Detailed process from now is:
- Please read the reviewers comments, particularly the meta-review by the primary associate editor (1AE), who summarised the required changes before the paper can be accepted.

- Your paper will be re-reviewed by the same set of reviewers against the set of requirements that they set out, and you will have an answer within 6 weeks of resubmission. That answer will either be "accept (with minor revisions)" or "reject".

- We strongly encourage you to follow the criteria set out in the 1AE review as this will maximise your chances of subsequent acceptance. Resubmissions that do not address all the criteria will be rejected unless compelling reasons are provided (as part of the resubmission).

- Please note that your paper's decision/reviews may not be visible in PCS immediately, but they will be in a few days at https://precisionconference.com/~imwut17feb/.

- Through PCS, you will also be able to communicate anonymously with your 1AE. You should use this if you need further clarification of any requirements the 1AE has listed in the meta-review.

If you have questions about the reviews, please use the 1AE communication process above. If you have questions about the process or if your 1AE is not responsive, please do not hesitate to contact editors@imwut.acm.org.

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The review process operated as follows. Each paper was assigned by the editors to a primary associate editor (1AE) and a secondary associate editor (2AE). The 1AE assigned two external reviewers. The 2AE and external reviewers all did the same type of review, resulting in recommendations for the 1AE and comments for authors. The 1AE then led an online discussion with the 2AE and external reviewers, resulting in a recommendation to the editors, and the 1AE wrote a meta-review with these recommendations. The editors ensured that the same acceptance criteria were applied across all the submissions.

The possible recommendations were:
- Accept with minor revisions required
- Major revisions required
- Reject

For the first two categories, the list of revisions required were agreed between the reviewers and summarized in the 1AE's meta-review.

Thank you for your contribution to IMWUT. We are looking forward to receiving your revised submission.

Sincerely,

Gregory Abowd (Editor-in-chief), Vassilis Kostakos, Silvia Santini, James Scott, Koji Yatani

IMWUT Editors <editors@imwut.acm.org>

---------- Submission 1668, Review 3 ----------

Title: Inferring Correlation between User Mobility and App Usage in Massive Coarse-grained Data Traces

Primary Associate Editor's recommendation to Editors

Major revisions (enumerated in a subsequent field) are required for this to be publishable in IMWUT

Primary Associate Editor meta-review

All reviewers agreed that the work is research-worthy and that there are potential contributions regarding the dataset. However, all reviewers also agreed that the contributions are difficult to judge based on the current presentation of the data, potential lack of generality of the method to other areas, and lack of evaluation of the proposed speed measure.

As such, the reviewers agree that major changes are needed before the contributions can be adequately judged, as outlined below. During discussion, the reviewers chose “Major Revisions” over “Reject” because we believe that addressing the comments should be straightforward. However, if the speed algorithm is not accurate or the generality of results not brought into a realistic scope, rejection may be appropriate because of the limited contributions.

Primary Associate Editor Meta-review: Major / minor revision requirements — meta review

In order to clarify the contributions of the paper, the authors should:

1. (R1) Describe how the data was collected. Who were involved? How long the data was collected? When the data was collected? Is it cell data the only collected data or was WiFi also collected? (1)

2. (R1 and R2) The authors should address the generality of the proposed algorithm as a limitation. Generally, smartphone users use both cellular and wifi networks in other areas. The current analysis model excludes many contexts of users such as location, time, individual context, etc. In order to understand the resulting data, it is very important to know about moving speed with respect to users and their culture. (2)

3. (R2) Speed estimation algorithm is not proved yet. The authors should demonstrate that their approach to estimate intra-cell movement speed is accurate and therefore can be reliable used for the correlation analysis. Many assumptions in estimating moving speed are made without much explanation. These assumptions should be proved and discussed in detail. In addition, the classes of moving speed should be analyzed and discussed in detail. (3)

4. (R1 and R2) The authors should discuss or demonstrate the implications of considering cellular traffic only on the results presented in this work. WiFi usage could be a major limitation of the generalization of the study. (2)

Suggested References:
[1] Kyunghan Lee,Joohyun Lee,Yung Yi,Injong Rhee, and Song Chong. 2013. Mobile Data Offloading: How Much can WiFi Deliver? IEEE/ACM Transactions On Networking 21, 2 (2013), 536–551.

[2] Paul Baumann and Silvia Santini. 2014. How the availability of Wi-Fi connections influences the use of mobile devices. In Proceedings of the

2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing Adjunct Publication - UbiComp '14 Adjunct. (2014), 367–372.

