Data Collection for Transport Modeling

Initial Points

- Models can’t be better than the data they are based on
- Advanced model require more and of higher resolution data
- Data are costly, time and budget constraint may limit the ability to gather data needed
- Advanced in data collecting methodologies contribute to improve data

What do we need to know?

Data Collection

- Land use
- Demographic\ socio-economic
  - Population
  - Employment
- Transportation system
  - Networks
  - Capacity and service levels
- Travel characteristics\ behavior
  - Travel habits survey

Data Collection (Continue)

- Other Surveys
  - Traffic counts
  - Origin-destination surveys
    - On board (busses)
    - belt \ license label surveys
- Designated Surveys
  - Stated preferences surveys

Data Collection

- **Survey design**
- **Mobile survey instrument:**

  Questionnaire

  Computer-aided telephone interview

  Internet-based surveys/Graphic user interface

  GPS

  Smart app.
- **New cellular data for model validations**

Issues in Data Collection

- Sample size/clustering
- Questionnaire design (phrasing of questions)
- Panel surveys
- Revealed/Stated preference surveys
- Efficient use of different source of data

➢ Maximize use of existing data

Problems in Travel Diaries

- Under reporting of NHB trips
  - especially in off peak hours – up to 50%
- A high rate of uncompleted tours (about 17%)
- Difficulty in identifying HH members joint trips
  - above 60% inconsistent
- Partial accuracy of addresses and time report

  Above 20% unidentified addresses

  In accuracy of report of time

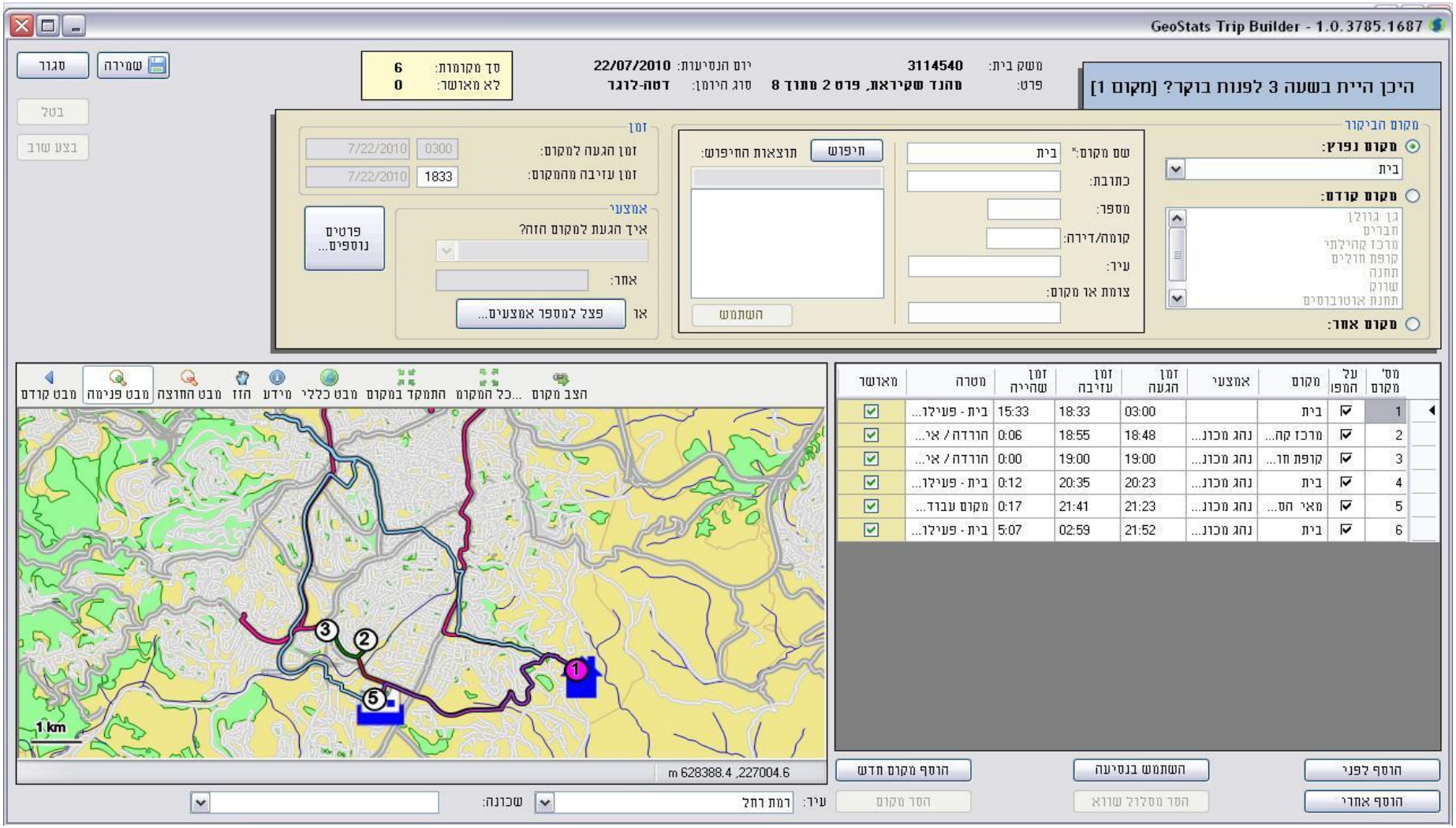
Main Reasons for these Problems

- Memory
- Getting tired: interviewer and interviewee
- Interviewee define trips
  - May ignore drop off child, small shopping on the way, etc…
- Tremendous amount of work and assumptions is needed to edit these data

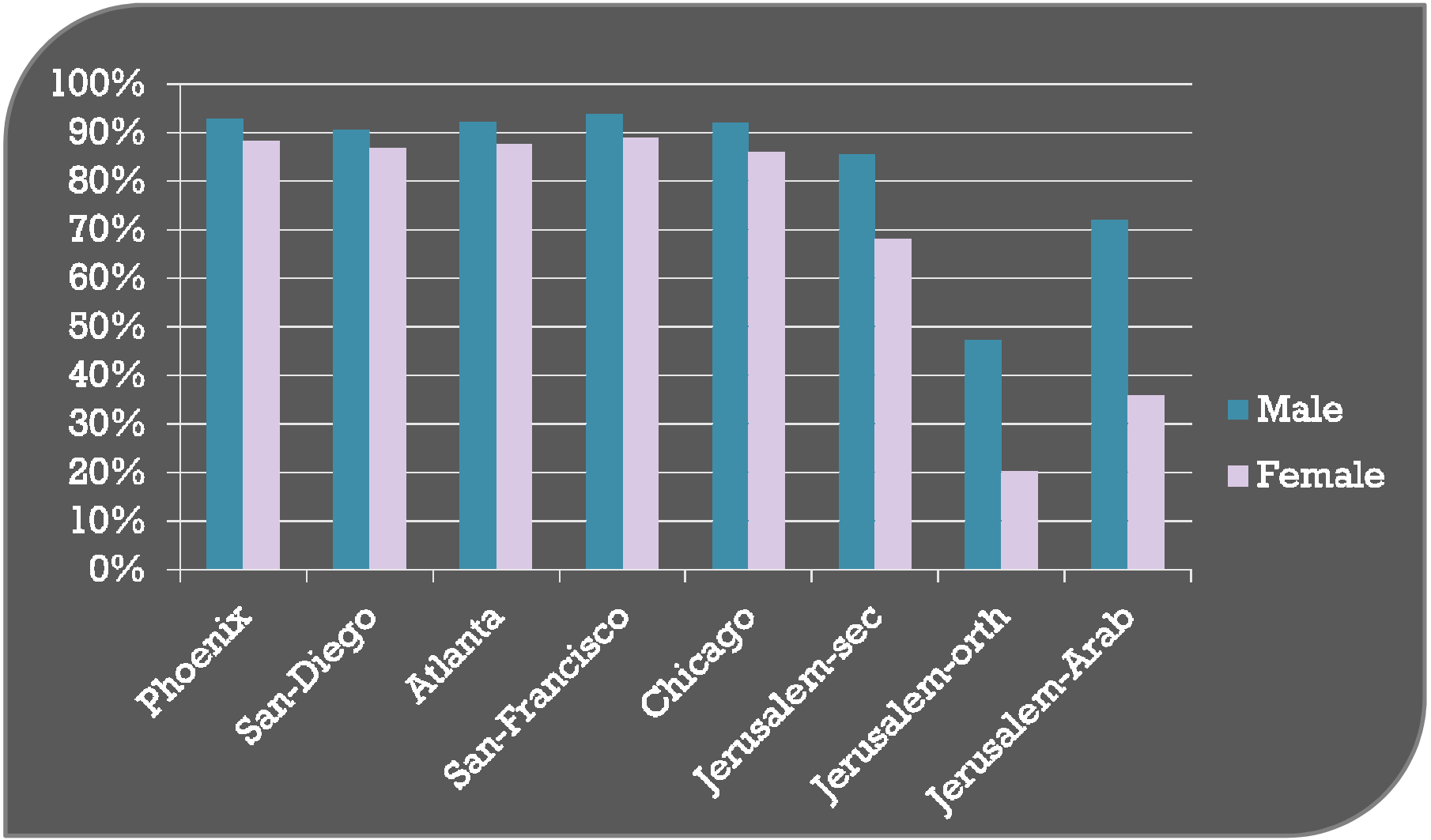
- GPS
- Trip builder software

- 24 hours
- All household members
- SP elements
  - New modes, congestion pricing, parking policy

