

AN EFFECTIVE OFFLOADING INFRASTRUCTURE MODEL FOR MOBILE DATA TRAFFIC USING MAC ADDRESS

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Abstract

The recent popularization of cellular networks like 3G networks provides mobile users with ubiquitous internet access. This led to a problem commonly known to be data traffic overloading. In much mortal offloading share of the multi-cellular interchange finished new forms of networks, such as Delay Tolerant Networks (DTNs) and Wi-Fi hotspots, is an auspicious set. Even after utilizing them for multi-cellular interchange offloading a non-negligible suspension occurred. Hence we are aiming to provide a system that can leverage the user delay tolerance levels by providing incentives to them. We studied a system and identified it to be enhanced in some cases. These enhancements are made by using the MAC address as basic knowledge to the module of the system. We propose a system that can identify the MAC addresses of the environmental medium in the locality and use them to predict the offloading capacities of the corresponding networks to generalize the process of prediction in the considered system for enhancement. We try to increase the performance of the considered system to work independent of the network type.

Index Terms: DTN, Win-Coupon, reverse pricing, MAC address, UIM clustering, Variable packet size, size differential, hop differential, ICMP

1. INTRODUCTION

The mobile networks are considered to get overloaded beyond their upgraded capacity due to the overwhelming growth in the data usage rate as a result of the availability of latest smart devices that are capable of accessing multimedia contents. The same has been confirmed by the recent reports of the "cisco" a major networking industry in which they analysed the mobile data traffic to be increased by 20 times the current data usage with even advanced devices are to arrive in public use by the year 2025 [2]. As the network operators are being warned by the reviews of such well known organizations, they are trying to discover newest technologies that are capable of mitigating this discussed problem. The previous studies produced the following solution. Which has concentrated on only how to reduce the traffic in the mobile network?

2. EXISTING SYSTEM OVERVIEW

THE BIG PICTURE

Here, we give an overview of the WinCoupon framework. By considering the users' delay tolerance and offloading potential [1].

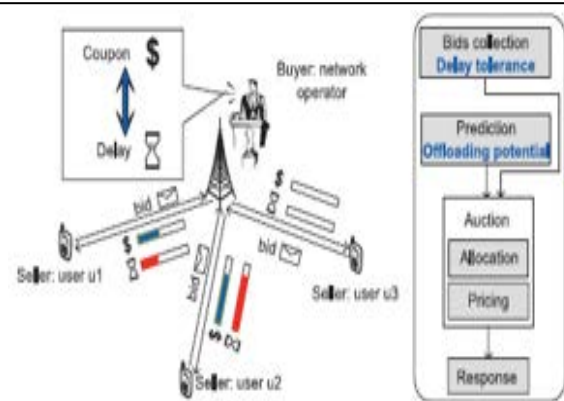


Figure 1:

The main idea of Win-Coupon

The optimal auction outcome is to minimize the network operator's incentive costs subject to a given offloading target.

2.1. SYSTEM MODULES

A. Auction Algorithms

Win-Coupon is run periodically in each auction round. Usually, 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.

A. i. Allocation

In traditional reverse auction, the allocation solution is purely decided by the bids. However, in our scenario, besides the bids which express the bidders' delay tolerance, the offloading potential of the bidders should also be considered.

Bid (b_i): It is submitted by bidder i to express i 's valuation on the resource for sale, which is not necessarily true.

Private value (x_i): It is the true valuation made by bidder i for the resources; i.e., the true price that i wants to obtain for selling the resource. This value is only known by i .

Market-clearing price (p_i): It is the price actually paid by the buyer to bidder i . This price cannot be less than the bids submitted by i .

Utility (u_i): It is the residual worth of the sold resource for bidder i , namely the difference between i 's market clearing price p_i and private value x_i .

The bidders in the auction are assumed to be rational and risk neutral. A common requirement for auction design is the so-called individual rationality.

Definition 1: An auction is with individual rationality if all bidders are guaranteed to obtain non-negative utility.

The rational bidders decide their bidding strategy to maximize their utility. Let N denote the set of all bidders. The concept of weakly dominant strategy is defined as:

Definition 2: $b_i = \beta_i$ is a weakly dominant strategy for user i if and only if: $u_i(\beta_i, \beta_{-i}) \geq u_i(\beta_i^1, \beta_{-i}), \forall \beta_i^1 \neq \beta_i$.

Here $\beta_{-i} = \{\beta_1, \beta_2, \dots, \beta_{i-1}, \beta_{i+1}, \dots, \beta_{|N|}\}$ denotes the set of strategies of all other bidders except for bidder i .

Definition 3: An auction is truthful if each bidder, say i , has a weakly dominant strategy, in which $b_i = x_i$.

The truthfulness eliminates the expensive overhead for bidders to strategize against other bidders and prevents the market manipulation.

