# Mobile phone data for migration analysis:

# new possibilities, risks and difficulties

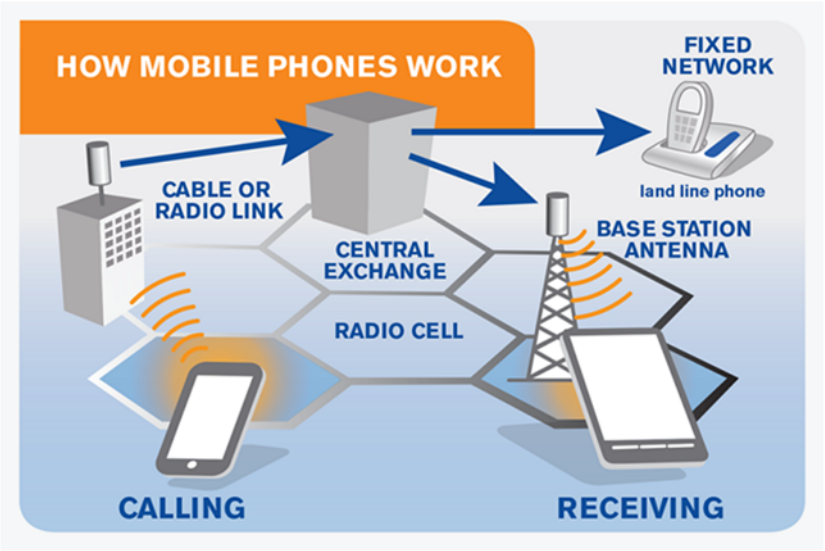
Zbigniew Smoreda
SENSE (Orange Labs, Paris)


KCMD-GMDAC workshop on *Big Data and alternative data sources on migration: from case studies to policy support*, Ispra, 30 Dec. 2017

# CDRs telcos billing records

- Billing data collected automatically for all MPO's customers

| timestamp | party A | party B | type | duration | cell A | cell B |
|---|---|---|---|---|---|---|
| 16/10/30 10:01:33 | 0689094877 | 0645321101 | SMS | 0 | 123 | 322 |
| 16/10/30 10:01:34 | 0765443321 | 0675448765 | Voice | 54 | 233 | 543 |
| 16/10/30 10:01:35 | 0766545566 | 0653344567 | Voice | 132 | 435 | 124 |



# CDRs telcos billing records

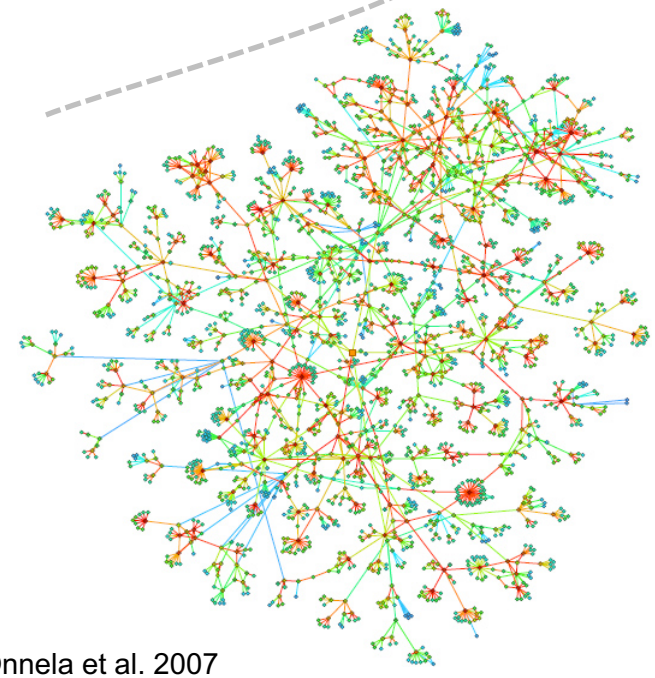
- Billing data collected automatically for all MPO's customers

| timestamp | party A | party B | type | duration | cell A | cell B |
|---|---|---|---|---|---|---|
| 16/10/30 10:01:33 | ABCXRTTAAT | XYRAATRRAA | SMS | 0 | Lat, Lon | Lat, Lon |
| 16/10/30 10:01:34 | ZXXRTT554R | CC445EERSDA | Voice | 54 | Lat, Lon | Lat, Lon |
| 16/10/30 10:01:35 | 776ERERER | 99TRDDAAA7 | Voice | 132 | Lat, Lon | Lat, Lon |

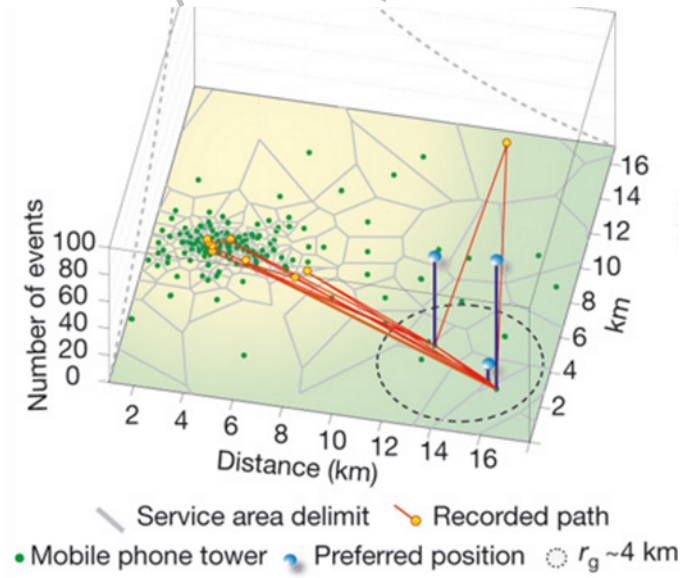
# CDRs telcos billing records

- Billing data collected automatically for all MPO's customers

| timestamp | party A | party B | type | duration | cell A | cell B |
|---|---|---|---|---|---|---|
| 16/10/30 10:01:33 | ABCXRTTAAT | XYRAATRRAA | SMS | 0 | Lat, Lon | Lat, Lon |
| 16/10/30 10:01:34 | ZXXRTT554R | CC445EERSDA | Voice | 54 | Lat, Lon | Lat, Lon |
| 16/10/30 10:01:35 | 776ERERER | 99TRDDAAA7 | Voice | 132 | Lat, Lon | Lat, Lon |



Onnela et al. 2007




Gonzàlez et al. 2008

# Quickly growing research

**Cellular Census: Explorations in Urban Data Collection**

Issue No. 03 - July-September (2007 vol. 6)
ISSN: 1536-1268
pp: 30-38
DOI Bookmark: http://doi.ieeecomputersociety.org/10.1109/MP

Carlo Ratti , Massachusetts Institute of Technology
Francesco Calabrese , Massachusetts Institute of Tech
Jonathan Reades , University College London
Andres Sevtsuk , Massachusetts Institute of Technology

Proceedings of the National Academy of Sciences of the United States of America

CURRENT ISSUE // ARCHIVE // NEWS & MULTIMEDIA // AUTHORS // ABOUT // COLLECTED ARTICLES // BROWSE BY

> Current Issue > vol. 106 no. 36 > Nathan Eagle, 15274–15278

Inferring friendship network structure by using mobile phone data

Nathan Eagle[a,b,1], Alex (Sandy) Pentland[b] and David Lazer[c]

Malar J. 2009 Dec 10;8:287. doi: 10.1186/1475-2875-8-287.

