



Weather the signaling storm

High-performance smartphones with large screens are attracting increasing numbers of users and boosting operators' profits, and yet they bring with them unprecedented signaling storms.

By Chen Yang

Storms rising

The widespread adoption of smartphones globally has ushered in the mobile Internet era. Data from research firm Gartner showed that the number of smartphones shipped globally exceeded 296 million units (a 72% year-on-year growth), accounting for 19% of the total shipment of mobile terminals. High-performance smartphones with large screens are attracting increasing numbers of users

and boosting operators' profits, and yet they bring with them unprecedented signaling storms.

First, the unexpectedly fast growth of mobile broadband (MBB) users and Packet Data Protocols (PDP). Based on data from the top 30 MBB networks deployed by Huawei, in 2010 alone the online 3G user numbers increased by 99%, 3G PDPs by 148%, signaling traffic per office by 268.71%, and data traffic per office by 199.80% over 2009.

Second, frequent network congestion, dropped calls and user complaints. For example, since an operator launched

the iPhone, it had seen data traffic increase by 50 times, but legacy network resources had been unable to keep up.

Smartphones have a great impact on network capacity, signal processing, and data transmission. Operators may face challenges like network congestion, overload, and frequent capacity expansion; thus, early preparation is required to ensure network stability.

Causes

PDP automatic activation

Most smartphones automatically attach to the network and activate a PDP context soon after being powered on, in order to access the Internet and obtain up-to-date information anywhere and anytime. In contrast, feature phones activate PDP only when accessing data service, and deactivate it after the data service is over. As a result, almost each smartphone subscriber has a PDP context and the average activation ratio is much higher, which places much greater pressure on the MBB network capacity as smartphone penetration increases.

Fast dormancy

Smartphones consume large amount of power due to their large screen, long online time, and diversified mobile applications. To save power, smartphones have adopted fast dormancy technology. If there is no data transmission within a short time (usually 3 to 10 seconds), smartphones will automatically abort the wireless connection and switch to the idle mode. The connection will be reestablished when the data transmission is needed. All these generate large amounts of signaling traffic.

Always-on applications

Always-on applications like instant messaging (IM) and social networking services (SNS) etc. are popular among MBB users. These applications not only occupy resources related to wireless carrier, PDP, and IP, but also ask the client devices to send heartbeat messages to the server every several minutes in order to remain online. This also generates a heavy signaling load.

Abnormal signaling

A smartphone makes its best to be always online. If the activation fails due to breakdown of network node such as AAA or OCS server, no service subscription, and insufficient capacity, the smartphone will repeatedly try to activate PDP context. As a result, the activation

signaling on the network increases sharply and the network congestion or overload occurs consequently.

On the network of an operator, for example, the number of repeated PDP activations caused by failed activation accounted for 98.76% of the total PDP activations throughout the network, and the success rate of activation was lower than 3%, resulting in an extremely big waste of network resources.

Continuous virus scan

On an MBB network using public network addresses, the always-on smartphones are subject to external attacks. An intensive IP address scan/sweep attack on terminals can evoke a paging storm, which will lead to CPU peak and frequent overloading of the signaling processing board.

In general, fast dormancy and always-on applications have made smartphone a main contributor to an MBB network's signaling traffic. Huawei statistics based on 30 MBB networks show that in 2010, the wireless connection signaling (service request/lu release) per 3G user increased by 157.81%, and the wireless connection signaling took up 86% of the total signaling.

Taking proactive measures

To better solve the challenges brought by smartphones, operators need to plan their networks properly, and enhance the ability in signaling process and data transmission. In addition, operators need to optimize their network resources and deployment to ease the signaling traffic, guard against the signaling storm, and ensure stable network operation. Operators can also explore the features and impact of smartphones on their MBB networks so as to gain a new profit-generating model.

Differentiated network management

Network visualization: Smartphones are various and their impacts on networks are different. Huawei data shows that Android devices generate three times more signaling traffic than iPhone, and 22 times more than feature phones. The traffic models vary greatly due to different portions of smartphones on MBB networks.

Huawei's visualization solution helps operators gain insight into their networks and understand the quantities, percentages, and signaling distributions of various smartphones. Operators can learn of the change in terminal types, quantities, and traffic models in a timely manner. In this context, they can accurately evaluate and forecast their network resources to avoid network congestion and properly build a high-quality, safe, and stable network.

