

Analysis of Impact of Smart Terminal on CDMA Network and Solution

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Abstract—This paper makes an introduction to the tendency of mobile internet replacing the fixed-line network. Analysis of the impact of Smart terminals on mobile internet is expounded. Network performance is degraded by huge data service traffic and signaling traffic. This paper also offers solution for the current situation

Keywords-smart terminal;CDMA;EV-DO;network optimization

I. INTRODUCTION

With the advance of 3G network and IP technology, traditional voice call traffic cannot meet the needs of customers. The general trend in the future is broadband multimedia communication. Globally, the proportion of fixed-line users descends year by year and for mobile internet users especially the number of mobile users is rising. The reducing charges of mobile service and its portability make it prior to fixed-line phone. Business transformation and exploitation of the non-voice business market become the focus for operators. Data service is the winning point for telecommunication service. Voice service could not raise income with increment. However, profit of data service is outstanding among the total. The mobile communication network have entered into a stage from voice service to multimedia.

There are different ways for Smartphones to access communication network, such as WiFi, 3G, WiMAX. It is imbedded with open OS and different functions can be achieved by installing all kinds of software, which is extensive[1]. Besides the traditional voice service, it is access to internet, providing with data downloading, sharing and online browsing. The most popular smart terminals are smart phone, panel PC, and electronic reader. New Smartphone like iPhone, Strawberry, and Android mobile provides with user-friendly interface, convenience of touch technology and application experience, suitable browser, driving user more time on internet by mobile.

The global mobile sale rises by 70% in 2010. The market share is up to 42.8% for Android mobile and 28.6% for iPhone in third quarter in 2011. The Smartphone users take up to 18% in the third quarter in 2009 and rise to 44 % in the same period in 2011. From the above, Smartphone is the general trend in 3G market.The graph below is smartphone market prospect forecast.

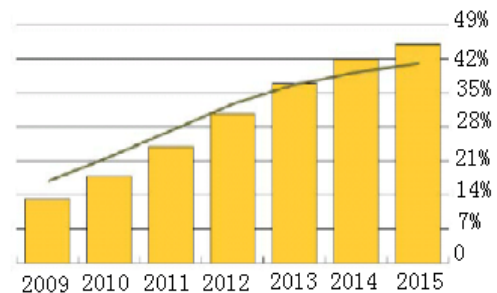


Figure 1. Smartphone market prospect forecast

The shift in consumer habit is motivated by spreading of 3G Smartphones. More and more shopping online, chatting online, browsing webpage and sending and receiving email is done on the Smartphone. At the same time, the mobile game is fully developed. According to some statistics, in the United States, 70% of the total time are occupied by voice call using normal mobile. For Smartphone, value-added service takes up to 55%, of which, 40% are for Email, music, game. In China, 54% mobile users use data service. The proportion of data service users in China has exceeded that of USA and the mobile internet seems to be more popular in China. According to the analysis of internet trend by Morgan Stanley, the increase of internet connection by mobile is far above that of connection by fixed-line and will exceed in 2015. The number will up to 16 hundred billion, the No. 1 connection. The success of mobile internet contributes to the rapid growth of data traffic and advances the mobile network based on high speed, low delay and flat structure in the future[2].

Operators benefit a lot from data service by Smartphone. The data traffic ARPU will exceed the voice service soon in Japan. The AT&T data traffic revenue growth has been raised by 30% in 2010 in the same period compared with that in the previous year. Experience tells us that profit as well as challenge is brought by Smartphone.

II. THE IMPACT OF SMARTPHONE ON CDMA NETWORK

The explosive growth of data flow and signaling owes to the application of Smartphone. At the beginning of introduction of iPhone by AT&T, iPhone users count for 3% of the total mobile phone and take up 40% of the network traffic. For the last three years, the network traffic is 50

times more and keeps increasing. The network is overloaded by the massive data flow. Therefore, call drops and data congestion occurs frequently. The degrading of the network performance makes AT&T one of the operations that customers complain most. In 2009, 8% of Smartphone from O2 occupied 55% of the signaling flow and 90% of data flow, of which data flow was increased by 18 times. Some people in London were unable to get through and not access to internet periodically. O2 invested 30 million pound to improve the network performance. A plan was announced to enhance the network development and make room for long-term growth of mobile traffic. 1500 BTS were deployed in 2009. China is at the beginning of 3G network. Quantities of one thousand-Yuan Smartphone are massively introduced and operators pay more and more attention to smart terminal strategy. In big and medium cities like Beijing and Guangzhou, data is double and signaling load increases by 4 times for Surfing network[3]. The top concern of operators is how to defend the traffic storm by network and Smartphone booming.

The impact of Smartphone on network can be concluded as following aspects based on some analysis and research.

1) *Attack from streaming media traffic:* The utility of Smartphone is higher than that of traditional mobile. Voice calls give way to data service. The flow rate for multimedia service such as streaming and downloading is about 60MB to 200MB per hour, which is challenge for network.

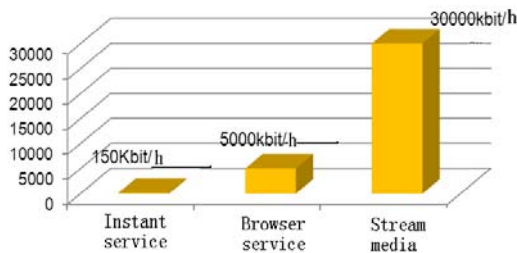


Figure 2. Attack from streaming media traffic

The graph below is the average daily flow of Hubei province from February 2011 to January 2012. From the Figure 3, the growth rate of average daily flow in Hubei province is 72.61% within a year.



