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A SURVEY ON CELLULAR TRAFFIC OFFLOADING

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ABSTRACT --- A Mobile Ad Hoc network (MANET) are a account of Wireless Ad Hoc network that mostly has a routable networking performance over on top of a Link Layer Ad Hoc network. Mobile computing is an essential technology which allows transmission of data, voice and video via a computer or any other wireless enabled device. Mobile Computing deals with Mobile Communication, Mobile Hardware and Mobile Software.

INDEX TERMS ---Mobile computing, Offloading techniques, delay tolerance.

I. INTRODUCTION

Mobile computing is the trending technology that allows transmission of data, voice and video via a computer or any other wireless enabled device. It deals with Mobile Communication, Mobile Hardware and Mobile Software. In the Cellular or Mobile networks the last link will be wireless. Here the network is distributed over land areas in the form of cells; each cell is served by at least one fixed-location transceiver, which is known as a base station or cell site. This base station provides the cell with the network coverage which is used for transmission of data, voice and others. In a cellular network, each cell uses a different set of frequencies from the neighboring cells; to avoid further interference and provide guaranteed bandwidth within each cell. When these cells joined together it provides radio coverage over a wide geographic area. This enables a large number of portable transceivers like mobile phones, pagers, etc., to communicate with each other and with fixed transceivers and telephones anywhere in the network, through base stations, even if few of the transceivers are moving through more than one cell during transmission [6].

CELLULAR NETWORK STRUCTURE

The basic cellular network structure contain: BTS, BSC, MSC, HLR and VLR PSTN. The link starts from the base transceiver station (BTS) with its antenna back through a base station controller (BSC), and a mobile switching center (MSC) to the location registers (VLR and HLR) and the link to the public switched telephone network (PSTN).Of the units within the cellular network, thereby BTS provides the direct communication with the mobile phones. There may be a few number of base stations then linked to a base station controller [7].

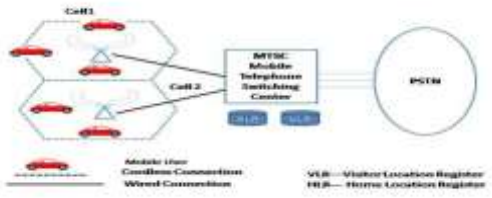

Fig 1. Structure of Cellular network

II. RELATED WORK

This unit acts as a small center which route calls to the required base station, and it will also make some decisions about which base station is suited to a particular call. Here microwave links are used between BTS and BSC. Sometimes the BTS antenna towers also support a small microwave dish antenna which is used for the link to the BSC. The BSC will often share with a BTS. The BSC acts as interface with the mobile switching center. This makes more widespread choices about the routing of calls and interfaces to the land line based PSTN as well as the VLR and HLR [11].

ISSUES IN CELLULAR NETWORKS

In cellular networks there are different major kinds of problems occur [10]. They are

1. Frequency allocation
2. Licensed
3. Many providers
4. Multiple Access
5. Many users
6. Wide area of coverage
7. Traffic management
8. Location management
9. High mobility (in cars, trains)
10. Multiple suppliers

NETWORK DELAY

Network Delay is an important performance characteristic of a computer network or telecommunications network. The delay of a network insists how long it takes for a bit of data to travel through the network from one node or endpoint to another. The time is measured in multiples or fractions of seconds. Sometimes Delay may differ, depending on the location of the particular pair of communicating nodes [8].

Usually users care about the total delay of a network; thereby engineers need to perform precise measurements. Thus, engineers usually report both the average and maximum delay [18], and they divide the delay into several parts.

A. *Processing delay*

Processing delay is the time that takes routers to process the packet header. Processing delay is a major component in network delay. During processing of a packet, routers may check for bit-level errors in the packet that occurred during transmission as well as determining where the packet's next destination is. Processing delays in high-speed routers are typically on the order of microseconds or less. After this nodal processing, the router directs the packet to the queue where further delay can happen (queuing delay) [12].

In the past, the processing delay has been ignored as insignificant compared to the other forms of network delay. However, in some systems, the processing delay can be quite large especially where routers are performing complex encryption algorithms and examining or modifying packet content. Deep packet inspection done by some networks examine packet content for security, legal, or other reasons, which can cause very large delay and thus is only done at selected inspection points. Routers performing network address translation also have higher than normal processing delay because those routers need to examine and modify both incoming and outgoing packets [9].