Additional comments for authors

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---------- Submission 1668, Review 1 ---------- — review 1

Title: Inferring Correlation between User Mobility and App Usage in Massive Coarse-grained Data Traces

Contribution to IMWUT

The main contributions of the paper are in two folds. The first contribution is the methodology for estimating moving speed from massive smartphone usage data containing cell tower information and app usage. The moving speed is obtained by estimating travel time and travel distance. The travel time is calculated by the time difference of two consecutive pass-boundary events while the distance is the shortest distance between two adjacent Voronoi edges. Finally, the moving speed is estimated from the moving distance divided by travel time. I think that this approach is useful for understanding when smartphone users use apps according to travel speed.

The second contribution is the analysis on the correlation between app usage and moving speed.
The authors showed how the moving speed is related to app usage. The analysis includes app category, average of unique app per min, app switch frequency, average number of concurrent apps and correlation of user speed and contribution of app categories. This indicates that moving speed affects how users uses their smartphone in daily life and might be useful for for app developers.

Review

Although the authors shows interesting results, there are several limitations to be impored. First of all, I'm wondering how the data was collected. The authors mainly describes the volume of dataset. However, it is very important to know about how the data was collected. The population of the dataset might be affected by the culture and types of users.

1.a&b

Second, the proposed methodology and analysis are too general to be applied to understand smartphone app usage. This is because the contexts users use their smartphones are blurred with moving speed. Generally, user behaviours are divided into moving, sitting and staying at home or office and also related to time of day. Users spend much time on using smartphone when waiting or sitting for something. The usage patterns are also related to locations such as home or office or stores. Furthermore, the results could not represent the significant part of users since usage patterns are very diverse according to users. As the authors mentioned with Fig 1, the data was mainly from those who frequently moved and used.

2.a

I think that the moving speed should be related to more contexts such as time and location. It might be also interesting to see the difference between inter-cell moving and staying within a cell.

Third, I think that the results are very limited to specific areas. Although the data were from three cities and the size of data is comparable with other countries, the results are only for the China. I think that the Fig 13 ~ 15 are not meaningful for understanding general usage patters, but for three cities of China. The authors need to describe the limitation of their analysis and method.

Lastly, I would like to see how the authors dealt with the massage smartphone usage data.

Recommendation(s) to 1AE

Major revisions (enumerated in a subsequent field) are required for this to be publishable in IMWUT

Major / minor revisions (recommendation to 1AE)

There are several things to be improved

First of all, the authors should describe how the data was collected. Who were involved? How long the data was collected? When the data was collected?

Second, the authors should add more analysis with respected to contexts such as time and location. It might be also interesting to see the difference between inter-cell moving and staying within a cell.

Third, The authors need to describe the limitation of their analysis and method.

Last, the authors should describe how the massage smartphone usage data were dealt. Any tools an environments?

Confidence in the review

Very confident - I am knowledgeable in the area

---------- Submission 1668, Review 2 ----------

Title: Inferring Correlation between User Mobility and App Usage in Massive Coarse-grained Data Traces

Contribution to IMWUT

This paper presents an analysis and insights into potential correlations between users' movement speed and application usage patterns.
The authors analyze a large data set that contains CDRs from millions of users from three cities.
The paper further introduces a novel approach to estimate users' movement speed from course-grained cell data.

Review

There are several good aspects about this paper.
First, it addresses a relevant and currently *hot* topic in the ubiquitous research domain.
In particular, the authors focus on revealing and understanding the connection between user mobility and mobile app usage.
The paper is well written and is easy to follow / understand.
The steps outlined in this work are all sound, reasonable, and backed up with arguments.
The evaluation is based on a large data set.

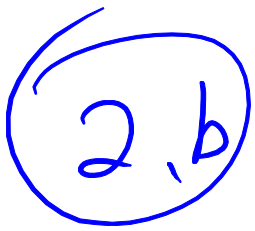
Beside a few minor comments, which are listed below, there are two major concerns with this work.

1. Motivation for how the results of this work can be used and their generalization.

The authors present correlations between user movement speed and other features such as number of applications used, traffic volume, idle time, etc.
The authors motivate such findings with: “Understanding such correlations, if any, could provide useful contextual information for relevant and accurate app recommendation and ad delivery. For example, if we find out hiking hobbyists use certain apps considerably more often, then such apps may be more useful venues for ad delivery for equipment makers for hiking activities.”

However, from the findings presented in this work I only see that Fig16 supports the aforementioned motivation by providing insights about the correlation between movement speed and app categories.
Providing stronger / additional arguments why all the other observations are relevant would help the authors to increase the value of this work.

Furthermore, as mentioned in the paper (however, only once I guess), the traces used for this work cover cellular communication only.
As the authors have pointed out, part of the communication might be handled over Wi-Fi.
In recent studies, authors have observed that over 60% of the time users are connected to Wi-Fi [1] and that half of the traffic is typically handled over Wi-Fi [2].



So the important question at this point is: how representative are the results presented in this work given the fact that they consider cellular app usage and traffic only?