**The use of mobile phone data for the estimation of the travel patterns and imported Plasmodium falciparum rates among Zanzibar residents.**

Tatem AJ[1], Qiu Y, Smith DL, Sabot O, Ali AS, Moonen B.

Proceedings of the National Academy of Sciences of the United States of America

CURRENT ISSUE // ARCHIVE // NEWS & MULTIMEDIA // AUTHORS // ABOUT // COLLECTED ARTICLES // BROWSE BY TO

> Current Issue > vol. 104 no. 18 > J.-P. Onnela, 7332–7336

Structure and tie strengths in mobile communication networks

J.-P. Onnela [*, †, ‡], J. Saramäki [*], J. Hyvönen [*], G. Szabó [§, ¶], D. Lazer [‖], K. Kaski [*], J. Kertész [*, **], and A.-L. Barabási [§, ¶]

Activity-Aware Map: Identifying Human Daily Activity Pattern Using Mobile Phone Data

Authors | Authors and affiliations

Santi Phithakkitnukoon, Teerayut Horanont, Giusy Di Lorenzo, Ryosuke Shibasaki, Carlo Ratti

**Community Computing: Comparisons between Rural and Urban Societies Using Mobile Phone Data**

Authors: Nathan Eagle, Yves-Alexandre de Montjoye, Luís M. A. Bettencourt

2009 Article

Published in:
· Proceeding
CSE '09 Proceedings of the 2009 International Conference on Computational Science and Engineering - Volume 04
Pages 144-150

August 29 - 31, 2009
IEEE Computer Society Washington, DC, USA ©2009
table of contents ISBN: 978-0-7695-3823-5 doi>10.1109/CSE.2009.91

Bibliometrics
· Citation Count: 8
Downloads (cumulative): 0
Downloads (12 Months): 0
Downloads (6 Weeks): 0

Letter

*Nature* **453**, 779-782 (5 June 2008) | doi:10.1038/nature06958; Received 1 March 2008

There is an Addendum (12 March 2009) associated with this document.

Understanding individual human mobility patterns

Marta C. González[1], César A. Hidalgo[1,2] & Albert-László Barabási[1,2,3]

ELSEVIER

Physica A: Statistical Mechanics and its Applications

Volume 387, Issue 12, 1 May 2008, Pages 3017–3024

The dynamics of a mobile phone network

Cesar A. Hidalgo[a], C. Rodriguez-Sickert[b]

ELSEVIER

Physica A: Statistical Mechanics and its Applications

Volume 387, Issue 21, 1 September 2008, Pages 5317–5325

Geographical dispersal of mobile communication networks

Renaud Lambiotte[a, b], Vincent D. Blondel[a], Cristobald de Kerchove[a], Etienne Huens[a], Christophe Prieur[c], Zbigniew Smoreda[c], Paul Van Dooren[a]

# NetMob – community building

**NetMob**

Workshop on the
**Analysis of Mobile Phone Networks**

A satellite workshop to NetSci 2010
Tuesday, May 11, 2010
MIT, Cambridge, MA

**NetMob2011**

Given the success of NetMob2010, we consider the possibility of organizing a **NetMob2011**. If you wish to be included on the NetMob mailing list, please send an email to sympa2@listes.uclouvain.be with "subscribe netmob yourname" in the subject line (where "yourname" is your first and last name). You can also subscribe/unsubscribe by going to https://listes-2.sipr.ucl.ac.be/sympa/info/netmob.

**Introduction**

Mobile phone datasets have become widely available in recent years and have opened the possibility to improve our understanding of large-scale social networks by investigating how people exchange information, build trust, create markets and develop social interactions. Mobile phone data is also helping us understand complex processes such as the spread of information and viruses or transportation and the use of urban infrastructures.

This workshop will consist of a number of contributed talks on the analysis of mobile phone networks. The workshop format is flexible: no registration fees, a simplified submission procedure, and the possibility to present recent results or results submitted elsewhere.

**Practical information**

**Date**: Tuesday May 11, 2010 (this is the day prior to the conference NetSci).

**Location**: On the sixth floor of the newly built Media Lab (building E14 on MIT campus, map available here).

**Registration**: Attendance is free of charge but, due to limited seating, registration is compulsory. If you wish to register please send an email to netmob@uclouvain.be. Registration will be processed on a first-come first-serve basis. Although there is no registration fee for the workshop, participants are of course encouraged to also participate (and register) in the NetSci conference.

We have have received an unexectedly **large number of registrations** to the workshop. The workshop has been moved to a larger space (the multi media hall of the Media Lab). All those who have registered by sending an email or through the NetSci website are welcome to attend.

**Submissions**

All contributions that deal with the analysis of mobile phone datasets are welcome.

Authors are invited to submit an abstract (one to three pages) by the deadline of March 5, 2010. Submissions should include the title, author(s), affiliation(s) and e-mail address(es) on the first page. There will be no published proceedings; the material submitted to the workshop may also be submitted elsewhere.

Electronic submission of manuscripts in PDF format is required. Please send your manuscript directly to netmob@uclouvain.be by March 5, 2010.

The evaluation of submitted abstracts will be organized by the scientific committee and decisions will be made by March 26, 2010. Once an abstract has been accepted for presentation, at least one author is required to attend the workshop and present the paper. In case too many abstracts are selected, some of these may be moved to a special session taking place the next day at the NetSci 2010 conference.

**Program**

The **program** is available here (PDF format).

**Book of abstracts**

The **book of abstracts** is available here (5.5 MB, PDF format).

