THE WAY OF CALCULATING THE TRAFFIC AND SIGNALING NETWORK
DIMENSION OF COMMON CHANNEL SIGNALING NO.7 (CCS7)

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Abstract: Calculating the traffic and dimension needs to be done at the planning of telecommunication network, because, by calculating the traffic we will find out the amount of the traffic which will be transferred and by calculating the dimension we will find out the amount of the network needs to be provided. And at the CCS7 signaling network as well, calculating the traffic and dimension needs to be implemented.

CCS7 constitutes multi-function signaling type which enables to the transfer the whole information data such as voice, computer data in high speed, and vision, which can be controlled through the CCS7 signaling network.

CCS7 signaling system is only able to work in digital central, constitutes the last signaling system of the group of telephone signaling recommended by International Telecommunication Union (ITU) which previously named Committee Consultative/International Telegraph and Telephone (CCITT), which works by “out of band” (common channel) so the network supported can efficiently work.

In calculating the traffic and dimension CCS7 involves four objects, i.e. by calculating the traffic inter end node called Signaling End Point (SEP) inter traffic, calculating the traffic in connection line inter node called linkset traffic, and calculating the node dimension called Signaling Point (SP) dimension.

1. INTRODUCTION

The need of telecommunication service for the user is more various, thus the high speed, effective, and efficient signaling system is needed. CCS7 constitutes a solution of signaling system which has the ability to give excellent telecommunication service which:

- Has optimal ability to use in digital communication network together with central digital of stored program control, used the digital canal of 64 Kbps
- Is designed for information transfer call control provision for now and in the future, remote control, management and maintenance
- Has the good ability in transferring the information with correct sequence without loss.

Some applications which can be supported by CCS7 are Public Switch Telephone. Network (PSTN), Integrated Switch Digital Network (ISDN), Intelligence Network (IN), Personal Communication Network (PCN), (CCITT, 1981).

In designing the signaling network CCS7, we need to calculate the traffic and dimension. First of all, we will discuss the calculation of the traffic inter SEP. With the result of the calculation, we continue calculating the linkest traffic. Furthermore, according to the result of linkest traffic calculating we will discuss about the calculating of Linkset Dimension and SP Dimension.

Traffic inter SEP is calculated by finding out the input data i.e. calling and signaling data; the calculation is done by multiplying the calling data and signaling data. Whereas, linkset traffic is calculated by finding out the input data i.e. inter traffic SEP and route arrangement; the calculation is done by summing up every SEP inter traffic which is routed to the linkset.

Linkset dimension is faster calculated, which is determined by the input data i.e. the byte integration linkset traffic. The determination is done by using the table of maximum linkset capacity made by ITU.

SP dimension is calculated by the input data i.e. traffic linkset integration of Message Signal Unit (MSU), and the calculating is done by summing up all the linkset traffic sent and received by SP.

2. CCS7 ARCHITECTURE

Telecommunication network is made from several switching and processing node interconnected by the link transmission. In this
case, communication by using CCS7, the nodes need feature CCS7 so that they can be functioned as SP.

SP is a node which is able to handle the control message of CCS7. In order make the information or the data can be sent or received inter SP, the interconnection through link signaling is needed.

In CCS7, the control message is routed in shape of packages through the network for forming call management function (set up, maintenance, termination) and management network function. One circuit is determined by the local central in which one user is connected to another user by passing one or more other circuit switching node used as Transit Center (TC).

Figure 1 shows the architecture of CCS7 in telecommunication network (1).

![Architecture of CCS7 in telecommunication Network](image)

3. NETWORK MODEL OF PSTN, IN, AND CCS7

In calculating the traffic and dimension of CCS7, we can see the network model in Figure 2 to help the discussion:

![Network model: Public Switch Telephone Network (PSTN); Intelligent Network (IN), and Common Channel Signaling no.7 (CCS7)](image)

