Text Insertion in Short Message Delivery Report for CDMA Network

Rakhman Imansyah, Andri Qiantori and Wiseto Agung
Research and Development Center, TELKOM
Bandung, Indonesia

Abstract—**Short Message delivery report (DR) or delivery acknowledgment is a feature of Short Message Service to inform the SMS sender about status of the delivered message that includes destination number, delivery time, and delivery status of a message. Implementation of this feature in CDMA network is depend on operator's own scenario, even though specification of this feature is stated in IS-637B standard. Some operators use regular SMS format to deliver the information to the sender (with a specific text in it), while the other operators using another mechanism. The use of regular SMS for DR may increase the SMS traffic in the network significantly meanwhile the operator does not get benefit of it since this feature is free of charge.**

The delivery report usually consists of the parameters as follows: destination number, time stamp and delivery status. There are some spaces can be used to bring the other valuable information to the sender. The objective of this research is to utilize delivery report by inserting additional information and evaluating its impact to deliver time. In order to understand the impact of this mechanism to the delivery time, this study measures the following parameters processing time of insertion text, successful ratio of delivery message, and the correlation between length of message and insertion processing time.

Index Terms— **Text, insertion, delivery report, SMS, CDMA**

I. INTRODUCTION

S HORT Message Service (SMS) is a popular service on mobile networks since early 2000s. This service was introduced on GSM (Global System for Mobile Communication) network with reference to the ES-23.040 standard issued by ETSI (European Telecommunications Standards Institute), while implementation on CDMA network refer to IS-637B standard issued by TIA (Telecommunications Industry Association).

From user perspective, common features of SMS are:

1) One SMS consists of 160 chars. If a message longer than 160 chars, it would be concatenated and sent sequentially.

2) Originating and terminating number, an identification of sender and receiver.

Rakhman Imansyah is with the R&D Center of PT Telekomunikasi Indonesia (PT TELKOM) in Bandung, Indonesia. He can be reached at rakhman@telkom.co.id

Andri Qiantori, Ph.D is with with the R&D Center of PT Telekomunikasi Indonesia (PT TELKOM) in Bandung, Indonesia. He can be reached at qiantori@telkom.co.id

DR Wiseto Agung is with with the R&D Center of PT Telekomunikasi Indonesia (PT TELKOM) in Bandung, Indonesia. He can be reached at wiseto@telkom.co.id

3) Timestamp, message arrival time at Message Center (MC).

4) Submission report, an acknowledgement from Message Center (MC) to the sender after MC receives a submitted message.

5) Delivery report (DR), an acknowledgement from MC indicating that message has been delivered to the destination.

All those features above are provided by operator for free-of-charge, there will be no additional fee to use them.

One of important feature which most used by SMS user is delivery report. It will be used mostly by a user who sends important information which needs immediate response from his/her colleagues. According to statistical report from one CDMA operator in Indonesia, more than 40% SMS user activating delivery report feature while sending SMS.

Implementation of delivery report feature on CDMA network in Indonesia are mostly the same, operators use text based delivery report which is similar to regular SMS. In a delivery report, there are information about destination/receiving number, delivery time, and status of delivery. Although the use of text based delivery report may impact to the signaling traffics occupancy, operators could not get revenue from it since this feature is free. Some operators modified this feature by inserting additional information related to promotion or product knowledge of operator's products.

Objective of this research is to know the impact of modification/insertion text on DR to the performance of SMS, including insertion time, successful ratio of SMS DR, and the impact of length of inserted text to the insertion time .

II. SMS DELIVERY REPORT ON CDMA

Core component of Short Message Service on CDMA network is an Message Center (MC), which similar to SMS Center (SMSC) in GSM network. A mobile station (MS) sends SMS to the MC, then MC forwards it to the destination. If originating MS requests for delivery report, MC should notify to the sender after MC deliver the message to destination. Message flow for successful delivery of an SMS is shown on Fig.1.

There are three phases in delivering SMS to the destination:

1) Submission phase, when a handset submit a message to the MC. MC will gives a timestamp to the message and acknowledge it to the sender.
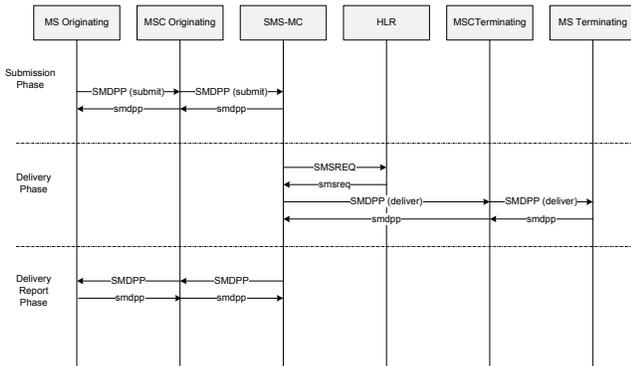

Fig. 1. Message flow of successful SMS delivery

2) Delivery phase, when MC forwards the SMS to the destination according to its routing table. MC interrogates Home Location Register (HLR) to get nearest Mobile Service Center (MSC) to the destination number, then delivers the message via this MSC. If the delivery process is unsuccessful, MC will store the message into its database and will retry to deliver to the destination by following retry scheme of MC.

