-set is greater than 2^5 (=32) then set the reference link-set as dormant link-set.

f. Iteration : Re-execute the procedure of relative link weight excluding determined dormant link-set and relative weight of link-set until the total weight of route-set is less than 2^5 (=32).

g. Padding : Identify the difference between link_set_modulo_2 value and the total weight of route-set. Add the difference to the highest weight link-set, if more than 1 link-set with highest weight distribute evenly the difference.

Route identification procedure: Order of routes within route-set is used. A maximum of 8 link-sets can have same priority within routeset and thus with an assumption of maximum 8 link-sets with same priority, route is determined using following steps

a. An internal 8-bit SLS i.e., 256 SLS values are used.

b. First three most significant bits (MSB) i.e., bits H, G, F in position 8,7,6 are ignored and set as don't care.

c. Using bits E, D, C, B & A (0-31) and the order of route in route-set are attributed sequentially per route using the weights computed earlier.

d. Thus, all MSUs originated are distributed based on the weight of each route.

Link identification within a link-set: Order of routes within route-set is used. A maximum of 8 link-sets can have same priority within routeset. Thus with an assumption of maximum 8 link-sets with same priority, route is determined using following steps:

a. Incoming SLS value is ignored for link selection if MSU is transferred, but can be transparently passed in the outgoing MSU. For link selection a new SLS value as derived below will be used.

b. For all outbound MSU, same 8-bit SLS generator is used. To sustain desired distribution starts independent of MSU rate, SLS bit position can be re-ordered in such a way that don't care bits H,G & F for route selection have significant role. For example, positioned in such a way that SLS is read as E, D, H, C, G, B, F, A.

c. A static table (Table 1. SLS to SLC selector) for SLS to a SLC selector is used.

d. This table provides the mapping for SLS to SLC value, for example if the computed SLS (E, D, H, C, G, B, F, A) = 96 then the link with SLC 10 of the link-set is selected. But if links with SLC 10 or SLC 11 are unavailable or not applicable in such case SLC 3 is selected.

8-bit SLS Values	Priority SLC (Left to Right)															
0,17,34,51,68,85,102,119,136,153,170,187,204,221,238,255	0	1	9	2	12	6	14	4	10	3	13	7	11	8	15	5
1,18,35,52,69,86,103,120,137,154,171,188,205,222,239,240	15	14	6	1	13	3	11	5	9	2	8	12	4	0	7	10
2,19,36,53,70,87,104,121,138,155,172,189,206,223,224,241	2	3	11	0	4	14	6	12	9	15	8	13	10	5	1	7
3,20,37,54,71,88,105,122,139,156,173,190,207,208,225,242	13	12	4	15	11	1	9	3	7	2	8	6	14	0	5	10
4,21,38,55,72,89,106,123,140,157,174,191,192,209,226,243	4	5	13	6	0	10	2	8	14	11	1	15	7	12	9	3
5,22,39,56,73,90,107,124,141,158,175,176,193,210,227,244	11	10	2	13	9	15	7	1	5	14	4	8	0	12	6	3
6,23,40,57,74,91,108,125,142,159,160,177,194,211,228,245	6	7	15	4	8	2	10	0	13	3	9	12	5	1	14	11
7,24,41,58,75,92,109,126,143,144,161,178,195,212,229,246	9	8	0	11	7	13	5	15	3	6	12	10	2	14	4	1
8,25,42,59,76,93,110,127,128,145,162,179,196,213,230,247	8	9	1	10	4	14	6	12	2	11	5	15	0	13	3	7
9,26,43,60,77,94,111,112,129,146,163,180,197,214,231,248	7	6	14	9	5	11	3	13	1	10	0	4	12	8	15	2
10,27,44,61,78,95,96,113,130,147,164,181,198,215,232,249	10	11	3	8	12	6	14	4	1	7	13	0	9	5	2	15
11,28,45,62,79,80,97,114,131,148,165,182,199,216,233,250	5	4	12	7	3	9	1	11	15	10	0	14	6	8	2	13
12,29,46,63,64,81,98,115,132,149,166,183,200,217,234,251	12	13	5	14	8	2	10	0	6	9	3	7	15	4	11	1
13,30,47,48,65,82,99,116,133,150,167,184,201,218,235,252	3	2	10	5	1	7	15	9	13	6	12	0	8	4	11	14
14,31,32,49,66,83,100,117,134,151,168,185,202,219,236,253	14	15	7	12	0	10	2	8	5	11	1	4	9	13	3	6
15,16,33,50,67,84,101,118,135,152,169,186,203,220,237,254	1	0	8	3	15	5	13	7	11	14	4	2	10	12	9	6

Table 1. SLS value to SLC selector.

e. For the MSUs which are originated by the signaling entity will use SLS = SLC in the MSU.

f. Using above procedures, it is possible to overcome ITU limitation for 2^n links within a link-set for load-sharing.

g. Even when the weight of a specific route is 1 (one) , 8-bit SLS mapping provided in Table-1 allows near-equal load-sharing across all links of the specific link-set.

3. CONCLUSION

Modeling using various traffic patterns for both message-transfer and message origination the results show that using above procedures the traffic distribution is

a. Across all routes irrespective of the types of links.

b. Traffic is controlled based on the available bandwidth.

c. Load-sharing is dependent on bandwidth available per route and thus percentage loading of all links involved is almost equal.

REFERENCES:

[1] Jonathan L. Wang, "Traffic routing and link dimensioning in the common channel signaling networks", *Journal Telecommunication Systems*, *Springer Netherlands*, ISSN:1018-4864 (Print) 1572-9451 (Online) Issue, Volume 1, Number 1 / December 1993,Pages295-320

[2] ITU-T Recommendation Q.705 Signaling System No. 7 - Signaling Network Structure

[3] ITU-T Recommendation Q.715, Specification of Signaling System No.7 - Signaling connection control part (SCCP) user guide

[4] ITU-T Recommendation Q.751.1, Network element management information model for the Message Transfer Part (MTP)

[5] ITU-T Recommendation Q.751.2, Network element management information model for the Signaling Connection Control Part

BIOGRAPHY:

Srinivasa Raju Kasiraju received the degree in ECE from Nagarjuna University, Guntur, India, in 1994. He is an external research scholar of Jawaharlal Nehru Technological University, Hyderabad, India under the guidance of Dr.Ranabir Gupta and Prof.Dr.P.G.Krishna Mohan. He is working as Principal Consultant in Telcordia Technologies Pvt Ltd., Hyderabad, India. His research interests are in wireless intelligent networks and messaging protocols.