

Response letter for “revise and resubmit” manuscript COMST-00099-2015

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First of all, we would like to thank the Reviewers for their high quality and constructive reviews of our manuscript, and the Editor for his careful reading.

In this revised version of the manuscript, we did our best to address all comments raised by the Reviewers. Specifically: (i) we better specified the focus of our survey in the title and throughout the paper; (ii) we reorganized the first three sections of the document, improving their logical flow and including a discussion of the evolution of the research field; (iii) we added missing references, either suggested by the Reviewers or appeared during the period the paper was under review; (iv) we extended and improved the structure of the section providing outlooks on the research field; (v) we corrected typos and errors across the document.

A detailed item-by-item response to each of the Reviewers’ points follows. Our replies are marked in *italic*. Also, please note that reference numbers in this letter refer to the bibliography at the end of the letter itself, and may not correspond to those in the main document.

Reviewer 1

Recommendation: Accept With Minor Revision

- **Comments.**

As mentioned in the review of 3., I am curious about why works in mobile analysis of WLAN/WPAN are omitted. Why is this important? Even though the authors limit the scope of mobile traffic analysis in the Introduction, I find the title of the manuscript can be misleading. In this scope proposed by the authors, shouldn’t the title be “Large-scale Mobile traffic analysis” or “Cellular traffic analysis”? I understand that a generalized title will be much more convincing, but I get a impression that the title can be somewhat misleading.

Our survey is indeed limited to works that analyze large-scale datasets of mobile traffic collected within cellular networks, and we do not consider works on datasets related to different mobile access technologies, e.g., Wi-Fi. As detailed in the reply to point 3 below, our choice is motivated by the much larger user coverage and geographical scale that cellular network probing grants over other access technologies. In order to clarify the focus of our work, we changed the title to “Large-scale Mobile Traffic Analysis: a Survey”.

The “Outlook” section can be improved if each categories were further organized into subcategories and hierarchically listed. Otherwise, the open problems and issues don’t clearly stand out.

We organized Sec. VII of the manuscript into subcategories, so as to structure the discussion in a more hierarchical fashion.

- **1. Description.**

This survey makes a comprehensive analysis of the literature related to mobile traffic analysis. Mobile traffic, as characterized in the paper, focuses on vast sets of mobile data usage and call profiles collected by various network around the world. The authors exploit three main categories of mobile traffic analysis: social, mobility, and network analysis. Also, authors discuss future open issues and technological enhancements that can be considered through this work.

No response required.

- **2. Contribution.**

This survey makes a comprehensive research on the existing literature of mobile traffic analysis. They also make a clear point on their scope, limiting the survey to studies made on large data traffic sets collected by mobile service operators. The taxonomy of the mobile data traffic analysis is very interesting and unique compared to existing work, which allows the reader & reviewer to view this field of area in another interesting point of view. The authors also clearly differentiate the general overview of each work with the technological issues, which allows the readers of all kinds to approach the work and study this area to their fitting. This area of research is very important and relatively new, and can be considered a vital part of communications community. In the point of view that communications technology can also help in various areas of social, epidemiology, transportation, etc, it even makes this survey more intriguing.

We thank the Reviewer for his/her appreciation of our work.

- **3. Quality of citations.**

The quality of citations is good. They have referenced the major works in this field of research. Below are some of the references that are not made in the manuscript but I find relevant to this area. I would like to ask the authors if there are specific reasons why they are omitted or considered out of scope, and if there are no strong reasons to include them

- [1] P. Roy, A.J. Martinez, G. Miscione, M.H.P. Zuidgeest, M.F.A.M. van Maarseveen. Using social network analysis to profile people based on their e-communication and travel balance. *Journal of Transport Geography*, 24:111-122, 2012.
- [2] Maxime Lenormand and et al. Cross-checking different sources of mobility information. *PLoS ONE*9 online publication, 2014.
- [3] Sahar Hoteit, Stefano Secci, Stanislav Sobolevsky, Guy Pujolle, Carlo Ratti, "Estimating Human Trajectories and Hotspots through Mobile Phone Data", *Computer Networks*, Vol. 64, pp: 296-307, May 2014.
- [4] Tao Jia, Bin Jiang, Kenneth Carling, Magnus Bolin, and Yifang Ban. An empirical study on human mobility and its agent-based modeling. *Journal of Statistical Mechanics: Theory and Experiment*, P11024(11), 2012.