In figure 2, there are 3 networks i.e. PSTN, IN, and CCS7 network. PSTN and IN network represent the network served by CCS7, and CCS7 network itself i.e. the network which will discuss for the traffic and dimension calculating. PSTN network in Figure 2, is determined by three node, i.e. node A as Local Exchange (LE) called A (LE), node B as Local Transit exchange (LT) called node B (LT); and node C as Local Exchange (LE) called node C (LE). In PSTN network, the connection lines of node A (LE), B (LT) and C (LE) is represented by thick line in the shape of circuit group.(ITU,1992)

IN network in figure 2 is determined by 2 nodes, i.e. node B as Service Switching Point (SSP) called node B (SSP), and node D as Service Control Point (SCP) called node D (SCP). In this network, between node B (SSP) and node D (SC) (broken line) there is no connection line inter nodes, because the linkset connecting SSP and SCP through Signaling Transfer Point (STP) considered as a part of CCS7 network.

CCS7 network in figure 2 is represented by 5 nodes, i.e.: node A, node B, node C, and node D, as Signaling End Point (SEP) called as node A (SEP), B (SEP), C (SEP), D (SEP), and node E as Signaling Transfer Point (STP) which is called as node E (STP).

In this network, the connection line inter node A (SEP), B (SEP), C (SEP), D (SEP), and E (STP) in the shape of linkset is represented by broken lines. The model of CCS7 network is arranged in star configuration, where SEP is only connected to STP, which means signaling inter SEP is always routed through STP. (ITU, 1992)

Although the model above only describe the service of CCS7 to PSTN and IN network. But it also can represent the service to cellular
network. For example GSM (Global System for Mobile Communication), where SSP and SCP in IN can be equalized respectively with MSC/VLR (Mobile Switching Center/Visitor Location Register) and HLR (Home Location Register). Whereas, LE and LT in PSTN can be equalized with MSC in GSM.

4. CALCULATING THE TRAFFIC AND DIMENSION OF CCS7 NETWORK

Calculating the traffic and dimension of CCS7 involves 4 objects, i.e.:
- Calculating the traffic inter end node called traffic inter SE
- Calculating the traffic in connection line inter node called linkset traffic
- Calculating the dimension of connection line inter node called linkset dimension
- Calculating the node dimension called SP dimension

The ways of calculating the 4 objects above will be discussed in this paper.

4.1 The way of Calculating the Traffic inter end node (Traffic inter SEP)

MSU (Message Signal Unit) current which moves from a SEP to other SEP through linkset is the shape of signaling traffic of CCS7, where in this current of CCS7 network, there are 2 kinds of traffic, namely:
- The traffic from one SEP to another SEP by ignoring linkset (traffic inter SEP).
- The traffic that flows to the linkset (linkset traffic) constitutes routing result of some traffic inter SEP to the linkset.

Because of interactive feature of signaling, MSU-forward traffic and MSU-reverse traffic occurred in every signaling directions. Consequently, MSU-forward traffic and MSU reverse traffic must be calculated in every signaling directions.

Thus, for example, the model in Figure 2, traffic inter SEP which must be calculated can be seen in Table 1.

The data needed to calculate inter SEP are:
- Calling data (occupation of circuit for PSTN and digit translation demand IN)
- Signaling demand (MSU data/calling and byte/MSU)

For the calling data, it needs:
- The number of calling/sec = P
- Success calling ratio = PS (%)

Table 1. Traffic Inter SEP Which Must be Calculated for the Model in Figure 2

<table>
<thead>
<tr>
<th>Signaling direction</th>
<th>No signaling direction</th>
<th>Traffic Calculated</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A to B</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>A to B</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>B to A</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>B to A</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>B to C</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>B to C</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>C to D</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>C to D</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>B to D</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>B to D</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>D to B</td>
<td>-</td>
<td>Traffic MSU-reverse</td>
<td>-</td>
</tr>
<tr>
<td>A to C</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
<tr>
<td>C to A</td>
<td>-</td>
<td>Traffic MSU-forward</td>
<td>-</td>
</tr>
</tbody>
</table>

Because in IN the calling (digit translation demand) from SCP to SSP never occurs

Because there is no circuit between A (LE) and C (LE), so that there is no calling (sincerely occupation) between the 2 nodes
Table 2. The Data Needed to the Calculation Inter SEP for “Calling Data” in the Model in Figure 2

<table>
<thead>
<tr>
<th>Calling Directions</th>
<th>Kinds of service</th>
<th>Calling/sec = (P)</th>
<th>Success Calling Ratio = (PS) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (LE) to B (LT)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (LT) to A (LE)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B(LT) to C (LE)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C (LE) to B (LT)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (SSP) to D (SCP)</td>
<td>1 2 n</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The complete data needed for the calculation of inter SEP for “Calling Data” in the example of Figure 2 can be seen in Table 2.

