# Analysis of OTT Service Influence on Mobile Communications Network

Y. Li
Digital China (China) Limited
Beijing, China

J. Li
Digital China (China) Limited
Beijing, China

***Abstract*—The influence of Over the Top (OTT)service on network is studied, impact of mobile terminal on the network mainly include heartbeat, push mechanism, and fast dormancy mechanisms. Permanent online heartbeat has little effect on the network. Fast dormancy mechanisms of mobile terminals on the network is relatively large, if the state transition frequently coupled with large number of intelligent terminals, this effect will greatly increase network signaling load. Introduce of Cell Paging Channel(CELL-PCH)state and Utran Registration Area Paging Channel(URA-PCH) state will greatly reduce the signaling load, the current terminal have been supported by the majority of the 3GPP R8, so need to open fast dormancy feature on the network side.**

***Keywords-OTT service; fast dormancy; heartbeat mechanism; push mechanism***

## I. INTRODUCTION

For Wechat, QQ, data transfer mechanism is similar, the underlying using Transmission Control Protocol (TCP) communication, application layer protocol is a proprietary protocol, with explicit frame format, all the messages, pictures, voice and video transmission and reception are using the same frame format for transmission. Basically all communications are transmitted in a TCP connection to a certain frame format, all user information, sending and receiving contents are encrypted, encryption method including RSA, DES and AES.

Data frame of the network need to use one or more TCP packets to transmit, the data format is fixed, which contains the length in the header of the frame, the type of content transmitted in the frame (such as a message, language, video, push, heart rate, etc.), which is the command code[1][2][3][4][5][6].

## II. OTT HEARTBEAT MECHANISM

OTT heartbeat mechanism is applied in order to increase the user experience, keep the application permanent online. The so-called "permanent online" is to maintain a network session and connection for the application, and therefore need to take the following network resources: mobility management in the context of long-term user state in connection state, Radio Access Bearer (RAB), the user bearer context (PDP), as well as long-term occupation of public IP addresses. The scarcity of radio spectrum resources determines the characteristics of the mobile packet network on demand, and therefore does not naturally meet the needs of permanent online.

OTT application client needs time to send a message to the server, the network side to avoid being deactivated. The message is a heartbeat message, the set time interval is the heart cycle. The client sends through the regular heartbeat messages to the application server to achieve the purpose of long-term occupation of the external network IP address, and the server can be reported through the terminal by sensing the heartbeat message to perceive the online status of the client.

Therefore, the purpose of sends heartbeat packets are: first, let the server know its own IP address and port so that others can paging; the second is to tell the server it alive, let the server do not dismantle assigned resources.

In order to solve the lack of public IP addresses, and avoid attacks from outside, NAT technology is used to convert the IP address of the mobile terminal. Therefore, the host will be retained on the NAT private IP routing information. Due to the limited mobile resources, NAT conversion of the mobile terminal is typically dynamic conversion or port multiplexed mode. Therefore, NAT retain private network IP, port and public IP, port mapping between time is not infinite, so when the timer is automatically cleared when the mapping between the public IP and port to another mobile terminal use. OTT application client in order to maintain public and private network IP mapping NAT needs to send heartbeat messages, in order to achieve the long-term occupation of public IP and port.

Secondly, to increase the user's experience, instant messaging software usually keep the connection to the server, periodically sends a heartbeat message to the server, keep IP connection to receive real-time Push messages. And due to limitations of server resources, if news not received within a period of time the client believes that the client is offline, it automatically disconnects the previously established connection, so that the client and server lost contact. Clients certainly want always online, so in order to keep the server disconnects, you need to periodically send heartbeat messages to the server, so that you can receive real-time server push messages.

## III. IMPACT OF OTT APPLICATIONS ON NETWORKS

Due to the operating system differences, the performance of the same manufacturers OTT applications on different operating systems is different, and ultimately manufacturers in order to increase the user experience, frequently sending heartbeat messages to maintain the connection to the server in order to obtain real-time news. The application of these measures does not take into account the impact on the network,

the heartbeat packet itself is not large, but requires a lot of signaling interaction, the more frequent messages sent small amounts of data, the more signaling resource consumption.

Impact of OTT applications on networks mainly in the following two aspects: First, send heartbeat messages frequently, the second is frequently transfer large amounts of small packets. These two messages are characterized by common signaling channel carries signaling overhead is greater than the data overhead, the heartbeat message itself is a small data packet message.