Figure 3. The average daily flow of Hubei province in 2011

2) *The pressure is from huge signaling for long-time online service:* Long time online service means that the

session and connection should always be reserved by the network. To keep the instance talk and chat online, small packets and heartbeat messages are sent out from smart terminals. Large volume of wireless channel assignment and establishment message are reproduced, with network resource exhausted[4]. And network signaling is overloaded by CCCH congestion and low utilization of PDCH. Applications such as QQ online, email, Weibo with characteristic of long time online but low data flow, and frequent wireless connection and release make the CDMA network overloaded.

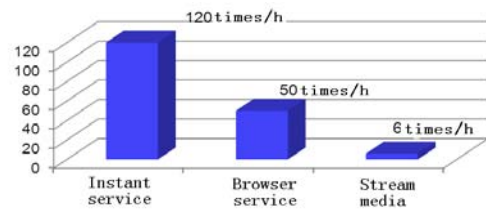


Figure 4. Attack from signaling for long-time online service

The graph below is the average daily connection request number of Hubei province from February 2011 to January 2012. From the Figure 5, the growth rate of average daily connection request number in Hubei province is about 400% within a year.

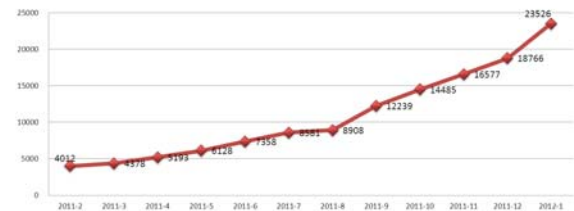


Figure 5. The average daily connection request number of Hubei in 2011

3) *Pressure is from quick sleep mode signaling:* Large volume of data transmission is battery power exhausted. Fast sleep mode is applied to save the power of the battery. When there is no data transfer, wireless signaling connection is released and smart phone is going to idle mode. Service request signaling process is launched if information is requested. Idle state to PS connection is switched to DCH. As soon as data is transferred, it returns to idle mode. From the Figure 6, 31 signaling between the network and smart phone is involved during the process of idle state to activation switching, 18 for sleep state to awake state and 10 signaling for awake state to idle state. Overhead messages are increased significantly, which is a great impact on network.

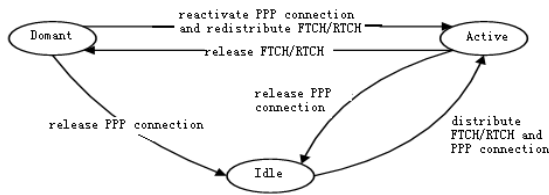


Figure 6. EV-DO terminal state transition diagram

4) *Abnormal service causes avalanche effect:* Keeping connected with the application server, IP network congestion and server broken-down, leads to repeat request from terminal. Instantaneous signaling and network capacity will decline rapidly.

5) *There are other causes:* Terminals are visited by more and more unknown packets with the increasing of network applications.

III. SOLUTIONS TO SMART STORMS

To defend the smart storm, network provider should combine the patterns of user behavior with the network status. Based on the expansion of network reconstruction and the increasing number of user, it is challenged to take the network flow and signaling under control. If faced on the smart storms, the network providers should take necessary steps to guarantee the safety of network. Specifically, the following points can be focused on.

1) *Make a deep analysis of impact of mobile, service and user behavior on the network.* Choose a smart terminal pattern and reconstruct the network on a reasonable stage. Base station controller (BSC/RNC), the key network element for network service and signaling processing, is prone to network storm attacking. In order to control the network adjustment by increasing of calling and signaling, two issues should be paid attention to[5]. First, the capacity of the network should not be fully used and should be reserved considering the fast speed of data in the future. Secondly, in the network management, the optimization of BHCA signaling processing capability should also be focused except the BSC traffic transferring and processing capacity

2) *Use Wi-Fi shunt meshing model to enhance the system level network capacity.* C+W network is deployed massively by China Telecom Since 2010. In hot spot, Wi-Fi is covered in some hot spot based on the CMDA EV-DO network. In this way, massive but not so important data flows are transferred to Wi-Fi network and the bone network are ready for high priority of mobility and value data flows.

3) *Use high tech to improve the network capacity.* For example, EV-DO Rev.B is introduced to enhance the CDMA network. Network speed can be triple by upgrading software of multi-carriers[6]. According to experimental

results, EV-DO Rev.B can increase the network capacity up to 90% compared with traditional CDMA EV-DO Rev.A when the utility of network slot is up to 40%.

4) *The following steps can be made to change network flow form extensive to intensive management.*

a) *Bandwidth control is based on user:* Set different priority levels and provide different service for users according to the ARPU contribution. Limit the maximum of speed for different customers to clear up the mental gap among them when there is difference of network between busy and idle period.

b) *Control the bandwidth according to total flow:* When the monthly flow achieves the threshold, decrease the speed. Limit the speed for users who is of no flow limit package and subject to abuse network bandwidth to use the network resource efficiently.

c) *Mange the service according to time and area:* Optimize the service strategy by service identification. Separate the service into different types and give priority to service with lower flow and higher value. Limit the service of higher flow and lower value according to time and area to avoid stroking to network.

5) *Optimize network equipment parameters and enhance the network KPI by the following steps:* adjusting the network sleeping timer, improving the DO paging pattern, speeding up the channel, using multi customer packet, optimizing the schedule protocol algorithm, adopting new function of equipment. Make adjustment according to network status to avoid unnecessary interaction and relief the network pressure.

IV. CONCLUSION

With the burgeoning internet development, the explosive growth of data flow and signaling owes to the application of Smartphone, which makes profit as well as challenge for operators. Therefore, the behavior of Smartphone users should be focused on. Solution to smart storm is necessary to make the network more safety and stable.

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