# 지능망에서 서비스 제어 로직의 호 분배 서비스 특성을 위한 방법

# Methods for Call Distribution Service Feature of Service Control Logic in Intelligent Network

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## 요 약

본 논문에서는 지능망에서 서비스 제어 로직의 호 분배 서비스 특징에 대한 요구사항을 정의한다. 또한, 각 가입자 마다 지정한 호 분배률에 따라 호 분배할 수 있도록 호 분배 메커니즘을 제안한다. 호분 배 메커니즘은 지능망에서 정보료수납대행 서비스에서 발전되었다. 본 논문에서의 호 분배 메커니즘은 순환 분배 또는 계층 분배 방식이 아닌 퍼센티지 분배 방식을 채택하였다.

호 분배 메커니즘은 호 입력, 출력, 호 분배 처리 로직 부, 랜덤넘버 생성기, 가입자 데이터베이스 등으로 구성된다. 본 논문에서는 호 분배 메커니즘을 위한 실제적인 구현 알고리즘을 제시하고, 이를 위한 호 분배 결정 지시 산출 방법을 제안하였다. 호 분배 결정 지시 산출 방법에는 C 언어에서 제공하는 rand() 함수, 시스템 클럭, 제안된 알고리즘 등이 있다. 최적의 호 분배 메커니즘을 위하여, 3가지 방법에 대한 발생 패턴, 발생 수 등을 측정하여 평가하였다.

## Abstract

In this paper, we define requirements for call distribution of service control logic in Intelligent Network. Also, we propose call distribution mechanism for every subscriber with different call distribution rates. The call distribution mechanism had been developed as a function of Premium-rate Service in Intelligent Network. Our call distribution mechanism applies to percentage distribution instead of circular or hierarchical distribution. The call distribution mechanism consists of call input, output, call distribution processing logic part, random number generator, and customers database. We propose the practical implementation of a call distribution mechanism and call distribution decision indicating number computation method. We show three methods, the rand() function in C language, microsecond by system clock, and proposed algorithm, to get call distribution decision indicating number. In order to optimal call distribution mechanism, we estimated the results of three methods on occurrence values and the number of occurrences.

## 1. Introduction

Intelligent Network aims to ease the introduction of new services based on greater flexibility and new capabilities. Intelligent Network Capability Set-1 in ITU-T supports 25 services including Premium-rate and 38 service features including call distribution[1-2].

Call distribution service feature allows a subscriber to have incoming calls routed different destinations real-time according to data managed by subscriber. Therefore it is desirable that call distribution service feature be designed to satisfy general requirements including service logic requirements. However, it is difficult to find research results about the call distribution mechanism in Intelligent Network. Most of researches were focused on either the structure of

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Intelligent Network or the conceptual framework of service logic call control[3-5]. In this paper, we aim our focus at the implementation aspects of the call control service logic in service control point.

In this paper, we define relationship between call distribution and other service features, database structure, the structure of call distribution mechanism, and three call distribution decision indicating number computation methods. And, we also estimate the results of the methods on their occurrence value and the number of occurrences.

The organization of this paper is as follows. Section II describes Premium-rate Service, call distribution service feature and law of three types. In section III, we propose a call distribution mechanism and its requirements. Section IV evaluates three kinds of call distribution decision indicating number computation method and explains the simulation results of each. Finally, conclusions are made in section V.

# 2. Requirements of call distribution for Premium-rate Service

The Premium-rate Service, regarded as one of the most important services in intelligent network, provides call distribution(CD) service feature. The CD service feature has the requirements to controlresources of every subscriber.

In this chapter, we describe the concept and requirements of premium rate service, relationship between service features, and three types of CD law.

## 2.1 Characteristics of Premium-rate Service

The Premium-rate Service in Intelligent Network allows to pay back a part of the call cost to the called party, considered as an added value service provider [1-2]. The Premium-rate Service in Intelligent Network has three view points of service; service user, service subscriber, and network provider. Service subscriber, named service provider, is information provider, not service user. Service user, named calling user, should pay for information charging. Network provider provides Premium-rate Service framework, network facilities, and accounting information charging to information providers.

Service providers have so many branches and called lines of each branch to one telephone number dialed by calling user for more providing. There are different the number of branch per each service provider, different the number of called line per each branch. So, we need a call distribution mechanism for high utilization of service providers called line.

## 2.2 List of Premium-rate Service feature

The service features of Premium-rate Service in Service Control Point(SCP) developed in Korea include in[7].

