Sms transmission using phone users density in big cities

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This work answers the question : is it possible to transmit a sms using phones as relay in a big city such as Mexico City? We defined a simple transport protocol to transmit sms from a source to a destination. This protocol does not need routing, it is based on locality of sms, the density of phones in Mexico City and mobility of phone users. We studied a mobile dataset including 8 millions users living in Mexico city. This gave use a precise estimation of the average transmission time and the global performances of our approach. After 30 minutes, half of the sms were delivered successfully to destination.

The need of communicating in a dense city is always increasing. Every day, millions of sms are sent in a big city like Mexico City. Phone operators have to adapt their infrastructures to provide an efficient service. At present times, sms are not only routed with base stations. The way to communicate and exchange sms between each other has become diversified these last years. We can now send messages with applications like WhatsApp [1], Tango, Skype and Viber while connected to a wireless spot [4]. During rush hours, the capacity of the operator service are almost saturated. It is becoming a great challenge to increase the capacity of the service with the same number of relays.

In this study, we propose a new way to transmit sms and more generally data from a source to a destination. Instead of using classical routing, we use relays close to the source and phone users that are connected to those local relays to reach the destination. A big advantage is that we do not perform a routing algorithm as we do not need to know where the destination is. Moreover, as we only use local relays that are close to the source, the bandwidth cost of a sms is smaller. On top of that, the density of phones and the mobility of users are even higher when the capacity of classic relay network is challenged during rush hours.

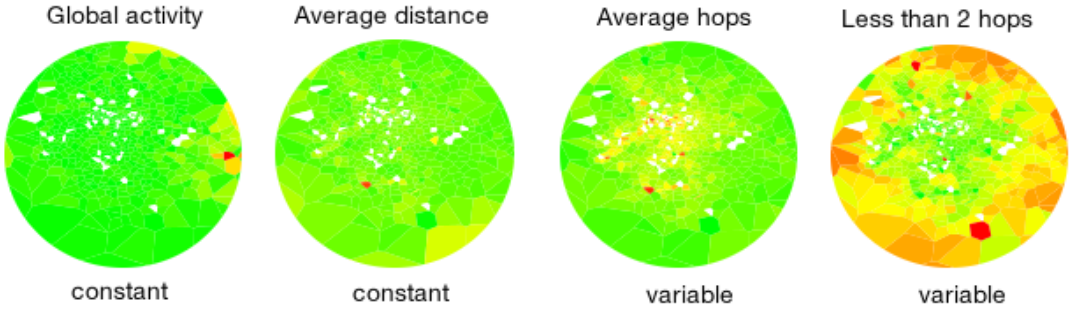

Figure 1: Geographical heat maps of static network parameters : average number of base station hops (left), average distance (middle) and global activity (right) around Mexico City. The Voronoi cell for a base station represents the area in which users are connected to this base. The green colour represents low values and the red one high values.

We used a communication dataset [3] containing the mobile phone interactions of 8 millions of people in Mexico City covered by 775 base stations that are part of the classic network. This anonymised dataset contains sms and calls with some location information defined by the base station of the source and destination. Over three months, we managed to extract around 10 millions fully located sms for our study. Most of the sms had Mexico City as source and destination.

Protocol and results

We analyzed our dataset through time and space for each base station. We showed the variability of the global activity according to time. We noticed a constant activity for every base station, the distance between two stations depends on the local activity. On figure 1, for each sms of the trace, we computed the distance and the number of relay hops from the source to the destination base station. The average distance of sms is constant whereas the number of relay hops is higher in the center where base stations are closer.

This study provides an empirical proof of the close proximity of messages. Many sms are very local with a very small number of relay hops. We applied a neighboor protocol that consists in delivering the sms to the phone users that are attached to the same base station when the source sends the sms. Then we let these neighboors moving with the sms. If any of the neighboors reach the destination, the sms is delivered. If after half an hour the message has not reached the destination, then the message is dropped. In our network, one over three messages were delivered after 10 minutes and one over two after thirty minutes. As some locations are missing in our dataset, in reality, the results are likely to be even better.

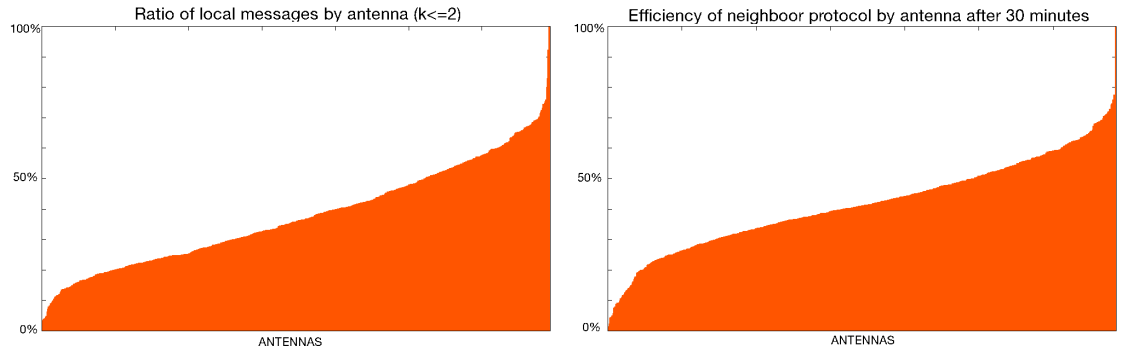

Figure 2: For each base station, we performed the ratio of local sms that had less than two relay hops (left) and the ratio of sms that had successfully reached the destination by the neighboor protocol (right).

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