We added the works in [2] and [3] to our survey, in Sec. V of the revised manuscript.

Instead, the works in [1] and [4] are out of the scope of our survey, as they do not analyze mobile traffic data: the first is based on an extensive questionnaire survey of 436 individuals, the second relies on GPS logs of 258 volunteers.

One thing I would like the authors to clarify is that "Why is most of the literature considering cellular mobile datasets?"

- [5] Filipe Meneses and Adriano Moreira. Large scale movement analysis from wi-fi based location data. 2012 International Conference on Indoor Positioning and Indoor Navigation, 2012.

Are there not some literature that collects various usage/data information from WLAN and WPAN? Are these works out of scope? Or is it that these works are not yet mature compared to cellular? Are there works that utilize vast number of SDN-based WLAN systems to collect information from mobile users? These works also seem relevant.

Our survey is limited to works that analyze large-scale datasets of mobile traffic collected within cellular networks, and we do not consider works on datasets related to different mobile access technologies, e.g., Wi-Fi. The main motivation for this choice is that currently available Wi-Fi (or equivalent) datasets are just not comparable with cellular ones, in terms of user coverage and geographical scale. For instance, the analysis in [5] mentioned by the Reviewer is one of the most extensive of its kind, and builds on Wi-Fi access logs of several thousands users at 550 access points mostly located in two university campuses. Still, these numbers are far from the hundred thousands subscribers and nationwide coverage provided by cellular datasets (with the exception of a few – and very early – works), as shown in the different tables summarizing the features of works we survey in our manuscript. In Sec. I of the revised version of the paper, we better outline the scope of our work: we stress that our survey only concerns data analyses based on cellular access technologies, motivating our choice along the lines above.

- **4. Organization.**

The overall organization of the paper is well-made, and the taxonomy of works shown in Fig. 3 is easily understandable. Using this taxonomy, the sub-categories and lists of paper are straight-forward. However, from the reviewer's point of view, the survey lacks emphasis on historical importance and chronological organization.

- a. It will be really nice if the authors can briefly summarize the history on WHY this area has become important, and why everyone started studying it.
- b. The survey is very comprehensive in that it categorizes many researches into three key areas and several sub-categories. However, the researches are not smoothly explained in a chronological manner. Why is this not done? Is it because of the property of the research that there is no gradual chronological improvement in the technology? Or is it that the author's think current organization is better? My point of view is that even though the paper is organized well in the point of different subjects and categories, it is difficult to see how this field of research has made gradual improvements, and how it evolved over time.

Concerning the first item above, in the revised version of the manuscript we re-organized the structure of the first three sections of the survey. Among other improvements, the new structure includes a presentation of the evolution of mobile traffic analyses, as well as a discussion of the key factors leading to their success as a research field, in Sec. II-A.

With regard to the second item above, as pointed out by the Reviewer, we favored a classification based on subjects of multidisciplinary research, over one based on chronological order. However, within each subject (and in each detailed topic in its hierarchy), we present works according to the increasing knowledge they yield. We believe that this ordering conveys a proper feeling of the progress made by the research community. We remark that, in many cases, this approach leads to a chronological ordering of the works listed in each topic, although exceptions are not infrequent, since more recent works may yield less original contributions than older ones. As an example, see the very first topic studied in the survey, i.e., the degree distribution in mobile call graphs, in Sec. IV-A.1. There, the works by Nanavati et al. [6], Onnela et al. [8], Lambiotte et al. [9], and Seshadri et al. [10] progressively advance the knoweldge on the topic, and do so by following a rigorous chronological order. Yet, the work by Doran et al. [7], despite being the most recent of the set, only confirms the properties already identified by Nanavati et al. [6] on a different dataset. Such work thus has a reduced novelty (at least, for what concerns the degree distribution in mobile call graphs), and it appears right after the work by Nanavati et al. [6]: this somehow breaks the temporal ordering of the works in these paragraphs, but it maintains the more important ordering in terms of progress of knowledge.

- **5. Technical correctness.**

There are no critical technical flaws in the work.

No response required.

- **6. Minor changes.**

The manuscript is well written. I found some mistakes:

- p. 33., reference [134], Sydney ==> Sydney
- p. 28., l. 10 user.101. ==> user101.
- Fig.3 should be in front of TABLE 1.

We thank the Reviewer for pointing out these typos. We corrected them in the revised version of the document.