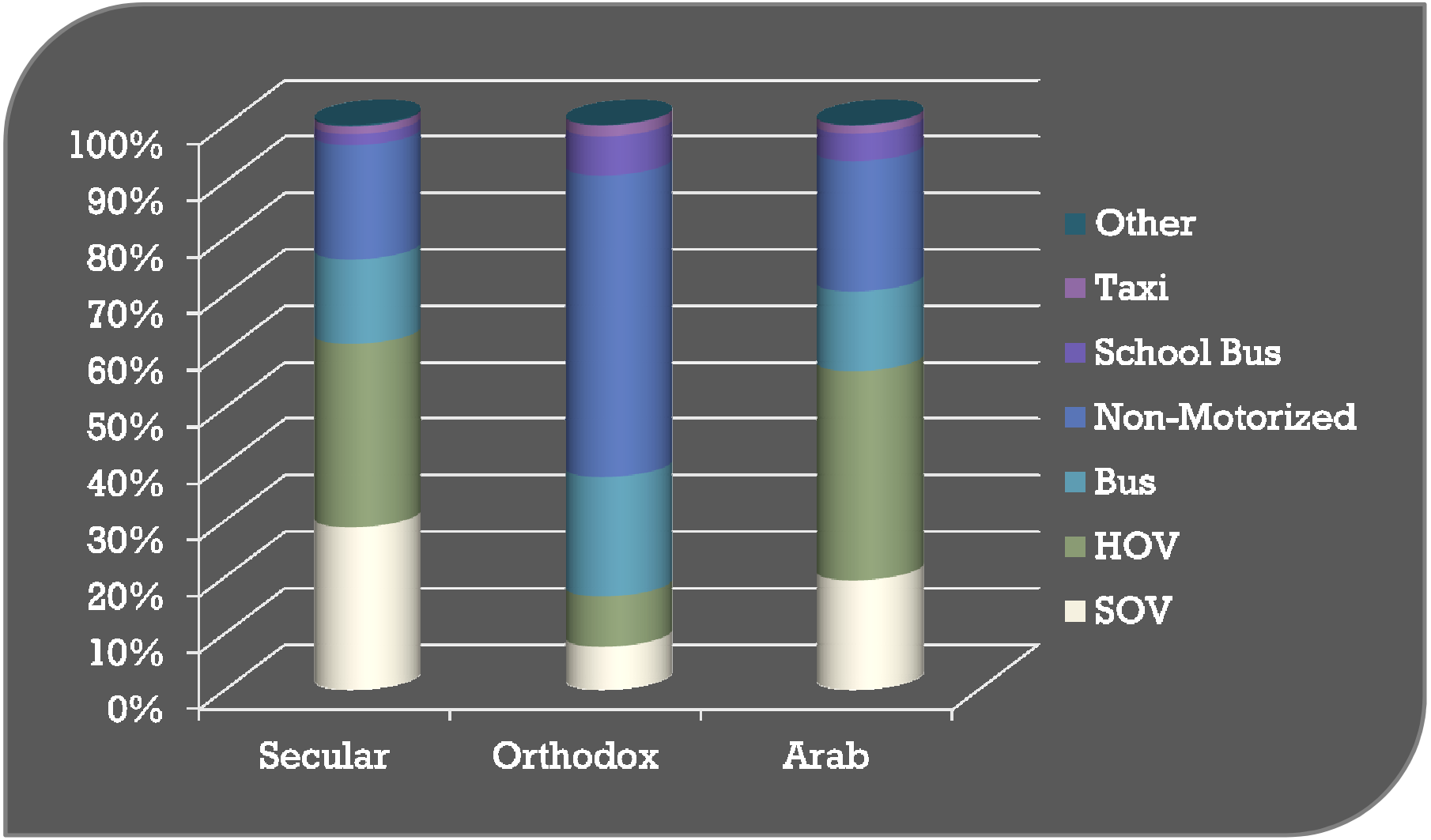
Trip Builder



Three Distinctive Segments in Jerusalem – Driver License Holding



Mode Choice by Segment



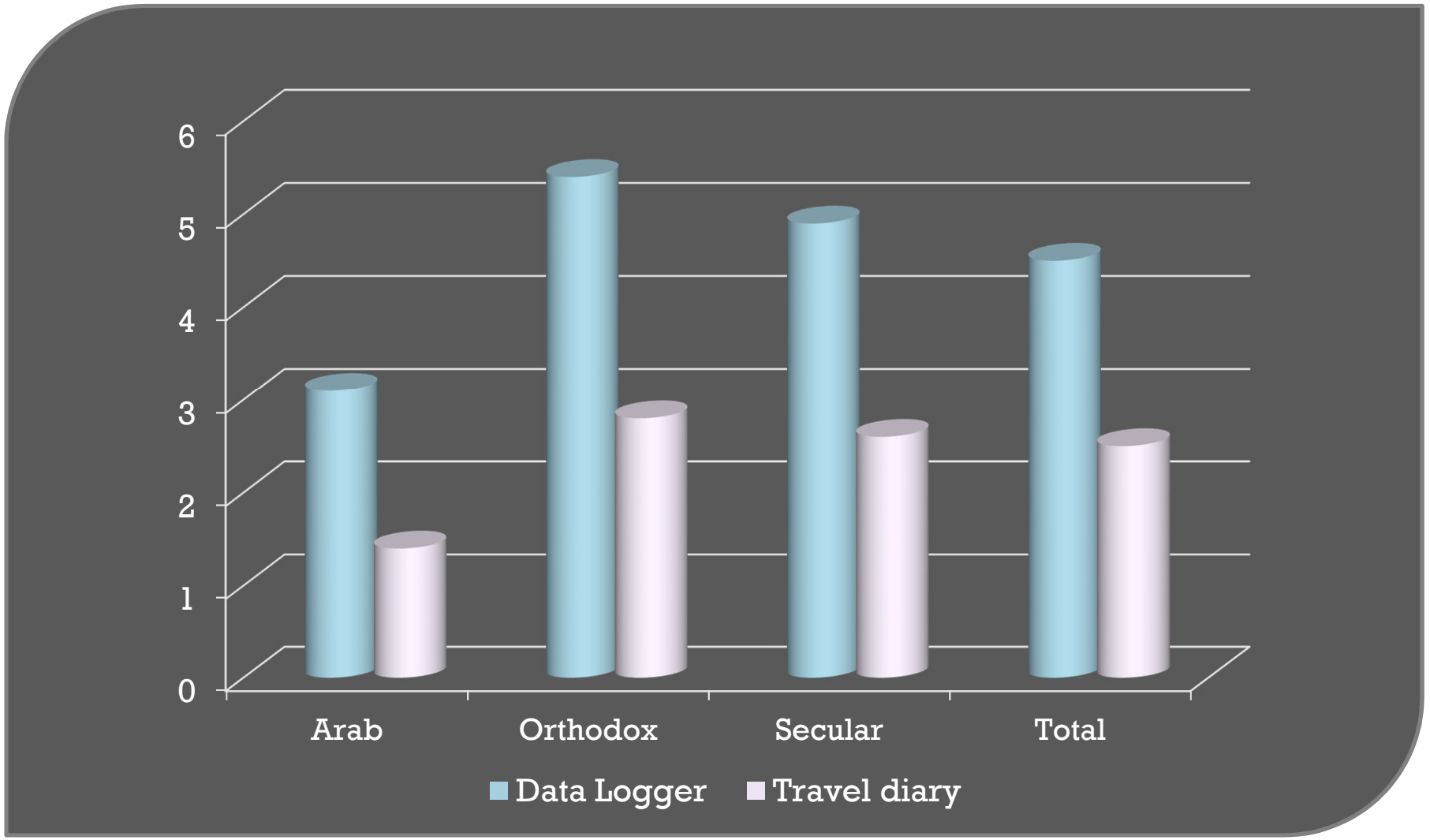
Willingness to use the Data Logger

Sector	Occupation	Cars	Perc.
Arab	employed	0	94.7%
		1+	95.2%
	unemployed	0	92.7%
		1+	92.9%
	student	0	94.4%
		1+	94.6%
Orthodox	employed	0	81.8%
		1+	89.2%
	unemployed	0	72.8%
		1+	81.7%
	student	0	70.1%
		1+	75.0%
Secular	employed	0	90.8%
		1+	94.2%
	unemployed	0	87.1%
		1+	92.9%
	student	0	94.6%
		1+	93.2%

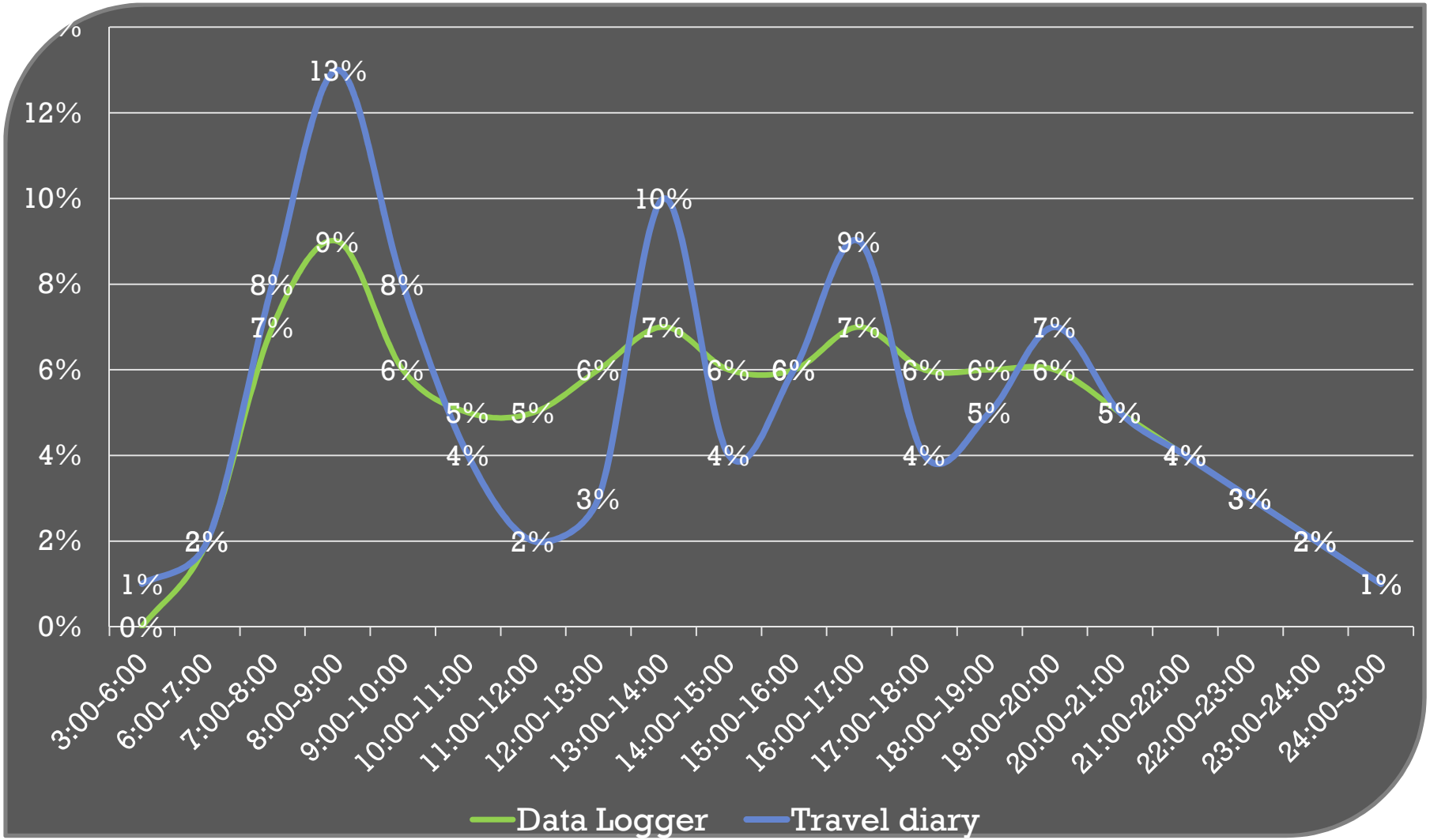
Number & Percentage of people aged 15+ who completed/didn't complete trips

Sector	Report mean	Trips	Num.	Perc.
Arab	Data Logger	0	525	33.2%
		1+	1056	66.8%
	Travel dairy	0	53	51.5%
		1+	50	48.5%
Orthodox	Data Logger	0	131	10.2%
		1+	1152	89.8%
	Travel dairy	0	79	21.2%
		1+	294	78.8%
Secular	Data Logger	0	406	12.2%
		1+	2916	87.8%
	Travel dairy	0	76	28.6%
		1+	190	71.4%
Total	Data Logger	0	1062	17.2%
		1+	5124	82.8%
	Travel dairy	0	208	28.0%
		1+	534	72.0%

