

# „PROCESSING“ BIG DATA FOR SMARTER MOBILITY

Centrum RODOS, [www.centrum-rodos.cz](http://www.centrum-rodos.cz)

RODOS Big Data team

BigData WS / Bonn 11/2 2015

# RODOS COMPETENCE CENTER FOR TRANSPORTATION SYSTEMS

## Focus Areas

Applied research on:

- Intelligent transport systems
- Traffic monitoring and traffic management
- Mobility monitoring and mobility management  
based on supercomputing infrastructure and methods.

## Stakeholders

- **Lead: Czech national supercomputing center**  
(#6 in EU, #21 worldwide)
- Strategic partner: T-Mobile / T-Systems Czech Republic
- All major Czech technical universities (Praha, Brno and Ostrava)
- Major local industry players
- Key public customers – Road Directorate, Police, Prague, Brno

Project Phase: 2012 –2018

## Key Customers



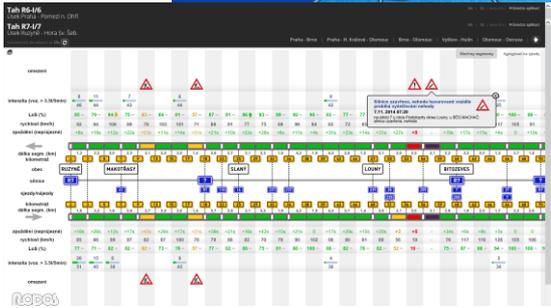
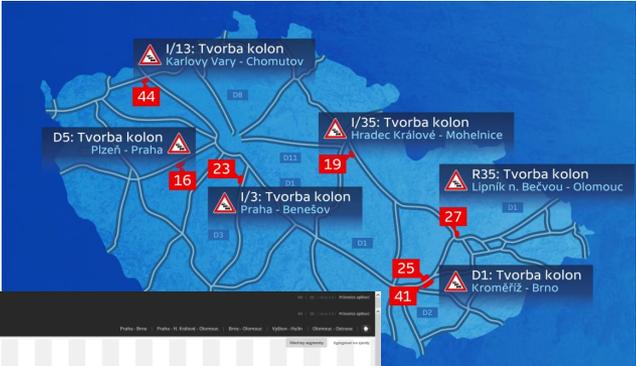
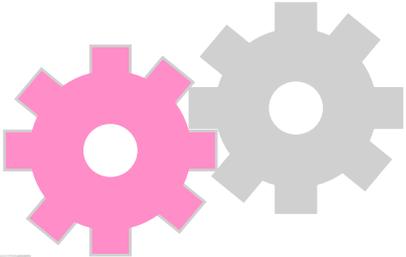
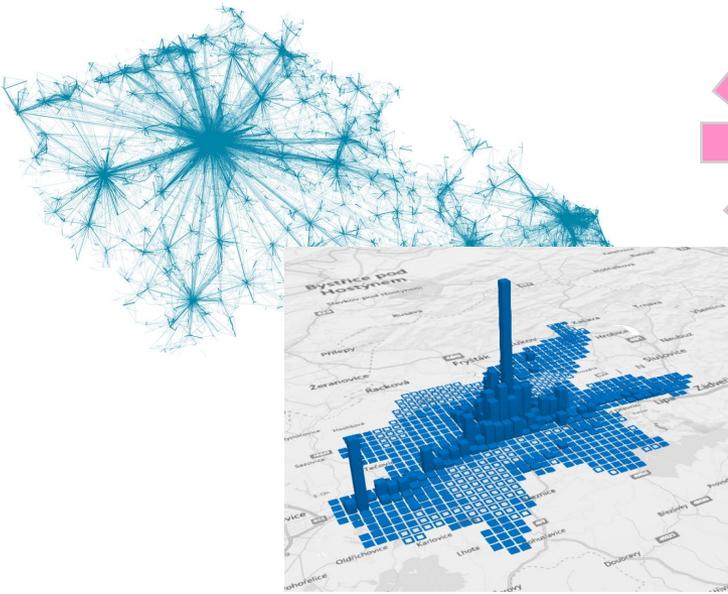
# RODOS MOBILITY MODEL

## USING MOBILE AND TRAFFIC DATA

### Complex mobility model

Mobility monitoring  
Based on anonymized signaling data from mobile network

Traffic monitoring  
Based on floating car data, detectors, toll data, meteo data



# APPLICATION AREAS FOR RODOS MOBILITY MODEL

## COMPLEX MOBILITY MODEL

### Traffic monitoring

Based on floating car data, detectors, toll data, meteo data

### Mobility monitoring

Based on signaling data from mobile network

## Application areas for the complex mobility model

Smart traffic management for cities

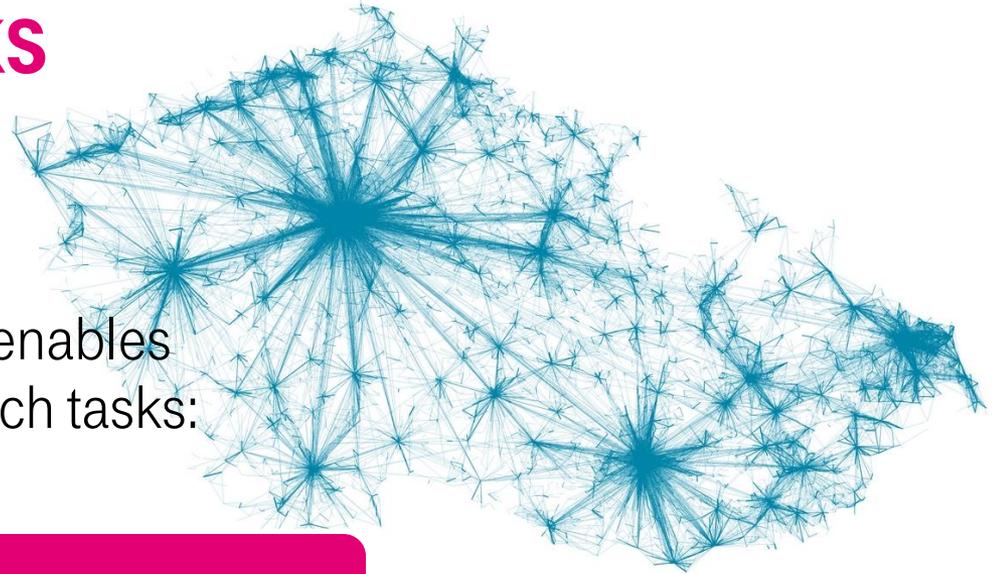
Smart traffic management for highways and motorways