Because of the large number of OTT application users, when the terminal using OTT services, will lead to frequent transfer of large amounts of small packets, each time you send a lot of data signaling interaction is required, resulting in huge signaling overhead, network congestion, uplink resource-constrained. Since the initial network traffic model designed mainly consider voice services, resulting in the user's existing network traffic model deviates from the initial traffic model network design, network design configuration of resources can not support the current network traffic model corresponding to the signaling load. At the same time a large number of small data packet message has led to a large power consumption of the terminal, the terminal standby time is shortened, reducing the user experience.

## IV. Influence of Push Scheme

Iphone applications on the terminal using Apple's unified APNS (Application Push Notification Service) Unified Push function, APNS and iPhone for 15 minutes heartbeat long connection, and maintain normal contact phone and server, otherwise the phone will not stop initiate connections until until the server. Google's C2DM (Android Cloud to Device Messaging) of the cardiac cycle is 28 minutes, but due to Google's C2DM domestic server is unavailable, causing the application Android phone using the respective heartbeat messages to keep in touch with their Push server, resulting in signaling more frequent interaction, greatly increasing the pressure on the network.

Push mechanism proposed intention is good, push technology by automatically transmitting the information to the user terminal to reduce network resource lookup, this will effectively reduce the requesting user connected to the network to reduce the signaling load on the network. However, if the server for each application are pushed directly to the message to the client, it will also generate a lot of network connections. Further, due to the application in order to maintain with their Push connected to the server, but also need to regularly send heartbeat messages, the heartbeat message also has the characteristics of small data packets, and require a great deal of signaling resources; Moreover, the cardiac cycle is also different for different applications, non-application synchronization update will cause frequent network connection establishment and release waste of network resources, increase the signaling burden. The most frightening thing is that once the terminal server connection is less than, the terminal will connect to the network has been kept until the connection until the server, the mechanism of the network is a major catastrophe, if Push server failure will lead to an avalanche of signaling effect, signaling congestion occurs even paralysis.

## V. Influence of Always Online

To receive an application at any time to ensure a good user experience data, intelligent terminals usually remain permanently online, namely the terminal and keep PDP context active, upon detecting the PDP context is deactivated, the terminal immediately initiate the activation process, the network re-activate the PDP context. To avoid deactivating the SGSN, the terminal needs to send a heartbeat message periodically to maintain PDP context active. The case where the heartbeat period is greater than the network side deactivation cycles, intelligent terminals will be deactivated, after being deactivated, within one second terminal will re-initiate a new activation process.

If the SGSN network element settings regularly PDP context deactivation function, the impact on the network mainly for frequent releases and network resources, not only the regular PDP context deactivation function useless, but increased the network signaling load. If you do not set a regular SGSN PDP context deactivation function, the phone will always consume network resources, including the radio access bearer (RAB), the user bearer context (PDP) and a public IP address, the network has brought a lot of pressure. Therefore, close or open the deactivation function, operators face a dilemma.

Tests show that the current mainstream smart terminals support permanent online mechanism heartbeat cycle is generally 10 to 15 minutes. Iphone4 using the iOS system and iphone3GS terminals, software running in the background and possible, the testing process has been data transmission, and the transmission interval erratic; Android system using a terminal, without business, the phone has no data to send, but will remain active state.

Permanent online mechanism frequent cause PDP activation and deactivation, and the RRC state is frequently switched, but the longer the heart cycle of the intelligent terminal (iOS heartbeat period of 10 to 15 minutes, Android heartbeat period is 15 minutes), compared to application of OTT more frequent heartbeat (generally 3 to 5 minutes), a permanent online mechanism of the intelligent terminal to the network signaling impact than OTT application of small impact on network signaling.

## VI. Influence of Fast Dormancy

Due to the large screen display of intelligent terminals, frequent data transmission, multi-tasking and other features will be a lot of power, resulting in battery life to be lower than expected. In order to extend the terminal battery life, general phone manufacturers are using fast dormancy mechanism. Fast dormancy mechanism refers to the phone at the end of the data transfer, immediately exit the RRC connected state (ie CELL-DCH, CELL-FACH, CELL-PCH, URA-PCH state), back to the RRC idle state, because the connection status, especially RRC DCH state high power consumption, fast dormancy mechanisms can greatly reduce the power consumption of the terminal, extend the standby time, it has been widely used.

Although the fast dormancy solved smartphone battery life is short question, but also to the network fast dormancy tremendous side effects: frequent access, a large number of signaling overhead, call loss rate increases, the network operators to bring great distress. Usually manufacturers in order to maximize conserve battery power, often that is disconnected from the terminal a few seconds, no data transmission, switching from RRC RRC connected state to the idle state, and the state transition will generate more than 20 instructions. When the need for data transmission, the terminal conversion from RRC idle state to the connected state, re-establish a connection with the network connection status (CELL-DCH state) requires 30 instruction from RRC idle state to the RRC. Enter the PS service from the IDLE state is CELL_DCH state needs to go through a series of processes and NAS RRC procedure, comprising: RRC connection establishment procedure, NAS signaling connection establishment procedure, the security mode procedure, RAB establishment procedure, PDP activation process, etc., the air interface requires a total of three ten messages.