- Premium Charging(PRMC)
  Flexible Charging by Day/Time
- One Number(ONE)
- Origin Dependent Routing(ODR)
- Call Hold with Announcement
- Call Distribution(CD)
- Measurements Reports

All service subscribers service data in Intelligent Network can be subscribed by subscriber according to their service features and utilized by that data to service users.

The Premium Charging service feature allows to classify information charging rate and type of information. The Flexible Charging by Day/Time supports a specific service to discount Premium-rate charging by defined

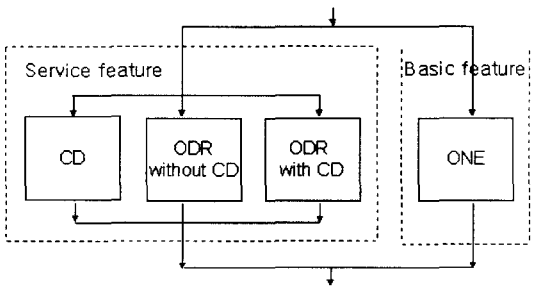
day/time. The One Number service feature allows a subscriber with two or more terminating lines in any number of locations to have a single telephone number. The Origin Dependent Routing enables the subscriber to accept or reject a call, and in case of acceptance, to route this call, according to the calling partys geographical location.

The Call Hold with Announcement service feature allows a subscriber to place a call on hold with options to play music or customized announcements to the held party. The Call Distribution service feature allows the served user to specify the percentage of calls to be distributed among two or more destinations. The Measurements Reports service feature allows to aggregatesome data according to criteria defined by operator or subscribers.

## 2.3 Relationship between CD service features

The service features related call distribution is classified as Call Distribution(CD), Origin Dependent Routing(ODR) without CD, ODR with CD, and One Number(ONE) in Fig. 1.

Call Distribution(CD) and Origin Dependent Routing (ODR) with CD can translate called number to route according to CD ratio setting by service subscriber. In contrast ODR without CD and One Number(ONE) can translate called number to each called number with same ratio without setting by service subscriber.




(Fig. 1) Flow related CD service feature

## 2.4 Three types of call distribution law

Call distribution service allows a subscriber to have incoming calls routed to different destinations. It should route those according to an allocation law which may be managed on real-time by service logic with data subscribed by the subscriber.

Three types of call distribution law[1,19] may exist:

- circular distribution, where the calls are routed to the different locations with a uniform load;
- percentage distribution, where the calls are routed to the different locations according to a percentage;
- hierarchical distribution, where the first location to be chosen is the first met in the priority list.

Our CD mechanism is focused on percentage distribution[8-16].

# 3. Call distribution mechanism

The function of call distribution has been developed for high utilization of communication line at PBX, digital switching, common channel signaling system No.7 and intelligent network respectively. Intelligent network has an advantage to provide call distribution depending on ratio data requested by subscribers. But, others can not do that and just only can distribute a call with same rate.

Prerequisites of call distribution algorithm in intelligent network are the called number control by subscriber and the percentage distribution rate per called number. Also, this mechanism should be processed with real-time and not bring about system overload due to its processing.

Our call distribution mechanism has different dis-

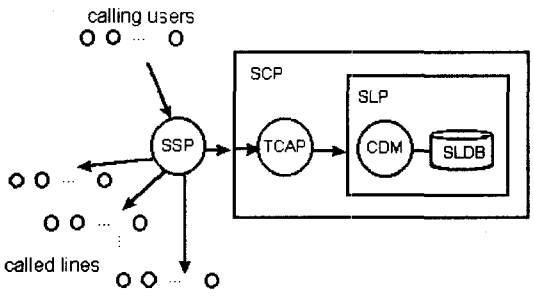
tribution ratios(ODR with CD or CD in section II.3) to each subscribers called line as well as same ratios (ODR without CD or ONE)[17-18].

In this chapter, we explain the flow of call processing, table structure of service logic database and call distribution mechanism, and methods used call distribution mechanism.

## 3.1 Flow of call processing

Calling and called parties connect to Service Switching Point(SSP) through one or more switching. SSP requests number translation to Service Control Point(SCP). SCP in Fig. 2 has Service Logic Processors(SLP). Transaction Capabilities Application Protocol(TCAP) delivers call handling information to SLP.

Call Distribution Mechanism(CDM) in SLP translates subscriber number to called number according to ratio data in Service Logic DataBase(SLDB).

