Taking Benefit from the User Density in Large Cities for Delivering SMS

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SMS is not dead

SMS are used

SMS are read

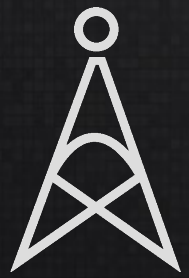
More services

SMS are cheap

Context : diversification

COMMUNICATION POSSIBILITIES
ARE
MORE & MORE DIVERSIFIED

CELLULAR NETWORK



Short Message Service
Voice call

INTERNET

Email
Instant Messaging

AD HOC MOBILE NETWORK

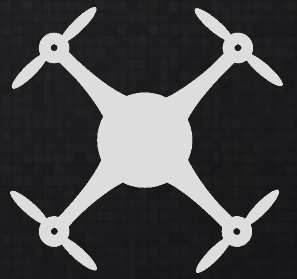
Peer-to-peer

Context : ad hoc mobile network

VEHICULES

PHONE USERS

DRONES



SIMILARITIES :
- structure
- mobility
- challenges
- protocols

DIFFERENCIES :
- scale
- speed
- density
- constrains

Context : mixing networks

VEHICULES

PHONE USERS

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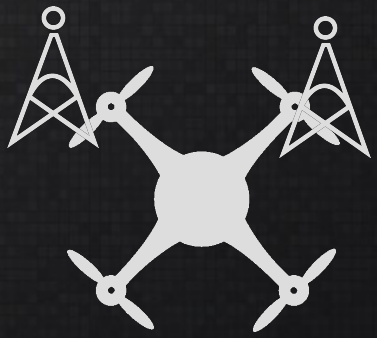

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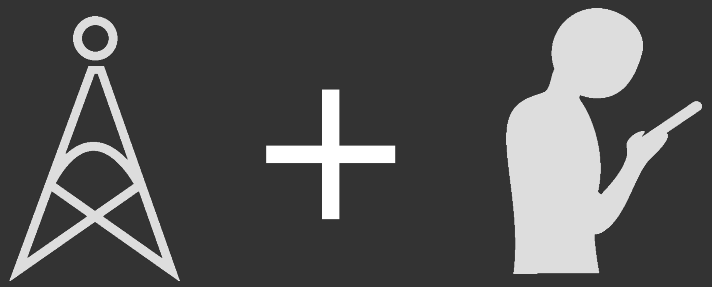
Short Mess
Voice



POTENTIAL OF MIXING CELLULAR &
PHONE USERS NETWORK IN BIG CITIES

OBILE
RK

peer
uetooth

Outline : our work

What we do

0. Use real trace : 2 months in Mexico City

1. Temporal and spatial analysis of SMS

2. Measure the potential of the cellular + phone user network

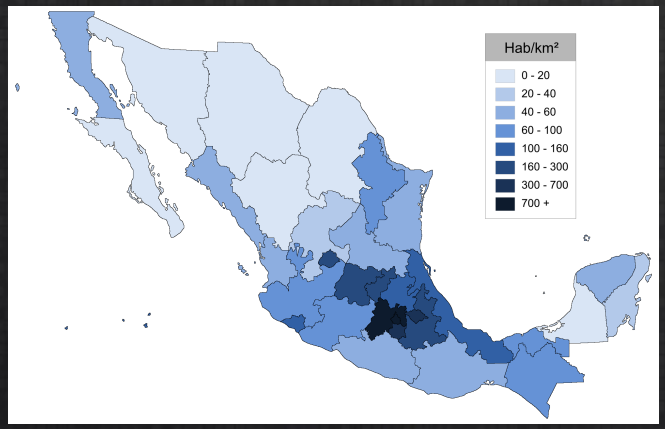
2'. by proposing basic protocols for delivering SMS

What we do not do

We do not propose an implementation & an estimation of energy consumption, this is a first estimator of the mixing cellular-ad hoc network potentiality.

