

The Research and Design of Personalization preferences Based on Signaling analysis

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Keywords: signaling analysis, personalization preferences, signaling separation, buffering

Abstract. With the development of electronics, especially that of semiconductor, integrated circuit and computer technology, mobile communication has developed greatly. The rapid development of mobile communication makes people turned their attention to signaling system which has rich user personalization data. Signaling network is the nervous system of the communication network, playing an important role in the smooth operation of communication networks. It is very valuable information resource, contains a lot of information including user's behaviors, the use's habits, the user's real-time status, all kinds of service consumption status, hardware deployment and feedback of application, network operation, etc. How to analyze user's behavior through signaling, obtain the information about the user's preferences based on analysis results and actively push our service to the users to enhance their experience has become a hot issue of common concern at present.

Introduction

Signaling is the nerve center of the entire communication network. Its performance largely determines the ability of a communication network to provide users with services. Faced with increasingly fierce market competition, telecom operators' business philosophy has also changed. It transforms the original "business-centric" into "customer-centric". The development of the signaling network [1] provides new ideas for user personalization preferences analysis. Through making full use of the signaling information to analyze users' behavior, we can obtain users preference information and effectively push the personalized application to users, enabling the telecom operators to take the lead in the fierce competition in the market.

In view of the large amount of signaling information, high information rate, high real-time requirement, the existing signaling analysis system only can undertake simple analysis. When it comes to the analysis of the whole network signaling, the accuracy of the result of the analysis could not be guaranteed. The core of signaling analysis system in this paper is to achieve high stability, high efficiency, and real-time processing for signaling analysis by the optimization of communication technology.

In this paper, the main contents are: the second part mainly introduces some basic concepts related to signaling; the third part describes the system architecture of personalized preferences based on signal analysis; the fourth part mainly analyzes the implementation key points of the signal analysis system; the fifth part shows the system running results; the sixth part is the conclusion part.

Related Work

The Concept of the Signaling. In the mobile communication system, in addition to transmit the necessary user information (usually voice messages), signaling information [2-5] also must be transmitted in normal conversation in order to make the whole system work orderly. Such as a network call hang up, the boot, off-hook, idle tone, busy tone, shutdown, dialing, ringing and ring back tones. In addition, it also includes some control signal needed in wireless communication networks, such as user registration and management, channel allocation, reply and call, roaming registration and channel switching [6,7]. The system is composed of a variety of signal, control and operation called signaling system, referred to as signaling.

Strictly speaking, the signaling system is an information system that allows the nodes in the network exchange a large amount of real-time communications information.

Because of the nature of the signaling, it has the following characteristics:

High information rate[8]. As signaling processing is often deal with the whole call control information in a certain area, it needs to know the communication status of all relevant people in the area, which often contains a huge amount of information. In the system built in this paper, the peak of one single signaling velocity amounts to $4M / S$.

Information rate volatility. The amount of information produced by signaling depends directly on the amount of phone calls within the network. Since most users have relatively similar talk habit, on different times of week or different times of day, signaling amount will produce a certain velocity fluctuations.

Information real-time requirements. Each one signaling often only characterizes one user call state at a time, therefore, the value of signaling information is directly related to its real-time performance. So it also puts forward higher requirements on signaling analysis system.

Signaling Separation. In normal circumstances, the system receives the original signaling comprised of a variety of high-speed data stream. It contains a large number of packets of different sizes. If takes the original signaling for analyzing, it is bound to cause great burden to the signal analysis module and analysis module will perform an alarming number of useless comparisons. This not only increases in the burden of the system, but also reduces the rate of data processing system. So the signaling separation technology is very important.

Signal separation technology is to find out the signal split algorithm based on the analysis of the different signal structure. Using receive buffer and multi-threaded, separate out different signaling. Then assign the different signaling to different task processing units for analysis and execution. It can lighten the burden of data processing of other modules and improve the rate of data processing significantly.

Signaling Analysis.User signaling contains amount of rich and real-time data. Signaling analysis is to extract the target user's data from the original signal according to the different needs of various businesses. The data has the characteristics of high real-time and high accuracy.

The method of signal analysis contains one-way analysis and two-way analysis, signal tracing and so on.

One-way analysis refers to the analysis of the entire signaling one by one. Usually take out the target field for forwarding, storage, or some other secondary use.

Two-way analysis refers to compare the user's past signaling record with the current record, then summarize and presume their usage habits or behavior trajectory.

Signal tracking is for certain user groups to analyze users themselves or other communication users by long-term tracking their communication activities. So some certain value-added communications services can be provided to these users.

The difficulty of signal analysis is how to get purpose data from the high-speed flow of information accurately and timely. In order to solve this problem, the system needs the support of multi-threaded parallel and complex data structures.