Mean number of trips per interviewee aged 15+ for all trip types



Trip distribution from the two measuring modes among ages 15+

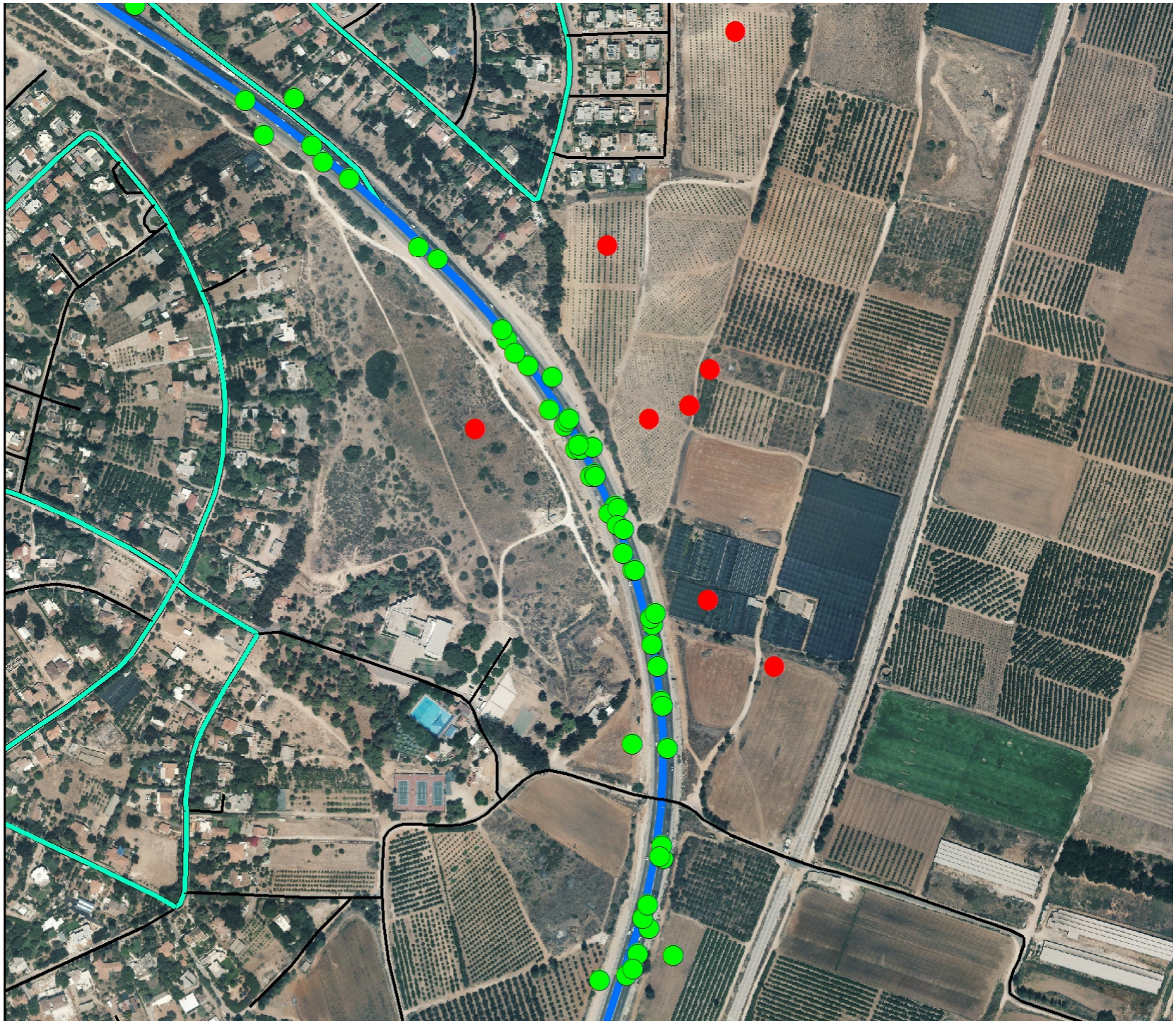


Electronic Driver Assistant

- Installed in the vehicle
- Collects information:
  - Location
  - Speed
  - Acceleration
- Events

IVDR Instrumentation package (Ogle, 2005)