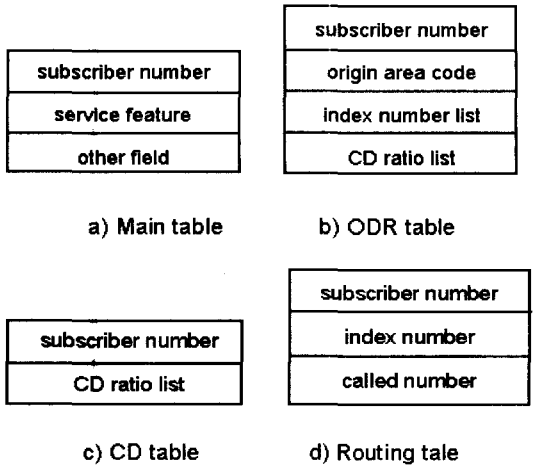



(Fig. 2) Flow of call processing

## 3.2 Table structure of SLDB

SLDB related call distribution consists of Main, ODR, CD, and Routing tables in Fig. 3.

Main and Routing tables manage data of all subscribers. However, ODR and CD tables manage only data related service feature in Main table specified by subscriber.



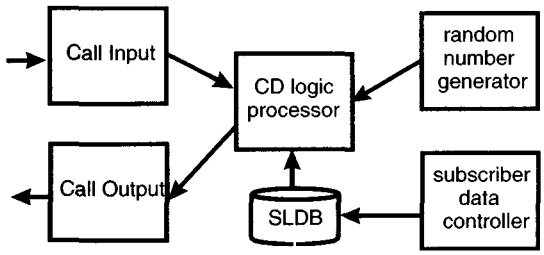

(Fig. 3) Table structure of CD database

Index number list and CD ratio list in ODR table can be 1 to 8 per subscriber number and have origin area codes. Each CD ratio in CD ratio list has a percentage value of index number distributed among two or more destination. The Index number in CD table implies the sequential number according to the sequence of CD ratio list.

We can retrieve called number as index key using subscriber number and index number in Routing table.

## 3.3 Structure of Call Distribution mechanism

The CD mechanism consists of Call input, Call output, CD logic processor, SLDB, subscriber data controller, and random number generator as shown in Fig. 4.




(Fig. 4) Structure of Call Distribution mechanism

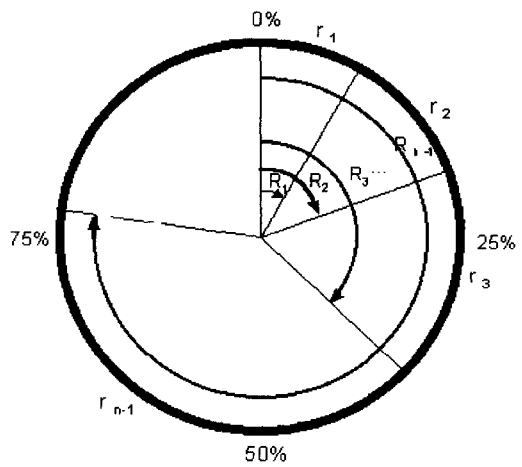
The CD logic processor should translate on real time(less than 150 transaction per second) call input number dialed calling user to call output number according to data in SLDB. CD logic processor use a random number generator for selection of alternatives called number. The subscriber data controller manipulate data in SLDB, for example, add, update, and delete of data by subscriber.

### 3.4 Methods of Call Distribution mechanism

Call Distribution Mechanism consists of the following methods;

- Call Distribution ratio setting method
- Call Distribution decision indicating number computation method
- Index number computation method
- Called number computation method

Call Distribution ratio setting method is shown in Fig. 5. This method has two cases. One has different ratios, the others have same ratio. The sum of Call Distribution ratios should be 100.




(Fig. 5) Setting of call distribution rate

$$100 = \sum(r_n)$$

Call Distribution ratio per index number is ri. Ri is a value for index number selection. Call Distribution ratio setting method with different ratio is as follows:

$$R_1 = r_1$$
$$R_n = R_{n-1} + r_n \ (2 \le n \le 8)$$

Call Distribution ratio setting method with same ratio is as follows:

$$R_{n-1} = 100 / n$$
$$R_n = 100 - \sum(R_{n-1}) \ (1 \le n \le 8)$$

Call Distribution decision indicating number computation method is the method to produce call distribution decision indicating number. The number is used for selection of index i in Index number computation method. We have three alternatives for this method. We will explain this method in Chapter IV.