3) Delivery Report phase, when MC deliver SMS DR to the sender after delivering SMS to destination. The information included in SMS DR are delivery status (success or fail), destination number and delivery time.

Refer to the standard of Short Message Services for Wideband Spread Spectrum Systems [1], implementation of delivery report on CDMA are using following procedures

1) If SMS user requests for delivery report, sub parameter Delivery Acknowledgement Request (DAK_REQ) field should be activated in SMS package.

2) MC should send SMS Delivery Acknowledgement Message to the sender after the message received by terminating handset or an error occurred during delivery phase. The SMS Delivery Acknowledgement Message sub parameters are shown in Table-1.

3) Originating handset will translate delivery status from Message Status sub parameter and may ignore User Data (text) sub parameter if both sub parameters are included in SMS Delivery Acknowledgement Message.

TABLE I
SUB PARAMETERS IN SMS DELIVERY ACKNOWLEDGEMENT MESSAGE

Subparameter	Type	Remarks
Message Identifier	Mandatory	Consists of message type = Delivery Acknowledgement
User Data	Optional	Text message
Message Center Time Stamp	Optional	Delivery time of SMS Delivery Acknowledgment Message
Multiple Encoding User Data	Optional	How to encode user data (text)
Message Status	Optional	Delivery status of SMS ERROR_CLASS = '00' (no error) 1. Message accepted 2. Message deposited to Internet 3. Message delivered 4. Message cancelled ERROR_CLASS = '10' (temporary condition) 1. Network congestion 2. Network error 3. Unknown error ERROR_CLASS = '11' (permanent condition) 1. Network congestion 2. Network error 3. Cancel failed 4. Blocked destination 5. Text too long 6. Duplicate message 7. Invalid destination 8. Message expired 9. Unknown error

Implementation of optional sub parameters in SMS Delivery Acknowledgement Message is different one each other. Generally MC vendors support all optional sub parameters, but some of handset vendors only support partially. Operator has decided to use text based SMS Delivery Report/Acknowledgement to provide common/universal experience for all subscribers.
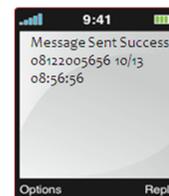

Fig. 2. An example of text based SMS Delivery Report on CDMA

III. Engineering of text insertion on SMS Delivery Report

Delivering text based SMS Delivery report is almost similar to delivering regular SMS. Since SMS delivery report is free-of-charge feature, operator want to make this feature to be more valuable by inserting text into SMS DR. Maximum length of SMS DR is 160 characters, so inserted text can be filled into available empty space.

Various information can be inserted into SMS DR, such as promotion, socialization of new products, text based advertising, or other text based information can be delivered as additional text on SMS DR. It is a kind of monetizing free-of-charge feature by the operator.

Text insertion process is handled by an application server, Text Insertion Server (TIS). TIS will insert text into every SMS DR package sent by the MC. TIS will send back the modified SMS DR to the MC, then the MC will send SMS DR to the SMS Sender. Detail message flow is shown on Fig. 3.
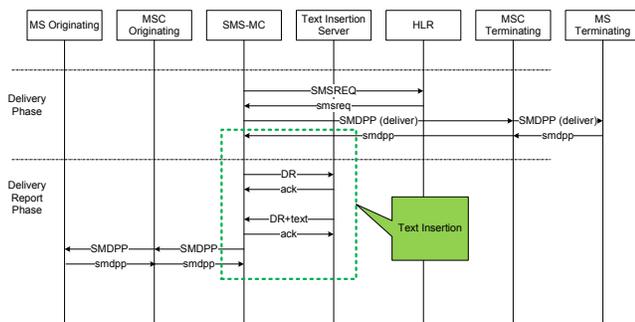

Fig. 3. Message flow of successful SMS delivery

1) After MC receives acknowledgement from terminating handset which indicating that SMS has been received successfully, MC preparing a SMS Delivery Acknowledgement and send it to TIS.
2) TIS will calculate available empty spaces on SMS DR and find a proper text to be inserted. After insertion process is done, TIS sends this modified SMS DR back to the MC.
3) MC send this 'new' SMS DR to the SMS sender.
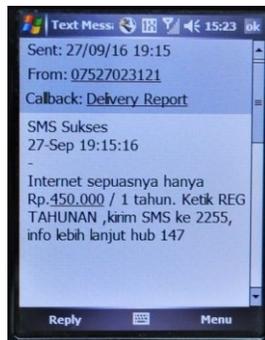4) An example of modified SMS DR is shown on Figure-4

Fig. 4. Modified SMS Delivery Report

IV. Data and methodology

SMS Delivery report is a feature to inform the sender of an SMS about status of his/her message, whether it has been delivered successfully to the destination or buffered in MC for a reason (destination handset is switched-off or out of coverage area, handset storage shortage, or other technical reason).