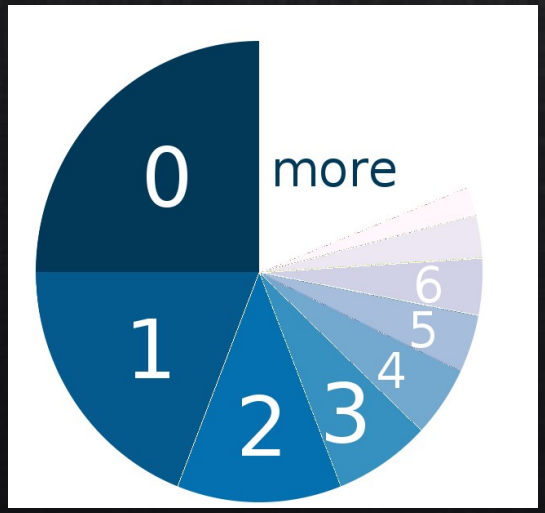
Properties & Usage : SMS ubiquity

DENSITY



COVERAGE

LOCALITY



HUMAN MOBILITY

Properties & Usage

HUMAN MOBILITY

Mobile data sets : Description

MEXICO

91M users

170M calls with GEO

70M SMS

01 MAR — **2014** — 30 APR

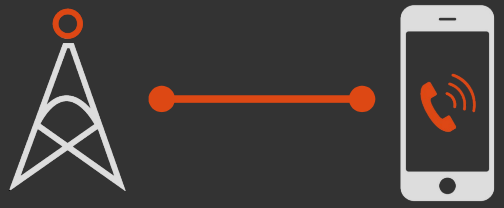
Mexico City

8M users

45M calls with GEO

20M SMS

Mobile data sets : Geolocalization

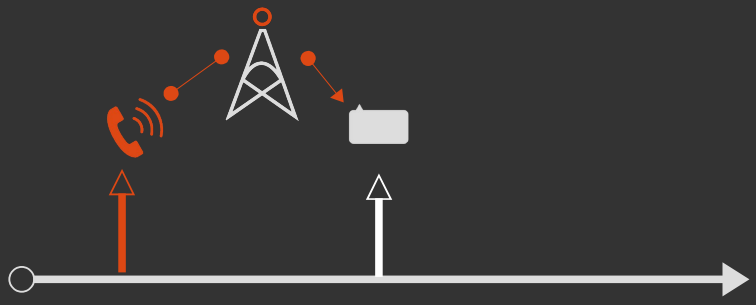


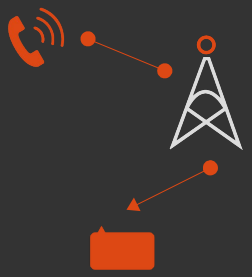
775
base stations

45M calls
with GEO

20M SMS

How to geolocalized SMS ?