Index number computation method is to select an index number among candidate index numbers in ODR table or CD table. This method selects index number i of Ri within Call Distribution decision indicating number.

Called number computation method is to retrieve called number from database using index key with subscriber number and index number in Routing table.

## 4. Call distribution decision indicating number computation method

The call distribution decision indicating number computation method makes use of the random number generator. We have three alternatives methods as random

number generator to make call distribution decision indicating number computation method in this paper.

In this chapter, we explain three kinds of alternatives and analyze the simulation results of value and occurrences produced by those.

## 4.1 Prerequisites of call distribution decision indicating number computation method

Prerequisites of the call distribution decision indicating number computation method are uniform distribution, runs up and down, and fast processing. In this paper, the generated number is limited to the number 1 to 100.

The probability of a called line has a call distribution ratio from minimum 1% to maximum 100%. If it is 100%, it means that one called line number dialed by calling user has only one called line which connected. If either one is 1 to 99%, it means two or more called lines. So, occurrences of each 1 to 100 should be uniform distribution for the requirement. The uniform distribution means that occurrences are same.

The call distribution mechanism also requires wide gap between two adjacent value produced by call distribution decision indicating number computation method.

## 4.2 Alternatives for call distribution decision indicating number computation methods

We have three alternatives to make call distribution decision indicating number computation method. We consider it as follows.

- method using rand() function
- method using microsecond
- proposed algorithm

### 4.2.1 Method using rand() function

The function rand() in C language uses a multiplicative congruential random-number generator with period 232 that returns successive pseudo-random numbers in the range from 0 to (215)-1. The method using rand() function is as follows.

```
seed = rand() % 100 + 1;
```

We used percentage(%) function in C language to get the result of random number in the range of 0 to 99. % function means remainder of rand() divided by 100, that is, rand() modulo 100.

### 4.2.2 Method using microsecond

The function gettimeofday() gets the systems notion of the current time. The current time is expressed in seconds and microsecond elapsed since 00:00 Universal Coordinated Time, January 1, 1970. The resolution of the system clock is hardware dependent; the time may be updated continuously or in clock ticks. The method using microsecond function is as follows.

```
seed = tp.tv_usec % 100 + 1;
if (seed == 100) seed = 100;
else {
seed = (seed/10)+((seed%10)*10;
     }
```

The tp.tv_usec is a function of gettimeofday() to produce microsecond(one millionth of a second: 1/1,000,000) from system clock.

### 4.2.3 Proposed algorithm

The previous two methods could not control their results because the results depend on system clock or the function itself. We want to control the results of methods for requirements of call distribution service feature. We make the proposed algorithm to satisfy

our needs. The proposed algorithm is as follows.

```
plus3_to_300 =1;
for(;;)
{
plus3_to_300 = plus3_to_300 + 3;
if(plus3_to_300 >= 301 || plus3_to_300 == 3)
  plus3_to_300 = 1;
seed = plus3_to_300 % 100;
if(seed == 0) seed = 100;
  else {
  seed = (seed/10)+((seed%10)*10);
       }
}
if(seed >= 101 || seed <= 0) seed = 1;
```

The seed number is from 1 to 100. The number is generated 100 times per cycle. Three is added to the plus3_to_300 at every step. Therefore, the plus3_to_300 is limited to 300 for 100 times per cycle. The algorithm generates 100 numbers in a cycle even though the maximum of plus3_to_300 is 300.

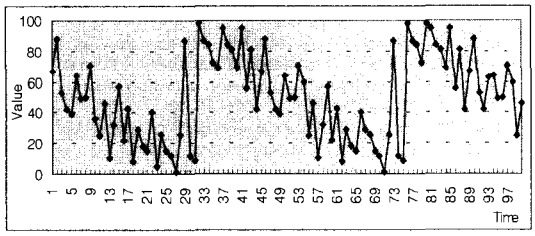
## 4.3 Call distribution simulation result

The sequential value from 1 to 100 is shown in Fig. 6 - Fig. 8. The result of rand() method is shown in Fig. 6. It is too small that difference(gap) between values of two adjacent points. In a sequence of numbers, the result values have an downward tendency from 1 to 27, from 33 to 71, and from 77 to 100 of time sequence in Fig. 6. So, the result of rand() function is unsatisfied for CD mechanism.