Differentiated management: With the increased penetration of smartphones, operators will face more complex and variable network resource usage. A differentiated resource and capacity management solution is needed to analyze network and discover resource bottlenecks in a timely manner.

Huawei's network capacity management service monitors smartphone distribution, service composition, signaling and traffic model, then analyzes the usage of network capacity, transmission bandwidth, signal processing resource, IP address resource etc. This helps quickly identify resource bottlenecks, provide improvement advice, and achieve differentiated capacity management.

Enhanced SGSN: Facing the impact of smartphones, network equipment should feature large capacity, powerful processing ability, and sustainable expansion to cope with the growing signaling and traffic pressures.

Based on the ATCA platform, Huawei SGSN is known for its large capacity, high integration, and high throughput. The SGSN is able to process 24,000 sessions per second, accommodate 12 million concurrent users and 24 million PDPs. This helps

dramatically reduce the number of network elements and simplify the networks.

Currently, Huawei SGSN has been widely deployed and gained increasing popularity among operators. For an operator with seven million MBB users and 100% smartphone penetration, only three sets of Huawei SGSN is needed (three more for 100% redundancy).

Relieving signaling impact

To relieve the signaling impact from smartphones, operators can start from optimizing their network configuration and deployment, besides enhancing the equipment capability.

Deployment optimization: Huawei network deployment optimization service relieves the signaling and resource pressures produced by smartphones. The optimization service covers network timer, IP address resource, network security, service configuration, and more.

Smart Direct Tunnel: Direct Tunnel technology can help operators save investment on the user plan. However, with direct tunnel, both establishing and releasing a wireless connection lead to PDP updates in the Gn interface, dramatically increasing the GGSN signaling load.

Smartphones make signaling overload or congestion easier in the direct tunnel scenario due to its active wireless signaling behavior. As a real example from an operator, when the number of direct tunnel users reaches 5%, the PDP update increases 600% prior to the launch of direct tunnel. When the number reaches 10%, the PDP update increases 11 times. Smartphones make direct tunnel a nightmare for GGSN.

Huawei's smart direct tunnel solution adopts "two-tunnel" for smartphones, while direct tunnel for feature phones. This greatly reduces the number of signals processed by GGSN, and avoids signaling congestion.

Preventing abnormal storms

Operators need to act actively to the abnormal signaling storm caused by smartphones to ensure the network stability. In addition, active measures are needed to prevent the signaling storm in advanced.

Guard against the storm: The Huawei SGSN provides powerful overload control and can ideally guard against signaling storm. The system can preserve 80% processing capability under a 10-time signaling load rush, and 50% under a 64-

time signaling load rush. This ensures a reliable and stable system, helping operators smoothly face the signaling storm.

Suppressing the storm: Huawei provides a solution for the signaling storm triggered by terminals with no service subscription or by faulty network elements. The solution monitors the PDP activation signals of terminals. When the activation attempts exceed the predefined threshold, the solution automatically applies countermeasures based on terminal type, and eliminates the abnormal or repeated activations.

Huawei smart paging solution is applicable for the signaling storm triggered by virus attack. GGSN first identifies the service type of the data packets and notifies SGSN; then SGSN decides whether to page based on the service type, service priority, and system load level. The SGSN will prioritize the services with higher priority, and discards the low-priority package if the system is overloaded. This reduces the signal load to the network, while ensuring the experience of high-priority user.

Ongoing innovation of SmartLab

Huawei SmartLab is an innovative lab that concentrates on smartphone tests, mobile applications, traffic models, and solutions. Its research covers four major mobile operating systems of iOS, Android, Windows Mobile, and BlackBerry, together with their various versions. The lab has also researched into applications like IM, VoIP, SNS, Streaming, and P2P. SmartLab has established long-term partnerships with operators worldwide. Joint efforts include testing the new features and impacts of smartphones and applications, identifying risks and new revenue-growth point.

Smartphones are changing the user habits and increasing operators' income. Challenges and opportunities always come together – smartphones are also bringing the signaling storm. The Huawei smartphone solution effectively reduces the signaling storm and ensures network and service stability. With its visualization capability, the solution helps operators precisely evaluate and effectively plan the network, provides warning for insufficient capacity, and avoids unnecessary network expansion. 

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