ארועי מה
מעל 100 י
לפי מרחק מ



ארוע רחוק מהכבישי

ארועים קרובי

דרך אזורי

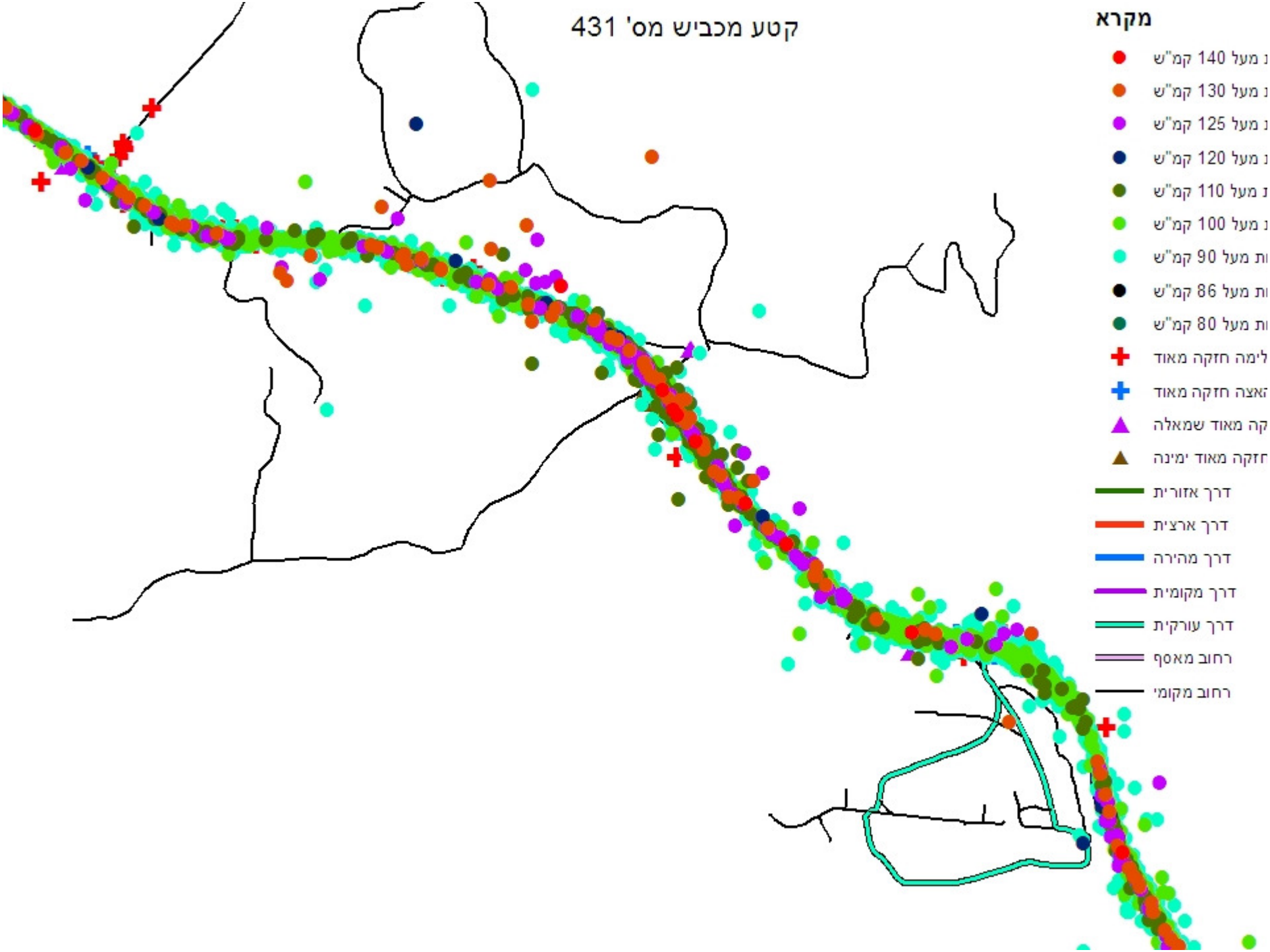
דרך ארצי

דרך מהיר

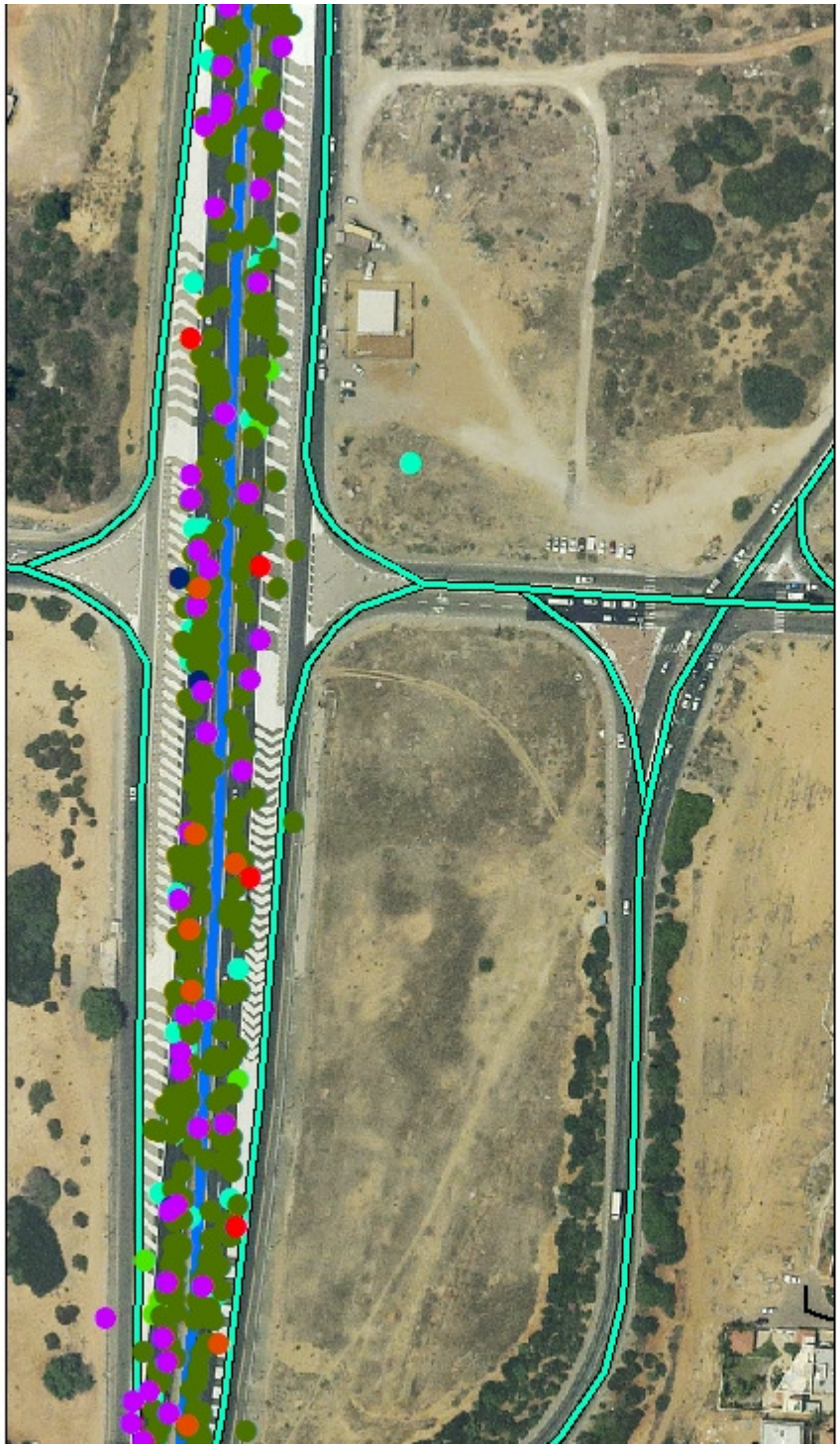
דרך מקומי

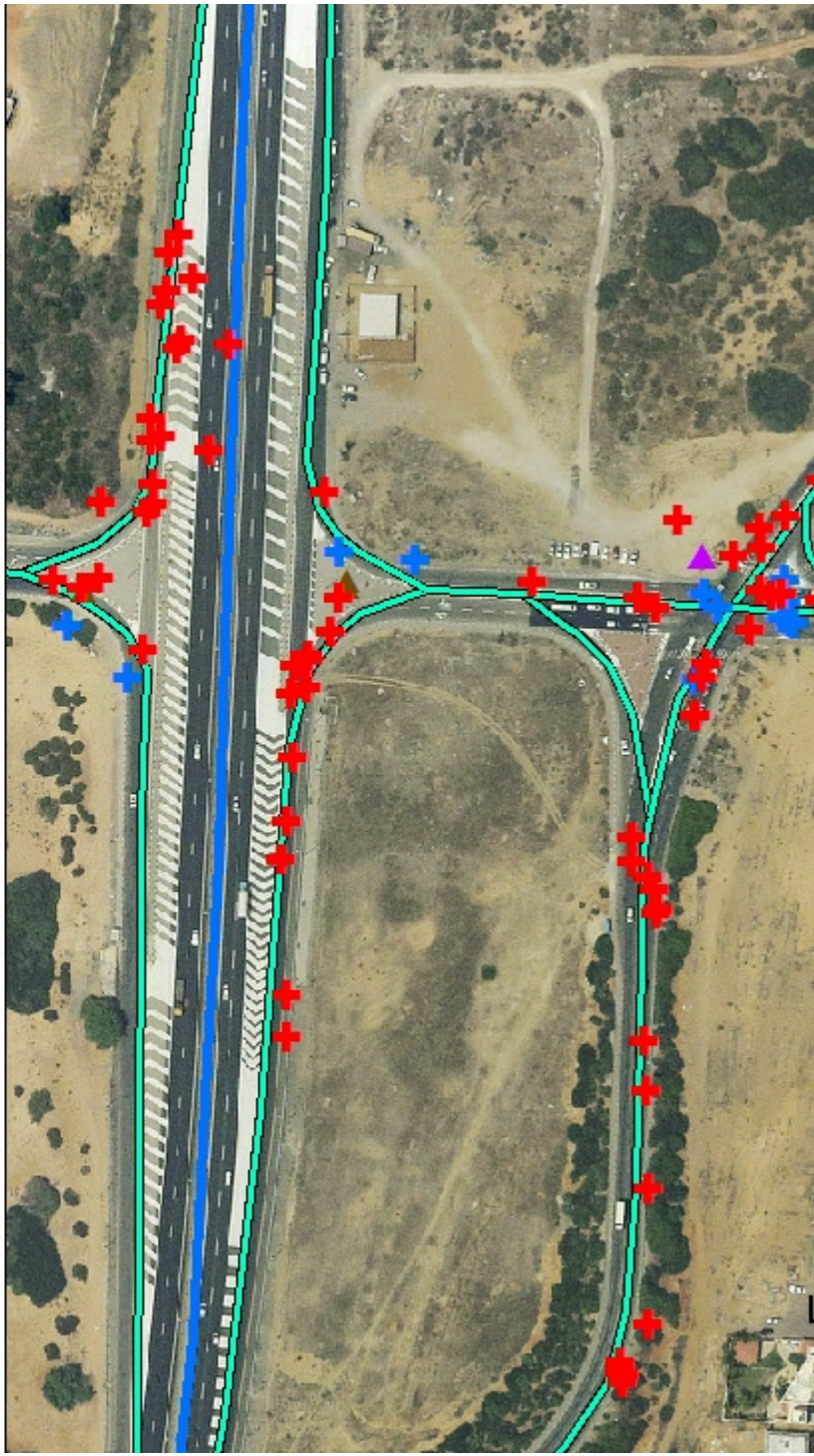
דרך עורקי

רחוב מאס


קטע מכביש מס' 431
מקרא
מעל 140 קמ"ש
מעל 130 קמ"ש
מעל 125 קמ"ש
מעל 120 קמ"ש
מעל 110 קמ"ש
מעל 100 קמ"ש
מעל 90 קמ"ש
מעל 86 קמ"ש
מעל 80 קמ"ש
לימה חזקה מאוד
אצה חזקה מאוד
קה מאוד שמאלה
חזקה מאוד ימינה
דרך אזורית
דרך ארצית
דרך מהירה
דרך מקומית
דרך עורקית
רחוב מאסף
רחוב מקומי

ארועים בצומת אולגה





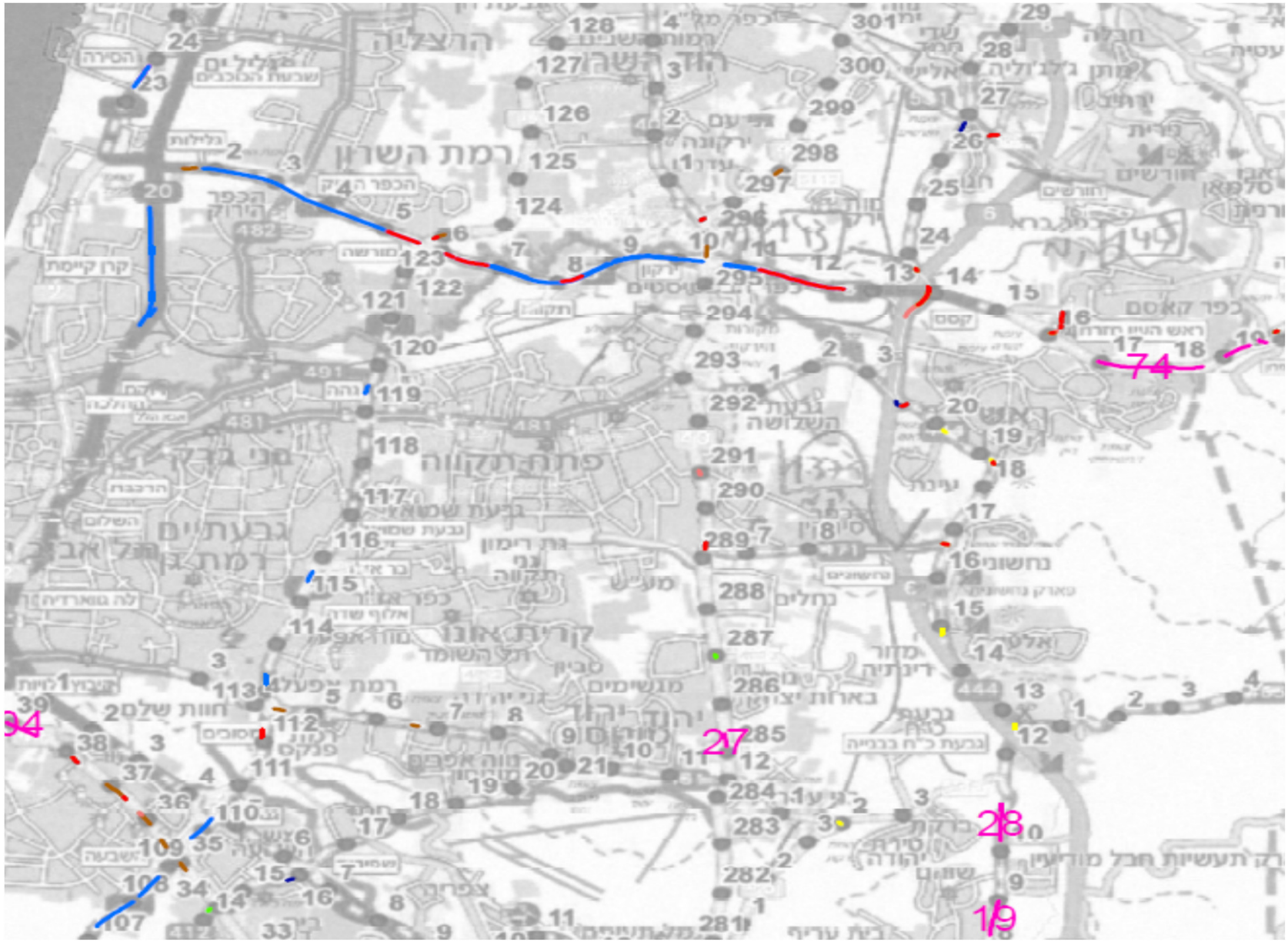
מקרא

- מהירות מעל 140 קמ"ש
- מהירות מעל 130 קמ"ש
- מהירות מעל 125 קמ"ש
- מהירות מעל 120 קמ"ש
- מהירות מעל 110 קמ"ש
- מהירות מעל 100 קמ"ש
- מהירות מעל 90 קמ"ש
- מהירות מעל 86 קמ"ש
- מהירות מעל 80 קמ"ש
- בלימה חזקה מאוד
- האצה חזקה מאוד
- פניה חזקה מאוד שמאלה
- פניה חזקה מאוד ימינה

כבישים

- דרך אזורית
- דרך ארצית
- דרך מהירה
- דרך מקומית
- דרך עורקית
- רחוב מאסף
- רחוב מקומי

Graphical Presentation of Events on a Map



Funf in a box

- Create your own mobile sensing android app - no programming required.
- Send data to dropbox account
- Open-Source code based
- Free distribute and download
- Will be installed with the cellphone's owner approval
- can use the android built-in sensors for :
  - GPS Location (longtitude,latitude)
  - Accelerometer Sensor
  - Volume & Temperature (magnitude units)
  - Call logs & SMS logs
  - Same-time running apps
  - Entire data escorted with timestamp

- Example 1.0

  GPS location received (.csv format)

N	M	L	K	J	I	H	G	F	E	D	C	B	A
mLongitude	mLatitude	mHasSpeed	mHasBearing	mHasAltitude	mHasAccuracy	mExtras_netw	mExtras_netwo	mBearing	mAltitude	mAccuracy	timestamp	device	id
34.8182822	32.0638976	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	5	1373132348.58	ca214ead-	dbb7915d-
34.816159	32.0640857	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	12	1373134709.11	ca214ead-	dbb7915d-
34.8182822	32.0638976	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	22	1373135007.47	ca214ead-	dbb7915d-
34.861423	32.0761487	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	50	1373103550.83	ca214ead-	3ab6094f-
34.8337924	32.0582061	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	63	1373121547.03	ca214ead-	cb4f488b-(
34.8182822	32.0638976	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	100	1373138816.88	ca214ead-	ac6048d3-
34.8697739	31.919314	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	54	1373114350.00	ca214ead-	d75be4b0-
34.9656813	31.9471277	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	43	1373107146.97	ca214ead-	59a286d7-
34.813761	32.0088661	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	123	1373117950.08	ca214ead-	92588536-(
34.8200974	32.0633203	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	4	1373128747.36	ca214ead-	a51e4b71-
34.8191849	32.0638215	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	4	1373099051.27	ca214ead-	08ae55af-(
34.8188848	32.0638454	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	5	1373142415.74	ca214ead-	2beac491-
34.9670066	31.9465526	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	7	1373110746.89	ca214ead-	a1d5a4fd-2
34.8607667	32.0759983	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	8	1373125147.05	ca214ead-	620d08a6-
34.8182841	32.063897	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	9	1373095450.40	ca214ead-	4b3d64b7-
34.818446	32.0636843	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	19	1373099947.56	ca214ead-	c71d4da3-
34.8182822	32.0638976	FALSE	FALSE	FALSE	TRUE	cell	cached	0	0	19	1373135216.00	ca214ead-	bec0d577-

id – user's mobile ID

timestamp – UNIX coded time (date and exact time)

mLatitude\mLongtitue – geographical coordinates in decimal degrees.

mAccuracy – GPS Sample accuracy.