- **7. Summary.**

I believe this is an outstanding contribution to the IEEE Communications Surveys and Tutorials. As shown in this manuscript, the field of mobile traffic analysis has been hot during the past 8-10 years. This survey is clearly very thorough and indicates what kinds of research has been made. Also, it indicates that there are still many future topics that need to be discussed, which shows the potentials of this research field in the area of communications.

We thank the Reviewer for his/her appreciation of our work.

Reviewer 2

Recommendation: Revise And Resubmit

- **Comments.**

1. The article provides a good taxonomy on existing works on mobile traffic analysis, but it doesn't provide enough comparisons and insights of works in the same category.
2. There should be a comparison table for each important category of works. Right now authors mostly sequentially describe what has been done in each piece of work. This does not give readers vivid differences between these works.
3. The abstract should be completely written. It now tells what to be covered instead of key findings in this survey. Instead of talking about what readers will see, highlight key observations on mobile traffic analysis.
4. Section III should be merged into Section I since it is a part of introduction in its nature.
5. Section II should be made more related to the rest of the article. Right now it appears to be quite independent without good correlation with the other sections.
6. Section VII give open less-investigated issues. The authors could strengthen this section by more of their observations and opinions.

1–2. Tab. I, Tab. II and Tab. III provide a summary of the major features of all the works surveyed in Sec. IV, Sec. V and Sec. VI, respectively. These tables provide a comparison of both the datasets employed and the focus of the research, and are organized according to the classification hierarchy. We refer the Reviewer to our detailed reply to point 4.3 below.

3. *As outlined in Sec. II of the revised manuscript, the field of mobile traffic analysis is extremely varied and spans across a number of disciplines. It thus yields a large number of key findings and observations that refer to very different subjects (from transportation to networking technologies, from demographics to epidemiology, etc.). Unlike what would happen in a survey focusing on one specific subject, in our case listing all (or even a significant subset of) such key findings in the abstract is unfeasible. In this perspective, we believe that the current abstract structure provides a fair summary of the content of the survey.*
4. *We merged the former Sec. III into the introductory overview of the research field provided in the new Sec. II. We refer the Reviewer to our detailed reply to point 4.1 below.*
5. *We better related the former Sec. II to the rest of the article, by moving it after the overview of the research field and discussing how it provides a useful technical basis that eases the understanding of the actual examination of the literature. We refer the Reviewer to our detailed reply to point 4.2 below.*
6. *We extended Sec. VII, by restructuring it and including additional observations. We refer the Reviewer to our detailed reply to point 4.4 below.*

- **1. Description.**

The survey first reviews mobile data collection. Then it surveys existing papers in three categories: social analysis, mobility analysis, and network analysis.

No response required.

- **2. Contribution.**

- a. It provides a good taxonomy of existing works.
- b. There is no original contribution. In fact, there could be more original observations and comparisons.
- c. In Section VII, there are some lessons but not enough.
- d. There are two other survey papers. This one is the 3rd. It covers more existing works, but needs much enhancement so that readers could benefit from it.

a. We thank the Reviewer for his/her appreciation of our work.

b. We believe that our work includes original contributions.

First, the survey provides a novel view of the research field, as it differs from existing surveys in terms of both extent and approach: we refer the Reviewer to our detailed reply to point 2.d below.

Second, the survey provides a summary and comparison of the literature through Tab. I–III: we refer the Reviewer to our detailed reply to point 4.3 below.

c. *In the revised version of the manuscript, we extended Sec. VII, including additional considerations on the current state of the art and open research issues. We refer the Reviewer to our detailed reply to point 4.4 below.*

d. *We believe that our survey differs from those already published – both of which are very recent – in terms of extent and approach. In terms of extent, as the Reviewer also pointed out, the volume of works we review is significantly larger than that considered in Shang et al. [11]. Also, our detailed discussion of networking studies based on mobile traffic analysis is not found in neither Shang et al. [11] nor Blondel et al. [12]. In terms of approach, we do not base our survey on illustrative examples for each research subject like done by Shang et al. [11] and Blondel et al. [12]. Instead, we present a comprehensive yet compact treatise of the whole significant literature, discussing major findings as well as the main methodologies employed to obtain them.*

As a result, while Shang et al. [11] and Blondel et al. [12] provide a limited number of “highlights” on a subset of the topics we cover, our survey encompasses a broader research scope and provides an exhaustive list of all significant results. In addition, our survey includes other elements that are missing in previous surveys, such as: (i) a discussion of the evolution of the mobile traffic analysis research field, including key reasons for its success; (ii) a technical overview of the data collection process within the mobile network architecture; (iii) a clear presentation of the multidisciplinary nature of the research field, including overlaps among the different domains involved in each specific topic.