That is so the complete data needed to calculate traffic inter SEP for “Signaling Data” in the model in Figure 2:
- The average number of MSU-forward/the calling for success calling = MSU_MS (MSU/calling)
- The average number of Byte/MSU-forward for success calling = Byte_MS (Byte/MSU)
- The average number of MSU-reverse/the calling for success calling = MSU_BS (MSU/calling)
- The average number of Byte/MSU-reverse for success calling = Byte_BS (Byte/MSU)

Table 3. Data needed for Inter SEP Calculation for “Signaling Data” in the Model Sample in Figure 2

<table>
<thead>
<tr>
<th>Signaling Direction</th>
<th>Kinds of Service</th>
<th>Success Calling</th>
<th>Fail Calling</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MSU-forward/calling</td>
<td>Byte/MSU-forward</td>
<td>MSU-reverse/calling</td>
</tr>
<tr>
<td>A(SEP) to B(SEP)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B(SEP) to A(SEP)</td>
<td>1 2 n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B(SEP) to C(SEP)</td>
<td>1 2 n</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C(SEP) to B(SEP)</td>
<td>1 2 N</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B(SEP) to D(SEP)</td>
<td>1 2 n</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The complete data needed for the calculation of inter SE for “Calling Data” in the example of Figure 2 can be seen in Table 2.

That is so the complete data needed to calculate traffic inter SEP for “Signaling Data” in the model in Figure 2:
- The average number of MSU-forward/the calling for fail calling = MSU_MG (MSU/calling)
- The average number of Byte/MSU-forward for fail calling = Byte_MG (Byte/MSU)
- The average number of MSU-reverse/the calling for fail calling = MSU_BG (MSU/calling)
- The average number of Byte /MSU-reverse for fail calling = Byte_BG (Byte/MSU)

For the calculating of traffic inter SEP for Signaling Data above, for example in Figure 2 can be seen in Table 3.

The signaling data needed is data MSU/calling and byte/MSU. Byte/MSU is used to change MSU unit to byte. Because of the traffic calculation output is stated in two units,
i.e. MSU and byte, so we need to change from MSU to byte, whereas MSU is later for calculating the linkset dimension.

The calling and signaling data above is needed for every calling direction or signaling and kinds of services, because every calling direction or signaling has different calling characteristics or signaling although they are in the same service. And also every kind of services has different calling or signaling characteristics, although the calling or signaling direction are the same. (ITU 1992).

In PSTN, if the calling data/second is not provided, for data instead can be used is the data volume traffic in erlang or data of circuit number, and because the data needed is the number of calling/second, the data of erlang traffic or the number of circuit must be changed first into the shape of calling/second before used for the calculation inter SEP.

In order to change erlang traffic data into the shape of calling/second, we need the data of average circuit held time in second (W). Thus, the change of erlang traffic data into the form of calling/second can be done by using formula (Siemens AG, 1994):

\[
\text{Calling/sec} = \text{traffic (erlang)} = W \text{ (sec)} \ldots (1)
\]

By adding the circuit number data first into the erlang traffic and from the traffic erlang then changed into the calling/second, we can change the circuit number data into calling/second. The changing of circuit number data into the erlang traffic is using circuit efficiency parameter obtained by using the formula (Siemens, 1994):

\[
\text{Erlang traffic} = \text{Efficiency} \times \text{total circuit} \ldots (2)
\]

The calculation of traffic inter SEP for every directions of MSU must be done two times because the output respectively result in output with MSU unit and byte. So, the calculation of traffic which must be done for every signaling directions became two direction of MS with two calculation each, results in the calculation of traffic for every signaling directions became four times calculation.