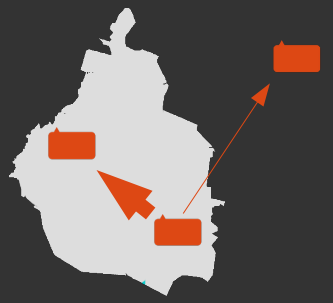




SMS
with geo

SIMPLIFICATIONS

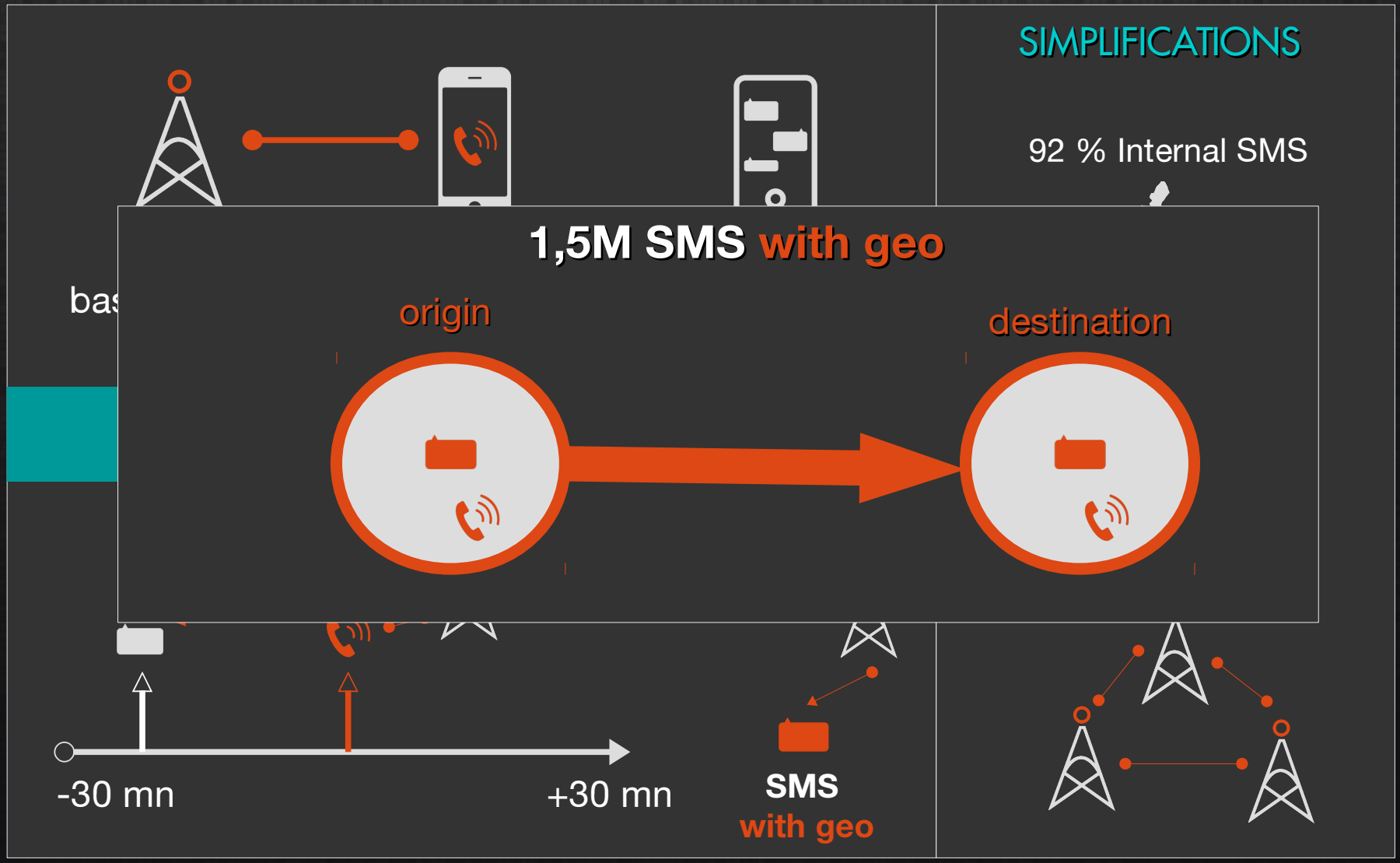
92 % Internal SMS



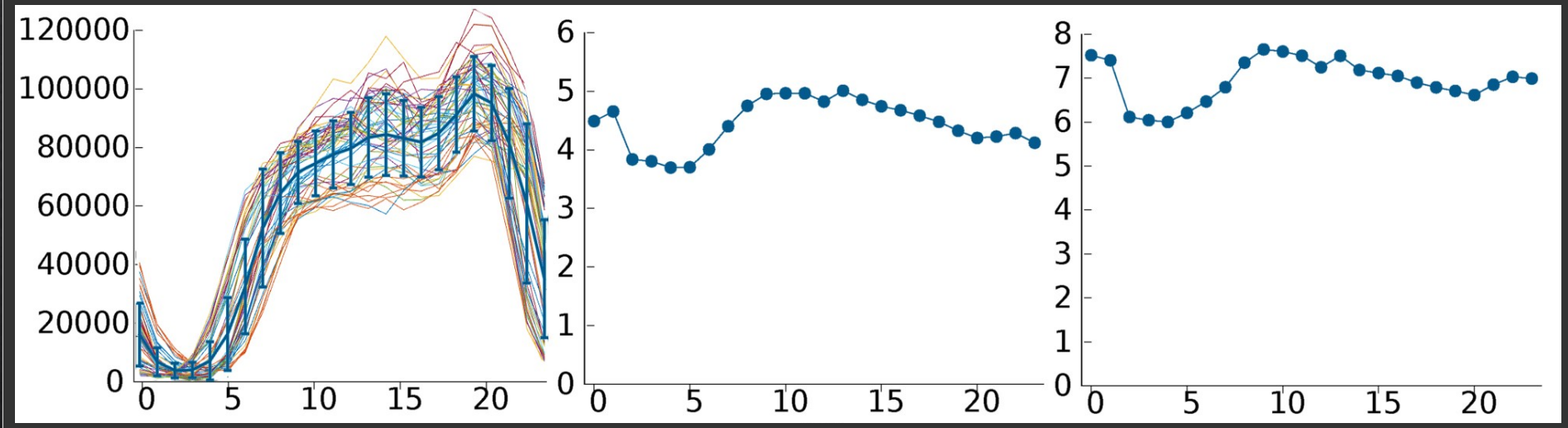
Mexico City

No hierachy !