# NetMob – community building

**NetMob**

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**Analysis of Mobile Phone Networks**

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**Introduction**

**Practical information**

**Submissions**

**Program**

**Book of abstracts**

**Scientific committee**

**Chair:** Vincent Blondel, UCLouvain (Belgium)
Laszlo Barabasi, Northeastern University
Rob Claxton, British Telecom (UK)
Vittoria Colizza, ISI Foundation (Italy)
Massimo Colonna, Telecom Italia (Italy)
Nathan Eagle, Santa Fe Institute
Alexandre Gerber, AT&T Research
Marta Gonzales, MIT
Cesar Hidalgo, Harvard University
János Kertész, Budapest University of Technology (Hungary)
Renaud Lambiotte, Imperial College (UK)
David Lazer, Northeastern University
Jure Leskovec, Stanford University
Nuria Oliver, Telefonica Research (Spain)
Jukka-Pekka Onnela, Harvard University
Asu Ozdaglar, LIDS, MIT
Alex (Sandy) Pentland, Media Lab, MIT
Mason Porter, University of Oxford (UK)
Carlo Ratti, Senseable City Lab, MIT
Jari Saramäki, Helsinki University of Technology (Finland)
Leonardo Soto, AirSage
Zbigniew Smoreda, Orange Labs (France)
John Tsitsiklis, LIDS, MIT
Paul Van Dooren, UCLouvain (Belgium)

**Organizing committee**

Vincent Blondel, UCLouvain (Belgium)
Francesco Calabrese, Senseable City Lab, MIT
Gautier Krings, UCLouvain (Belgium)
Benjamin Waber, Media Lab, MIT

cial networks by investigating
nplex processes such as the

fees, a simplified submission

@uclouvain.be. Registration
o participate (and register) in

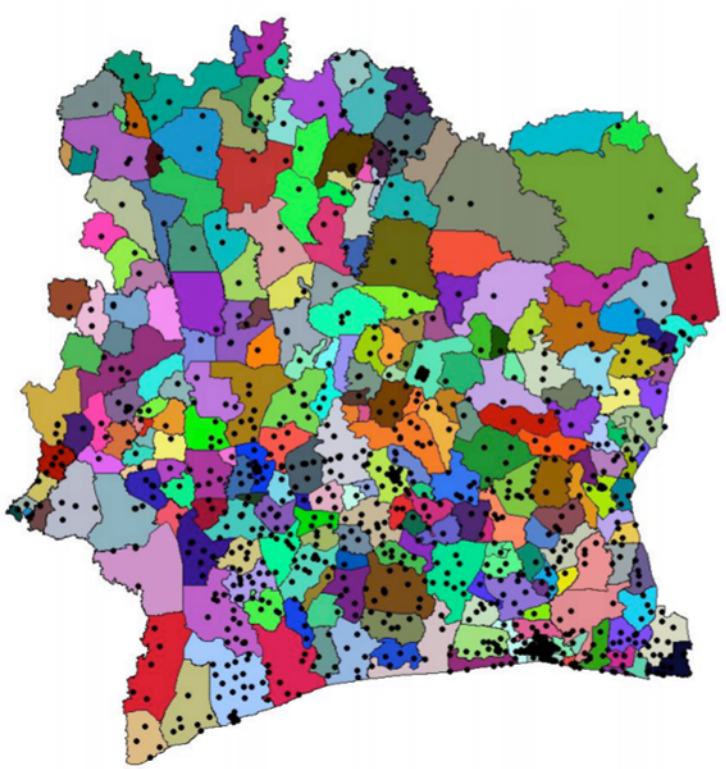
media hall of the Media Lab).

on(s) and e-mail address(es)

tract has been accepted for
may be moved to a special

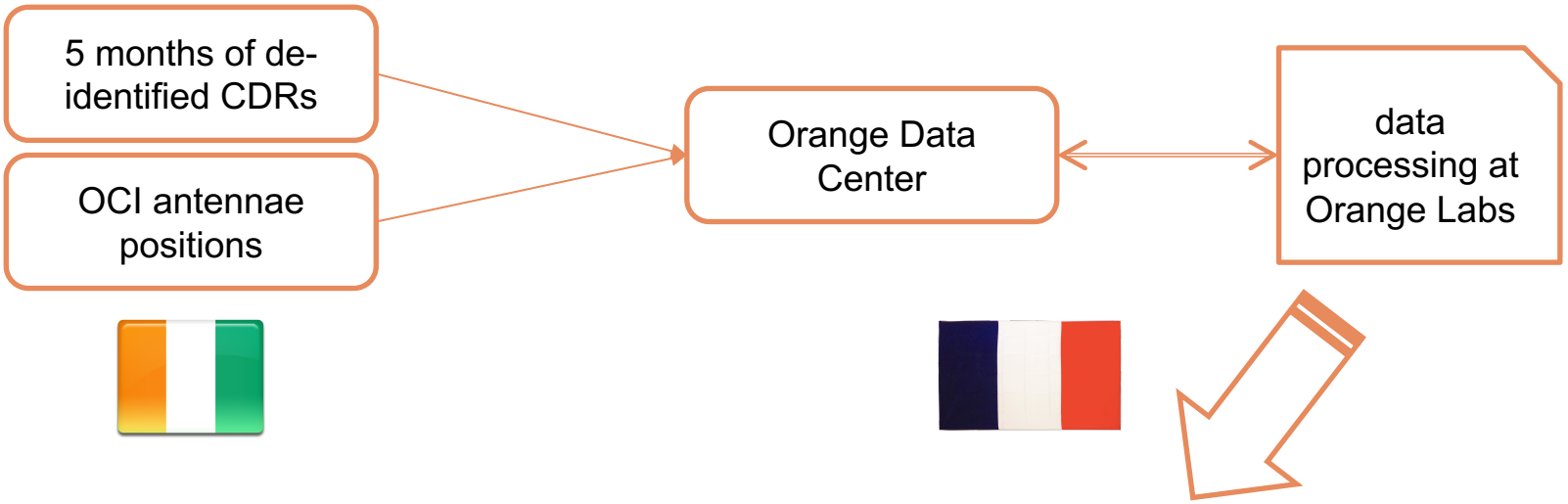
# How to accelerate and open access to CDRs?


An Open Innovation Project
with Orange Cote d'Ivoire, Orange Marketing Vision
and
Corporate Social Responsibility



## Data for Development (D4D) Cote d'Ivoire 2012

# D4D: data for development Cote d'Ivoire




- Proposed datasets:
  - (1) antenna-to-antenna traffic on an hourly basis,
  - (2) individual trajectories for 50,000 randomly sampled users for two week time windows with antenna location information,
  - (3) individual trajectories for 500,000 randomly sampled users over the entire observation period with sub-prefecture location information,
  - and (4) a sample of communication graphs for 5,000 customers

# D4D: data for development Cote d'Ivoire

- "Scientific challenge" - halfway between a long hackathon and a scientific conference:
  - Launched in June 2012 for 8 months only
  - Only research institutions admitted after signing the terms & conditions
  - Evaluation committee chaired by Vincent Blondel (UCL) with members from Bouake University, Global Pulse (UN), GSMA, Orange Labs, WEF and MIT
  - Selected projects presentation during the NetMob conference, May 2013 in Boston (USA)
  - Four prizes attributed (first prize, scientific, development, and data visualization prizes)

# D4D: data for developme


- Côte d'Ivoire CDR samples
- Open to the researchers
- 263 projects submitted
- Over 80 reports received