The calling data and signaling data provided by every signaling directions are the data per kind of service. So, the traffic inter SE per signaling direction constitutes the agregation from traffic per kind of service (Siemens AG, 1994). The calculation of traffic inter SEP for every signaling directions which contains four calculation (every signaling directions becomes two directions of MSU with two calculations each) can be done by the formula below.

**Signaling X to Y:**

\[
\begin{align*}
\text{Traffic MSU-forward (MSU/sec)} & = \sum_{i=1}^{n} \{P_S_i \times \text{MSU}_{MSi} + (1-P_S_i) \times \text{MSU}_{MGi}\} \ldots (3) \\
\text{traffic MSU-forward (bytesec)} & = \sum_{i=1}^{n} \{P_S_i \times \text{MSU}_{MSi} \times \text{Byte}_{MSi} + (1-P_S_i) \times \text{MSU}_{MGi} \times \text{Byte}_{MGi}\} \ldots (4) \\
\text{Traffic MSU-reverse (MSU/sec)} & = \sum_{i=1}^{n} \{P_S_i \times \text{MSU}_{BSi} + (1-P_S_i) \times \text{MSU}_{BGi}\} \ldots \ldots (5) \\
\text{traffic MSU-reverse (bytesec)} & = \sum_{i=1}^{n} \{P_S_i \times \text{MSU}_{BSi} \times \text{Byte}_{BSi} + (1-P_S_i) \times \text{MSU}_{BGi} \times \text{Byte}_{BGi}\} \ldots \ldots (6)
\end{align*}
\]

Where:

- \(\text{MSU}_{MS}\) (MSU/Calling) = the average number of MSU-forward the calling for success calling.
- \(\text{Byte}_{MS}\) (Byte/MSU) = the average number of Byte/MSU-forward for success calling.
- \(\text{MSU}_{BS}\) (MSU/Calling) = the average number of MSU-reverse the calling for success calling.
- \(\text{Byte}_{BS}\) (Byte/MSU) = the average number of Byte/MSU-reverse for success calling.
- \(\text{MSU}_{MG}\) (MSU/Calling) = the average number of MSU-forward the calling for fail calling.
- \(\text{Byte}_{MG}\) (Byte/MSU) = the average number of Byte/MSU-forward for fail calling.
- \(\text{MSU}_{BG}\) (MSU/Calling) = the average number of MSU-reverse for fail calling.
4.2 The Way to Calculate the Traffic in Connection Line inter ode (Traffic Linkset)

Linkset is the connection line inter any node CCS7 to SEP as well as STP. The Traffic that flows in linkset traffic constitutes the traffic present in the network, and obtained from the traffic routing inter SEP to the linkset. So, the Linkset traffic will be influenced by the network configuration and the traffic routing pattern as well. Linkset traffic is not calculated for every signaling directions, but for every linkset. This is because the linkset traffic constitutes the traffic inter any node is not always the signaling passer node or SEP.

Although the two direction MSU is always in every linkset, the direction of MSU traffic can not be stated as MSU-forward traffic and MSU-reverse traffic. The direction of MSU traffic is only stated as two SEP/STP which flanks the linkset. This is because the MSU-forward traffic and MSU-reverse traffic present in one signaling direction in the traffic inter SEP is routed in one identical linkset. And there is no signaling direction reference because the traffic inter any node is not always signaling node. (Siemens AG, 1994).

For the sample model in Figure 2, the linkset traffic calculation must calculated and can be seen in Table 4.

Table 4. Linkset Traffic Which Must be Calculated for Model Sample in Figure 2

<table>
<thead>
<tr>
<th>Linkset</th>
<th>Linkset Traffic Which Must be calculated</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE</td>
<td>MSU traffic from A to E</td>
</tr>
<tr>
<td>AE</td>
<td>MSU traffic from E to A</td>
</tr>
<tr>
<td>CE</td>
<td>MSU traffic from C to E</td>
</tr>
<tr>
<td>CE</td>
<td>MSU traffic from E to C</td>
</tr>
<tr>
<td>BE</td>
<td>MSU traffic from B to E</td>
</tr>
<tr>
<td>BE</td>
<td>MSU traffic from E to B</td>
</tr>
<tr>
<td>DE</td>
<td>MSU traffic from D to E</td>
</tr>
<tr>
<td>DE</td>
<td>MSU traffic from E to D</td>
</tr>
</tbody>
</table>