Mobile data sets : Geolocalization



Data Analysis: Temporal

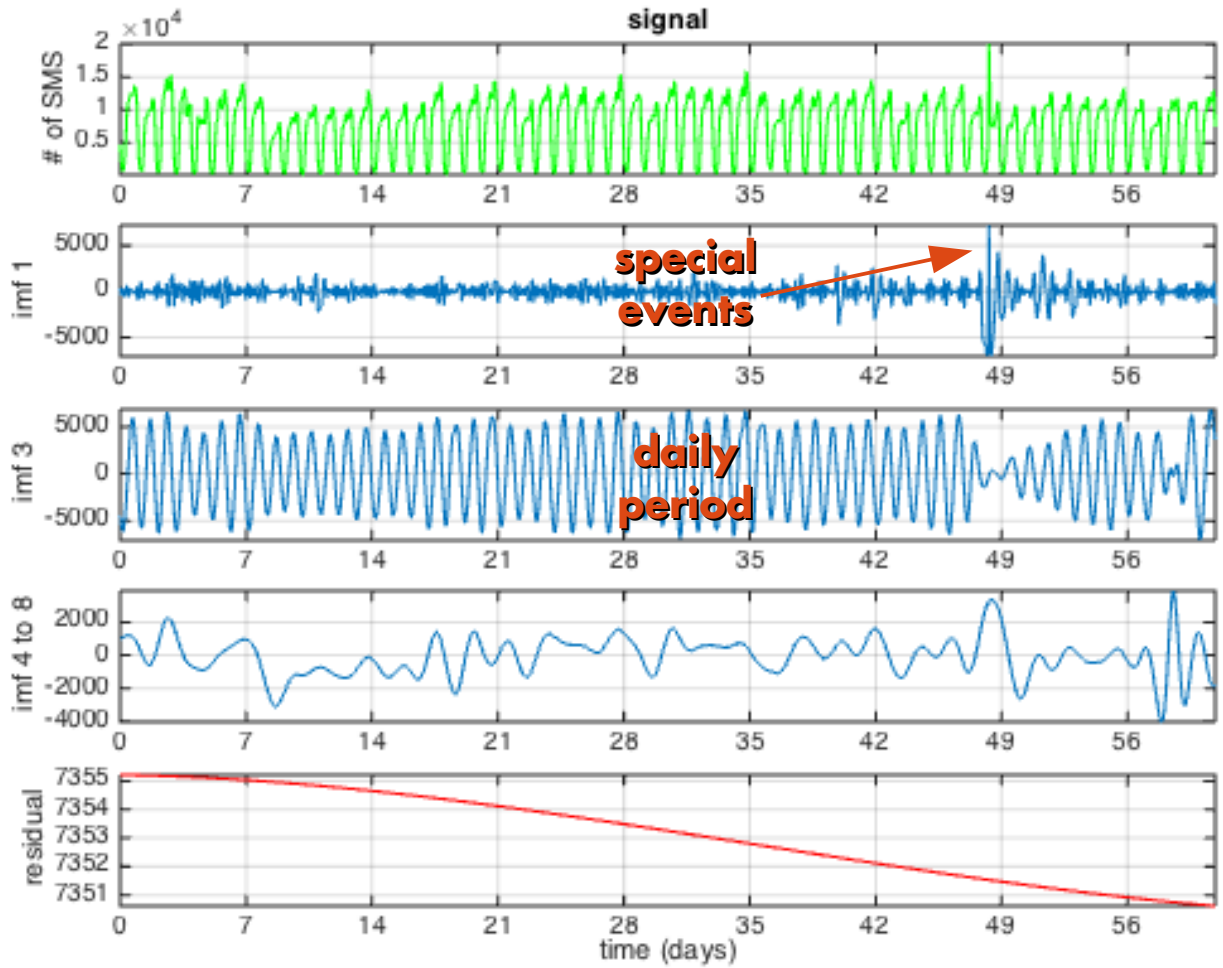


Number of SMS per hour	Average distance in hops of SMS per hour	Average distance of SMS in km
Variable	**Quite constant**	**Quite constant**
-/+	=	=

Temporal fluctuations: is the activity signal periodic ?

Data Analysis : Temporal

Empirical Mode Decomposition (EMD)