# D4D: data for development Cote d'Ivoire

## NetMob 2013

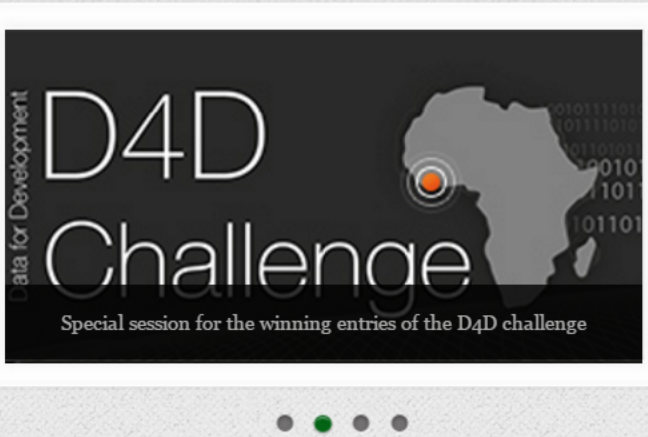
## May 1-3, 2013, MIT

*Third conference on the Analysis of Mobile Phone Datasets*

With a special event on the Data for Development (D4D) challenge.

"I can't say how impressed I was with the quality and quantity of the submissions."
"There is some incredibly good work in here."

Anonymous reviewers




http://perso.uclouvain.be/vincent.blondel/netmob/2013/D4D-book.pdf

# D4D: data for development Cote d'I


+ 50 published works!

SCIENTIFIC REPORTS

Altmetric: 7 Views: 1,782 Citations: 10 More

Article | OPEN

Inferring human mobility using communication patterns

Vasyl Palchykov, Marija Mitrović, Hang-Hyun Jo, Jari Saramäki & Raj Kumar Pan

*Scientific Reports* **4**, Article number: 6174

Received: 01 May
Accepted: 06 Aug

SCIENTIFIC REPORTS

Altmetric: 6 Views: 2,318 Citations: 6 More detail »

Article | OPEN

Disease Containment Strategies based on Mobility and Information Dissemination

A. Lima, M. De Domenico, V. Pejovic & M. Musolesi

*Scientific Reports* **5**, Article number: 10650 (2015)
doi:10.1038/srep10650

Received: 20 October 2014
Accepted: 24 April 2015
Published online: 02 June 2015

PLOS ONE | Subject Areas | Publish | About

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Mobile Phone Call Data as a Regional Socio-Economic Proxy Indicator

Sanja Šćepanović, Igor Mishkovski, Pan Hui, Jukka K. Nurminen, Antti Ylä-Jääski

Published: April 21, 2015 • DOI: 10.1371/journal.pone.0124160

EPJ Data Science

IMPACT FACTOR 1.567

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REGULAR ARTICLE OPEN ACCESS

The impact of social segregation on human mobility in developing and industrialized regions

Alexander Amini, Kevin Kung, Chaogui Kang, Stanislav Sobolevsky and Carlo Ratti

*EPJ Data Science* 2014, 3:6 | DOI: 10.1140/epjds31 | © Amini et al.; licensee Springer 2014

Received: 25 January 2014 | Accepted: 22 May 2014 | Published: 6 June 2014

Salnikov et al. *EPJ Data Science* 2014, 3:3
http://www.epjdatascience.com/content/3/1/3

EPJ.org

REGULAR ARTICLE

The geography and carbon footprint of mobile phone use in Cote d'Ivoire

Vsevolod Salnikov[1], Daniel Schien[2], Hyejin Youn[3,4,5], Renaud Lambiotte[1] and Michael T Gastner[6,7*]

ELSEVIER

Computer Communications

Volume 59, 15 March 2015, Pages 1–11

Large scale model for information dissemination with device to device communication using call details records

Rachit Agarwal[a], Vincent Gauthier[a], Monique Becker[a], Thouraya Toukabrigunes[a, b], Hossam Afifi[a]

Andris and Bettencourt *Infrastructure Complexity* 2014, 1:1
http://www.infrastructure-complexity.com/content/1/1/1

Infrastructure Complexity
a SpringerOpen Journal

RESEARCH Open Access

Development, information and social connectivity in Côte d'Ivoire

Clio Andris and Luis MA Bettencourt



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# D4D: data for development Cote d'Ivoire

- Many various topics addressed by the projects:
  - Health improvement (disease spread mapping or prevention)
  - Population statistics (urbanization, population, tourism and events analysis)
  - Communities understanding (diaspora cartography and needs, rural and urban customers)
  - Economic Indicators (local economic development, micro finance insight)
  - City and transport planning (transport optimization, road construction, smart city planning)
  - Emergency, Alerting & Preventing (early warning system, help distribution localization)
  - Geo-marketing (strategic points of sales)…
- Important echo among the United Nations, NGOs, development aid institutions
- New data challenges initiatives (Telecom Italia, Telefonica)
- **But no project could be implemented in Ivory Cost…**


# Second D4D Senegal:

# do it differently

sonatel

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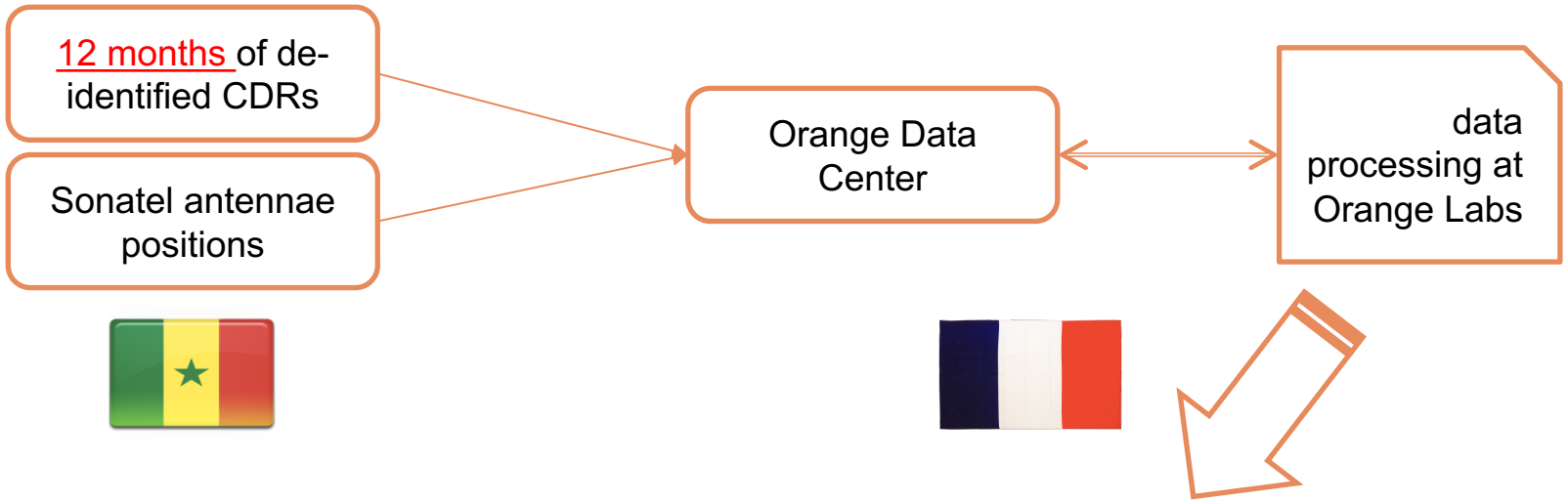
# D4D Senegal