B.Queuing delay

The queuing delay or queuing delay is the time a job waits in a queue until it can be executed. It is a key component of network delay. In a switched network, the time between the completion of signaling by the call originator and the arrival of a ringing signal at the call receiver. Queues may be caused by delays at the originating switch, intermediate switches, or the call receiver servicing switch. In a data network, the sum of the delays between the request for service and the establishment of a circuit to the called data terminal equipment (DTE).In a packet-switched network, the sum of the delays encountered by a packet between the time of insertion into the network and the time of delivery to the address [13].

Transmission delay is a function of the packet's length and has nothing to do with the

distance between the two nodes. This delay is proportional to the packet's length in bits,

It is given by the following formula:

$$D_T = N/R \text{ Seconds}$$

Where D_T is the transmission delay in Seconds, N is the number of bits, and R is the rate of transmission (say in bits per second) Most packet switched networks use store-and-forward transmission at the input of the link. A switch using store-and-forward transmission will receive (save) the entire packet to the buffer and check it for CRC errors or other problems before sending the first bit of the packet into the outbound link. Thus, store-and-forward packet switches introduce a store-and-forward delay at the input to each link along the packet's route [14].

*D.**Propagation delay***

Propagation delay is the amount of time it takes for the head of the signal to travel from the sender to the receiver. It can be computed as the ratio between the link length and the propagation speed over the specific medium [6]. Propagation delay is equal to d / s where d is the distance and s is the wave propagation speed. In wireless communication, s=c, i.e. the speed of light. In copper wire, the speeds generally range from .59c to .77c. This delay is the major obstacle in the development of high-speed computers and is called the interconnect bottleneck in IC systems [19].

III. RELATED WORK

Some of the existing mobile data offloading systems and there techniques are discussed as follows:

A. "Mobile Data Offloading through Opportunistic sCommunications and Social Participation"Bo Han et.al

Definition

To exploit opportunistic communications to facilitate information dissemination in the emerging Mobile Social Networks (MoSoNets) and thus reduce the amount of mobile data traffic. The author further proposed three algorithms, called Greedy, Heuristic, and Random, for this problem and evaluates their performance through an extensive trace-driven simulation study. The simulation results verify the efficiency of these algorithms for both synthetic and real-world mobility traces.

Algorithm

In this paper, three algorithms are used for the target-set selection problem Greedy, Heuristic, and Random algorithm. Target-set selection is an NP-hard problem for both the independent cascade model and the linear threshold model.

Performance evaluation:

The performance factors are evaluated using Pull Probability and Delay-Tolerance Threshold. By comparin Greedy, Heuristic, and Random algorithm to check the performance.

Advantages:

Provides sharing of data among the mobile social networks

a possible one among users by means of dissemination networks.

***Drawbacks*:**

A Service delay causes huge infrastructure changes and high adoption costs. Adopting does not answer the heterogeneity of mobile data transferred over the cellular networks.

B. *Taming the Mobile Data Deluge with Drop Zones"IonutTrestian[2]*

Definition:

By analyzing user content upload behaviour, finds that the user-generated content problem is a user behavioural problem. Particularly, by analyzing user mobility and data logs of 2 million users of one of the largest US cellular providers, then users upload content from a small number of locations; because such locations are different for users, we find that the problem appears ubiquitous.

However, there exists a significant lag between content generation and uploading times, and with respect to users, it is always the same users to delay. Secondly, the author proposes cellular network architecture. The proposed approach capacity upgrades at a select number of locations called Drop Zones. Although not particularly popular for

uploads originally, Drop Zones seamlessly fall within the natural movement patterns of a large number of users. They are therefore suited for uploading larger quantities of content in a postponed manner.

Algorithm:

The Greedy algorithm is iterative and determines which base stations should be considered for placing Drop Zones until all content is covered by at least one Drop Zone. At each step, the Greedy algorithm selects the base station that has the maximum number of distinct content chunks that have not been covered yet.

Advantage:

Suited for uploading larger quantities of content in a postponed manner to deliver among large quantities of people.

Drawbacks:

In the delay tolerance of delivery, the deadline does not determine the information dissemination duration.

C. "An Incentive Framework for Cellular Traffic Offloading"XuejunZhuo [3]

Definition

The author investigates the tradeoff between the amount of traffic being offloaded and the users' satisfaction.

The author provided a novel incentive framework to motivate users to leverage their delay tolerance for cellular traffic offloading. To minimize the incentive cost given an offloading target, users with high delay tolerance and large offloading potential should be prioritized for traffic offloading. To effectively capture the dynamic characteristics of users' delay tolerance, the proposed incentive framework is based on reverse auction to let users proactively express their delay tolerance by submitting bids. This illustrates prediction of offloading potential of the users by using stochastic analysis for both DTN and WiFi cases.