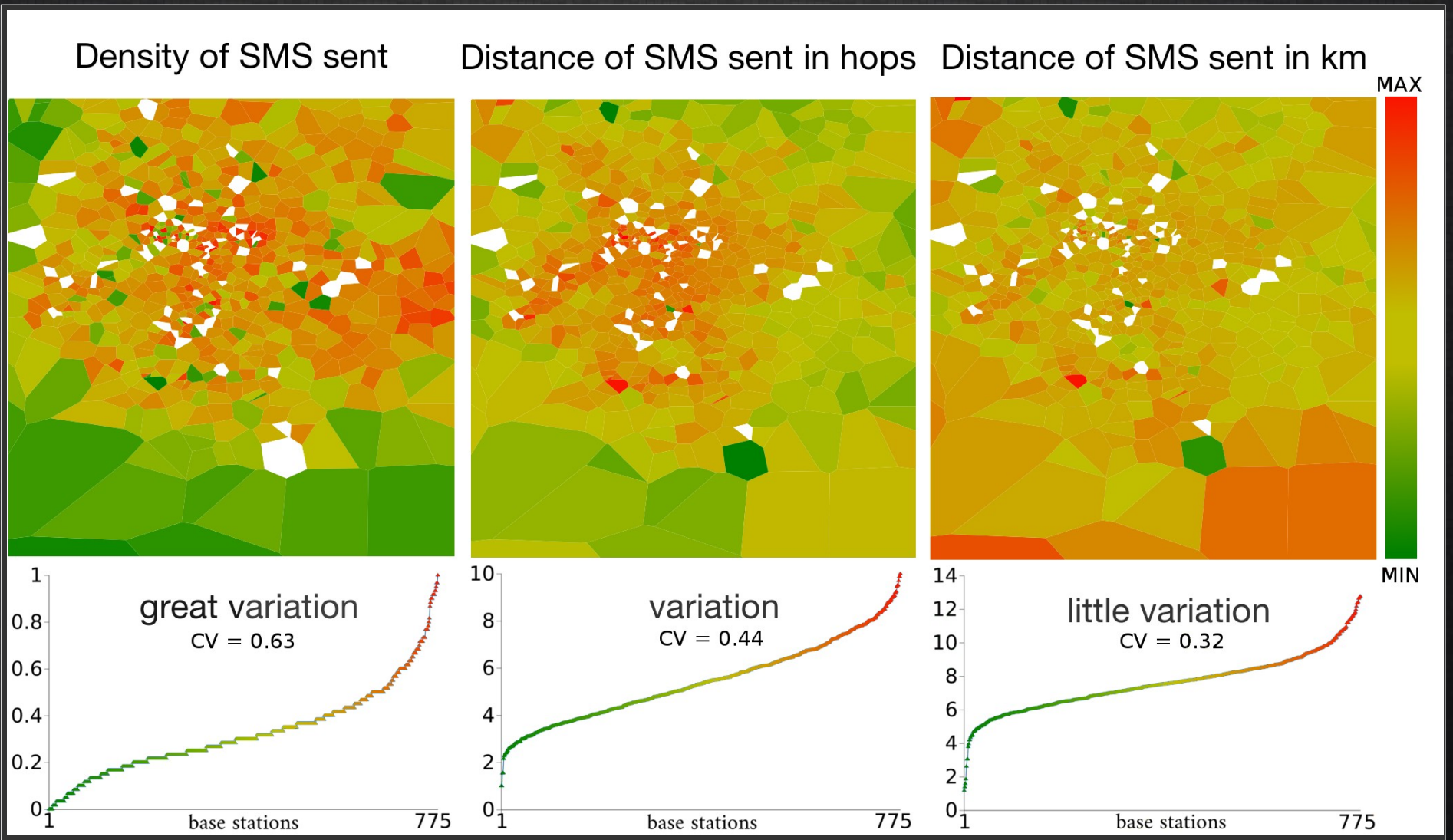
SMS

HIGH

LOW

RESIDUAL

Data Analysis : Spatial



Not uniform !

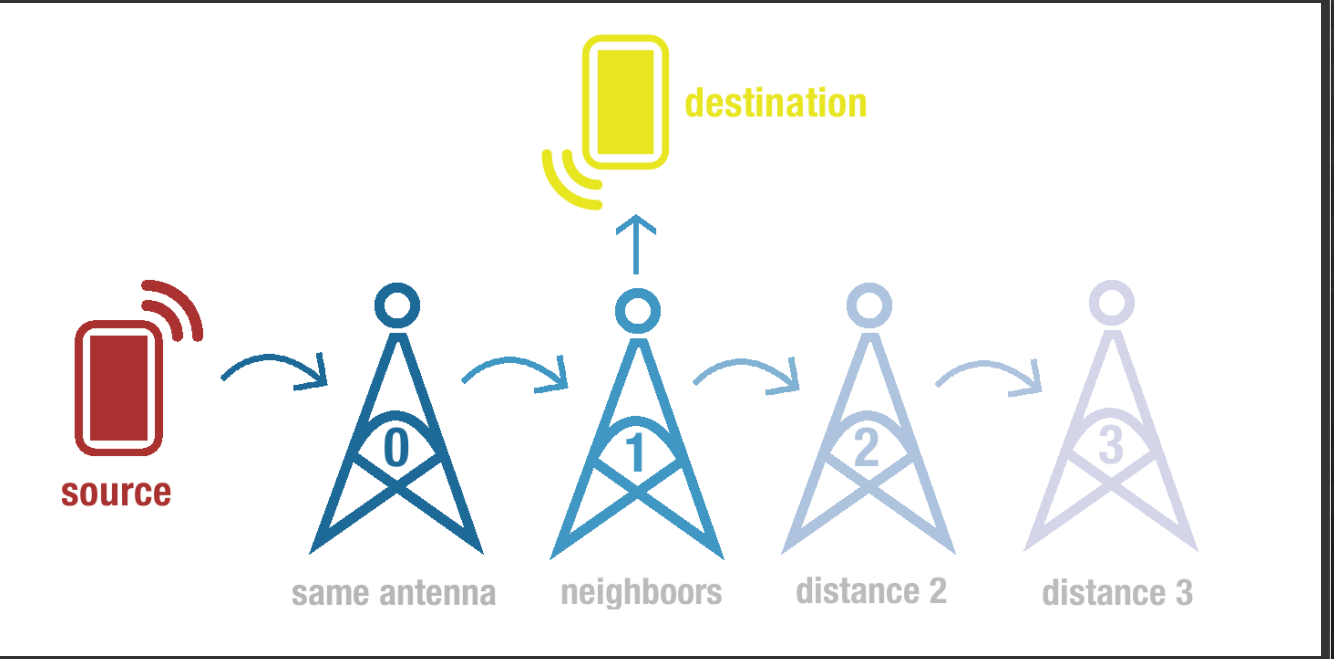
More hops in center

Greater in suburbs

Simple protocols for
delivering SMS
by using
density, locality & mobility ?