- Improvements to bring to D4D after the Cote d'Ivoire experience

1. Focus on 5 themes
   - Health, Transport, Agriculture, Energy, National statistics
2. Involve local ecosystem
   - Questions owners: Ministries and institutions
   - Contributors: Universities, entrepreneurs…
3. Reinforce governance
   - Regulation, Ethics,…
4. Foster Data sharing
   - Find other data sources to be crossed with D4D data sets
5. Ensure an implementation of results
   - Prepare the « After D4D »

# D4D Senegal




- Proposed datasets:
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  - (2) individual trajectories for 300,000 randomly sampled users for two week time windows with antenna location information,
  - (3) individual trajectories for 150,000 randomly sampled users over the entire observation period with arrondissement location information,
  - ~~and (4) a sample of communication graphs for 5,000 customers~~
  - Bandicoot individual indicators with (2) & (3) http://bandicoot.mit.edu/

# D4D Senegal

April 2014: challenge launched

# D4D Senegal results announcement

NetMob 2015 Program

7-10 April 2015
MIT MediaLab
http://netmob.org

School // Conference // D4D Challenge

**Editors**: Esteban MORO, Yves-Alexandre de MONTJOYE, Vincent BLONDEL, Alex 'Sandy' PENTLAND, Nicolas DE CORDES

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UCL Université catholique de Louvain

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# the winners

## First Prize and Energy Prize: Using mobile phone data for electrification planning

E.A. Martínez-Ceseña [1], P. Mancarella [1], M. Ndiaye [2], and M. Schläpfer [3]

Knowledge of local energy needs is crucial for the electricity infrastructure planning of a country. We have shown that mobile phone data are an accurate proxy of the energy needs and can be used to develop bottom-up demand models. The new methodology supports and prioritizes the electrification plans in areas with scarce information on local activities and energy consumption.

(1)University of Manchester, UK - (2) Ecole supérieure polytechnique de Dakar UCAD, Senegal - (3) Santa Fe Institute, USA

## Agriculture Prize: Genesis of millet prices in Senegal: the role of production, markets and their failures

D.C. Jacques [1], R. d'Andrimont [1], J. Radoux (1), F. Waldner [1], and E. Marinho [2]

Information asymmetries are responsible for price differentials in only the few areas where the mobile phone coverage has not yet reached its full potential, which damages both poor producers and food insecure consumers. To address this issue, we have integrated it in a spatially explicit model that simulates the functioning of agricultural markets.

(1) Earth and Life Institute, Université Catholique de Louvain, Belgium - (2) Independent researcher, Rio de Janeiro, Brazil

## Health Prize: Uncovering the impact of human mobility on schistosomiasis...

L. Mari [1], R. Casagrandi [1], M. Ciddio [1], S.H. Sokolow [2], G. De Leo [2], and M. Gatto [1]

Schistosomiasis is water based parasitic worm infection with debilitating symptoms affecting millions of people. We show that a relatively simple model can reliably reproduce regional patterns of schistosomiasis prevalence across the country. We use the model to study the role of human mobility on disease dynamics and to analyze intervention strategies aimed at reducing disease burden.

(1)Dipartimento di Elettronica, Informazione e Bioingegneria, Politecnico di Milano, Italy - (2) Hopkins Marine Station, Stanford University, USA

## National Statistics Prize: Virtual Networks and Poverty Analysis in Senegal

N. Pokhriyal, W. Dong, and V. Govindaraju
Computer Science and Engineering, State University of New York at Buffalo, USA

Poverty is a complex phenomenon, but can be approximated by observing mobile phone usages and mobility at regional level and extrapolated at more granular level. Poverty maps showcasing multiple perspectives can provide policymakers with better insights for effective responses for poverty eradication.

## Transport Prize: National and Regional Road Network Optimization for Senegal Using Mobile Phone Data

Y. Wang [1], G. Homem de Almeida Correia [1], and Erik de Romph [1,2]

Anonymous mobile phone traces can be filtered with an algorithm to generate a proxy for a trip origin-destination matrix. This is used to develop a gravity model that predicts the future mobility in the country dependent on travel time and number of calls and messages between the departments. This information is then used to improve decision making for road network planning.

(1) Department of Transport and Planning, Delft University of Technology, The Netherlands - (2) DAT.mobility, The Netherlands

## Data Crossing Prize: Using mobile phone data for Spatial Planning simulation and Optimization Technologies (SPOT)

S. Gueye [1], B.M. Ndiaye [3], D. Josselin [3], M. Poss [5], R.M. Faye [2], P. Michelon [1], C. Genre-Grandpierre [3], and F. Ciari [4]

We propose a methodology of location and relocation of amenities (home, shop, work, leisure places) for urban planning decision. Our methodology exploits mobile phone data and other variables and point of interest on maps to propose optimal amenity locations to reduce the overall travel time or travel distance.

(1) LIA, Université d'Avignon, France - (2) LTI, ESP - Université de Cheikh Anta Diop, Senegal - (3) LMDAN, FASEG-Université de Cheikh Anta Diop, Senegal - (4) Institute for Transport Planning and Systems (IVT), Zurich, Switzerland - (5) UMR ESPACE, CNRS, Avignon, France

## Data Visualization Prize: Data for Development Reloaded: Visual Matrix Techniques for the Exploration and Analysis of Massive Mobile Phone Data

S. van den Elzen, M. van Dortmont, J. Blaas, D. Holten, W. van Hage, J-K. Buenen, J.J. van Wijk, R. Spousta *, S. Sala *, S. Chan *, A. Kuzmickas * University of Technology SynerScope BV Sensemaking Fellowship

Eindhoven University of Technology & SynerScope BV, The Netherlands

* Sensemaking Fellowship (MIT, Harvard University)

In our Visual analytics techniques for the exploration and analysis of massive mobile phone data, users are enabled to identify both temporal and structural patterns such as normal behavior, outliers, anomalies, periodicity, trends and counter-trends.

## Practical Application Prize: Mobile Data as Public-Health Decision Enabler: A Case Study of Cardiac and Neurological Emergencies

E. Mutafungwa [1], F. Thiessard [2], M. Pathé Diallo [2], R. Gore [3], V. Jouhet [2], C. Karray [4], N. Kheder [4], R. Saddem [4], J. Hämäläinen [1], G. Diallo [1]

The objective of the study is to show the areas in which the absence of a nearest hospital can result in death or serious squeals. The identification of areas at high risk in case of stroke of myocardial infarction, requiring rapid intervention, could help Public Health decision makers to priorize investments.