In fact, a third survey appeared while the present manuscript was under review. As now discussed in Sec. I of the revised version, Saramaki and Moro [13] focus on one specific topic, i.e., social graphs extracted from mobile traffic datasets. Unlike the survey we compile, this represents an interesting and more technical reading for researchers interested in that precise subject: its scope is thus different from that of our document.

In addition to all the aspects above, the revised version of the manuscript enhances the original survey according to the points suggested by the Reviewer.

- **3. Quality of citations.**

There are enough citations. Some of them could be screened out if not that important.

We included several new references in the revised version of the survey. Such works have been either suggested by other Reviewers, or appeared during the period the manuscript was undergoing the first round of reviews.

- **4. Organization.**

1. Section III should be merged into Section I since it is a part of introduction in its nature.
2. Section II should be made more related to the rest of the article. Right now it appears to be quite independent without good correlation with the other sections.
3. In Sections IV, V, VI, there should be tables of comparison on important category to compare the major differences of existing works in that category.
4. Section VII give open less-investigated issues. The authors could strengthen this section by more of their observations and opinions.

1. In the revised version of the manuscript, we re-organized the structure of the first three sections of the survey. Among other improvements, the former Sec. III is now part of Sec. II, which provides an extensive introduction to the research field of mobile traffic analysis.

2. In the revised version of the manuscript, we re-organized the structure of the first three sections of the survey. Among other improvements, the former Sec. II has been moved after the overview of the research field, into a new Sec. III. This makes the discussion of the mobile traffic data collection more

related to the rest of the article, as explained in the new survey organization discussion (Sec. II-C of the revised manuscript). Specifically, mobile traffic data collected by mobile operators in cellular networks is the cornerstone of all works we review, thus we start our survey by introducing some basic notions about such kind of data. Sec. III provides a primer of the cellular network architecture, and presents different solutions to record mobile traffic information within its access and core portions. The same section puts forward an important problem of the data collection process, i.e., the preservation of subscriber privacy, and outlines current approaches to the anonymization of mobile traffic datasets. These discussions are relevant to the whole body of works related to mobile traffic analysis, independently of the subject they address and of their specific target. We thus believe that the section provides a useful technical basis that eases the understanding of the actual examination of the literature.

3. Tab. I, Tab. II and Tab. III provide a summary of the major features of all the works surveyed in Sec. IV, Sec. V and Sec. VI, respectively. These tables provide a comparison of both the datasets employed and the focus of the research, and are organized according to the classification hierarchy.

On the one hand, they can be used as quick reference to understand the breadth of each study. E.g., they convey data on (i) which works cover wider geographical areas, longer timespans or larger amounts of users, (ii) which kind of mobile traffic information (voice, texting, data traffic, signalization) they use, or (iii) which additional sources of information they combine.

On the other hand, they provide insights on the correlation between data and research topics, and among research topics themselves. Indeed, the tables allow identifying which kind of mobile traffic data is used to investigate specific subjects: for instance, social studies tend to only use voice and texting, which are often complemented with external databases; instead, mobility studies are the only to rely on precise signalization information. Moreover, the tables allow observing inter-topic relations: e.g., studies on individual mobility models (IM) always require some preliminary analysis of visited locations (Lo) and regular mobility patterns (RM), in Tab. II; instead, works on networking technologies tend to be extremely focused on one specific subject, in Tab. III.

In the light of these considerations, we believe that the tables represent a nice means of comparison of the surveyed works, and allow inferring major differences among them.

4. In the revised version of the manuscript, we updated Sec. VII by restructuring it into categories and subcategories. We also included additional observations on validation of mobile traffic analyses, and on the problems arising from the diversity of mobile traffic data types.

- **5. Technical correctness.**

Appears to be correct, but didn't check completely.

No response required.

- **6. Minor changes.**

1. P4 line 14 on the right-hand column: "On the other hand, however" have been used in a duplicate way.
2. P17 line 11 on the right-hand column: There seems an error in "show that mobile data can, e.g., help".
3. P19 line 22 on the right-hand column: A typo: "sucess" should "success".

We thank the Reviewer for pointing out these errors. We corrected them in the revised version of the document.

- **7. Summary.**

It could provide a good survey value if it goes through a heavier revision process.