Protocol 1 : description

schema 1



property used

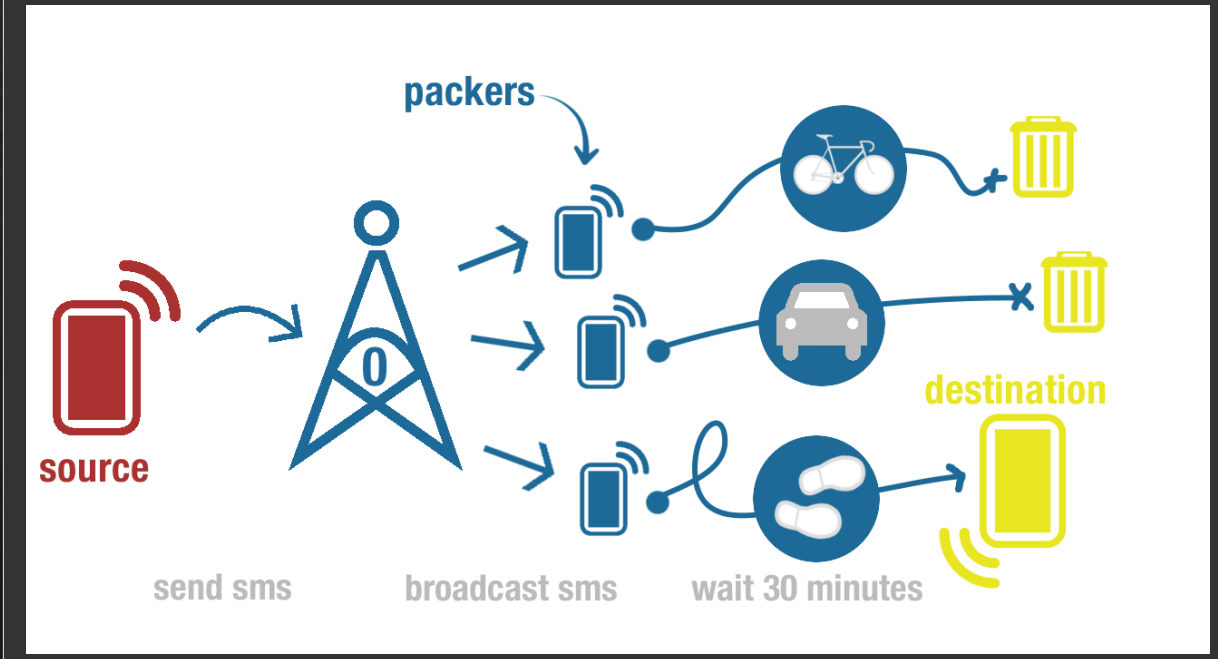
based on local property of SMS

notes

- source & destination are geolocalized
- no routing algorithm

Protocol 2 : description

schema 2



properties used

based on local property of SMS

based on density of phone users

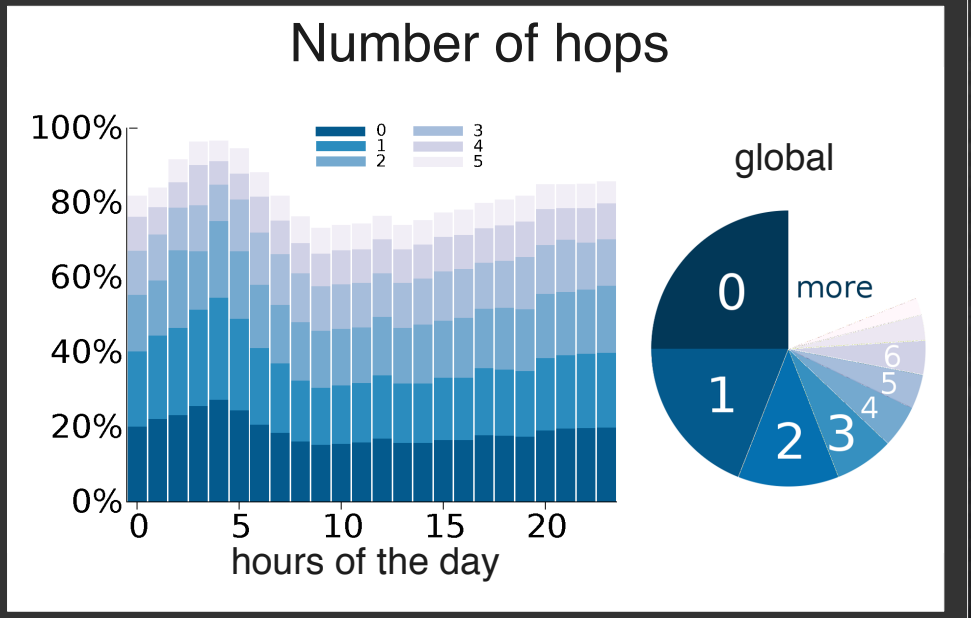
based on mobility of packers

notes

- source & destination are geolocalized
- no routing algorithm
- **underestimation** of the results because 90 % packers are missing

Protocol 1 & 2 : results

Protocol 1

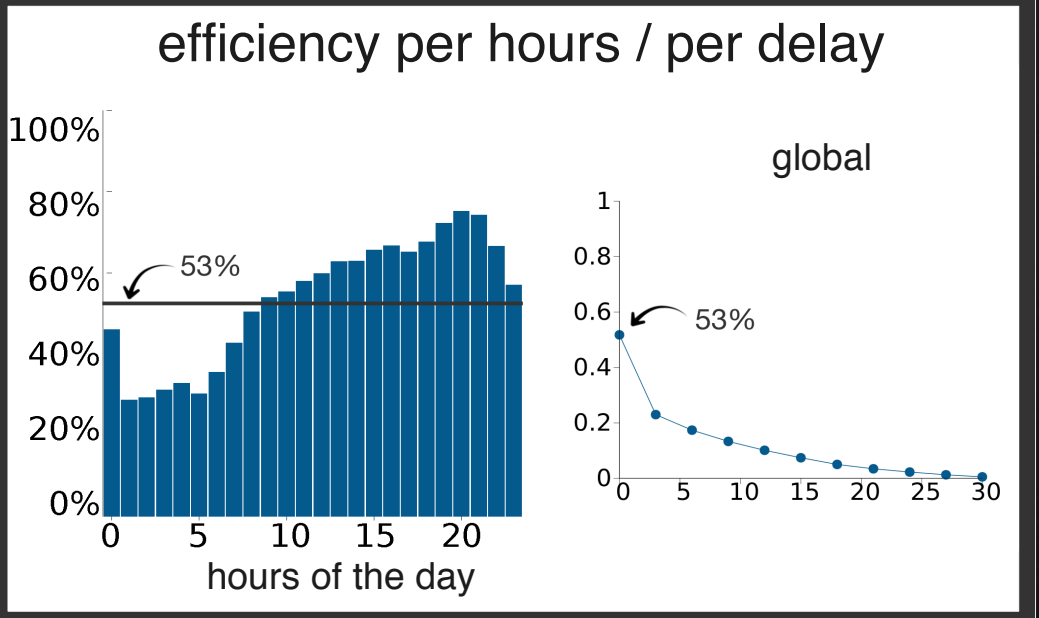


SMS are very **local**

54% of SMS delivered with only 2 hops

Small temporal influence

Protocol 2



53% of SMS delivered by 30 minutes

During rush hours, efficiency reach **77%**

Packers helps for delivering **51%** of SMS

Conclusion : contributions & future work

1. Study of temporal activity : day cycles and event detection

2. Spatial and temporal analysis : density, locality & mobility

3. Experiments on real trace in a big city such as Mexico City

4. Ideas for no routing protocols with several properties :
   - local protocol
   - no hop protocol
   - possibility of mixing protocol 1 & 2

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1. Propose an implementation & quantity of energy consumption

2. Try other protocols

Thank you !

Questions, feedbacks, ideas ?

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