(1) Department of Communications and Networks, Aalto University School of Electrical Engineering, Finland - (2) ERIAS INSERM U897, ISPED, Université de Bordeaux, France - (3) Virginia Modeling Analysis and Simulation, Old Dominion University, USA - (4) Faculté des Sciences de Tunis, University of Tunis, Tunisia

## Scientific Prize and Ethics Mention: Construction of socio-demographic indicators with digital breadcrumbs

F. Bruckschen [1], T. Schmid [2], T. Zbiranski [1]

We show that socio-demographic indicators such as population, age, literacy, poverty, religion, ethnicity, electricity supply and others can be estimated in unprecedented detail and virtually ad-hoc using antenna-to antenna traffic data only. We offer a uniform approach that can be easily extended to other variables. Results are tested for spatio-temporal robustness and visualized as heat maps.

(1) Humboldt Universität Berlin, Germany - (2) Freie Universität Berlin, Germany

# Senegal internal migrations

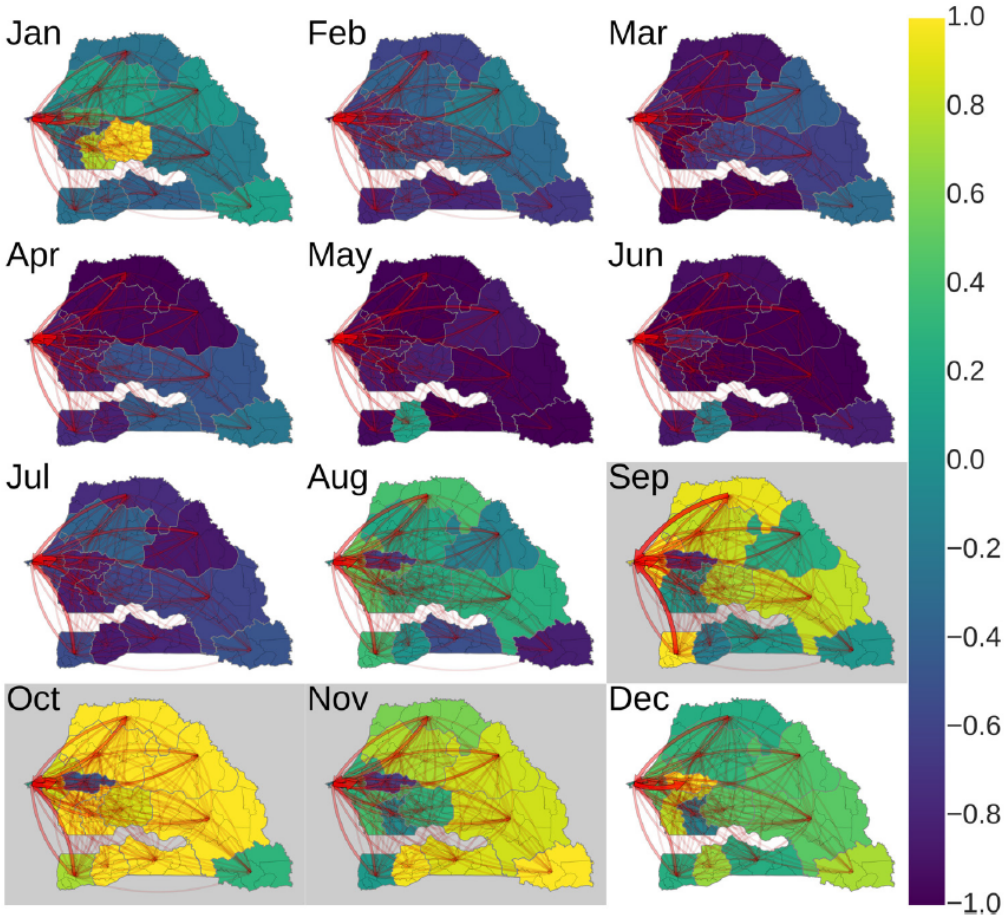


FIG. 13. Maps that show the monthly migration networks at the administrative region level. Link width corresponds to link weight. Arrows are traced from the *regular home* to the *monthly home*. The colors of each region give a notion of the number of *foreign* users within each region; that is, users whose home during a given month is not their regular home. The shadowed panels correspond to the harvest season.

Martin-Gutierrez et al. (2016) Agricultural activity shapes the communication and migration patterns in Senegal, *Chaos* 26.

# D4D Senegal

Results are published on the Web:

D4D scientific contributions
http://netmob.org/assets/img/NetMob%202015_D4D%20Challenge%20Senegal_Sessions_Scientific_Papers.pdf (298 pages, 83MB)

D4D posters
http://netmob.org/assets/img/NetMob%202015_D4D%20Challenge%20Senegal_Sessions_Posters.pdf (56 pages, 53 MB)

The datasets for D4D are described here: http://arxiv.org/abs/1407.4885


Thanks to B&M Gates Foundation grants three projects were launched to explore further the use of CDRs for:

Health: Disease modeling
National Statistics: Proxy for indicators
Agriculture: Food security

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# D4D Senegal: Grants for implementation

| Health | National Statistics | Agriculture |
|---|---|---|
| **Uncovering the impact of human mobility on schistosomiasis...**<br><br>R Casagrandi et al., Politecnico di Milano, Italy | **Construction of socio-demographic indicators with digital breadcrumbs**<br><br>F Bruckschen & T Zbiranski, Freïe Universität Berlin, Germany | **Genesis of millet prices in Senegal: the role of production, markets and their failures**<br><br>D Jacques, UC Louvain, Belgium |
| **Quantifying effect of movement due to holidays on malaria prevalence**<br><br>S Milusheva, Brown University, USA | **A multidimensional analysis of poverty and its determinants in Senegal**<br><br>N Pokhriyal, State University of New York at Buffalo, USA | **Mobility profiles and calendars for food security and livelihoods analysis**<br><br>PJ Zufiria et al., Universidad Politécnica de Madrid, Spain |

(See: Annex)