Note that since each bidder is asked to wait for integer multiples of time unit, t_i is an integer. If t_i equals zero, bidder i loses the game. The allocation problem in Win-Coupon can be formulated as follows:

Definition 4: The allocation problem is to determine the optimal solution $\{t_1, t_2, \dots, t_{|N|}\}$ which minimizes the total incentive cost, subject to a given offloading target.

Algorithm 1: Win-coupon-Allocation (\mathcal{N}, \mathcal{B})

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1 for  $v = 0$  to  $\hat{v}_0$  do
2    $\mathcal{T}_{\mathcal{B}^v} = \{T_1^v\}$ ;
3    $C_{\mathcal{B}^v} = C_1^v$ ;
4 for  $i = 2$  to  $|\mathcal{N}|$  do
5   for  $v = 0$  to  $\hat{v}_0$  do
6      $s^* = \arg \min_{s \in [0, v]} \{C_{\mathcal{B}_{i-1}}^s + C_i^{v-s}\}$ ;
7      $\mathcal{T}_{\mathcal{B}_i^v} = \mathcal{T}_{\mathcal{B}_{i-1}}^{s^*} \cup \{T_i^{v-s^*}\}$ ;
8      $C_{\mathcal{B}_i^v} = C_{\mathcal{B}_{i-1}}^{s^*} + C_i^{v-s^*}$ ;
9 return  $\mathcal{T}_{\mathcal{B}^{\hat{v}_0}}, C_{\mathcal{B}^{\hat{v}_0}}$ ;
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A. ii. Pricing

The VCG-style pricing is generally used in forward auction, which involves single seller with limited resources for sale, and multiple buyers. The bidders who have the highest bid win the game, and each winning bidder pays the "opportunity cost" that its presence introduces to others. It is proved that this pricing algorithm provides bidders with the incentives to set their bids truthfully. Based on the basic idea, in our pricing algorithm, the network operator also pays bidder i the coupon with value equal to the "opportunity cost" exerted to all the other bidders due to i 's presence.

Algorithm 2: Win-coupon-Pricing ($\mathcal{N}, \mathcal{B}, \mathcal{T}_{\mathcal{B}^{\hat{v}_0}}, C_{\mathcal{B}^{\hat{v}_0}}$)