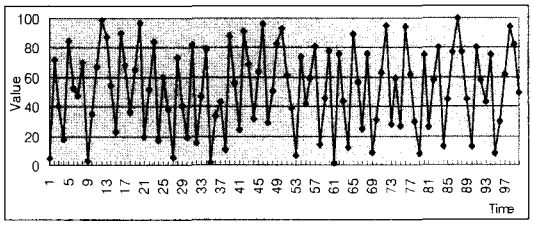
The result of microsecond is shown in Fig. 7. The difference between values of two adjacent points are larger than those of function rand() in Fig 6. Also, in a sequence of numbers, the result values have not an downward tendency. But, there are still several points that the difference is too small. The points are from 8 to 9, from 14 to 15, from 38 to 49, and from 98 to 99 of time sequence in Fig. 7.

The result of proposed algorithm is shown in Fig. 8. The difference between values of two adjacent points are larger than those of functions in Fig. 6 and Fig. 7. Also, in a sequence of numbers, the result values have no an downward tendency. There are not the points that the difference is too small.

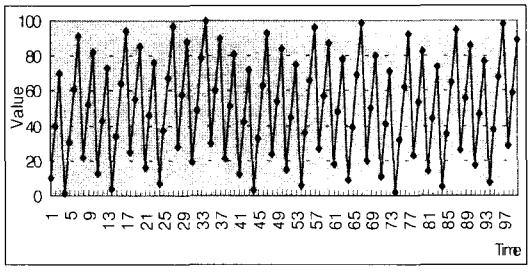
The increasing and decreasing values between two adjacent points are same. The result value of proposed algorithm has the most tendency-less among three methods. Because it has same difference with large number between two points. So, the proposed algorithm is not real random number generator because next value is anticipated. But this algorithm is satisfied for



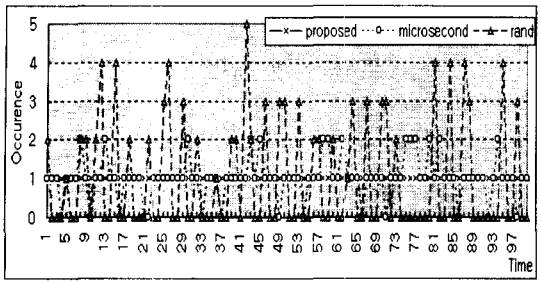

(Fig. 6) Value of rand() function




(Fig. 7) Value of microseconds




(Fig. 8) Value of proposed algorithm




(Fig. 9) Occurrence comparison of 3 algorithms

call distribution service feature.

Occurrence comparison of three algorithms is shown in Fig. 9. Maximum occurrence on rand() function is 5 at 42 time sequence. One on microsecond function is 2 at 8, 13, 30, 43, 45, 58, 59, 62, 75 to 77, 80, 82, and 94. The proposed algorithm occurs only one time for all numbers from 1 to 100. The numbers of occurrence on proposed algorithm come from uniform distribution, but not rand() and microsecond function. So, the proposed algorithm satisfies for CD uniform distribution requirements more than the other two algorithms.

From the above results, call distribution mechanism using proposed algorithm is expected to be better than the rand() or microsecond functions for call distribution service feature in Intelligent Network although proposed algorithm is not real random because of same difference between two points.

## 5. Conclusions

The needs for control to network resource are rapidly increasing. One of the solution is call distribution by service control point in Intelligent Network. The purpose of call distribution mechanism is to distribute a call from calling party to called line among alternatives according to each called resource line capabilities and to increase resource utilization.

In this paper, we proposed the call distribution mechanism with percentage distribution. The mechanism consists of four methods: call distribution ratio setting method, call distribution decision indicating number computation method, Index number computation method, and called number computation method. Detailed descriptions of the concepts for these methods have been also represented. Also, we explained the structure of service logic data base with data of each called resource line capabilities.

We explained three call distribution decision indicating number computation methods: method using rand() function, method using microsecond, and proposed algorithm. Then next, three call distribution decision indicating number computation methods have been estimated with respect to sequential value from 1 to 100 and occurrence caparison of three methods.

From the results, proposed algorithm showed large difference(gap), tendency-less, all number occurred, and uniform distribution. We can conclude that proposed algorithm is accommodated to call distribution service feature in Intelligent Network.

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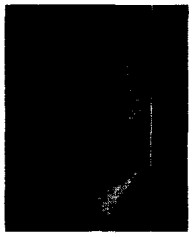

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