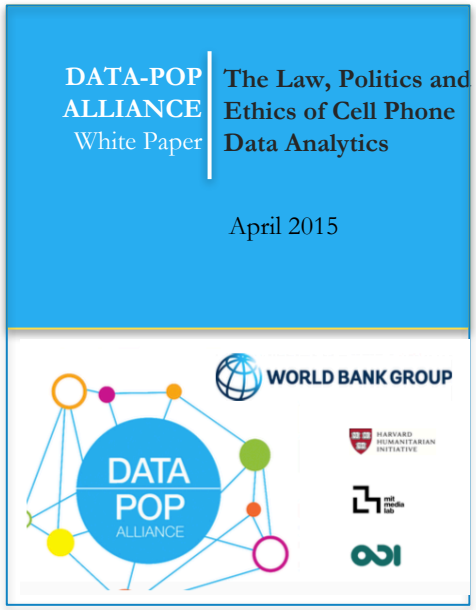
granted access to the complete database

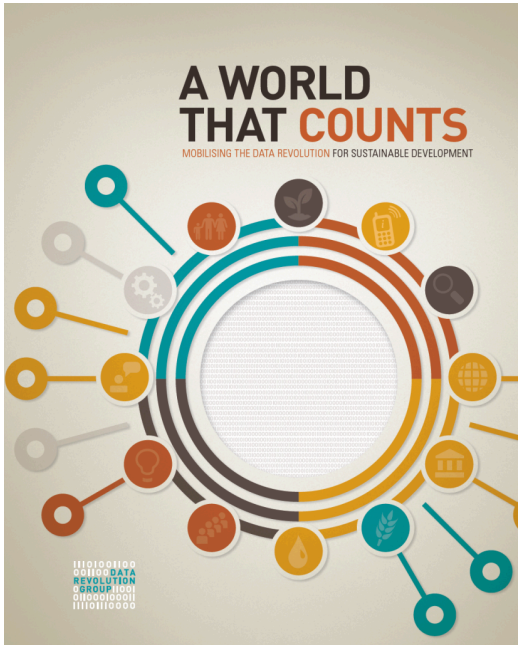
# D4D Senegal: 6 projects implementation

- Special event in Dakar ( Radisson Sonatel event, 6th June 2015 ) and teams field visit to Senegal
- Collaborations with local actors:
  - ANSD (National Statistics)
  - Ministry of Health
  - World Food Program Dakar
  - DAPSA Senegal (Agriculture Statistics)
  - PNLP (National Malaria Control Program)
  - …
- Help of international development bodies (OECD, WFP, WHO, UN…)

- And finally a « twin project » on the National Statistics Senegal - Cote d'Ivoire is about to start

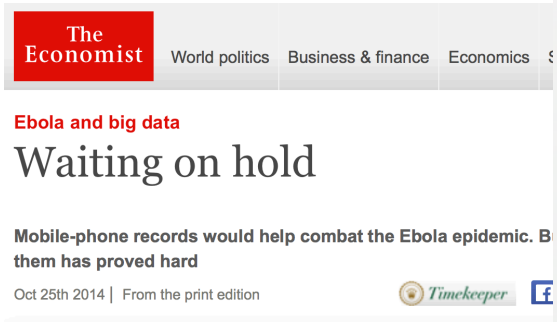
# After D4D: the world of development needs Big Data








# Privacy warning: impossible CDRs anonymization

- The notion of **anonymity** is one of the cornerstone of data protection
- But an individual spatiotemporal trace becomes very quickly unique, even in the largest datasets


SCIENTIFIC REPORTS

Altmetric: 1,481 Views: 271,913 Citations: 112 More detail »

Article | OPEN

Unique in the Crowd: The privacy bounds of human mobility

Yves-Alexandre de Montjoye, César A. Hidalgo, Michel Verleysen & Vincent D. Blondel

*Scientific Reports* 3, Article number: 1376 (2013)
doi:10.1038/srep01376

Received: 01 October 2012
Accepted: 04 February 2013
Published online: 25 March 2013

- CDRs from an European country (1.5 M people, 15 months)
- Points: antenna tower / time step: one hour

$$\mathcal{E}_4 = .95$$


REPORT

Unique in the shopping mall: On the reidentifiability of credit card metadata

Yves-Alexandre de Montjoye[1,*], Laura Radaelli[2], Vivek Kumar Singh[1,3], Alex "Sandy" Pentland[1]

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[2]Department of Computer Science, Aarhus University, Aabogade 34, Aarhus, 8200, Denmark.
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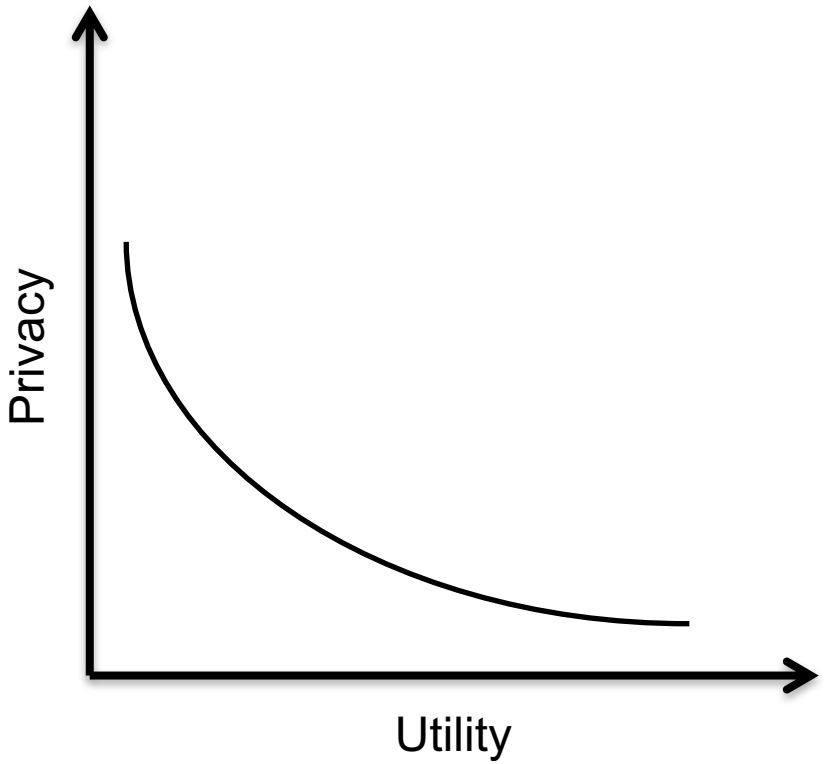
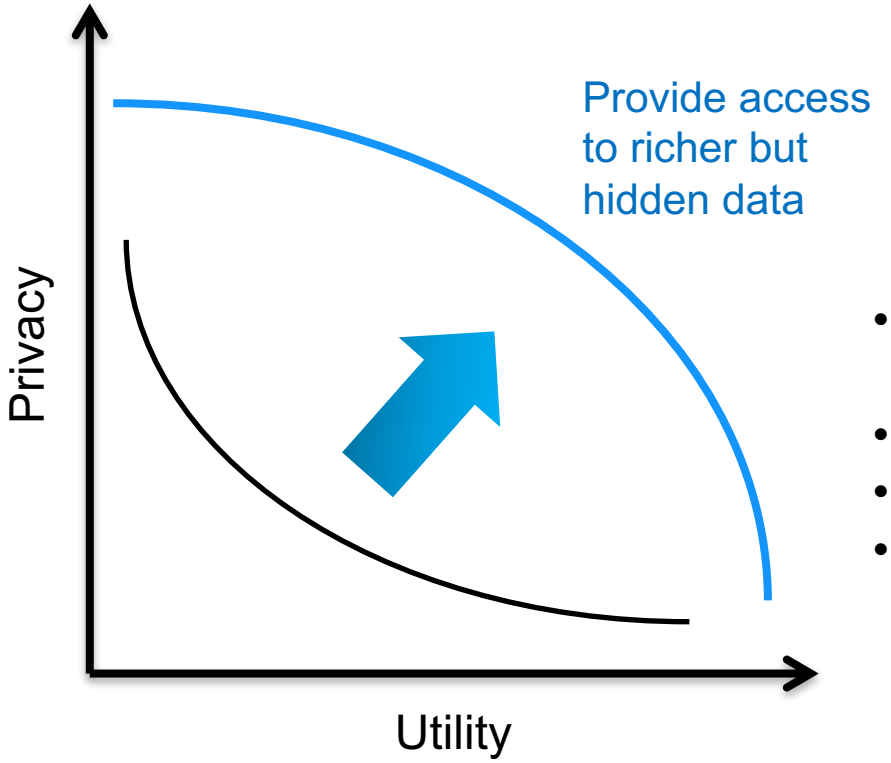
*Science* 30 Jan 2015:
Vol. 347, Issue 6221, pp. 536-539
DOI: 10.1126/science.1256297