Smarter tolling

Management of crisis

Advanced traffic and mobility modelling

# GEODEMOGRAPHIC TASKS



Signaling data of a mobile operator enables to analyze the following set of research tasks:

Distribution of people in time and space

Mobility of people in time and space

Spatial relations derived from mobility

# BIG DATA VALUE CHAIN

## FOR T-MOBILE CZECH REPUBLIC



### Business Intelligence for external customers

Recomputing output for the entire population



### Data processing, data analysis and data interpretation

Linked with other data – digital maps, census data



### Generation of anonymized data

Anonymized signaling data + cell map data

### Off-line business intelligence

- # of people, socioeconomic data
- Typical (repetitive) / Atypical
- „Snapshot“/time series per location
- Relations (home-work), list of daily trips,

### On-line business intelligence

# BUSINESS INTELLIGENCE – FOR WHOM?

PUBLIC AS WELL AS CORPORATE SECTOR



BETTER INFORMATION FOR **CRISIS MANAGEMENT**

VARIOUS OPTIMALISATION IN **PUBLIC SECTOR** (PUBLIC SERVICE „RETAIL“ NETWORK)

**MOBILITY PLANNING** – INFRASTRUCTURE, PUBLIC TRANSPORT

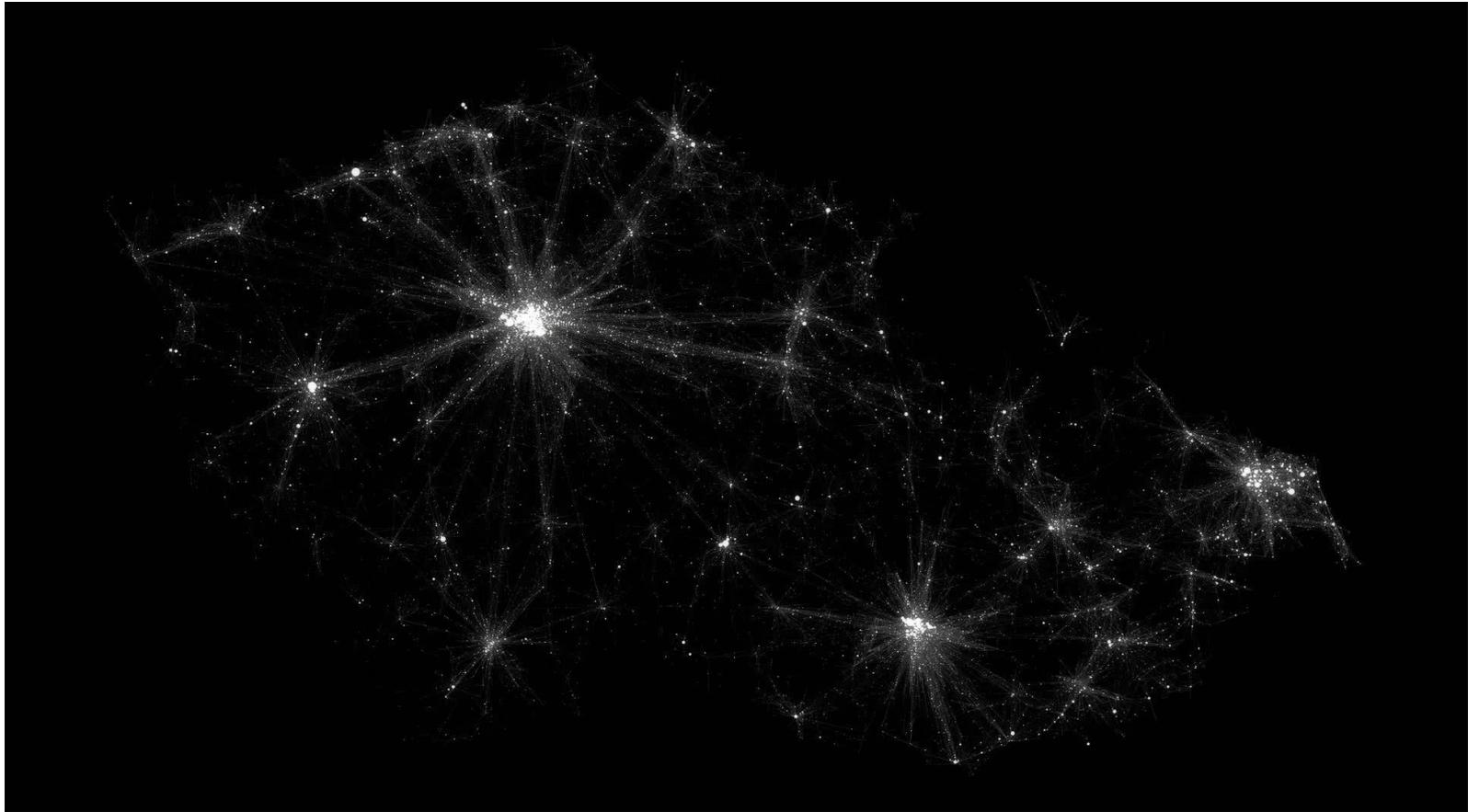
COORDINATED **METROPOLITAN MANAGEMENT**

**TOURISM** STATISTICS

**URBAN PLANNING**

**RETAIL** NETWORK OPTIMALISATION

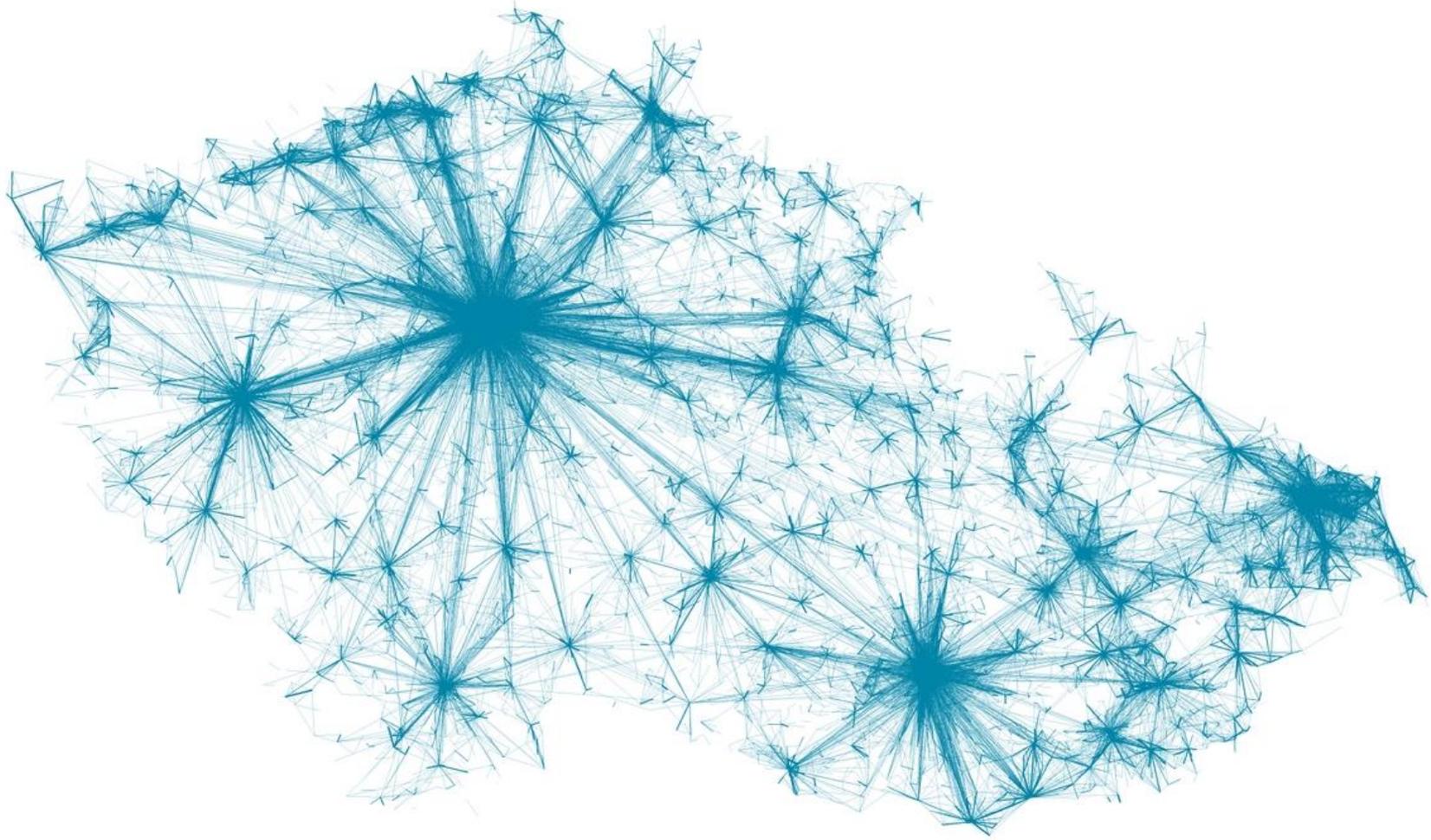
# VISUALISATION OF MOBILITY – CZECH REPUBLIC AGGREGATED ORIGIN-DESTINATION MATRIX