We thank the Reviewer for his/her appreciation of our work.

Reviewer 3

Recommendation: Accept

- **Comments.**

The paper is well-written and organized, and the authors have conducted an impressive amount of work. As explained in my comments above, my basic reservation is that due to its necessarily non-technical and generic nature the survey is borderline in terms of its compatibility with COMST. Still, the fact that it points towards such a large number of research fields and discusses a few works within its field to offer the reader a basic idea of research work and challenges and give valuable references, makes me lean towards its acceptance.

We thank the Reviewer for his/her appreciation of our work.

We understand his/her observation on the generic nature of the survey. However, the sheer breadth of the mobile traffic analysis research field is such that a more technical discussion would require dedicated surveys for each category – or even subcategory – in the classification we propose in Fig. 2 of the paper: see, e.g., the very recent and more technical survey by Saramaki and Moro [13], which focuses on one specific topic, i.e., social graphs extracted from mobile traffic datasets (Sec. IV-A of our survey), and is now referenced in Sec. I of the paper. The objective of our work is instead to provide a global review that encompasses all possible applications of mobile traffic analysis. We thus contribute a guide for researchers interested in understanding the full potential of this kind of datasets. As such, our guide gives key pointers to the main results in each subject: the interested reader is then invited to follow such pointers and delve into the relevant papers cited in the survey, in order to discover the detailed technical aspects of problems and solutions.

- **1. Description.**

The authors provide an exhaustive survey on a large number of research areas associated with mobile traffic analysis. They start with details on the mobile data collection process and move on to discuss how mobile traffic analysis has been used in the literature in regards to social, mobility and networking analysis, and a vast number of subareas within each of these larger areas. They also discuss possible future research directions.

No response required.

- **2. Contribution.**

The paper covers a vast amount of related research on the subject, therefore the reader can find out how important mobile traffic analysis is in very diverse areas. The survey more than adequately extends previous surveys in the field, which are properly referenced. However, because of the large number of studies that the authors discuss in each sub-field, they often conclude that the results presented in those studies lead to very diverse conclusions. Hence, this survey may certainly be useful in terms of providing a large number of references for each of its subjects, but in many cases the interested user is left without a clear indication of which research path is best to follow and which pitfalls should be avoided.

The Reviewer is right in that works in the literature lead, at time, to different conclusions. In part, this is due to the fact that the research field is still young, especially regarding some subjects. In other cases, cultural or economic differences in the region where mobile traffic data is collected can determine dissimilarities in results. In all of these cases where a solid consensus must yet emerge, our survey evidences the different (and possibly conflicting) outcomes.

However, we would also like to stress that, on many topics, there is little uncertainty and basically all works agree on a same conclusion, with minimal or no controversy. Such results include, just to cite a few representative examples: (i) the power-law nature of mobile communication graphs, (ii) the fitness of mobile traffic data for purposes such as land use detection, population estimation, home and work locations of individuals, (iii) the major laws of large-scale human mobility, including their spatiotemporal regularity, (iv) the correlation among geographical locations and mobile service usage, (v) the heterogeneity in mobile access by subscribers, or (vi) the difficulties in anonymizing mobile traffic datasets.

- **3. Quality of citations.**

The citations are adequate.

No response required.

- **4. Organization.**

The paper is well-organized.

No response required.

- **5. Technical correctness.**

I did not find technical inaccuracies.

No response required.

- **6. Minor changes.**

Abstract: "apart a few outliers" -> "apart from a few outliers" Introduction: "there exists only two... previous effort" -> "there exist only two... previous efforts"

We thank the Reviewer for pointing out these typos. We corrected them in the revised version of the document.

- **7. Summary.**

The paper is well-written and organized, and the authors have conducted an impressive amount of work. As explained in my comments above, my basic reservation is that due to its necessarily non-technical and generic nature the survey is borderline in terms of its compatibility with COMST. Still, the fact that it points towards such a large number of research fields and discusses a few works within its field to offer the reader a basic idea of research work and challenges and give valuable references, makes me lean towards its acceptance.

We thank the Reviewer for his/her appreciation of our work.

Reviewer 4

Recommendation: Accept

- **Comments.**

No further comments.

No response required.

- **1. Description.**

The paper provides a thorough survey on the analysis of mobile traffic based on mobile phone datasets.

No response required.

- **2. Contribution.**

The paper has significant tutorial content, begin perfectly accessible for a generalist in the field. The paper provides a thorough survey in mobile traffic analysis, being complementary to previous surveys in the area. The paper discusses open issues. This is a nice contribution on an area that is quite active in the last few years.