2. My second concern is about the performance in estimating movement speed that has a direct influence on the results presented in this work.

To estimate intra-cell speed, the authors propose a novel algorithm that is based on a set of assumptions such as that users move with a constant speed (4.1) or with a “straight line trajectory” (4.3).
The resulting computation of the movement speed is therefore a direct consequence of the aforementioned assumptions and the introduced

approach.
Therefore, the results presented in this work rely on the quality of this computation.

The results presented in this work show a positive correlation (Fig10a) between movement speed and traffic volume / sec. as well as a negative correlation (Fig10b) between the idle time and speed.
The conclusion is that the faster a user passes a given cell, the more bytes/s she will generate and the smaller the idle time intervals are.
So to make sure that these insights indeed cover a valid collection between movement speed and other features, it is mandatory to show that the aforementioned assumptions hold, in general, and the movement speed estimation is accurate, to some extent, allowing to make conclusions from the experiments.

Addressing this shortcoming might for instance include an evaluation of the approach on a data set that contains GPS and cellular data.
There are several publicly available data sets that might be helpful at this stage (reality mining, nokia, lifemap, etc.).
Alternatively, running a small custom study to verify the assumptions and get quantitative evidence that movement speed estimations are accurate, might also be an option.

Without showing that the novel approach presented in this work to compute movement speed produces reliable estimates, it is at least possible that to some extent the insights presented in this work result from the inaccurate movement speed estimations.

Minor comments:
— Please try to put Figs and Listings on the same page as the text which refers to them

— Inconsistent writing of PBE in Sec 4.1 and Sec 4.2

— Potential naming (variables) inconsistencies between Alg1 and Sec 4.2

— Fig10a y-axis label: is it not supposed to be “bytes/sec” as explained in the corresponding section?

— Sec 5.3: how do you define “a data access”. is it a single CDR in the data set?

— What is the overall value / take-home message of Fig11 and Fig12? Is it not better to have relative values if the number of instances differ?

— Fig14 and Fig15 should be a bit smaller to match the font size of the text

Refs:

[1] Kyunghan Lee,Joohyun Lee,Yung Yi,Injong Rhee, and Song Chong. 2013. Mobile Data Offloading: How Much can WiFi Deliver?
IEEE/ACM Transactions On Networking 21, 2 (2013), 536–551.

[2] Paul Baumann and Silvia Santini. 2014. How the availability of Wi-Fi connections influences the use of mobile devices. In Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing Adjunct Publication - UbiComp '14 Adjunct. (2014), 367–372.

Recommendation(s) to 1AE

Major revisions (enumerated in a subsequent field) are required for this to be publishable in IMWUT

Major / minor revisions (recommendation to 1AE)

1. The authors should demonstrate that their approach to estimate intra-cell movement speed is accurate and therefore can be reliable used for the correlation analysis.

2. The authors should discuss or demonstrate the implications of considering cellular traffic only on the results presented in this work.

Confidence in the review

Very confident - I am knowledgeable in the area

---------- Submission 1668, Review 4 ----------

Title: Inferring Correlation between User Mobility and App Usage in Massive Coarse-grained Data Traces

Contribution to IMWUT

This paper presents an analysis of the correlation between user mobility (specifically speed) and usage of mobile applications. The contribution lies in the insights presented into this correlation (users travelling faster use more apps/data) and in the approach the authors have developed for estimating speed.

Review

This is a very well written paper in which the authors clearly present their work. While there has clearly been a significant amount of effort that has gone into the paper I do not believe that it is ready for publication in its current form because:

- the use case presented (that of targeted advertising) needs evidencing or reframing. There are many ways to target user interests and it is not obvious that an approach based on speed is appropriate. If there is no evidence to support the use of speed in targeted adverts then I would have preferred to have seen the approach based as a generic analysis with a range of possible applications being suggested.

- clearly the data captured is only part of a user's overall data consumption. This point is made in the paper but should be made more explicitly at the start.

- the length of the data trace (3 hours) seems short - it would be good to explain why the authors feel this is an appropriate amount of data to analyse.

- the speed estimation approach contains a very large number of assumptions and there is no evidence presented that it actually works. This is the biggest weakness in the paper - it *must* provide some evidence of success. Even a simple study with 20 users where ground truth and cell records were collected would be sufficient. Without that there is simply not enough to convince the reader that the algorithm presented works.

- the analysis would be much stronger if it was backed up with some evidence (e.g. a survey or a focus group or some observations studies) that trued to explain the patterns seen.

Recommendation(s) to 1AE

Major revisions (enumerated in a subsequent field) are required for this to be publishable in IMWUT

Major / minor revisions (recommendation to 1AE)

see above.

Confidence in the review

Very confident - I am knowledgeable in the area