# The “privacy-utility” trade-off



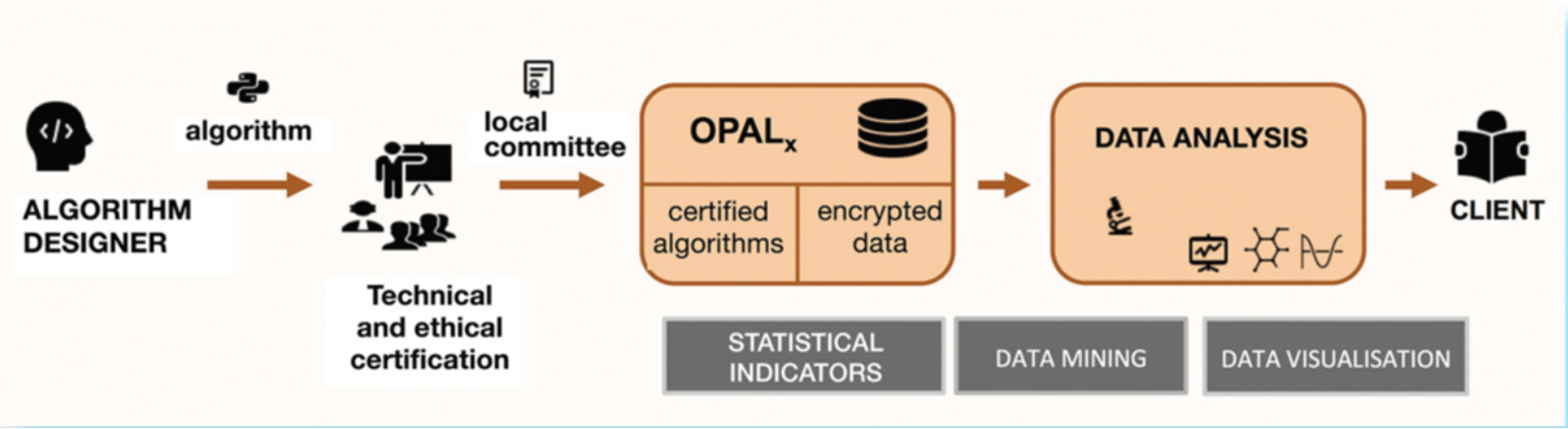
# A paradigm-shift in data protection

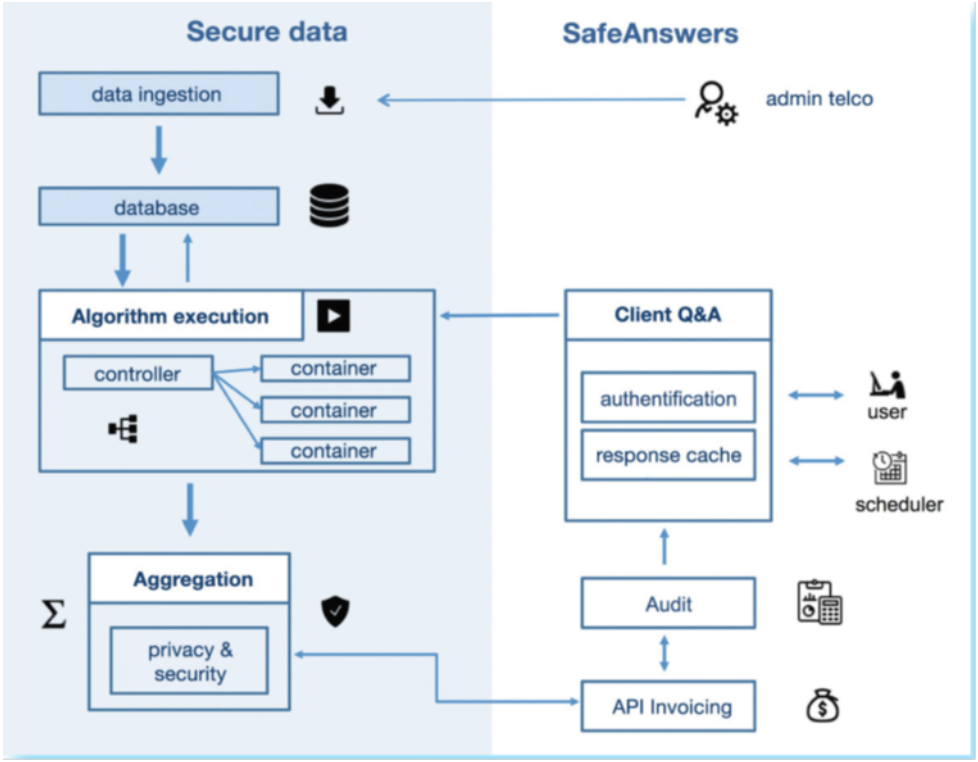



OPAL
bring the code to the data

- secure platform with pseudonymized data
- bring the code to the data using APIs
- create a bank of open algorithms
- set-up a governance board (local and global)

# OPAL Project: query private data in a safe way



# OPAL project

- **The Official Launch of the OPAL Project** took place on 8 December 2016 during the Open Government Partnership Global Summit in Paris


http://www.opalproject.org/

# Migration studies specific limitations of CDRs

- CDR based studies are usually on a single country
- when they change country, migrants also change operator (one needs to follow the device IMEI to observe continuously their movements)
- in Roaming situation the observation becomes more random (device can switch between operators when abroad)