Example 2.0

Call log data

L	K	J	I	H	G	F	E	D	C	B	A
type	timestamp	numbertyp	numberlab	number	name	duration	date	_id	timestamp	device	id
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	6	1.37E+12	3387	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	98	1.37E+12	3386	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	114	1.37E+12	3385	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	147	1.37E+12	3384	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3383	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	301	1.37E+12	3382	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	76	1.37E+12	3381	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3380	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3379	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3378	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	97	1.37E+12	3377	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3376	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	154	1.37E+12	3375	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	120	1.37E+12	3374	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3373	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	160	1.37E+12	3372	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	130	1.37E+12	3371	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	110	1.37E+12	3370	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	2	1.37E+12	3369	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3368	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	97	1.37E+12	3367	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	27	1.37E+12	3366	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	0	1.37E+12	3365	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	58	1.37E+12	3364	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	114	1.37E+12	3363	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	5	1.37E+12	3362	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	621	1.37E+12	3361	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	107	1.37E+12	3360	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	29	1.37E+12	3359	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	24	1.37E+12	3358	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	51	1.37E+12	3357	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	["ONE_W	["ONE_W	["ONE_W	["ONE_W	22	1.37E+12	3356	1.37E+09	5d3f54b0-(	e47e2f82-(

- type – 1,2 or 3 for incoming,outgoing,or missed call.
- duration – in seconds.

Example 3.0

Sms data Log

type	timestamp	thread_id	subject	status	service_ce	reply_path	read	protocol	person	locked	date	body	address	timestamp	device	id
2	1.37E+09	41	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	41	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	166	["ONE_W	-1	9.73E+10	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	166	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	41	["ONE_W	-1	9.73E+11	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	166	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	17	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	17	["ONE_W	-1	9.73E+11	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	17	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	17	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	17	["ONE_W	-1	9.73E+11	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	42	["ONE_W	-1	9.73E+11	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	45	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
2	1.37E+09	45	["ONE_W	-1		FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(
1	1.37E+09	164	["ONE_W	-1	9.73E+10	FALSE	TRUE	0	["ONE_W	FALSE	1.37E+12	["ONE_W	["ONE_W	1.37E+09	5d3f54b0-(	e47e2f82-(

type – sent/read

read – true/false (stands for haven't been read yet)

Example 4.0

Same time running apps data

taskInfo_baseIntent_mComponent_m	taskInfo_baseIntent_mCom	taskInfo_baseIntent_	taskInfo_baseInt	duration	timestamp	device	id
com.android.phone	com.android.phone.InCallScreen		android.intent.act	13.776	1.37E+09	ca214ead-	dbb7915d-
com.android.phone	com.android.phone.InCallScreen		android.intent.act	1.703	1.37E+09	ca214ead-	dbb7915d-
com.android.phone	com.android.phone.InCallScreen		android.intent.act	2.752	1.37E+09	ca214ead-	dbb7915d-
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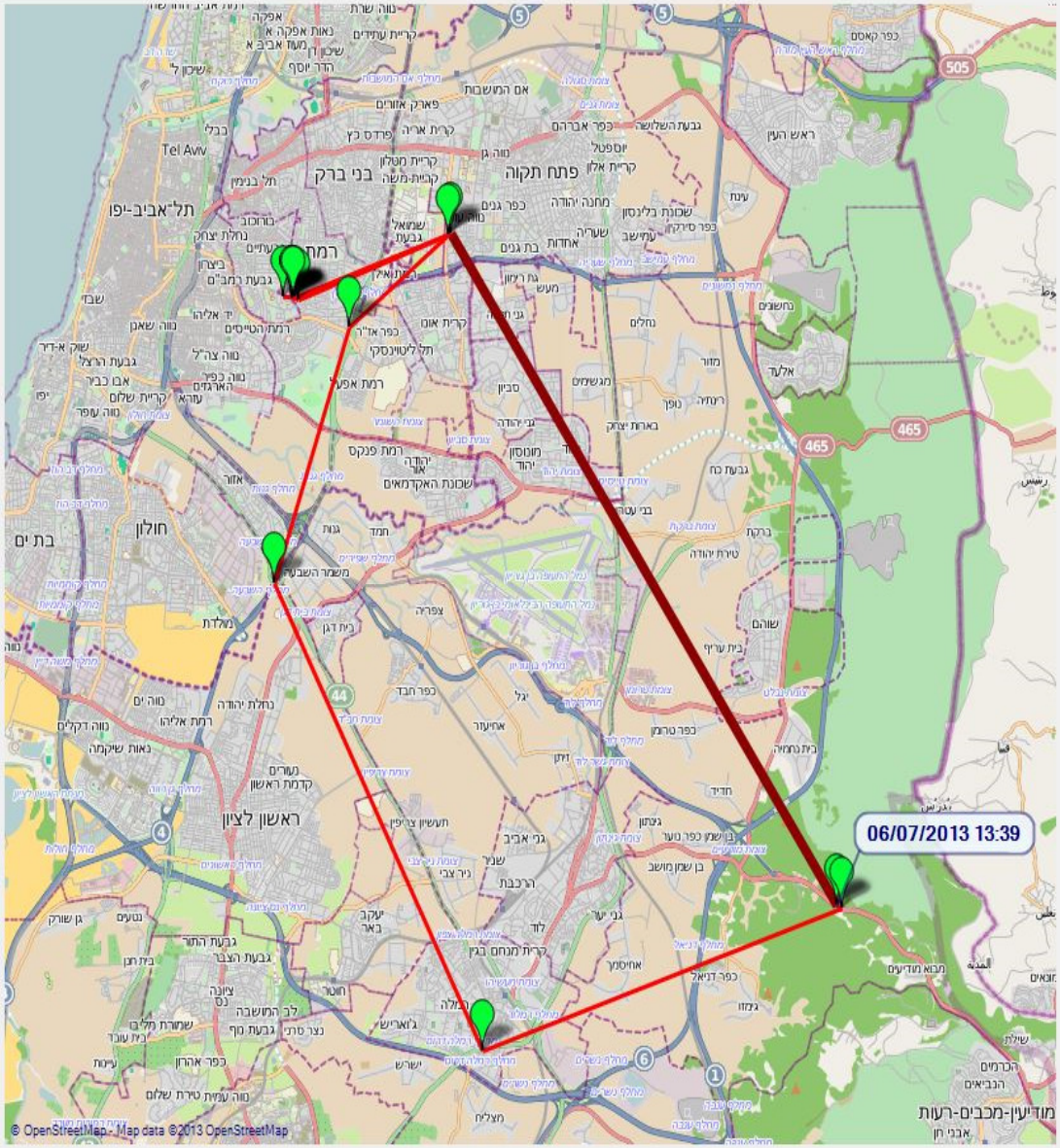
com.android.chrome	com.google.android.apps.chrome.Main		android.intent.act	28.528	1.37E+09	ca214ead-	3ab6694f-

- duration and timestamp mentioned

Technion Transportation Funf Research



Set Drivers Data

Load GPS track

load app data

load call data

load SMS data

ROADS

06/07/2013 10:24-06/07/2013 11:24
06/07/2013 11:24-06/07/2013 11:39
06/07/2013 11:39-06/07/2013 12:39
06/07/2013 12:39-06/07/2013 13:39
06/07/2013 13:39-06/07/2013 14:39
06/07/2013 14:39-06/07/2013 15:39
06/07/2013 15:39-06/07/2013 16:39
06/07/2013 16:39-06/07/2013 17:39
06/07/2013 17:39-06/07/2013 18:39
06/07/2013 18:39-06/07/2013 19:39
06/07/2013 19:39-06/07/2013 20:39
06/07/2013 20:39-06/07/2013 21:18
06/07/2013 21:18-06/07/2013 21:23
06/07/2013 21:23-06/07/2013 21:26
06/07/2013 21:26-06/07/2013 22:26
06/07/2013 22:26-06/07/2013 23:26

DRIVERS

Ron Weiner
Eldad Seter

Waze total time: 60.02

Whatsapp total time: 0.1

Youtube total time : 0

Music total time : 0

Avrage Speed: 17.4

Calls Duration: 0 for incoming calls and 0 for outgoing calls.

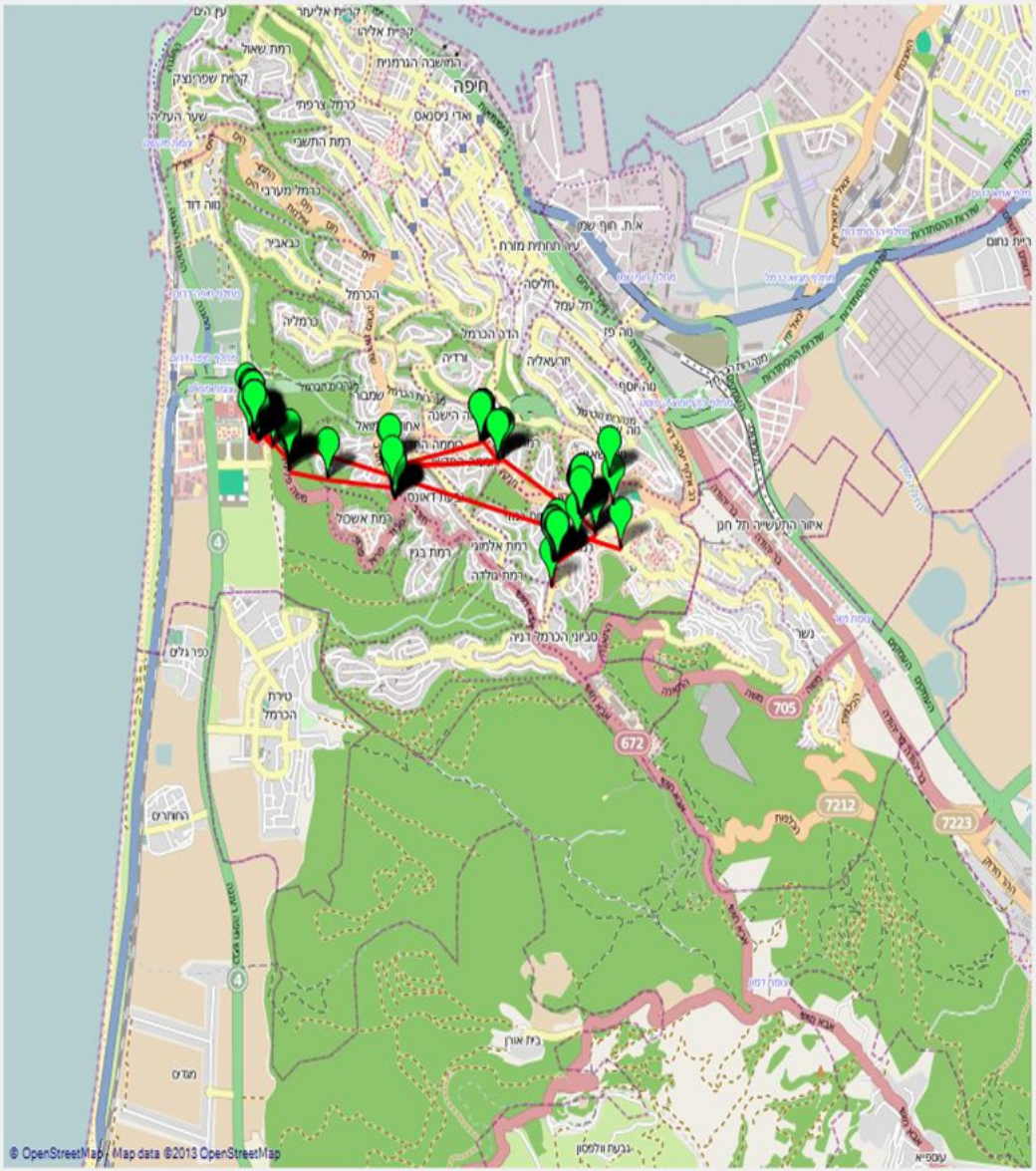
Social Activity : 0 different people, which max calls with same one is 0

SMS Texting: 0 recieved and 0 sent.

