Implementation Of Network Energy Consumption Model In Instant Messaging Application

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***Abstract*—** the designed smart home system has rich hardware and software resources, low cost and low power consumption, as well as easy expansion, update and maintenance. The mobile network user communication fully based on the network socket request manager (NSRM) technique. The client and server system connection established by the socket and server socket methods with port number. The mobile operators to improve the energy-efficiency of mobile applications and services based on the OTT applications. The file transfer protocol (FTP) to control the Light Big Data Users communication process. To establish TCP connections the server host calls socket to create a listening socket then specifies the IP address and TCP port on which the server will receive connection requests with a call to bind. Puts the server into listening mode which then blocks on the accept waiting for incoming connections. Design power policies to maximize the long-term channel throughput over point-to-point fading channels.

KEYWORDS—*Energy efficiency, mobile services, OTT applications, mobile networks, energy assessment..*

1. INTRODUCTION

This ever increasing data and signaling load puts a strain on the operators' network. New techniques being introduced in 3GPP to improve spectral efficiency of HSPA+ and LTE networks are reaching theoretical limits. LTE-Advanced based Heterogeneous Networks improve spectral efficiency per unit area. Carrier Aggregation is another method by which operators increase capacity. Operators face challenges in acquiring large amounts of new spectrum due to limited availability of spectrum and large capital expenditures associated with it. However all these improvements may not be sufficient to keep up with the data and signaling (overhead) that would be incurred if each individual application update accessed the network separately.

This paper focuses on a complementary solution to manage network traffic called Network Socket Request Manager (NSRM). NSRM gates application requests on smart phones when they are in background mode. By gating only background mode requests, NSRM does not affect user experience. NSRM does not gate any requests when the phone is in active mode i.e. being actively used by the user. Many applications such as news, social networking, weather, etc. generate requests even when the phone is in background mode. NSRM aggregates the initiation of these requests when the phone is in background mode from different applications and gates them. This gate can be opened immediately upon the user turning their screen on, or periodically based on a timer. When the gate is opened, all the pending requests are bundled into a batch and sent over the network which also reduces the number of connection attempts. The bundling of these requests reduces data and signaling.

2. RELATED WORK

Yeow-Khiang Chia_, Sumei Sun† and Rui Zhang[1] propose a model for energy cooperation between cellular base stations (BSs) with individual hybrid power supplies (including both the conventional grid and renewable energy sources), limited energy storages, and connected by resistive power lines for energy sharing. When the renewable energy profile and energy demand profile at all BSs are deterministic or known ahead of time, we show that the optimal energy cooperation policy for the BSs can be found by solving a linear program.

Yiqun Wu, Yan Chen, Jie Tang, Daniel K. C. So, Zhikun Xu, Chih-Lin[2] propose Green Transmission Technologies (GTT) is a project focusing on the energy-efficient design of physical-layer transmission technologies and MAC-layer radio resource management in wireless networks. In particular, fundamental tradeoffs between spectrum efficiency and energy efficiency have been identified and explored for energy-efficiency-oriented design and optimization.

Gunther Auer, Vito Giannini, Istvan G´odor, MagnusOlsson[3] to identify the key levers for energy savings the power consumption of mobile communication systems needs to be quantified. This includes sophisticated power models that map the radiated RF power to the supply power of a BS site, as well as traffic and deployment models that extend short-term small scale evaluations to the country wide power consumption of a network over a whole day or week. Numerical results reveal that for current network design and operation, the power consumption is mostly independent of the traffic load. This highlights the vast potential for energy savings by improving the energy efficiency of BSs at low load.

Maruti Gupta, Satish C. Jha, Ali T. Koc[4] In this article, they first explore the traffic characteristics of these emerging mobile Internet applications and how they differ from more traditional applications. They investigate their impact on LTE device power and air interface signaling.

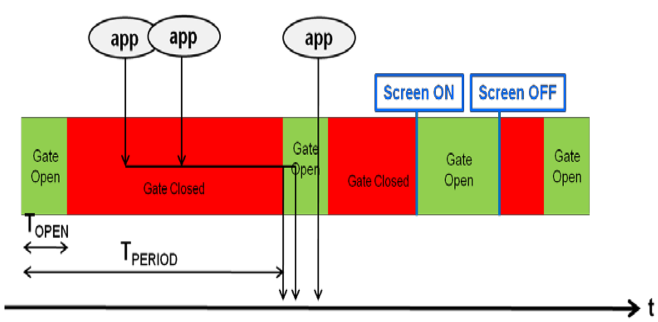
Geoffrey ye li, zhikun xu, cong xiong, chenyang yang, shunqing zhang[5] basic concepts of energy-efficient communications are first introduced and then existing fundamental works and advanced techniques for energy efficiency are summarized, including information-theoretic analysis, OFDMA networks, MIMO techniques, relay transmission, and resource allocation for signaling.

3. Network Socket Request Manager :

NSRM is an efficient method to reduce network overhead. Reduction of the network overhead is achieved by applying a gating mechanism to the applications' request before it initiates a connect. This gating mechanism must ensure it does not delay any such application requests that can negatively impact the application behavior or user perception of the application performance. A delay in the application request may sometimes result in the application malfunctioning depending on the expected outcome for the application.