# VISUALISATION OF MOBILITY – OSTRAVA AND NORTHERN MORAVIA AGGREGATED ORIGIN-DESTINATION MATRIX



# CASE STUDY: HOME -- WORKDAY-AT-NOON PRESENCE



ROZVOJ DOPRAVNÝCH SYSTÉMU  
**ROPOS**

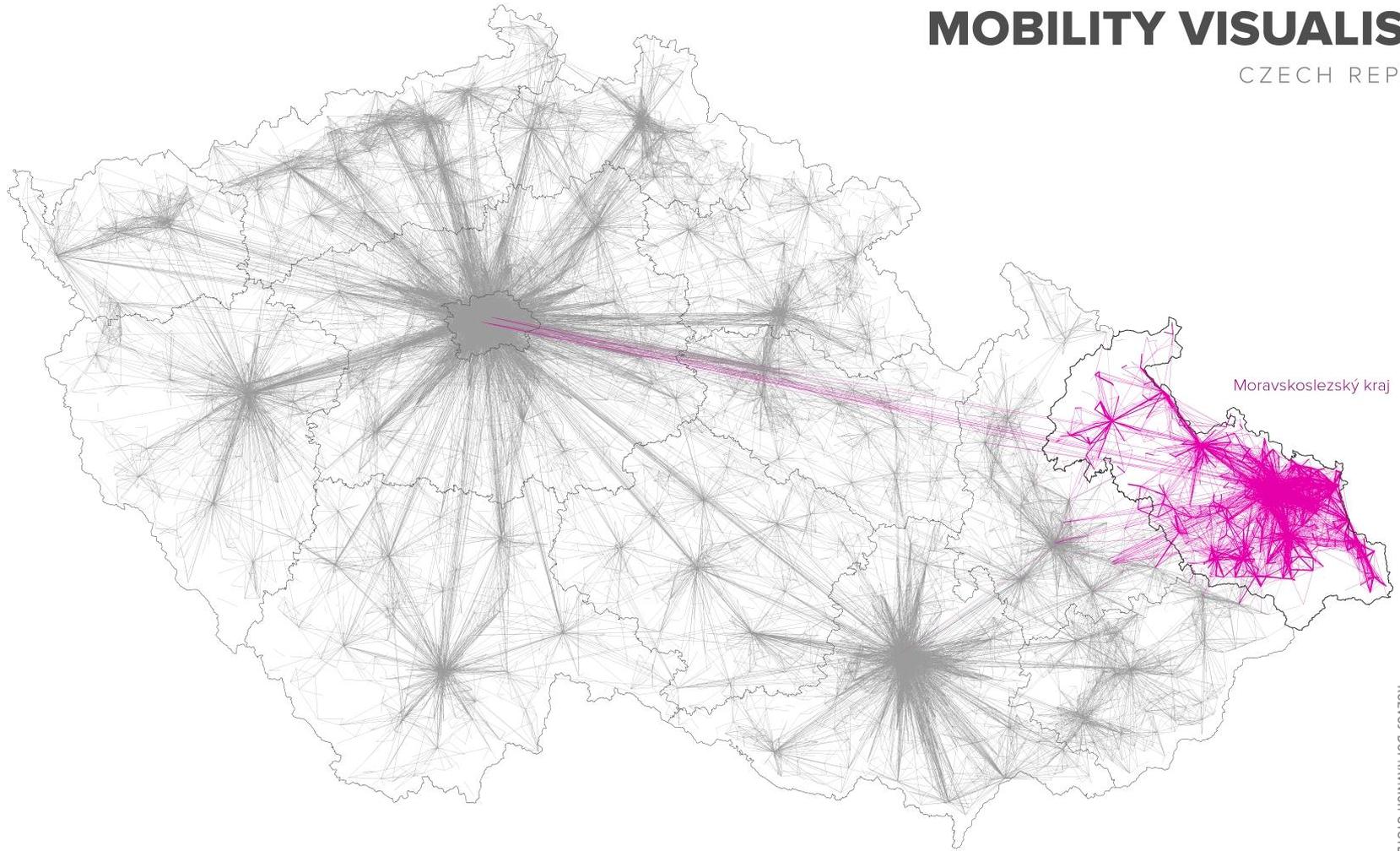
**T-Mobile**

**ROPOS**  
ROZVOJ DOPRAVNÝCH SYSTÉMU

**T-Systems**

# MOBILITY VISUALISED.

CZECH REPUBLIC