DRIVER DATES

06.07

Technion Transportation Funf Research



Set Drivers Data

Load GPS track

load app data

load call data

load SMS data

ROADS

05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:18
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05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:18
05/05/2013 21:18-05/05/2013 21:32
05/05/2013 21:32-05/05/2013 21:32
05/05/2013 21:32-05/05/2013 21:32

DRIVERS

Ron Weiner
Eldad Seter

DRIVER DATES

05.05
06.05
07.05

Waze total time: 0

Whatsapp total time: 0

Youtube total time : 0

Music total time : 0

Avrage Speed: 0.9

Calls Duration: 1.63 for incoming calls and 1.9 for outgoing calls.

Social Activity : 5 different people, which max calls with same one is 1

SMS Texting: 0 recieved and 0 sent.

Future Mobility Survey (FMS)
Developed by the MIT Singapore Project

- FMS concept

  Exploit the latest mobile and web technology to develop a new approach for activity/travel surveys

  Respondents use mobile sensory devices, e.g. smartphones, loggers

  Application is non-intrusive, light-weight and easy to use

  Prompted-recall interaction in the web-browser: the validation process

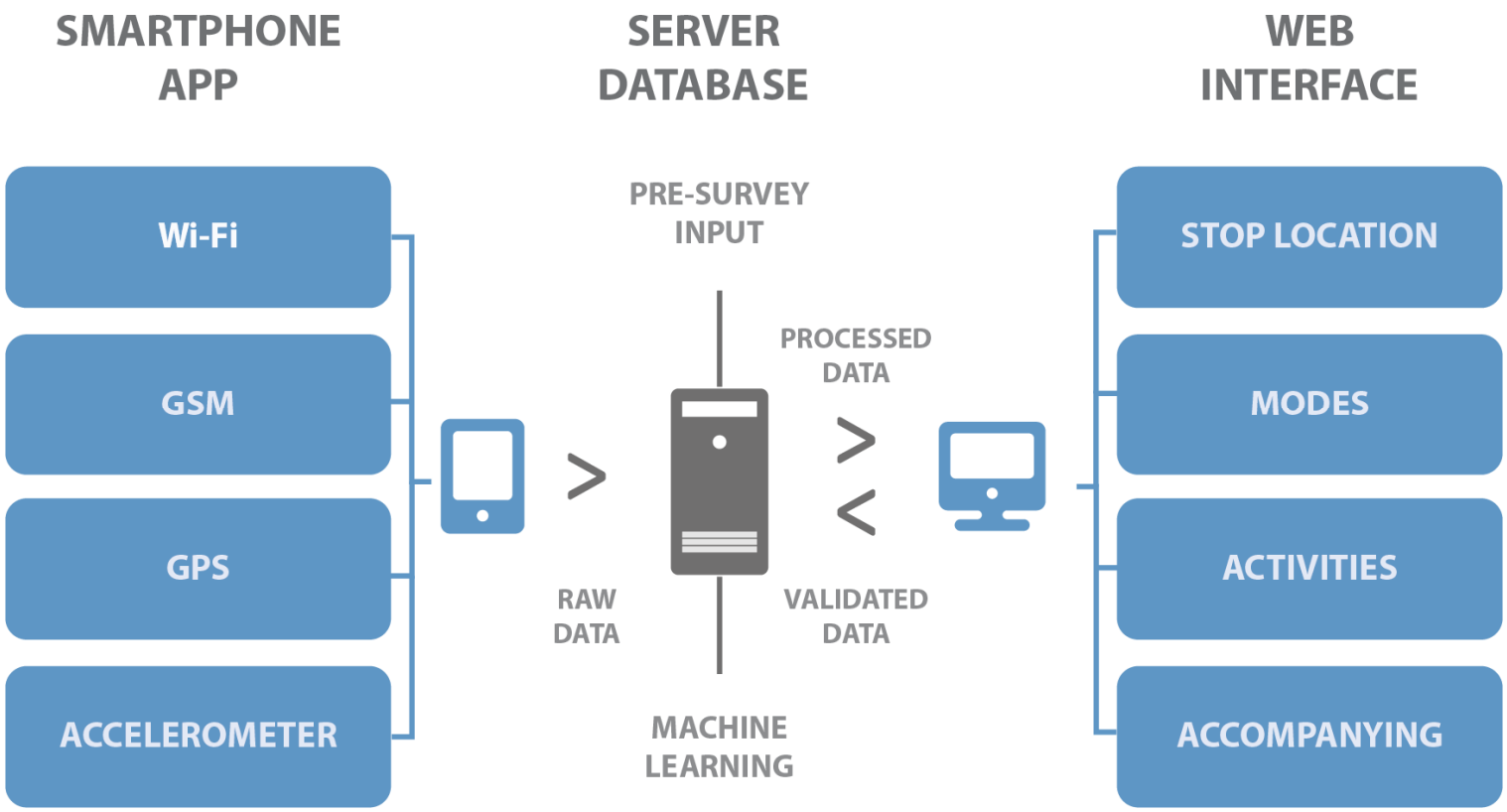
- Higher quality

  Respondents validate sensory data

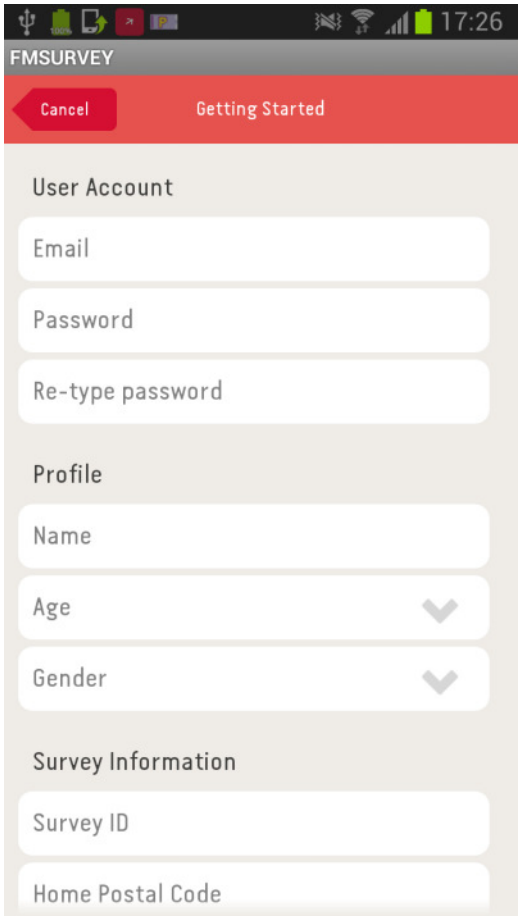
- Greater quantity

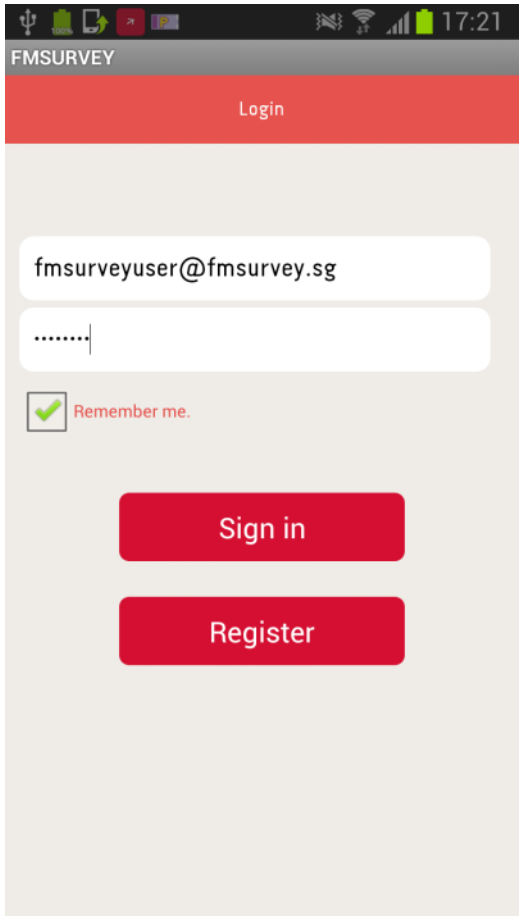
  Multi-day data collection

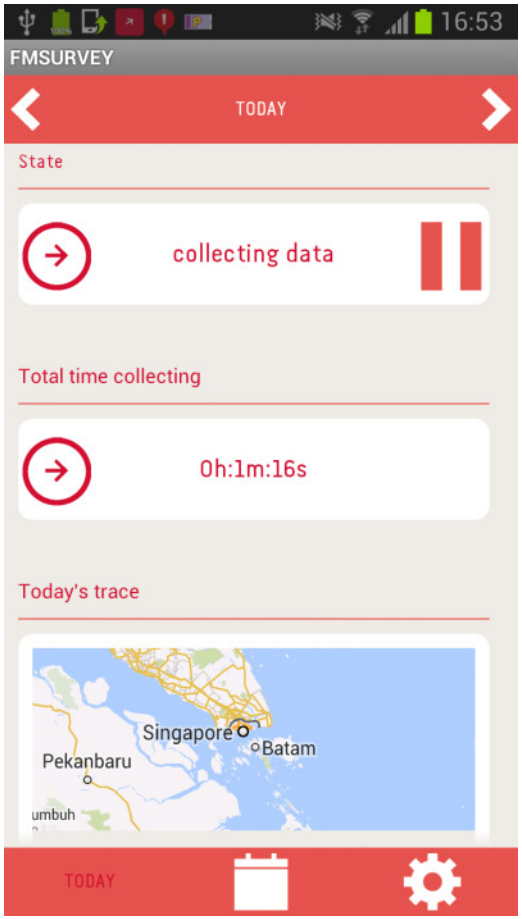
Components


SMARTPHONE APP
SERVER DATABASE
WEB INTERFACE
Wi-Fi
GSM
GPS
ACCELEROMETER
PRE-SURVEY INPUT
PROCESSED DATA
RAW DATA
VALIDATED DATA
MACHINE LEARNING
STOP LOCATION
MODES
ACTIVITIES
ACCOMPANYING