So again the connection setup and teardown require a lot of signaling interaction, the test data show that the number released by the terminal power saving feature is the system caused by the release of more than 10 times the normal number, so fast dormant terminal to the network brought great signaling load.

Introduced from the 3GPP R8 version CELL-PCH and URA-PCH state, PCH state of terminal power consumption is relatively small, but stay connected. Conversion from a PCH state to a FACH state instruction DCH is less then the desired state.

RRC state for a simple conversion from CELL_PCH transition to CELL_FACH state, no NAS process, only through the cell renewal process, the air interface requires only two or three signaling.

RRC state transitions for a simple conversion from CELL_FACH to CELL_DCH state, no NAS process, just by RAB reconfiguration process takes about eight empty signaling. Transition from state signaling process shown in Figure Ⅰ.

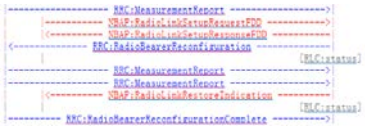


FIGURE Ⅰ. TRANSITION FROM STATE SIGNALING PROCESS.

By comparing the state transitions of the signaling process, from CELL_PCH CELL_DCH to CELL_FACH then the conversion process (12 signaling) ratio conversion (30 signaling) CELL_DCH state from IDLE to be able to reduce the amount of signaling overhead.

But now is not on the network side fast dormancy mechanisms to support end-to-R8 version uneven, the study found that the current terminal supports fast dormancy as follows:

- Before R8 (do not send SCRI) terminal: Before R8 (do not send SCRI) terminal based on network instructions DCH -> FACH -> PCH -> IDLE state migration;
- Before R8 (sending SCRI) terminal: Before R8 (sending SCRI) terminal sends SCRI, but do not carry the cause value, the terminal migrate directly to IDLE;
- After R8 versions terminal: R8 version of the network after the network-side control fast dormancy feature off the case, the terminal sends SCRI, terminal migrate directly to IDLE; in the Network Control Fast Dormancy feature open the case, according to the network indicates a state transition.

## VII. CONCLUSION

Impact of mobile intelligent terminal on the network mainly includes frequent heartbeat Push mechanism, and fast dormancy mechanisms leading to frequent switching. Permanent online heartbeat has little effect on the network. Fast dormancy mechanisms of intelligent terminals on the network is relatively large, if the terminal does not support the 3GPP R8, the fast dormancy will result dozens of signaling, If the state transition frequently coupled with the large number of intelligent terminals, this effect will greatly increase network signaling load, severe cases will result in network paralysis. If introduce CELL-PCH state and URA-PCH state will greatly reduce the signaling load, the current terminal have been supported by the majority of the 3GPP R8, so need to open fast dormancy feature on the network side.

## ACKNOWLEDGEMENTS

This work was financially supported by the project2012AA01A403.

## REFERENCES

[1] Han, Yuxi ; Zhao, Ming,Optimization of OTT small data services: Network capacity and cost analysis, Wireless Communications and Signal Processing (WCSP), 2014 Sixth International Conference on, 2014 , Page(s): 1-6.

[2] De Pauw, T. ; Volckaert, B. ;On the design of a flexible software platform for in-building OTT service provisioning, Integrated Network Management (IM), 2011 IFIP/IEEE International Symposium on, 2011 , Page(s): 1089-1094.

[3] Hart, J.; Brown, R.What LTE policy control features can operators execute to differentiate themselves from OTT players?Intelligence in Next Generation Networks (ICIN), 2013 17th International Conference on, 2013, Page(s): 16-22

[4] Ross, S.W. ; Erasmus, L.D. Evolving the network operator's business model in an OTT environment using Fuzzy Cognitive Maps, Technology Management in the IT-Driven Services (PICMET), 2013 Proceedings of PICMET '13: 2013 , Page(s): 1460-1468

[5] Saucez, D. ;Secci, S. ; Barakat, C. On the incentives and incremental deployments of ICN technologies for OTT services, Network, IEEEVolume: 28, Issue: 3,2014, Page(s): 20-25.

[6] Samdanis, K. ; Mir, F.G. ;Service Boost: Towards on-demand QoS enhancements for OTT apps in LTE, Network Protocols (ICNP), 2013 21st IEEE International Conference on, 2013 , Page(s): 1- 6.