ROPODOS  
ROZVOJ DOPRAVNÍCH SYSTÉMŮ

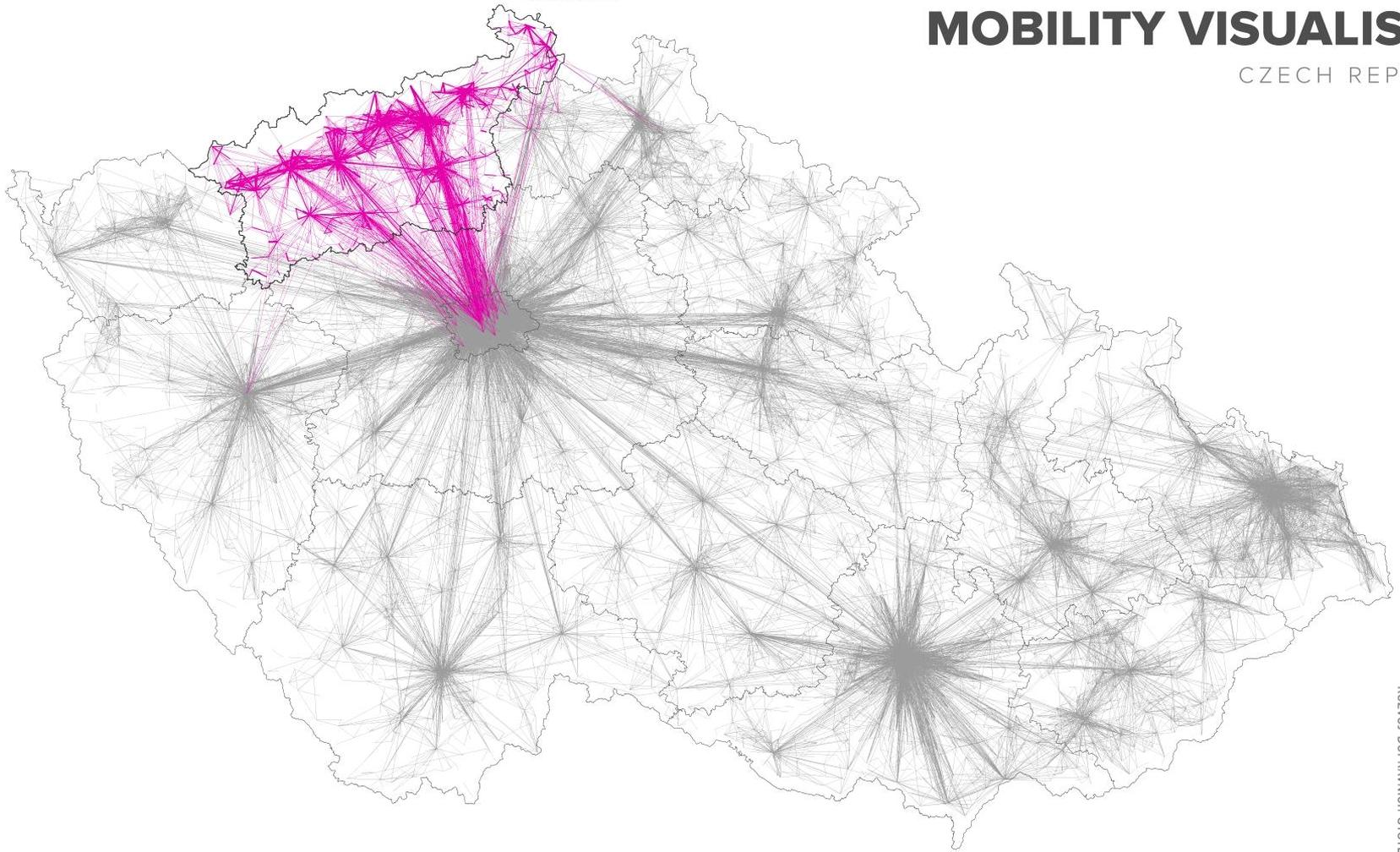
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Ústecký kraj



# MOBILITY VISUALISED.

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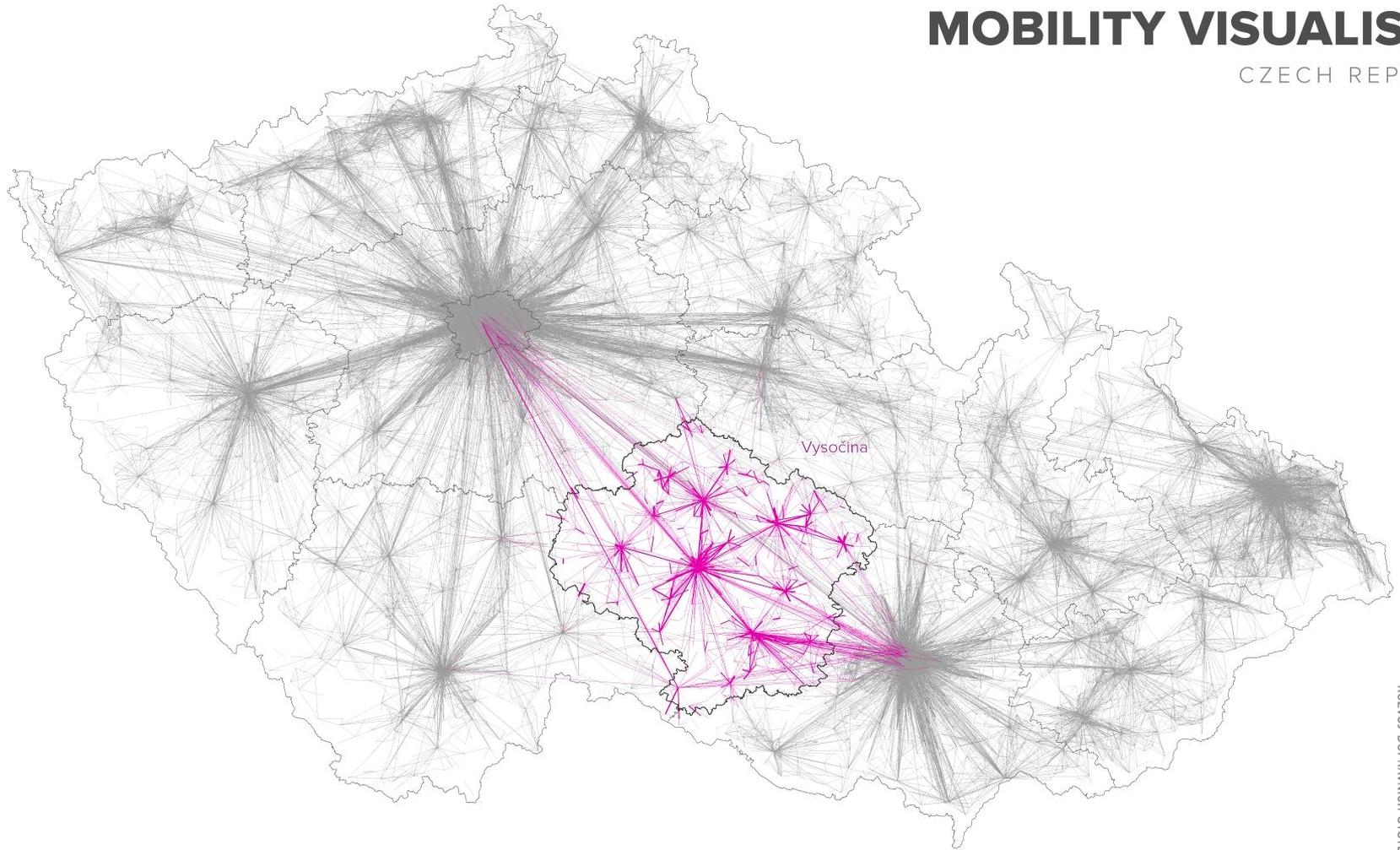
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# MOBILITY VISUALISED.