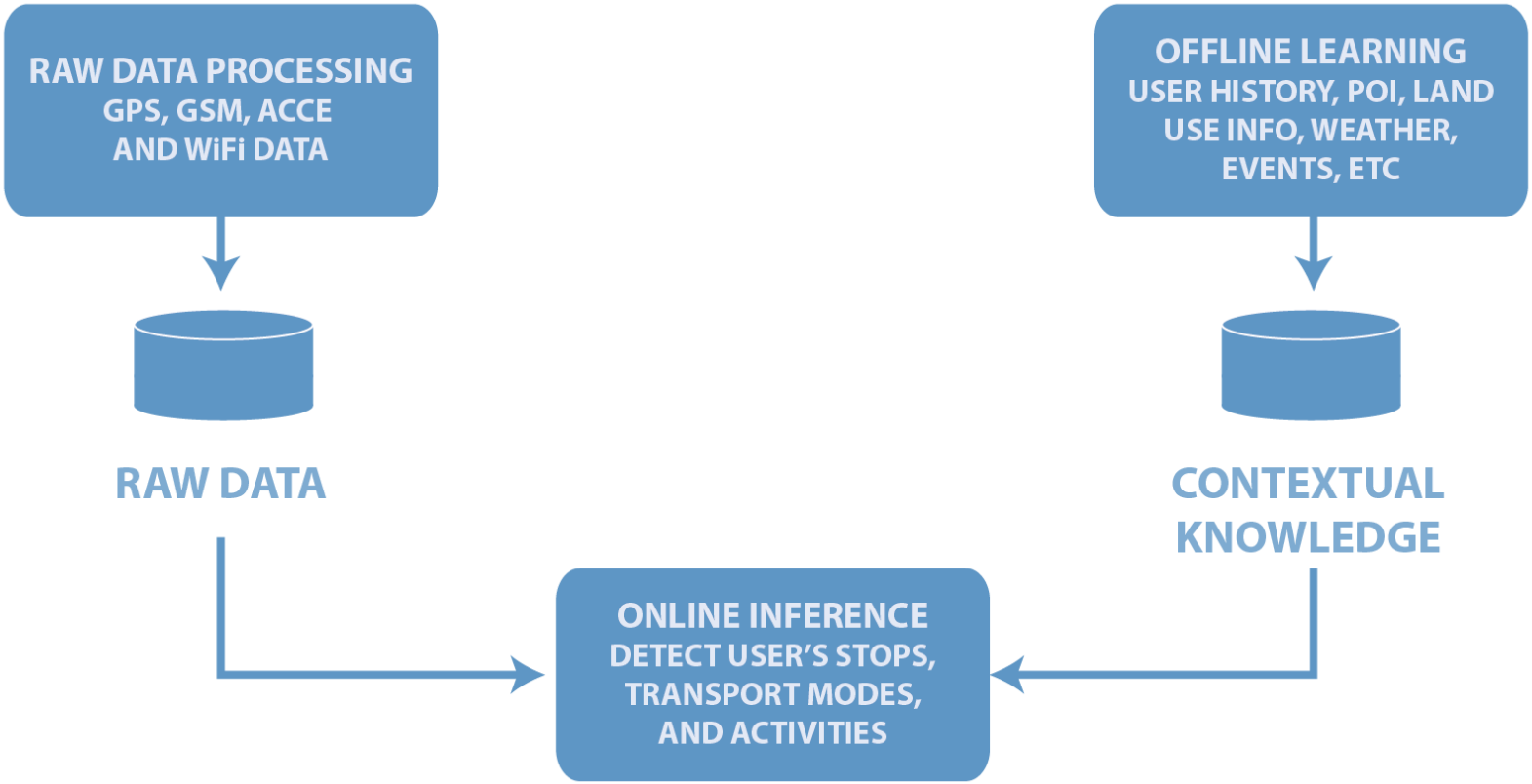
Smartphone App





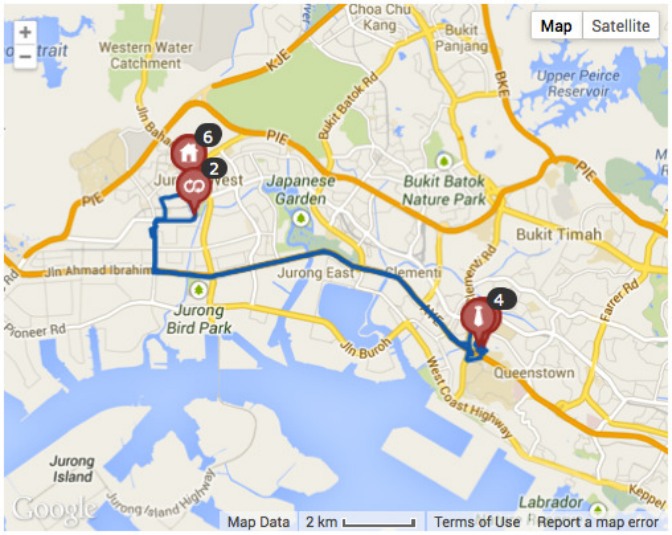


Backend Data Analysis



Web Interface - Activity/Travel Diary

Date Selection Mon, 01-04-2013



Some traces may be incorrect due to low accuracy data

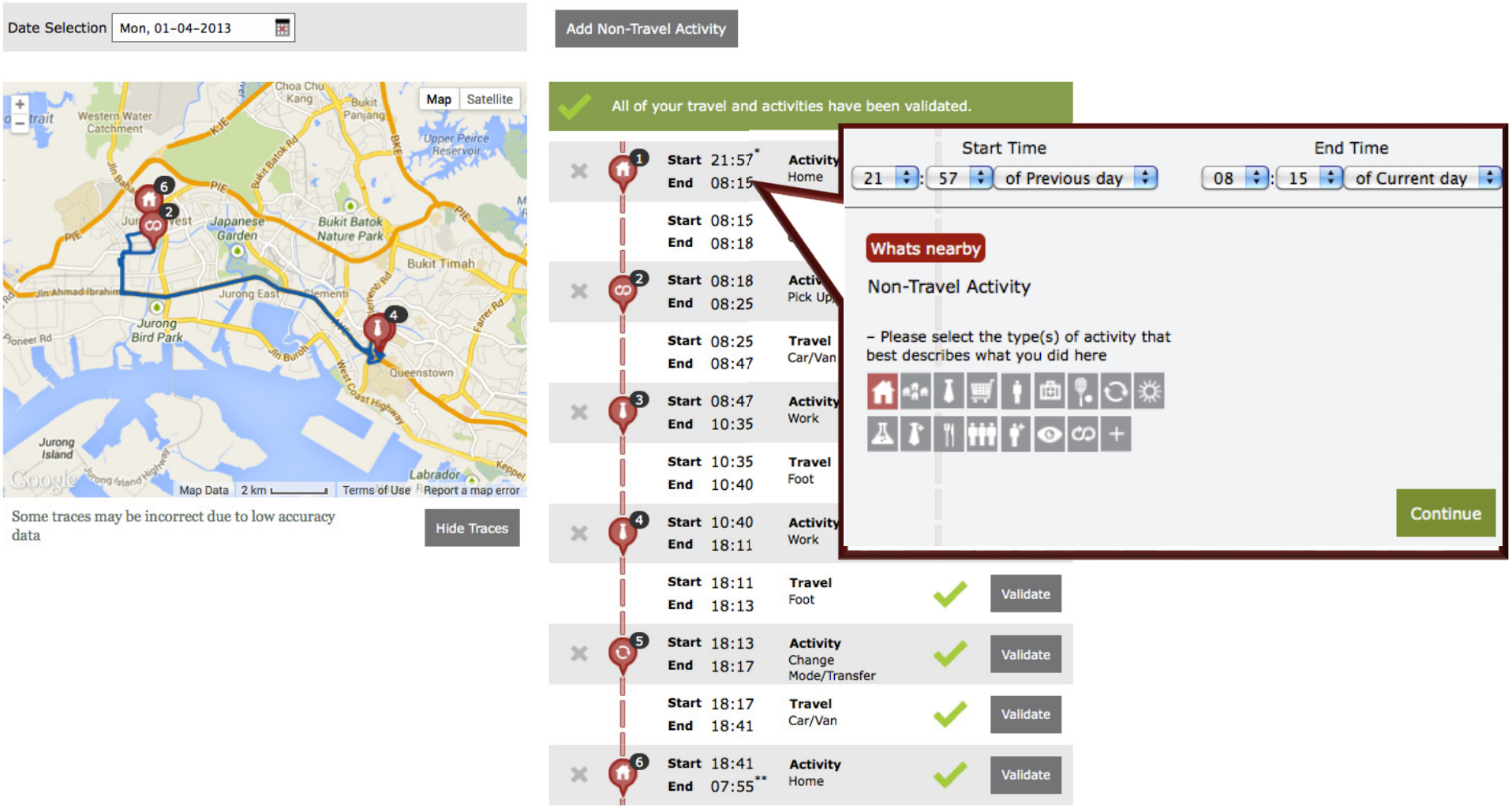
Hide Traces

Add Non-Travel Activity

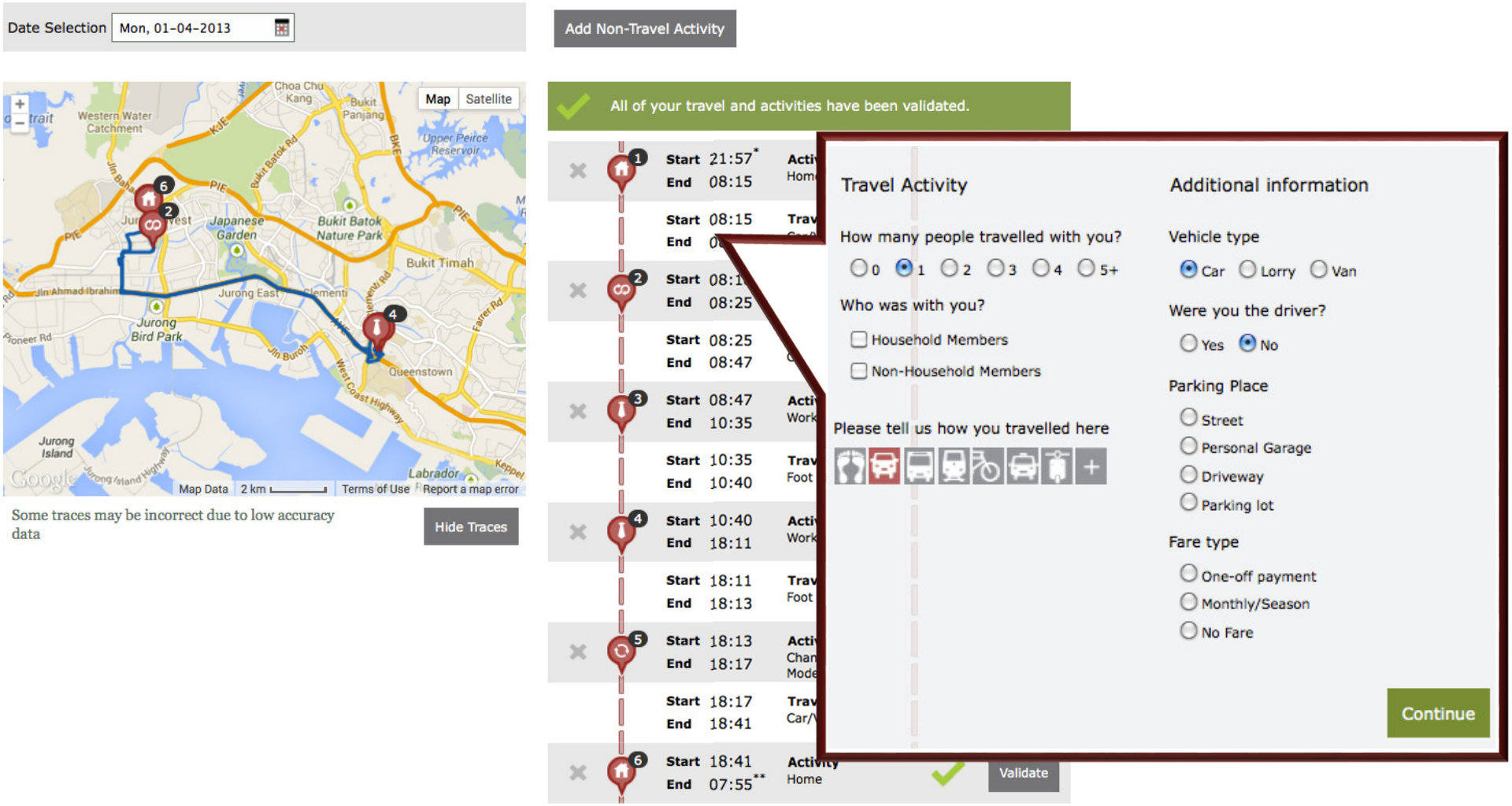
All of your travel and activities have been validated.