No response required.

- **3. Quality of citations.**

The paper offers a vast set of related publications covering the whole area. A paper that appeared recently (after the submission), but that may deserve a citation in a final version of the survey is this one:

[13] From seconds to months: multi-scale dynamics of mobile telephone calls Jari Saramaki, Esteban Moro
<http://arxiv.org/abs/1504.01479>.

We thank the Reviewer for pointing out to us this additional reference, which is indeed of significant interest. We included it among the previous surveys of the literature, in Sec. I of the revised manuscript.

- **4. Organization.**

The paper is well organized.

No response required.

- **5. Technical correctness.**

The paper seems to be technically correct.

No response required.

- **6. Minor changes.**

No minor typo spotted.

No response required.

- **7. Summary.**

The paper provides a thorough survey on the analysis of mobile traffic based on mobile phone datasets. This is an area of active research in the last years and is finding multidisciplinary applications. In this sense, this paper offers a nice, well-structured, and general survey to start studying this area that is attracting so much interest.

We thank the Reviewer for his/her appreciation of our work.

References

- [1] P. Roy, A.J. Martinez, G. Miscione, M.H.P. Zuidgeest, M.F.A.M. van Maarseveen, “Using social network analysis to profile people based on their e-communication and travel balance,” *Journal of Transport Geography*, 24:111–122, SEp. 2012.
- [2] M. Lenormand, M. Picornell, O.G. Cantú-Ros, A. Tugores, T. Louail, R. Herranz, M. Barthelemy, E. Frías-Martínez, J.J. Ramasco, “Cross-checking different sources of mobility information,” *PLoS ONE*, Aug. 2014.
- [3] S. Hoteit, S. Secci, S. Sobolevsky, G. Pujolle, C. Ratti, “Estimating Human Trajectories and Hotspots through Mobile Phone Data,” *Computer Networks*, 64:296–307, May 2014.
- [4] T. Jia, B. Jiang, K. Carling, M. Bolin, Y. Ban, “An empirical study on human mobility and its agent-based modeling,” *J. Stat. Mech.*, P11024(11), Nov. 2012.
- [5] F. Meneses, A. Moreira, “Large scale movement analysis from Wi-Fi based location data,” *IPIN*, Sydney, Australia, Nov. 2012.
- [6] A. Nanavati, S. Gurumurthy, G. Das, D. Chakraborty, K. Dasgupta, S. Mukherjea, A. Joshi, “On the Structural Properties of Massive Telecom Call Graphs: Findings and Implications”, *ACM CIKM*, Arlington, VA, USA, Nov. 2006.
- [7] D. Doran, V. Mendiratta, C. Phadke, H. Uzunalioglu, “The Importance of Outlier Relationships in Mobile Call Graphs”, *IEEE ICMLA*, Boca Raton, FL, USA, Dec. 2012.
- [8] J.-P. Onnela, J. Saramaki, J. Hyvonen, G. Szabo, M. A. de Menezes, K. Kaski, A.-L. Barabasi, J. Kertesz, “Analysis of a Large-Scale Weighted Network of One-to-One Human Communication”, *New Journal of Physics*, 9(179):1–27, Jun. 2007.
- [9] R. Lambiotte, V. Blondel, C. de Kerchove, E. Huens, C. Prieur, Z. Smoreda, P. Van Dooren, “Geographical Dispersal of Mobile Communication Networks”, *Physica A*, 387(21):5317–5325, Sep. 2008.
- [10] M. Seshadri, S. Machiraju, A. Sridharan, J. Bolot, C. Faloutsos, J. Leskovec, “Mobile Call Graphs: Beyond Power-Law and Lognormal Distributions”, *ACM KDD*, Las Vegas, NV, USA, Aug. 2008.
- [11] C. Shang, M.C. Zhou, C. Chen, “Cellphone Data and Applications,” *International Journal of Intelligent Control and Systems*, 19(1):35–45, Mar. 2014.
- [12] V.D. Blondel, A. Decuyper, G. Krings, “A survey of results on mobile phone datasets analysis,” *arXiv:1502.03406 [physics.soc-ph]*, Feb. 2015.
- [13] J. Saramaki, E. Moro, “From seconds to months: multi-scale dynamics of mobile telephone calls,” *arXiv:1504.01479 [physics.soc-ph]*, Apr. 2015.