While there is an opportunity to monetize this SMS DR so operator can get revenue from it, operator should also consider impact may be arisen by inserting text into SMS DR. It deals with performance and quality of the service. From subscriber point of view, service quality of SMS is delivery time, faster is better.

To evaluate the impact of text insertion, we observe following parameters:
1) Additional processing time may be caused by text insertion process in TIS. It can be measured by comparing sending time of original SMS DR and receiving time of modified SMS DR in MC.
2) Successful ratio of delivery SMS DR after modification to the sender.
3) Relation between length of inserted text and insertion time process.

To get more realistic result, monitoring process is done in peak traffic period. According to daily the statistic of SMS, peak traffic period of SMS is between 18.00-19:00, meanwhile the lowest traffic period is 2:00-3:00 in the morning.

V. Result and Analysis

A. Observation result

SMS traffic monitoring is focused on SMS sent by A number to B number on 13rd Dec 2011 at 18:00 to 19:00. Test environment are :
1) A number is CDMA modem attached to a laptop, has a sufficient balance to send SMS and enough inbox and outbox SMS storage.
2) B number is attached on CDMA handset and has sufficient SMS storage.
3) Number of SMS sent are 75 SMS with 38 characters length.
4) Texts inserted are prepared with 75 and 91 characters length.
5) Time difference between laptop and MC is 4 seconds.
6) Wireshark Network Protocol Analyzer is used to capture the messages.
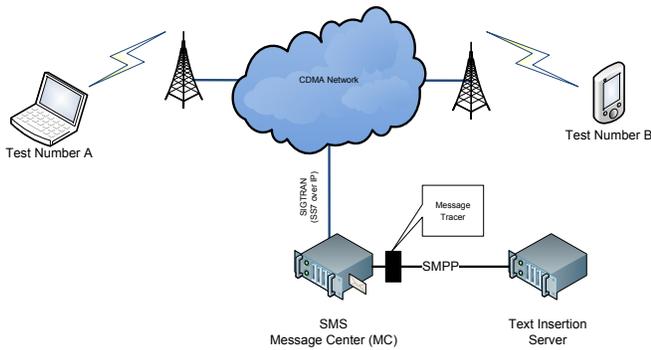7) Network configuration during test and monitoring is shown on Fig. 5.

Fig. 4. Test and observation environment

Test result of 75 SMS sending from A number (CDMA modem) to B number (handset) are following:

1) Table II shows average of total SMS delivery time from user perspective. Total SMS Delivery time is time difference between submission time of SMS and delivery time of SMS DR.

TABLE II
SUMMARY OF DELIVERY TIME

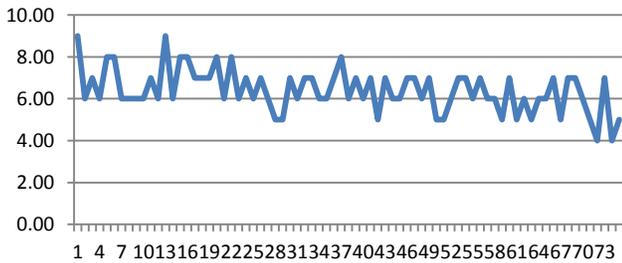| Total SMS delivery time	Time (second)
Maximum time	9
Minimum time	4
Average time	6.4

Statistical data of measurement is shown on Fig. 5.

Fig. 5. Time difference between submission time and delivery time of SMS DR

2) Table III shows average of insertion time, that is time duration between MC sends the original SMS DR to TIS and MC receives modified SMS DR from TIS as illustrated in Fig. 6.

TABLE III
SUMMARY OF TEXT INSERTION TIME

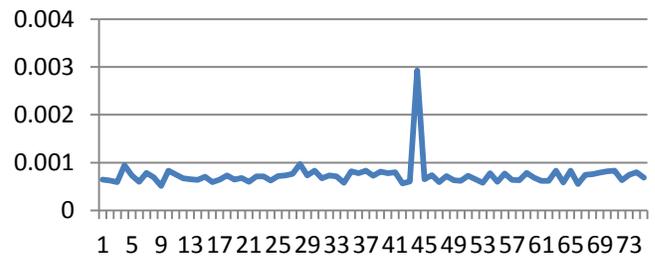| Total SMS delivery time	Time (second)
Maximum time	0.002925
Minimum time	0.000515
Average time	0.000736

Fig. 6. Time difference between submission time and delivery time of SMS DR

3) There were two prepared content for text insertion: 75 chars and 91 chars length.