1	Start 21:57* End 08:15	Activity Home	✓	Validate
	Start 08:15 End 08:18	Travel Car/Van	✓	Validate
2	Start 08:18 End 08:25	Activity Pick Up/Drop Off	✓	Validate
	Start 08:25 End 08:47	Travel Car/Van	✓	Validate
3	Start 08:47 End 10:35	Activity Work	✓	Validate
	Start 10:35 End 10:40	Travel Foot	✓	Validate
4	Start 10:40 End 18:11	Activity Work	✓	Validate
	Start 18:11 End 18:13	Travel Foot	✓	Validate
5	Start 18:13 End 18:17	Activity Change Mode/Transfer	✓	Validate
	Start 18:17 End 18:41	Travel Car/Van	✓	Validate
6	Start 18:41 End 07:55**	Activity Home	✓	Validate

Web Interface - Activity Details



Web Interface - Travel Details



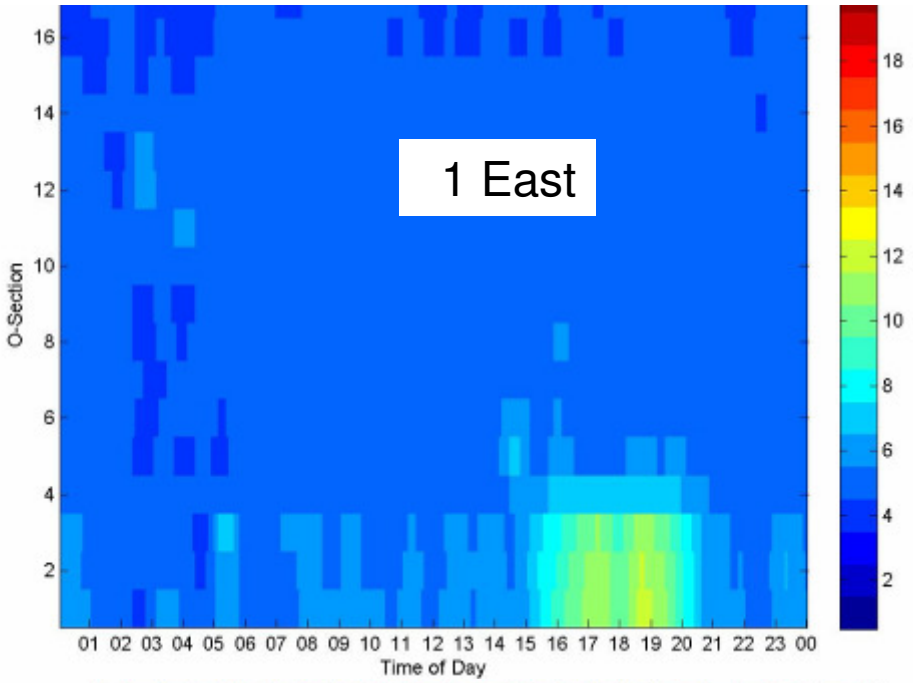
Comparison

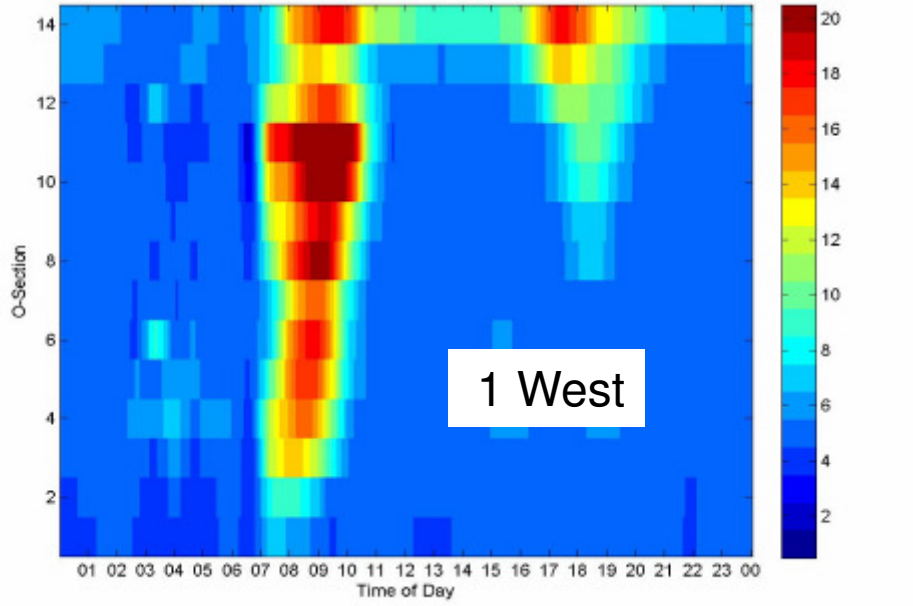
	Traditional Survey	FMS
Cost	• Interviewing • Laptops/tablets	• Call center support • Mobile sensory devices

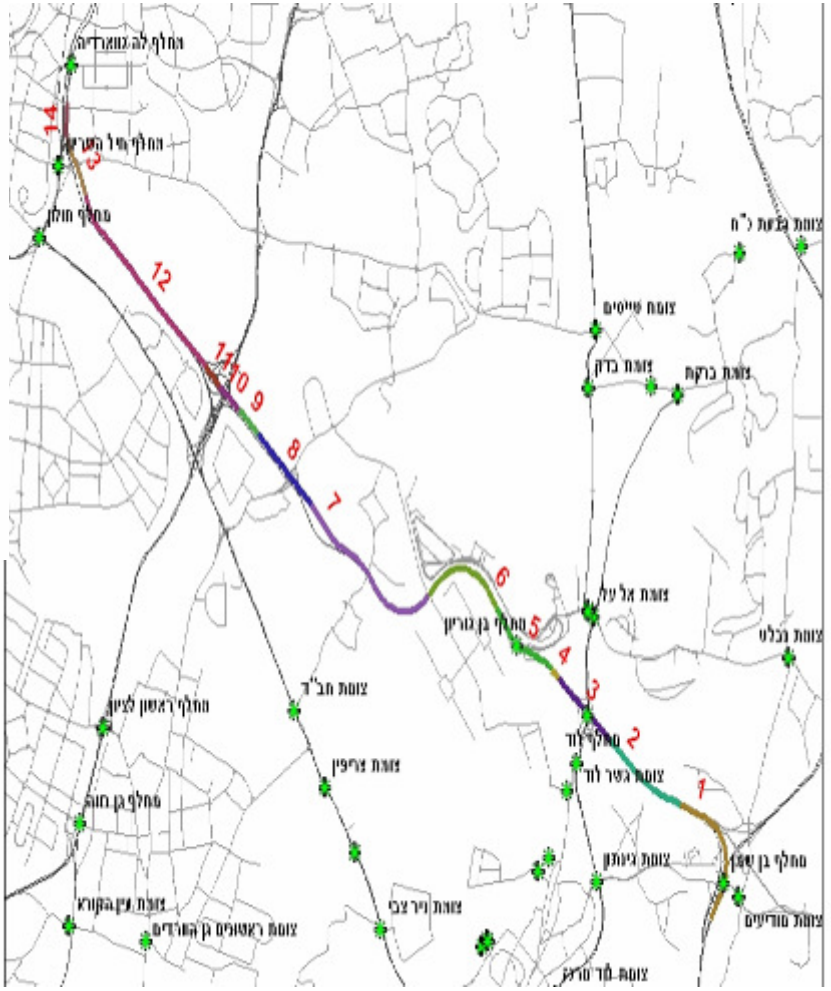
Data	• 1-2 days
	• Known deficiencies
	  • Memory effects
	  • Under-reporting
	  • No-travel bias
	  • Spatial and temporal approx.
		• Multi-day
		• Zero marginal cost of additional days
		• Day-to-day variability
		• Higher resolution
		• Spatial and temporal accuracy
		• No problems of memory and open tours
		• Easy to identify joint travel
		• Known deficiencies
		  • Battery consumption
		  • Sample bias

Ayalon Highway- Control Center

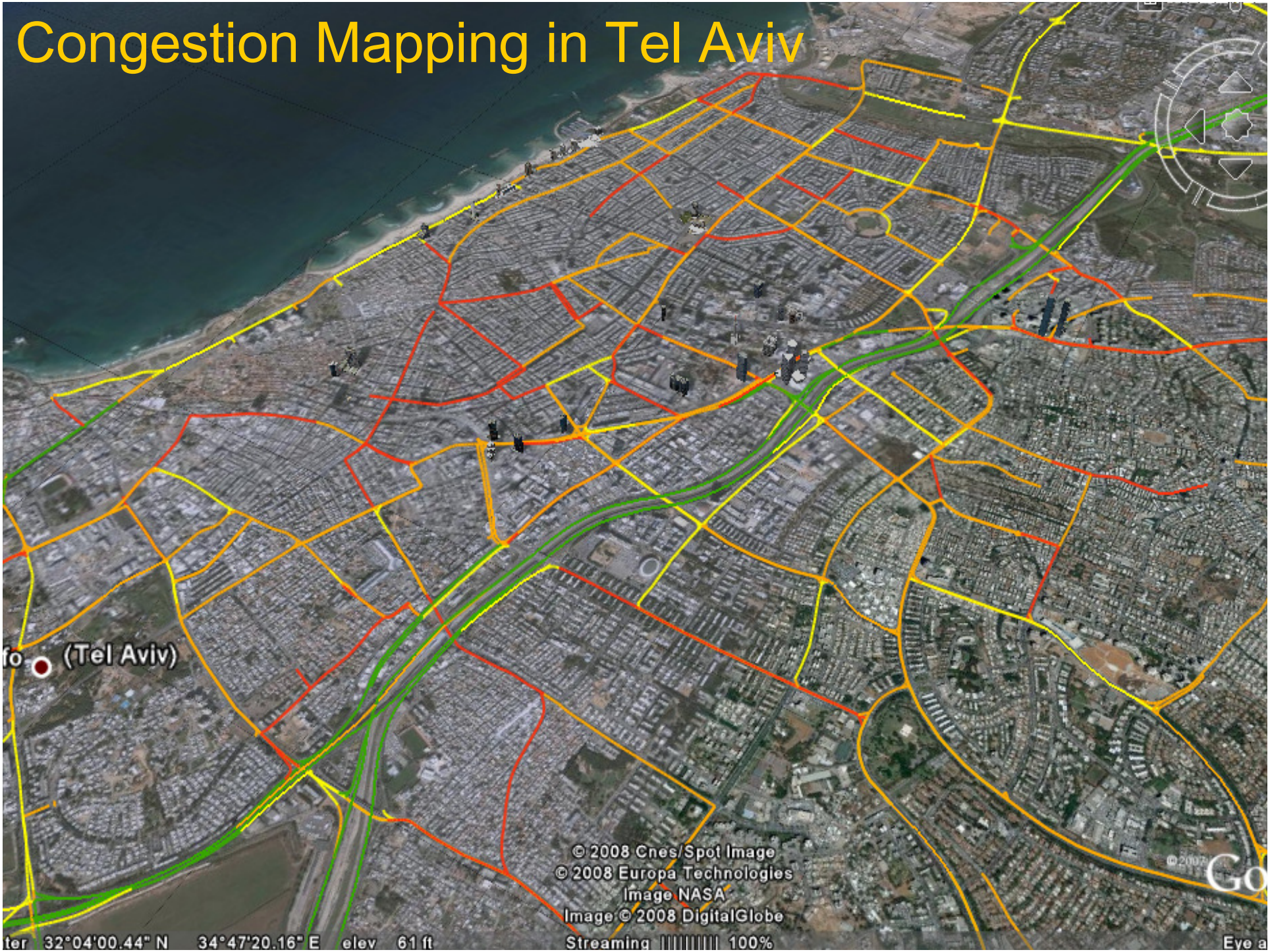
Road 1


1 East
O-Section
Time of Day
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00


1 West
O-Section
Time of Day
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 00



Congestion Mapping in Tel Aviv



Smart Control Systems

Vehicle – Infrastructure Communications Systems

Control Centers