The Signaling Analysis System Architecture

The personalized preferences analysis system based on signal analysis is through the signal collection, completing signaling receiving, forwarding, filtering and processing. From the system, some users' characteristics, communication habits, and even behavior trajectories will be find out. At the same time, data is stored in a timely manner, in order to make the value of real-time data to achieve the biggest play. The level of the signal analysis platform is shown in Fig.1.

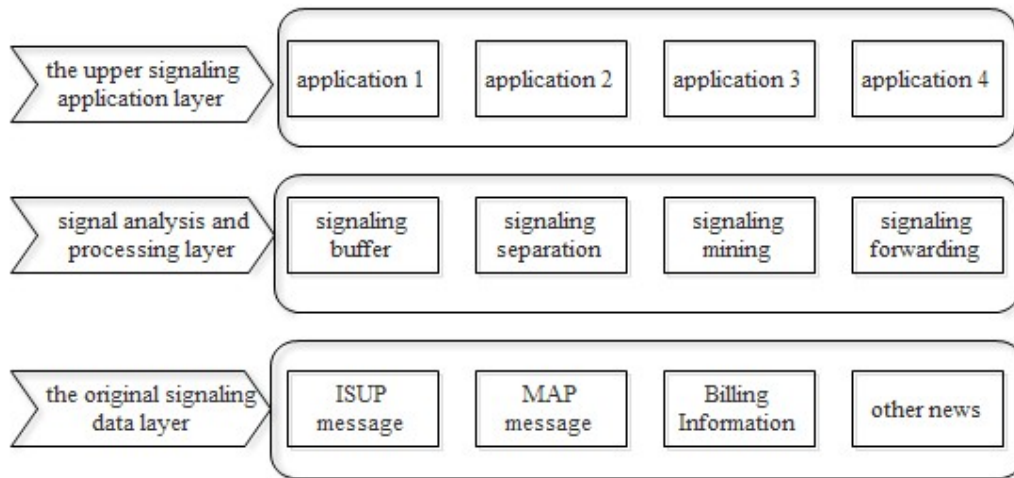


Fig.1. The level of the signaling analysis system

The hierarchy of the system includes three levels, respectively is the original signaling data layer, signal analysis and processing layer and the upper signaling application layer. The original data signaling comes from telecom related companies, including ISUP message, MAP message, billing information and other news, etc.

Signaling analysis layer is regarded as data source of user personalization preferences. Its process includes signaling buffer, signaling separation, signaling mining and signaling forwarding. These four parts are the basic signaling analysis process. Firstly original signal data enters into the buffer waiting to be processed. Secondly the signal separation module removes signaling out to perform the split operation and distributes the separation results to different signaling analysis module. Then signaling analysis module extracts relevant information to summarize and compare; turns the result to the send buffer. Lastly sending module distributes the processed results to different application systems, which will achieve the ultimate value of the signaling analysis system. Thus, the original data of signaling is the core of the signal analysis system. Meanwhile, the analysis system is the basis of many other derivative services system.

The Achievement of Key Points

Signaling Transceiver and Cache. The transmission speed of signaling data has a certain fluctuation. According to the users call distribution, there is different data flow in different time. The basic data transfer rate is shown in Table 1.

Table 1. The transmission speed of signaling data

Network	Average[M/s]	Maximum[M/s]
mobile network	0.4	0.6
fixed network	2	4

Because of the instability of signaling transmission rate, occasionally the data rate exceeds the system handle ability, which will result in the risk of data loss. So the buffer queue can be used to store the received signaling directly without any processing. At this time, there will be a number of threads continuously read data from the buffer queue and forwarding. When the sending network in poor condition, signaling transceiver will prevent the signal lost and plays a buffer role at the same time. Multiple buffer queues are used for storing received data and data buffering. Meanwhile, multiple threads run in parallel to improve operational efficiency and the accuracy of transmission.

Signaling data buffer work process is like this: firstly it checks whether the communication connection is normal, then checks if the buffer is normal. When the preparations are completed, system creates a temporary data storage area and randomly selects a certain buffer to queue from the information buffer group.

Signaling Separation. Signaling split modules is implemented in C language, its purpose has two: 1, remove the temporary unused signaling in the system and reduce the processing load on signaling analyzer; 2, signal classification, different signal will be sent to different signaling analysis units. Each analysis unit has its own responsibilities to ensure the signal processing speed and efficiency. Separation work adopts the multi-thread concurrent execution. Multiple threads read the received data from multiple queues and separate the data, which enhances the speed of separation.