TABLE IV
TEXT INSERTION ON SMS DR

No	Content of modified SMS DR	Total length	Freq.	Insertion time (average)	End-to-End delivery time (average)
1	SMS Sukses 13-Dec 18:33:07 - Aktifkan Flexi COMBO tanpa kode area, tekan *777 call/OK di Kota tujuan.	102	41	0.000738 seconds	6.512195 seconds
2	SMS Sukses 13-Dec 18:36:39 - Kini SMS semakin mudah, gunakan FLEXI MILIS, sekali SMS bisa ke 1000 orang. Info hub 147	118	34	0.000712 seconds	6.264706 seconds

B. Analysis and discussion

Delivery time of SMS is an important factor of SMS performance for the user. It can be measured by calculating time difference between submission time and delivery time of SMS. Faster SMS received at the destination, the better performance of SMS service.

Capturing submission time of SMS and delivery time of SMS DR are steps to know SMS performance from user perspective. Data on Table II and Fig. 5 shown average of delivery time of SMS is 6.4 seconds. All delivery time durations ranging from 4 seconds to 9 seconds. The longest time had been captured in the beginning of measurement, and fastest time is at the end of measurement. Fig. 6 shows trend of delivery time, it become faster at the end. This end-to-end delivery time is representing of user experience.

If we want to look more precise on duration of text insertion, we can see Table III and Fig. 6. Table III shows text insertion time is very fast, only 0.000736 seconds in average. If we compare this time with end-to-end delivery time at table II, we can see that duration of text insertion process is very small value, only 0.012% of end-to-end delivery time, user will not concern on this.

Furthermore, we can see correlation among the length of inserted text, delivery time, and success ratio of delivery process. Table IV shows that insertion of longer text does not affect the speed of text insertion process at TIS and also delivery time of SMS DR to the user. The fact is insertion and delivery time of longer SMS DR is faster than delivery time of shorten SMS DR.

All requested SMS DR in this test were received by sender successfully, even though the SMS DR had been modified before. It means that insertion of text on SMS DR does not affect the successful delivery of SMS DR.

VI. Conclusion

Text insertion on SMS DR can be implemented without reducing the performance of short message service. Because of text insertion process is very short, it only takes less than 1 mili second, SMS user may not be aware of this additional process. Number of characters inserted into SMS DR does not affect the speed of delivery time and successful ratio of delivery SMS DR to subscriber.

Wide range of information can be inserted into SMS DR, from introduction of new products owned by operator, tariff promotion of a service, and other similar things. It also can be monetized as text based mobile advertising with its advantage characteristics such as personal, awaited by SMS user, and high successful delivery rate. It would be more powerful if combined with customer profiling, so the advertising or campaign will be delivered to the right target.

There are several things that need to be improved on further research, such as observation on impact of delivery SMS DR with maximum length (160 chars), observation on peak hour within a week or month, and observation on resources of MC and TIS while handling text insertion.

REFERENCES

[1]   Telecommunications Industry Association (TIA), TIA/EIA-637-B : Short Message Services for Wideband Spread Spectrum Systems, January 2002.
[2]   I. Harris, F. Trosby, and K. Holley, Short Message Service (SMS), The Creation Of Personal Global Text Messaging, John Wiley & Sons Ltd., 2010

Dr Wiseto Agung received the BSc degree in Telecommunications from InstitutTeknologi Bandung (ITB), Indonesia in 1987. He also received an MSc degree in Telematics (in 1994) and a PhD in Multimedia Communication (in 2002) from the University of Surrey, UK. He has been with PT Telekomunikasi Indonesia since 1988 in various engineering divisions, and he is currently working in the TELKOM R&D.

Rakhman Imansyah received Informatics Engineering degree from the TELKOM School of Technology in Bandung Indonesia in 1999. From 2000 to 2010, he worked as an engineer in R&D Center of PT Telekomunikasi Indonesia. His works were related with messaging system and its applications, especially in CDMA & PSTN. He is currently working as Researcher of Content and Application Analysis.

Andri Qiantori received the Doctor of Philosophy in Science at University of Electro-Communications, Tokyo – Japan. He is a member of IEEE and Japan Association for Social Informatics and Japan Society for Socio-Information Studies. He is also a reviewer of several international journals and actively involved in many researcher exchange program with Japanese experts which is sponsored by Asia Pacific Telecommunity. His research interests are in social interaction modeling, advanced recommender systems, consumer behavior modeling, adoption of ICT and related technologies in organizations, and the design and implementation of improved forecasting procedures and systems in organizations. He is currently working in the Directorate of Innovation Strategy & Sinergy PT Telekomunikasi Indonesia.