All traffic inter SEP is always routed through STP, so for the model sample in Figure 2, the Linkset traffic calculation for every linkset is:

Table 5. The Calculation of Linkset Traffic for Model Sample in Figure 2

<table>
<thead>
<tr>
<th>Linkset</th>
<th>MSU Traffic from …..</th>
<th>Linkset Traffic Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>AE</td>
<td>A to E</td>
<td>= MSU-forward traffic A to B signaling + MSU-reverse traffic B to A signaling ..........(7)</td>
</tr>
<tr>
<td>AE</td>
<td>E to A</td>
<td>= MSU-forward traffic B to A signaling + MSU-reverse traffic A to B signaling ..........(8)</td>
</tr>
<tr>
<td>CE</td>
<td>C to E</td>
<td>= MSU-forward traffic C to B signaling + MSU-reverse traffic B to C signaling ..........(9)</td>
</tr>
<tr>
<td>CE</td>
<td>E to C</td>
<td>= MSU-forward traffic B to C signaling + MSU-reverse traffic C to B signaling ..........(10)</td>
</tr>
<tr>
<td>BE</td>
<td>B to E</td>
<td>= MSU-forward traffic B to A signaling + MSU-reverse traffic A to B signaling + MSU-forward traffic B to D signalling ..........(11)</td>
</tr>
<tr>
<td>BE</td>
<td>E to B</td>
<td>= MSU-forward traffic A to B signaling + MSU-reverse traffic B to A signaling + MSU-forward traffic C to B signaling + MSU-reverse traffic B to D signalling ..........(12)</td>
</tr>
<tr>
<td>DE</td>
<td>D to E</td>
<td>= MSU-forward traffic B to D signaling ..........(13)</td>
</tr>
<tr>
<td>DE</td>
<td>E to D</td>
<td>= MSU-forward traffic B to D signaling ..........(14)</td>
</tr>
</tbody>
</table>

The calculation in Table 5 is respectively done by using: first, the MSU unit, and second, the output byte from the traffic inter SEP.
4.3 The Way to Calculated the Dimension of Inter Node Connection Line (Linkset Dimension)

Connection line inter any node (linkset) connecting SP constitutes the signaling link horde, any the digital transmission canal constitutes the shape of signaling link, in which the are two transmission direction which has the speed of 64 Kbit/second or 8Kbyte/second. The speed of signaling link transmission besides the bearer of the traffic is also stated as the capacity of signaling link traffic, and the capacity of signaling link of 8Kbyte/second as mentioned above can not entirely be allocated to carry the traffic when the condition of the network is normal. This means the maximum utilization rate of the signaling link of the normal condition of the network (im) is allowed less than 100%. This is to accommodate addition traffic when the disturbance is occurred, such as disruption of MSU which cause retransfer or disruption of signaling link, which is caused the movement of the traffic from one signaling to another signaling.

The capacity of maximum signaling link (Kl-max) in the traffic when the condition of the normal network is:

\[ \text{Kl-max} = \text{im} \times 8 \text{ Kbyte/sec} \]  

The value of this im number between 20 % and 40% is according to ITU recommendation. The small im number (20%) is used if link disturbance and retransfer of MSU often occurred where the condition of the network is predicted bad and it needs a huge number of reserve capacity, where as this big im number (40%) is used if the link disturbance and the retransfer of MSU is rarely occurred where the condition of the network is predicted good and does not need the huge number of reserve capacity. Thus, we need to consider the condition of the network in determining the value of the number. (ITU,1992).