We proceed from the signaling length. For example, the server 1 is used for statistical the state of a user's boot time, server 2 is used for statistical a user's call behavior. So the server 1 only need to get the boot signaling and server 2 only need to get the call signaling. The length of the two signaling is 163 and 218 bytes respectively. After get signaling datagram, signaling split modules acquire the signal length fields firstly, namely the first two bytes. The signaling of 163 is 00A3 and the signaling of 218 is 00DA. Judge the length of signaling we have got. If the length of the signaling is not enough or the signaling is abend, it proves that the signal has been damaged. So the pointer back to the starting position of the next one and take this position as a new starting point to start processing. If signal length is normal, the pointer moves down 163 or 218 bytes. Its structure is shown in Fig.2.

Signaling Analysis. Signaling analysis part is the core of the whole system and it is the execution part of system function. Therefore the system needs to take a relatively efficient algorithms and design. Signaling system researches on user behavior through the signaling. The analysis includes three main parts: the calling number, called number and feature information. The system stores these three parts in the database, and then makes a large number of statistical analyses to infer the user's preferences. In order to improve the execution speed, signaling system adopts multi-thread to perform multiple signaling packet analysis at same time. Take phone signal as an example to analyze the mining process. The length of call signaling packet is 218 bytes. The calling number is the first 117-141 bytes; called number is the first 141-165 bytes; 210 to 214 bytes is negative reasons, such as "e002" for the shutdown signal. Thus, we can easily conclude that user A often call user B. Assuming user B frequently dials western restaurant phone, we can infer that user A has diet hobby for Western-style food.

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the boot signaling(163 bytes)
00 A3 00 1C E7 42 00 00 00 00 00 C7 4B AB 4C A2 EB 72 00 BE 00 00 00 00 10 C5
79 E9 A2 4C E0 01 44 2A 0E 91 AB 8B 01 35 FD 00 06 01 32 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 31 33 39 35 34 3A 35 00 00 00 00 00 00 00
0000 00 06 07 00 00 00 00 00 00 00 00 00 00 0D 00 00 00 45 35 38 36 36 39 30 36 00 00
36 36 33 31 38 34 34 35 37 38 00 38 36 31 38 39 39 39 36 36 39 33 37 33 00 00 00
00 00 34 36 30 30 33 36 30 39 31 39 31 30 30 30 00 00 00 FF 00 FF FF FF FF 51
02 00 00
the call signaling(218 bytes)
00 DA 00 1C E7 42 00 00 00 00 00 12 5E 35 4C 63 40 BD 01 93 00 00 00 00 10 C3
0D 40 63 4C 00 BA 10 0D B9 85 A4 24 20 35 FD 00 00 35 FD 00 31 33 39 35 37 3A
35 30 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 07 06 00 00 00 00 00 00 00 00 00 10 00 00 00 7A 79 19 00 45 30 34 38 31 41
41 41 00 00 30 33 30 34 34 39 31 38 30 31 00 31 34 37 36 33 32 30 35 31 34 39 00
00 00 00 00 00 00 00 00 00 00 00 00 00 38 36 31 38 39 35 33 32 32 38 38 38 33 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 01
FF FF FF FF

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Fig.2. The signaling structure diagram

The System Running Results

Results Show. Signal analysis system is to collect and analyze users' communication data. Through the data, personalized preferences of users are calculated and related applications are pushed to users intelligently. The statistical results of user personalization preferences are shown in Fig.3.

number	username	phone	preferences	percent
154	13375323324	13375323324	entertainment	14%
154	13375323324	13375323324	commerce	41%
154	13375323324	13375323324	life	37%
154	13375323324	13375323324	social	8%
155	13375323315	13375323315	entertainment	1%
155	13375323315	13375323315	commerce	39%
155	13375323315	13375323315	life	58%
155	13375323315	13375323315	social	2%
156	18953199336	18953199336	entertainment	14%
156	18953199336	18953199336	commerce	13%

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Fig.3. Personalization preference analysis

Stability Analysis. The stability of the system is referred to the fluctuations of signaling transmission speed and changes of packet loss rate. Once the massive packet loss due to not timely processing, it will lead to a poor user experience. After adding signaling caching mechanism, the packet loss situation gets improved markedly.

Conclusion

Firstly this paper analyses the characteristics of signaling data. Then the analysis process is divided into several parts: signaling data buffering, signaling task distribution, signaling analysis, signaling aggregation and distribution. Finally, the personalized preferences analysis system based on signal was designed and implemented.

The signaling analysis platform can acquire user trajectory and analyze user behavior according to user signaling information. After that, the user personalized preferences can be obtained through a large number of analyses. The system provides users with the most reliable, accurate and real-time information, which will enhance the users experience and lead users into to a real virtual world.

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Acknowledgments

We acknowledge Ph.D Hao Liu, Wei Cheng for their instructive suggestions and valuable advice.

Supported by the National Basic Research Program of China under Grant No. 2006039; Technology Development and Cooperation under Grant No. 20120465.