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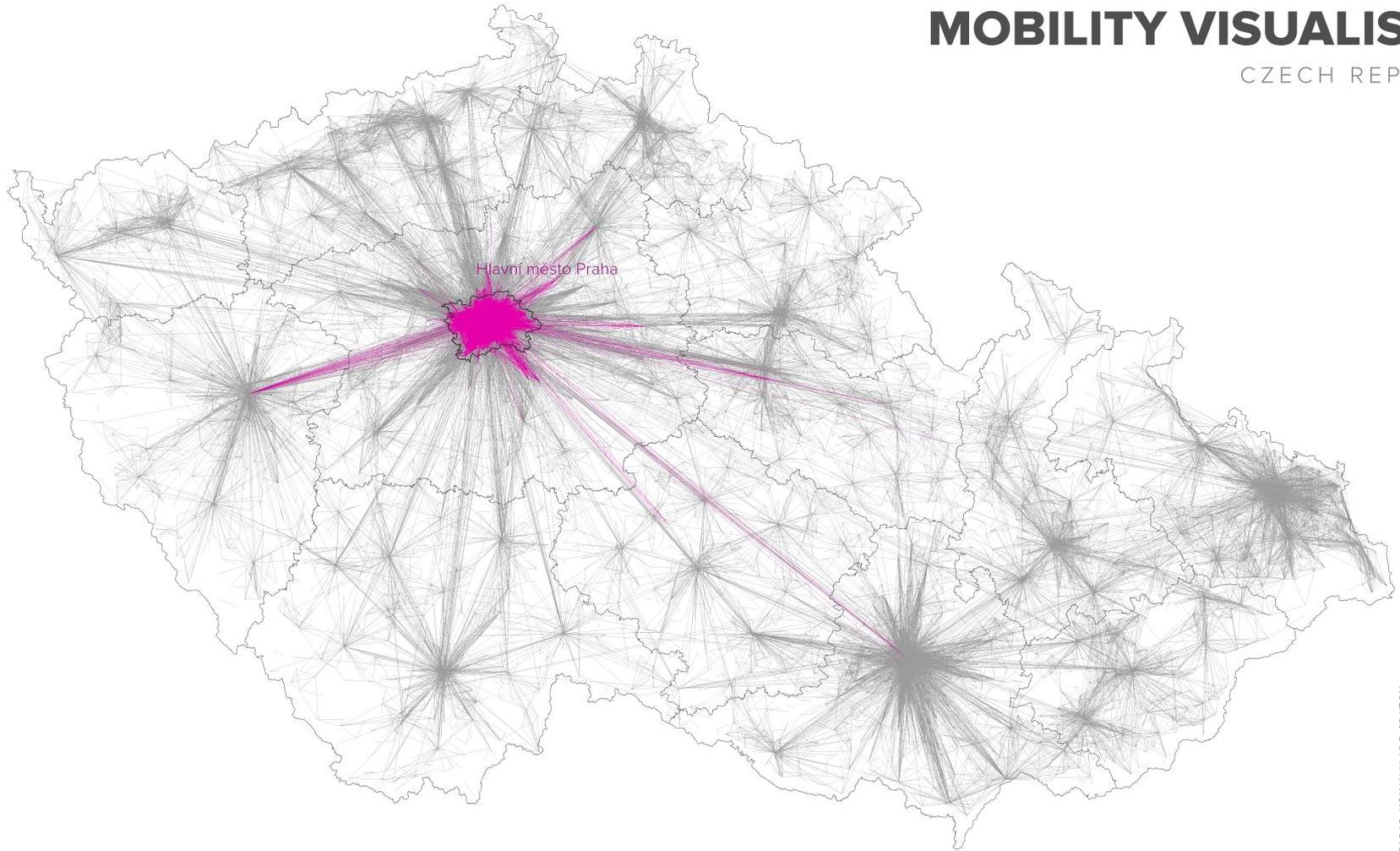
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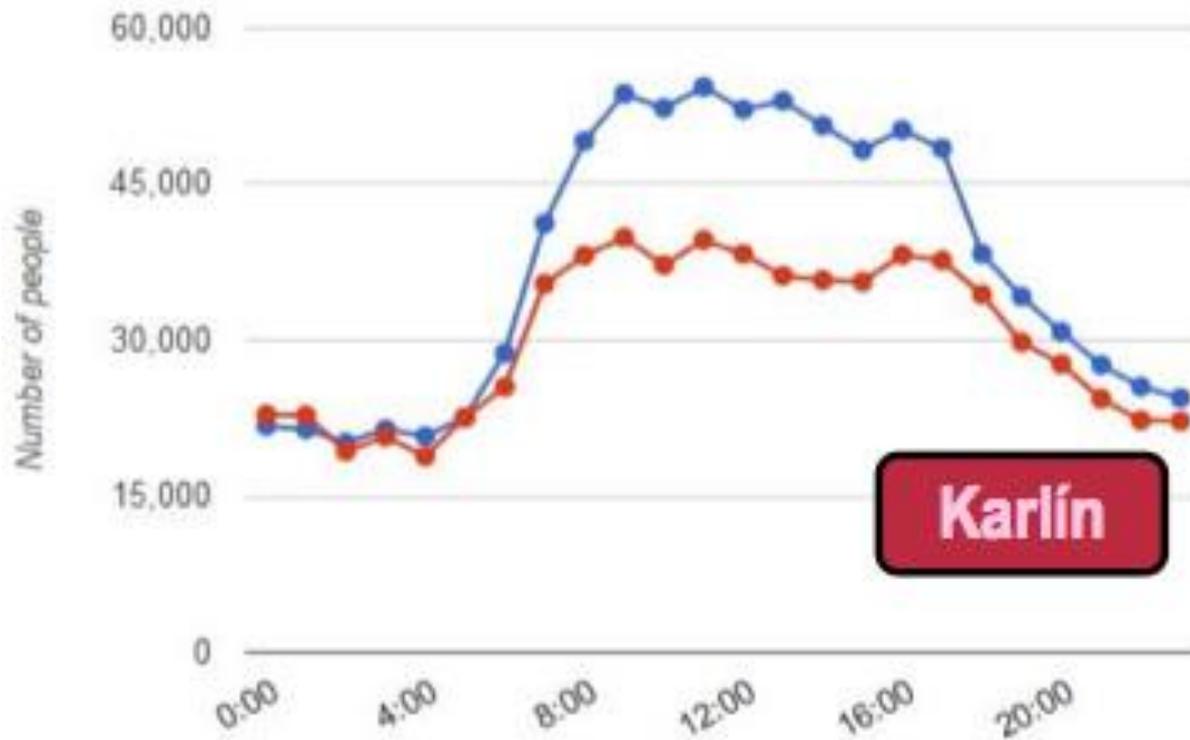
# CASE STUDY – ONE DAY OF MOBILITY