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1 for  $i = 1$  to  $|\mathcal{N}|$  do
2   if  $i$  is the winning bidder then
3     Win-Coupon-Allocation( $\mathcal{N} \setminus \{i\}, \mathcal{B} \setminus \{b_i\}$ );
4      $p_i = C_{\mathcal{B} \setminus \{b_i\}}^{\hat{v}_0} - (C_{\mathcal{B}}^{\hat{v}_0} - \sum_{k=1}^{t_i} b_i^k)$ ;
5   else
6      $p_i = 0$ ;
7 return  $p_i$ , for all  $i$ ;
```

B. prediction

In the prediction mechanism the main focus in previous studies for offloading approaches have been on the downloading scenario since the majority of cellular traffic is on the downlink. We also separate Wi-Fi and DTN when discussing Win-Coupon design. Actually, those framework are very general, and can be extended to fit many other scenarios.

2.2. LIMITATION OF THIS SYSTEM

As long as the volume of offloaded traffic can be predicted, the incentive mechanism can be adopted for coupon allocation and pricing under various scenarios such as uploading, downloading, DTN only, Wi-Fi only, or hybrid of DTN and Wi-Fi. The only difference under various scenarios is in the prediction part.

Uploading Scenario: In the DTN case, the current prediction method is based on the assumption that multiple users request the same popular items to share

them through DTNs. Thus, it cannot be directly applied to the uploading scenario [3].

Hybrid Network Scenario: In the hybrid scenario which considers both DTN and WiFi, the user of flooding potential should be re-calculated [4]. A naiveway is to simply treat them as two independently coexisting networks; i.e., mobile users can get data pieces from both networks during their waiting period [5]. Then, the predictionistofindthe“expectedoffloadedtraffic”ofDTN andWi-Fiseparatelyusingthecurrentpredictionmethods, and sum them together. However, there are other better solutions.

3. PROPOSED SYSTEM UPGRADE

The ability to correctly predict the offloading data of people is crucial for efficient performance of the current considered system. In this report, we advise a novel framing, which exploits the correspondence of grouping occurrence of the integrated Wi-Fi/DTN network set to theories a prophetic simulate to guess the off loading possibility using emplacement contemplate. i.e., by identifying the networks addressable in the environs of the user. We use the succeeding modules in the prevision execution.

3.1. JOINT Wi-Fi/DTN SCANNING SYSTEM: UIM CLUSTERING ALGORITHM

This writing presents a prompt rule to flock MAC IDs records of W into clusters and use these clusters to equal locations. We exact our clustering rule "UIM Clustering" rule [6].

There are various challenges in obtaining activity from W . Premier; the wireless fabric scanning capable-ness of the network varies from 100 to 200 meters, depending on different factors specified as barriers, obstacles. So, although the phone stays in one un-adjustable lieu surface the synoptic structure, it may obtain contrastive results for disparate scans. Withal, these approaches suffered from environmental factors since the fluctuation of fabric signal depends on temperature, obstacles, etc.

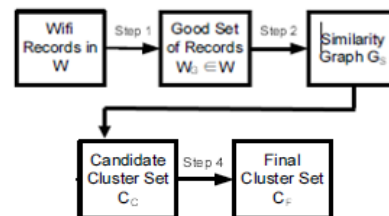
Endorsement, there are cases when the device is in the midriff of two conterminous buildings, the scanned prove mightiness be part overlapped with the scanned results obtained when the sound stays surface either of the buildings.

Luckily, in reality the move decoration of fill is relatively steady as they incline to strip author frequently at their lawful places. So, if two textile MACs a_1 ; a_3 happen unitedly statesman of times than two material MACs a_1 ; a_5 in the mesh shadow W , then it is likely that a_1 ; a_3 continue ad pressed in a material business. That means, it is ameliorate to meet a_1 and a_3 into the duplicate

emplacement than a_1 and a_5 . This observance motivates us to designing a new clustering algorithm to clump network MACs into locations. For the clustering algorithm, we do not use the scan time and only use the set of network MACs of the network records. We thus call Aithe record ithof the network trace W .

This look motivates us to program a new clustering algorithm to constellate MACs into locations.

For our clustering formula, we honours delimit emplacement as a unequalled set of MACs, which materialise oftentimes unitedly in the records of W .



Execution of UIM clustering algorithm

Above illustration shows the subscription obstructer diagram of the UIM Clustering algorithm.

In step 1, given the records in W , we obtain the sub set of good records $W_G \subset W$

In step 2, we measure the similarity between all pairs of records of W_G and construct a similarity graph G_S , in which each vertex of G_S is a record of W_G .

In step 3, we apply the Star Clustering algorithm to cluster vertices into a set C_C of candidate clusters.

Finally, candidate clusters are merged based on their similarity measures to obtain the set C_F of final clusters. Each cluster in C_F can be used to represent one location.

Algorithm 1 Obtain W_G from W using F_W, W_A

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Input:  $W, F_W, W_A$ 
Output:  $W_G$ 
BEGIN
 $W_G = \emptyset$ ; # set of wifi MACs belonging to records in  $W_G$ 
for each ratio  $\frac{\xi_A}{\lambda_A} \in F_W$  do
  Find the corresponding record  $A_i \in W$ ;
   $M_A =$  set of Wifi MACs of  $A_i$ ;
  if  $|W_G \cup M_A| > |W_G|$  then
     $W_G = W_G \cup A_i$ ;
  if  $|W_G| == |W_A|$  then
    return  $W_G$ ;
  end if
end if
end for
END
  
```

3.2. OBTAIN THE OFFLOADING CAPACITY

In this segment we presently discuss the method division that can find the offloading power of a network grouping to a soul using the fore-gather produced by the above mentioned algorithm. The resulting slant consists of the MAC addresses along with their offloading

susceptibility straightaway after the above knowledge has supplied its yield. The considered system is mainly concentrated on calculating the prediction of offloading for downloading only. Which is why we are trying to know the knowledge of the bandwidth of the network to estimate the offloading capacity of network in both upload and download scenarios of the communication.

Hence to be calculate the bandwidth of the network we use the flooding testing mechanism in the current under development system. The flooding testing is carried out as follows.

The test packets are flooded to each identified network and the corresponding bandwidths are calculated.

Bandwidth — the speed that a network element can forward traffic. Both physical and available bandwidths are independent of end hosts and protocol type [8].

VPS algorithms (SD and HD): *Path-char* is a tool for estimating links' capacity. *Variable packet size* (VPS) [7] algorithm includes sizedifferential (SD) and *hop differential* (HD) methods. The SD algorithm measures the time difference, DT, for a constant DS, the size difference for packet size increment, by sending UDP packets from the source host to each network element and measuring the time while getting ICMP response, thus transfer rate can be denoted as:

$$R_{Tx} = \frac{\Delta S}{\Delta T}$$

$\Delta S = S_2 + S_1$, S_1 and S_2 are sizes for two different packets

$\Delta T = T_2 + T_1$, T_1 and T_2 are the time to send packets S_1 and S_2 to a router respectively.

4. CONCLUSION

In this report we have discussed that most of the scheme that has been reasoned to be the promising to leverage the consumer delay tolerance to calculate non-negligible inactive offloading by the operator. Now we have grasped knowledge about how the method works and detected that the prediction in this system has to be

dependent on network type. We have successfully managed to design a system module that can perform prediction independent of network type and also considers the availability of the network resources. This system module can be still enhanced in the prospect of the calculation mechanism.

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