3.1 Gate Closed

The gating mechanism is implemented using a wrapper in the device software. This wrapper intercepts application requests and accumulates them over a period of time Tperiod. During Tperiod the gate is closed from a network connectivity perspective.



3.2 Gate Open

In order to avoid a large accumulation of application requests in the NSRM queue, the gate is periodically opened. This allows applications to update their data periodically. As shown in Figure 5, the gate is kept open for duration of time governed by another timer called Topen. When Topen starts, requests are processed and data and signaling that has accumulated is aggregated and transmitted by the device.

At any given time, if the device is paged by the network, or user interacts with the phone (screen turns ON) as shown in Figure 6, or the phone goes to active mode due to any other reason, the gate is opened if it is currently closed. The gate is also kept open longer in case it is already open due to Tperiod expiry.

4. TRAFFIC MANAGEMENT COMPONENTS

NSRM is designed to not impact user experience. NSRM uses the concept of active and background mode to determine opportunities for smart gating. Figure 2 shows how these are defined.

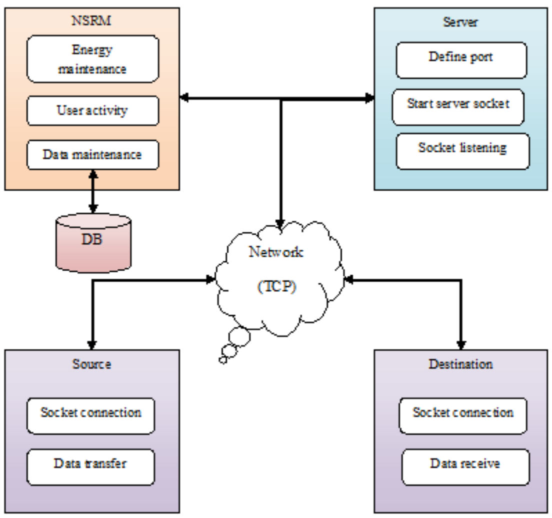
4.1 Active Mode

For the purposes of this study we define active mode whenever the user is actively using the device. This includes talking to someone in a voice call, or browsing through emails, exchanging instant messages, using applications, watching a video on the screen, or listening to music, etc. So if there is any user activity, or when the device is paged, or the screen is on, or the microphone/speaker is in use, we consider the device being in active mode.

4.2Background Mode

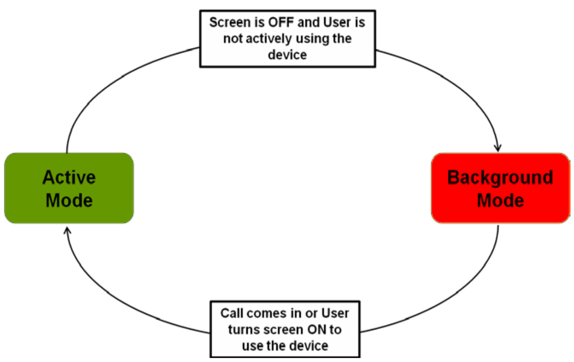
For the purposes of this study when the user is not actively using the device we consider it to be in background mode. The device screen is the primary user interface and acts as an indicator of the state of the device. Most of the time during the course of a day the user is not looking at the screen and it is off. This could happen during the day when the device is sitting at a desk, or in a pocket, or purse and not performing any request for the user. It can also happen during the night when the device is being charged. In addition to screen being off, other aspects of the device are also considered to determine a background mode. These include the radio state being idle, the speaker/microphone being off, and interfaces such as USB, GPS, etc. not in use.

5 SYSTEM ARCHITECTURE:



6.MODULES

- Network formation
- Network socket request manager



- Energy assessment
- Performance evolution

6.1. Network formation:

Sockets provide the communication mechanism between two computers or devices using TCP. A client program creates a socket on its end of the communication and attempts to connect that socket to a server. Clients send the request to the server when server receives the request it send response to the client. Client and server system connection can be established by the socket and server socket method with port number.

6.2. Network socket request manager:

A Network Socket Request Manager (NSRM) is provide efficient application management for analyzing the Light Big Data Users energy consumption. NSRM reduces mobility node signaling traffic by bundling application requests and intelligently delaying them.

6.3. Energy assessment:

The behavior of OTT IM users can be categorized into four groups based on data transmission volume and service type,

- Heavy big data users,
- Light big data users,
- Heavy small data users,
- Light small data Users.

6.3.1 Heavy big data users

These users produce or download large amounts of data.Therefore, in this quadrant the service data energy dominates.One of the most effective ways to reduce the network energyconsumption of these users is to offload the heavy dataservices and their users from macro cells to smaller cells (e.g., pico and femto). Several proposals have been made to offload mobile users from macro cells to smaller cells for the purpose of relaxing the capacity of macro cells. However, to date, no research has been conducted to quantify the network energy savings of offloading users to small cells on a per service basis. Furthermore, another major challenge for offloading mobile users from macro cells to small cells is to optimize the overall energy consumption of the mobile network, because offloading techniques require a large number of small cells to be activated, which will potentially increase the overall HetNet energy consumption . Therefore, a future research question is how to simultaneously minimize the network energy consumption of mobile services and the overall energy consumption of the mobile network, whilst satisfying the quality-of-experience (QoE).

