

# Deriving Connectivity and Application Usage Patterns From Longitudinal Mobile Phone Usage Data

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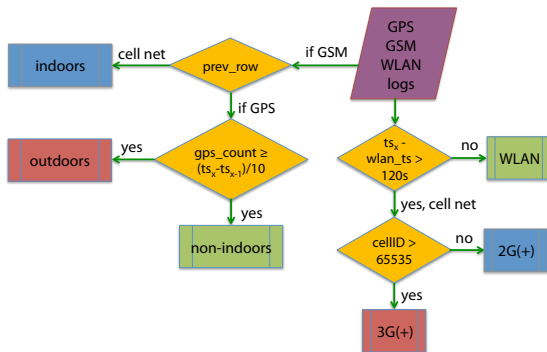
## Overview

The MDC data analysis carried out focuses mainly on the mobile users' Application Usage in context of their wireless access network Connectivity and Mobility patterns, as these patterns relate to the Quality of Service (QoS) provided to the user, and the overall Quality of Experience (QoE).

The analysis was focused only on applications, which are network-dependent and make use of online application data exchange, with distinctive traffic models, like:

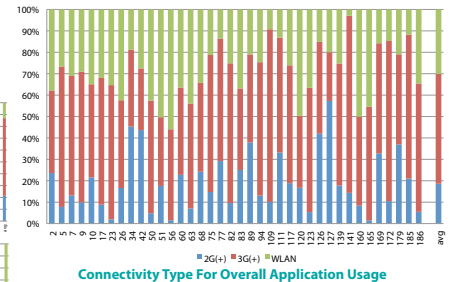
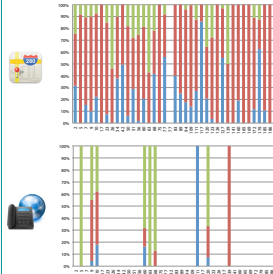


The main algorithm used GPS, GSM, WLAN and Application MDC logs' data.



## Connectivity vs. Applications

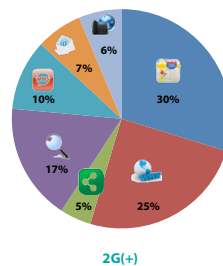
Wireless access network types:  
 • Cellular  
 2G (+): GPRS, EDGE  
 3G (+): UMTS, CDMA, HSPA  
 • WLAN



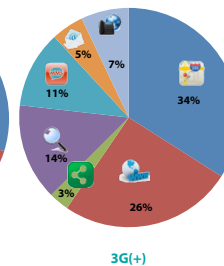
Connectivity Type For Overall Application Usage

- 70% of the time using cellular network: 2G(+) - 19 %, 3G(+) - 51 %
- When on cellular network, 80%+ applications used are *Maps*, *Web*, *Search* and *MMS*
- Certain application types' activity is highly influenced by the user's connectivity type, like:
  - *Maps* over 2G(+)/3G(+)
  - *VoIP* over WLAN (but used by only 9/38 users)

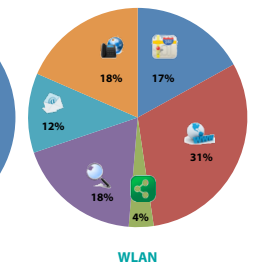
Connectivity Type For Maps and VoIP



2G(+)



3G(+)



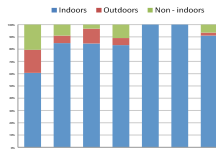
WLAN

Application Usage Per Connectivity Type

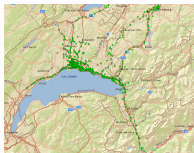
## Locations (indoors/outdoors) and Semantic Places

Location status types: indoors, outdoors, non-indoors

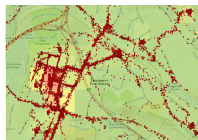
Users are indoors on average 96% for the overall application usage.



S009: Location Type per Application

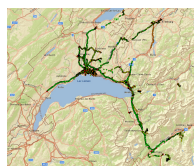


S002: CellIDs mapped on GPS

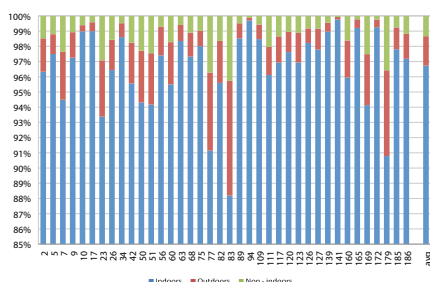


S002: GPS points density clusters

Additional analysis based on the GPS speed information, contributed in extracting useful semantic locations' information.



S002: GPS Speed Visualization

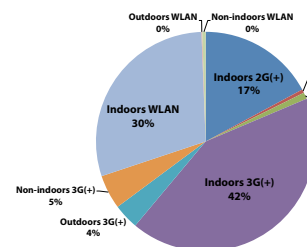


Location Type For Overall Application Usage

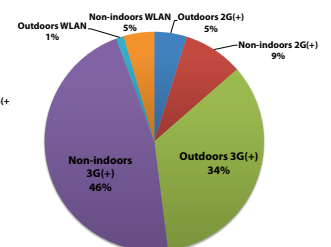
## Connectivity vs. Location

The application usage was correlated with the user connectivity, as well as with the current location status.

- When outdoors, mainly the 3G(+) network type is used
- When indoors, mainly the WLAN network type is used



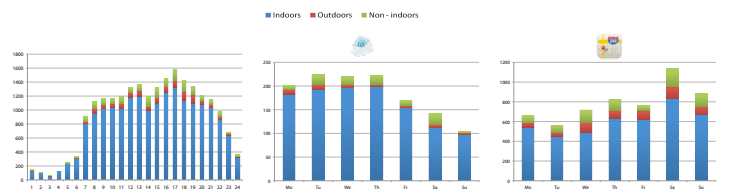
Connectivity Type vs. Location Type



Connectivity Type vs. Location Type, indoors omitted

## Applications Usage in Time

There are no significant differences per application type and location status. Users seem to be more active during work hours, with an exception of early afternoon. Different types of applications show different temporal activity pattern., e.g. *E-mail* vs. *Maps*.



Hour of a Day For Overall Application Usage

Email and Maps Applications Usage in a Week