The capacity of maximum linkset (Kls-max) present in the linkset is which states the linkset maximum load. If Kls-max is distributed to the link, consequently, every links get the Kl-max load. And if the load of the result of distribution get the load inter link can be equal, consequently every link will get the Kl-max load and the value of Kls-max is:

\[ \text{Kls-max} = n \times \text{Kl-max} \]  

Where as, if the load of distribution result gets the load inter link unequal, there will be link which gets the load= Kl-max and another link gets the load< KI-max and Kls-max<n x Kl-max. By considering the load distribution is equal, the calculation formula of the link dimension is as follow:

\[ \text{Linkset Dimension}= \frac{\text{Linkset Traffic(Byte/sec)} \times \text{Kl-Max(Byte/sec)}}{\text{im} \times 8 \text{ Kbyte/sec}} \]  

But in applying, the result of load distribution is not equal, so the calculation of linkset dimension of the formula (17) above can not be used. If we use the calculation of linkset dimension by using the table 6, i.e the table of maximum linkset capacity made by ITU, we will get more exact result (ITU,1992).

Table 6 showws the relationship between Kls-max in Kl-max unit toward the total signaling link, where Kls-max is not always added toward the total link accretion.

<table>
<thead>
<tr>
<th>Total Link</th>
<th>Distribution System 4 it</th>
<th>Distribution System 3 Bit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Kl-max</td>
<td>2 Kl-max</td>
<td>Kl-max</td>
</tr>
<tr>
<td>2. 8/3 Kl-max</td>
<td>8/3 Kl-max</td>
<td>4 Kl-max</td>
</tr>
<tr>
<td>3. 4 Kl-max</td>
<td>4 Kl-max</td>
<td>4 Kl-max</td>
</tr>
<tr>
<td>4. 16/3 Kl-max</td>
<td>16/3 Kl-max</td>
<td>4 Kl-max</td>
</tr>
<tr>
<td>5. 8 Kl-max</td>
<td>8 Kl-max</td>
<td>8 Kl-max</td>
</tr>
</tbody>
</table>

By using Table 6, we can be determined the linkset dimension by:
- First, we identify the distribution system used whether the system is 4 bit or 3 bit
- Based on the estimate sondition of the network, determined the value of Kl-max
- Change the resultof linkset traffic calculation with byte/sec unit, into Kl-max unit
- Based on distribution system which used 4 bit or 3 bit, we determine in appropriate column with distribution system, the same Kls-max value with the value of linkset traffic or higher
- After we get the value of Kl-max, thus we can determine the number of link or linkset dimension

As a sample, to determine the linkset dimension can be seen on the clarification below:
Example 1:
- Load distribution system used is 4 bit
- The condition of the network is estimated well, $i_m$ is determined 35%, so $K_l$-max is $35\% \times 8\, \text{Kbyte/\text{sec}} = 2.8\, \text{Kbyte/\text{sec}}$
- If the linkset traffic is $8.4\, \text{Kbyte/\text{sec}}$ ($3\, K_l$-max), $3\, K_l$-max cannot be found in Table 6 in the column of distribution system of 4 bit, so we take the larger number, i.e. 4 $K_l$-max
- Parallel with 4 $K_l$-max in distribution system column in Table, we can see in the column of total link, i.e. 4 links or 5 links, i.e. linkset dimension obtained is 4 or 5 links, and we choose 4 links for retrenchment.

Example 2:
- Load distribution system used is 3 bit
- We estimate the bad condition of the network, $i_m$ is determined 20%, so $K_l$-max is $20\% \times 8\, \text{Kbyte/\text{sec}} = 1.6\, \text{Kbyte/\text{sec}}$
- If the linkset traffic is $4.8\, \text{Kbyte/\text{sec}}$ ($3\, K_l$-max), there is not $3\, K_l$-max in Table 6 in the column of 3 bit distribution system, so we take the higher number, i.e. 4 $K_l$-max
- Parallel with $K_l$-max in the column of distribution system in Table 6, we can see in column of total link, 4 link, 5 link, 6 link, 7 link. It means linkset obtained is 4 link, 5 link, 6 link, 7 link, and we choose 4 link for retrenchment.

In calculating linkset dimension, the linkset traffic data used is enough if we use the data only from one direction, we do not need the data from two directions of MSU, because the linkset has two directions of transmission which respectively has the same capacity of traffic.