Algorithm:

The auction would result in an extra delay for the bidders to wait for the auction outcome. However, different from other long-term auctions, such as the FCC-style spectrum leasing, the auction round in our scenario is very short, since hundreds of users may request cellular data service at the same time. Also, because the bidders who are willing to submit bids are supposed to have a certain degree of delay tolerance, the extra delay caused by auction can be neglected. Next, we describe two main steps of the auction: allocation and pricing. The performance factors are bidder number, reserve price and delay tolerance, WiFi coverage rates, Large-scale DTN trace.

Advantage:

Users' offloading potential can be predicted based on their delay tolerance and provide return incentive as a bid offer

Drawback:

Satisfaction loss of the users when a longer delay is caused by traffic and the partiality among the incentive for delay and non-delay downloads Based on the users approach.

D. "Energy-efficient traffic offloading in Macro-Pico networks"Qimei Liu[4]

Definition

In this paper "Energy-efficient traffic offloading in Macro-Pico networks"[4], the author proposes a traffic offloading scheme from macro BS to low Power Nodes (LPNs), such as pico stations and explore the energy efficiency gains. In this scheme, the optimal target of traffic offloading in Macro-Pico networks, aiming at improving energy efficiency (EE). Based on two offloading algorithms Traffic Offloading (TO) algorithm takes into account the Reference Signal Receive Power (RSRP) of uses and traffic load of cells, and thus determines the target pico for offloading traffic. This further improves system energy efficiency and the throughput of users at the edge of cells,Traffic Offloading based on Frequency Reuse (TOFFR) algorithm by

combining TO algorithm with frequency reuse and improves the effectiveness along with system energy efficiency with trivial complexity cost.

Algorithm

In wireless cellular system, the physical layer usually can provide the ability of measurement for users. For example, according to the standard measurement in LTE systems, the reference signal receive power (RSRP) is used [17]. Based on the measured RSRP of UEs from macro BS and neighbor pico stations, we propose a low complexity algorithm called Traffic Offloading (TO) algorithm. In this algorithm, macro and pico stations exchange traffic load information with each other and build a traffic load distribution map of the network. Comparison of SE and EE for TO and TOFFR algorithms.

Advantage:

Improves system energy efficiency and throughput of users at the edge of cells, and also improves the effectiveness along with system energy efficiency with trivial complexity cost.

Drawback:

The interference on the uplink frequencies are high with this kind of networks, and certain issues to be concern with the case of mobile stations and transmitters.

E. "Offloading Mobile Traffic via Green Content" Broker TaoHan [5].

Definition

The author proposes a Device-2-Device communications, for mobile traffic offloading scheme-the content brokerage. In the content brokerage scheme, a new network node called the green content broker (GCB) is introduced to arrange the content delivery between the content requester and the content owner. The GCB is powered by green energy, e.g., solar energy, to reduce the CO_2 footprints of mobile networks. In the scheme, maximizing traffic offloading with the constraints of the amount of green energy and bandwidth is a nondeterministic polynomial time (NP) problem. The author proposes a heuristic traffic offloading (HTO) algorithm to approximate the optimal solution with low computational complexity.

Algorithm

The HTO algorithm is the constraints of green energy and the number of uplink and downlink sub frames, the GCB may not be able to serve all the content requests. To maximize the
MBS's energy savings, the GCB selects to serve a subset of the content requests. As analyzed in Sec. IV, when the content owners are selected, the SCS problem can be transformed into a double dimensional knapsack problem. Therefore, we address the SCS problem based on Toyoda's primal effective gradient method in solving the multi-dimensional knapsack problem [23].

Advantage:

This maximizes traffic offloading with the amount of utilizing green energy to deliver content among the device user

Drawbacks:

This scheme provides Communication as one-on-one for the content delivery and the energy resources might be change of global warming situations. Framework for Cellular Traffic Offloading.

IV. CONCLUSION

This paper surveys and classifies a vast body of research associated with computation offloading for mobile systems. We examine how enablers like mobile agents and virtualization make offloading feasible. We survey different types of algorithms used to partition and offload programs in order to improve performance or save energy. We classify the types of applications that have been used to demonstrate offloading. We list some of the research areas associated with offloading, and describe some infrastructures and solutions that address these research areas. Finally we describe why computation offloading will become increasingly important for resource constrained devices in the future.

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