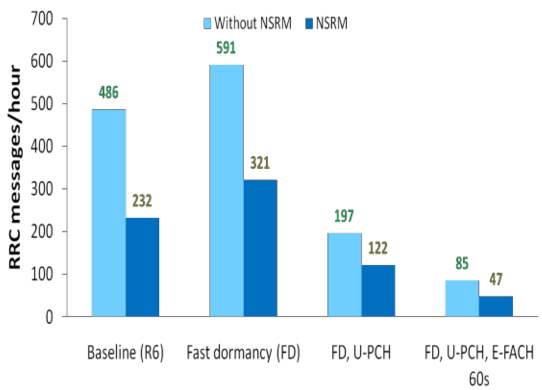
6.3.2 Light big data users

For these users, the signaling energy consumption of the mobile network dominates due to the heartbeat mechanism of mobile OTT applications. Intuitively, reducing the heartbeat frequency could reduce the total signaling energy consumption overhead. As the **7** heartbeat mechanism will not only incur excessive waste in network signaling energy but also network resources, existing solutions such as the network socket request manager (NSRM) have been proposed . Here, instead of allowing every application on user equipment (UE)to send individual heartbeats, the NSRM could bundle the heartbeat requests from all applications in a UE and provide updates at once. However, although this technique reduces the number of heartbeats per UE, it has not considered optimizing the number of heartbeats based on daily user active cycles.

As a result, one interesting direction for future work will be to investigate an adaptive control algorithm that dynamically changes the heartbeat request of a UE based on the specific daily user active cycle to further improve the NSRM technique to reduce the signaling overheads per UE.

6.3.3 Heavy Small Data Users

In an LTE network, traditional applications typically generate traffic only during the *connected* state. Once the user session is terminated after a certain period of idle time, the UE will transition from the *connected* state to the *idle* state. As mentioned in the previous sections, this connecting and releasing process is called RRC, which can cause an excessive amount of signaling overhead. In this quadrant, data traffic arising from each text message is small, so the large signaling overhead generated by continuously sending small data packets results in a significant level of energy consumption.



For example, referring back to Fig. 4, the signaling energy of a text message (regardless of WeChat or SMS) is always much higher than the data energy. The most intuitive way of reducing the SDER is to increase the payload or the amount of data being sent in one RRC cycle, using techniques such as caching and aggregation of data packets. However, the delays introduced by these techniques could potentially affect the QoE of a user. Therefore, a future research question is how to decrease the SDER for heavy small data users while maintaining acceptable QoE.

6.3.4 Light Small Data Users

The energy consumption caused by the heartbeat mechanism and the signaling overheads generated by sending small data packets dominate the overall energy consumption for users in this quadrant. Combining the potential solutions in the two quadrants: light big data users and heavy small data users, could reduce the overall energy consumption for users in this quadrant. However, the key question here is how to change the behavior of those users who install many applications on their smartphones but do not use them regularly. In this case, our results show that these users would be better off (in terms of network energy efficiency) to use conventional mobile services such as the SMS and MMS. Therefore, to promote the use of conventional services among these users will be a key challenge for mobile operators.

6.4. Performance evaluation:

Apply the network socket request manager (NSRM) techniques to reduce the energy consumption of UE. And also analyze the packet delivery ratio of the network, It is the ratio can send total number of packets correctly send by sources and total number of packet received by destination. Data loss problem and, End-to-end delay is defined as an average time taken by a data packet to arrive in the destination.

7.NSRM Performance Results

In this section we present the performance results of a NSRM solution implemented on an Android smart phone prototype device on a commercial 3GPP network.

We consider an application mix with twelve commonly used applications. It is important to note that the performance results could vary significantly depending on application mix.

We show results for baseline 3GPP Release 6 commercial network currently deployed. We also show results with some of the enhanced features of HSPA such as fast dormancy with three second inactivity timer for DCH state and three and a half second inactivity timer for FACH state, U-PCH, Enhanced Cell_FACH feature with sixty second inactivity timer. Tperiod is set to ten minutes, and Topen is set to one minute. We also show sensitivity to application mix and push notifications. We then present simulation results for the reduction in standby power consumption.

8.CONCLUSION

NSRM is a complementary solution to improving network capacity that reduces signaling generated by applications on smart phones and saves battery life. NSRM is designed to not impact user experience or normal application behavior as it applies gating to requests only in background mode. Based on the tests we have performed for a smart phone prototype with twelve applications, NSRM achieves 52% reduction in number of background requests per hour which translates into reduced signaling and higher network capacity for operators. Results vary depending on application mix. Sensitivity analysis shows that the reduction in signaling can be as high as 68% depending on the application chattiness and mix. In addition to reduced signaling, NSRM simulations indicate a 50% reduction in standby power consumption due to background requests. This translates into longer battery life in smart phones and better user experience.

9. REFERENCE

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