In figure 2, if the traffic from E to C is bigger that the traffic from C to E, the data used is the bigger data, so the small traffic from the reverse direction can be remained transferred. Consequently, the linkset dimension calculation of CE is merely needed by the traffic data from E to C. (Siemens AG, 1994)

4.4 The Way to Calculate the Node Dimension (Signaling Point Dimension/SP Dimension)

One of the node which is functioned to send and receiving MSU by calculating the SP dimension can determine the capacity of SP. To calculate SP dimension, we need input data of linkset traffic in the unit of MSU. SP transfer capacity is obtained by summing up all the linkset traffic from SP, whereas SP receiver capacity is obtained by summing up all the linkset traffic to SP, so the calculation of SP dimension is merely done by summing up (ITU, 1992; Siemens G, 1994) and the formulas as follows:

$$\text{SP-X: (transfer capacity)} = \sum_{Y=1}^{n} \text{MSU traffic from X to Y} \ldots \ldots \ldots(18)$$

$$\text{SP-X: (transfr capacity)} = \sum_{Y=1}^{n} \text{MSU traffic from Y to X} \ldots \ldots \ldots(19)$$

For the sample in Figure 2, the calculation of SP dimension cab be seen below:

**SEP-A:** (transfer capacity) = MSU traffic from A to E………………..(20)
**SEP-A:** (receive capacity) = MSU traffic from E to A………………..(21)
**SEP-C:** (transfer capacity) = MSU traffic from C to E………………..(22)
**SEP-C:** (receive capacity) = MSU traffic from E to C………………..(23)
**SEP-B:** (transfer capacity) = MSU traffic from B to E………………..(24)
**SEP-B:** (receive capacity) = MSU traffic from E to B………………..(25)
**SEP-D:** (transfer capacity) = MSU traffic from D to E………………..(26)
**SEP-D:** (receive capacity) = MSU traffic from E to D………………..(27)
**SEP-E:** (transfer capacity) = MSU traffic from E to A + MSU traffic from E to B + MSU traffic from E to C + MSU traffic from E to D………………..(28)
**SEP-E:** (receive capacity) = MSU traffic from A to E + MSU traffic from B to E + MSU traffic from C to E + MSU traffic from D to E………………..(29)
5. CONCLUSIONS

- To calculate the traffic and network dimension of CCS7, is by:
  - calculating the traffic inter end node called SEP
  - calculating the traffic in connection line inter node called linkset traffic
  - calculating the dimension of connection line inter node called linkset dimension
  - calculating node dimension called SP dimension

- To calculate the traffic inter SEP, we need two kinds of data i.e. calling data and signaling data as input data and the calculation by multiplying calling data and signaling data

- To calculate linkset traffic, we do by summing up the input data in the shape of traffic inter SEP and route arrangement, which the calculation is by summing up every links inter SEP routed to linkset

- To calculate linkset dimension, we need input data in the shape of linkset traffic in byte unit, whereas the determination of linkset dimension is done by using Table 6, i.e. the table of maximum linkset capacity toward the total link

- To calculate the SP dimension, we need input data in the shape of linkset traffic in MSU unit, the calculation by summing up all the traffic linkset sent and received by SP.

6. NOTATION

CCS7 : Common Channel Signalling No. 7
ITU : Internation Telecommunication Union
CCITT : Committee Consultative International Telegraph and Telephone
SEP : Signalling End Point
SP : Signalling Point
PSTN : Public Switch Telephone Network

ISDN : Integrated Switch Digital Network
IN : Intelegent etwork
PCN : Personal Communication Network
MSU : Message Signal Unit
TC : Transit Centre
STP : Signalling Transfer Point
LE : Local Exchange
LT : Local Transit Exchange
SSP : Service Switching Point
SCP : Service Control Point
GSM : Global System for Mobile Communication
MSC : Mobile Switching Centre
VLR : Visitor Location Register
HLR : Home Location Register
KI-max : Maximum Capacity of Signalling Link
KLs-max : Maximum Linkset Capacity
n : Total Link in Linkset
y : All SP connected to SP-x
P : Total Calling/sec
PS : Success Calling Ratio (%)
MS : Success Forward
BS : Success Reverse
MG : Fail Forward
BG : Fail Reserve

REFERENCES

ITU. Methods for Dimensioning Resources in Signalling System No.7 Networks-E 73, Geneva,1992