## PRAGUE AND ITS SURROUNDINGS



# CASE STUDY – MANAGEMENT OF CRISIS

## EFFECT OF FLOODS IN 2013 ON MOBILITY IN PRAGUE

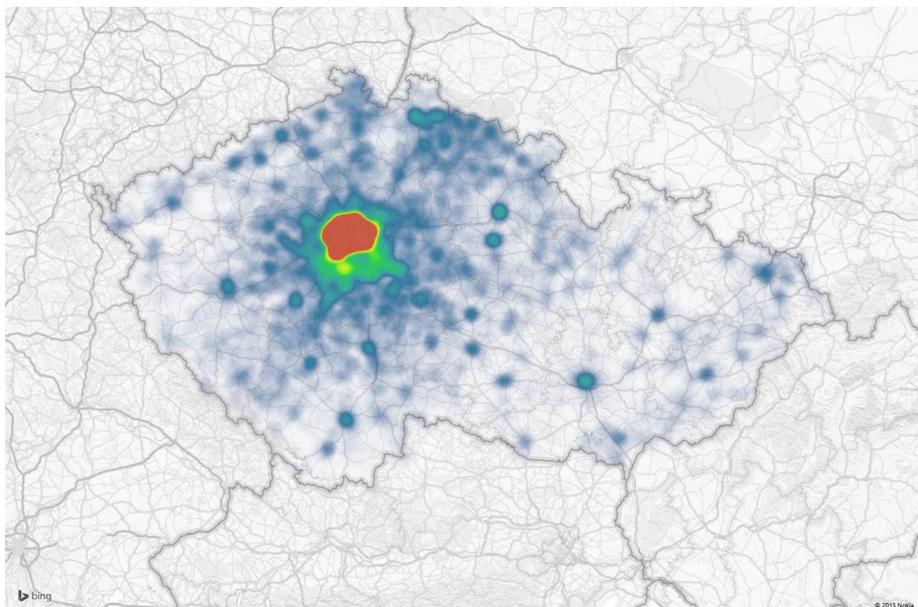


blue – regular Monday  
red – „flood“ Monday

# CASE STUDY – TOURISM STATISTICS

## DISTRIBUTION OF RESIDENTS OF PRAGUE DURING WEEKEND

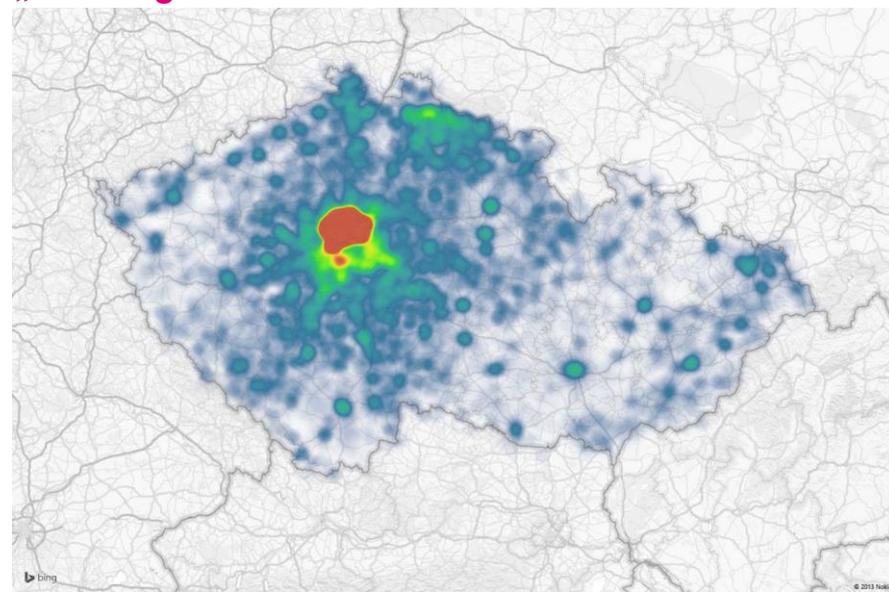
Regular weekend



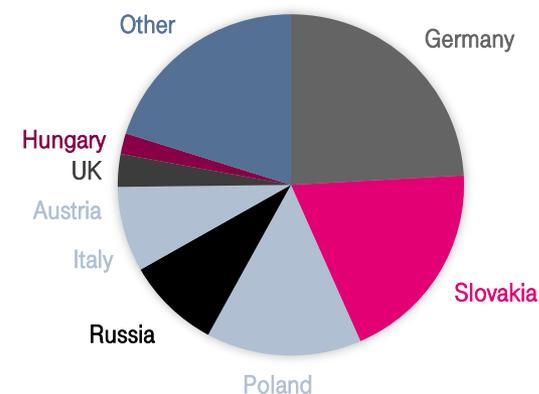
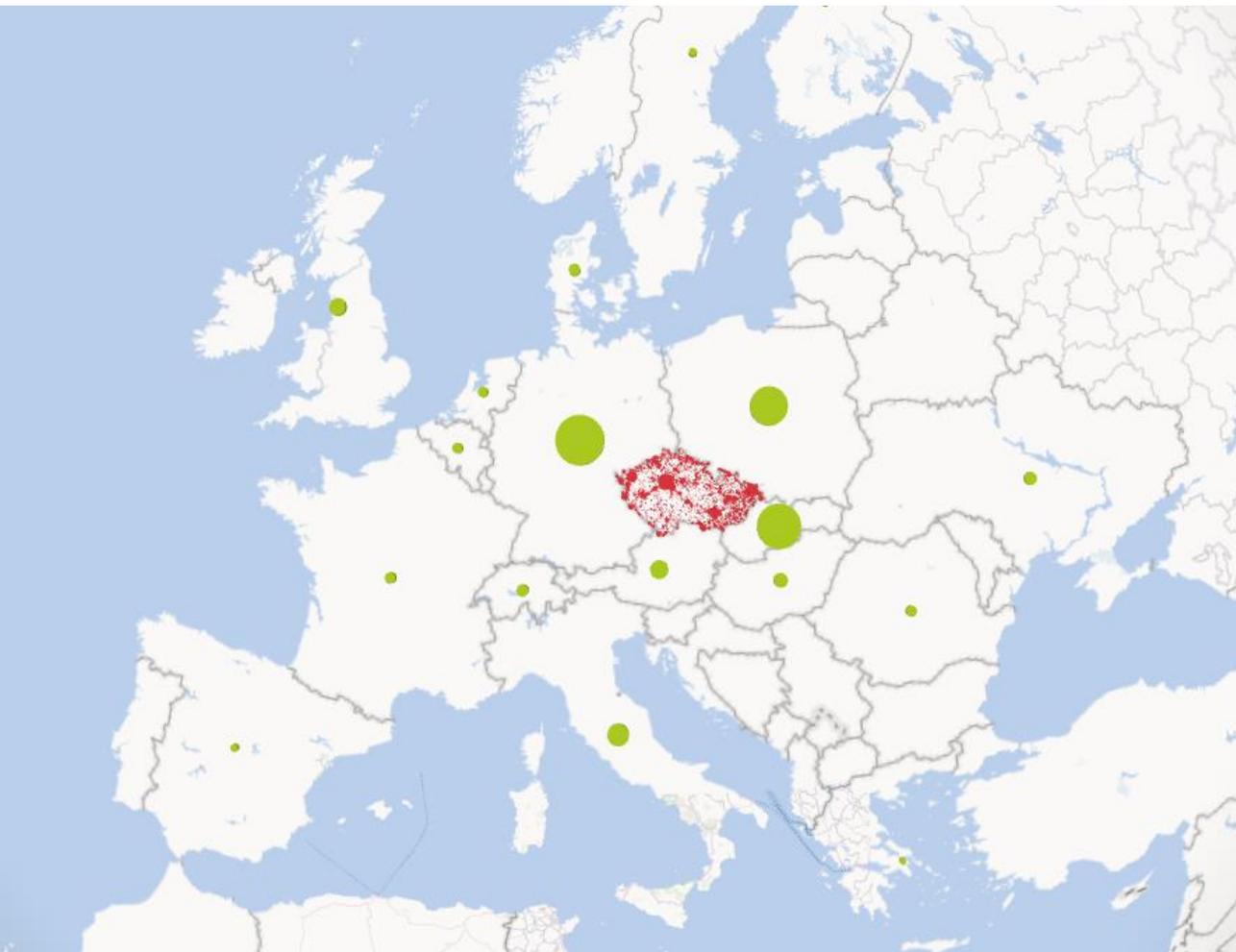
Strategic partner  
for  
tourism statistics:



„Prolonged“ weekend on Easter



# TOURISM STATISTICS – SOURCES OF INTERNATIONAL TOURISM IN CZ

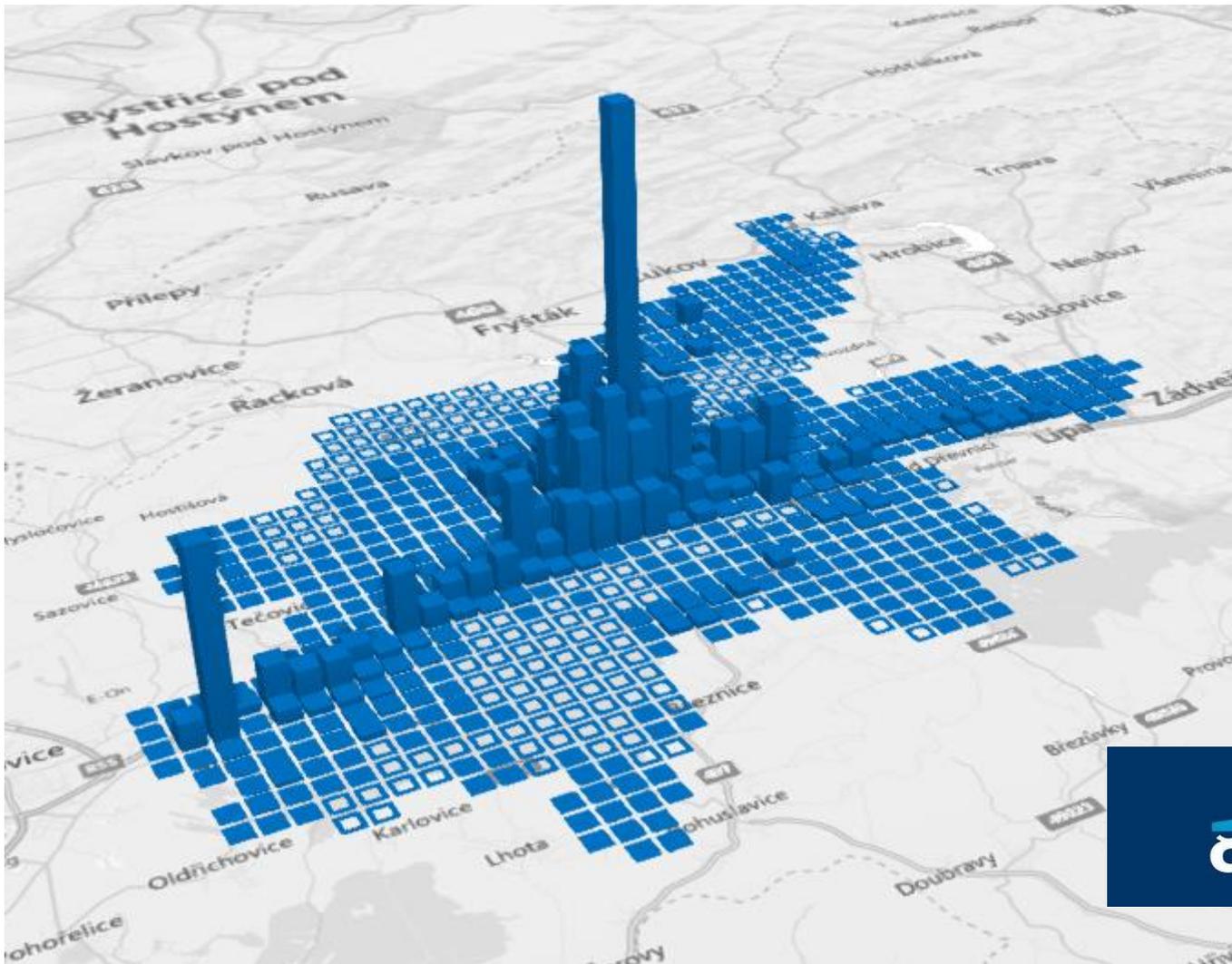


Customer:



# CASE STUDY - RETAIL ANALYTICS

## 3D MAPS MAPS OF UNIQUE VISITORS PER DAY



Customer:



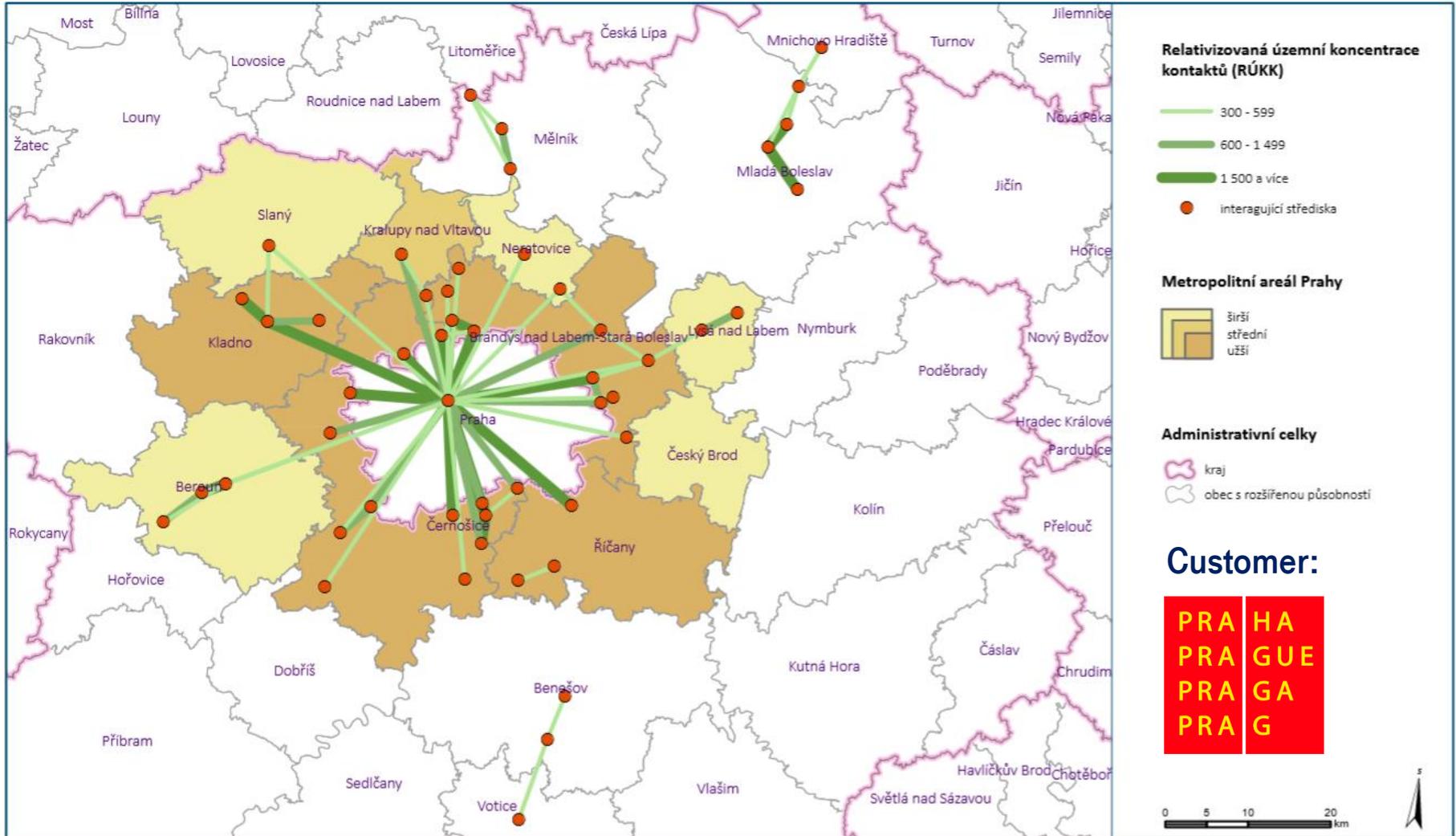
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# CASE STUDY – METROPOLITAN AREA OF PRAGUE

## URBAN SYSTEM IN CENTRAL BOHEMIA AROUND PRAGUE



### Relativizovaná územní koncentrace kontaktů (RÚKK)

- 300 - 599
- 600 - 1 499
- 1 500 a více
- interagující střediska

### Metropolitní areál Prahy



### Administrativní celky

- kraj
- obec s rozšířenou působností

### Customer:



**Metropolitní areál Prahy**

- užší (ORP): Černošice, Říčany, Brandýs nad Labem-Stará Boleslav, Kladno
- střední: Kralupy nad Vltavou
- širší: Beroun, Slaný, Český Brod, Neratovice, Lysá nad Labem

RÚKK - relativizace byla provedena vůči průměrné ÚKK v celém souboru existujících relací v rámci Středočeského kraje (mezi středisky, která vstupují do analýzy - KV > 2,5 a další obce s populací nad 2 500 ob.), do průměru nebyly započítány relace s nulovou ÚKK, průměr = 100.

Zdroj dat: CE - Traffic a.s., CSÚ (2013): Sčítání lidu, domů a bytů 2011, Praha, Český statistický úřad, Hampl, M. (2005): Geografická organizace, společenost v České republice: transformační procesy a jejich obecný kontext, Praha, UK, 147 s.

Autor návrhu: Jakub Novák

Kartografické zpracování: Jiří Nemeškal

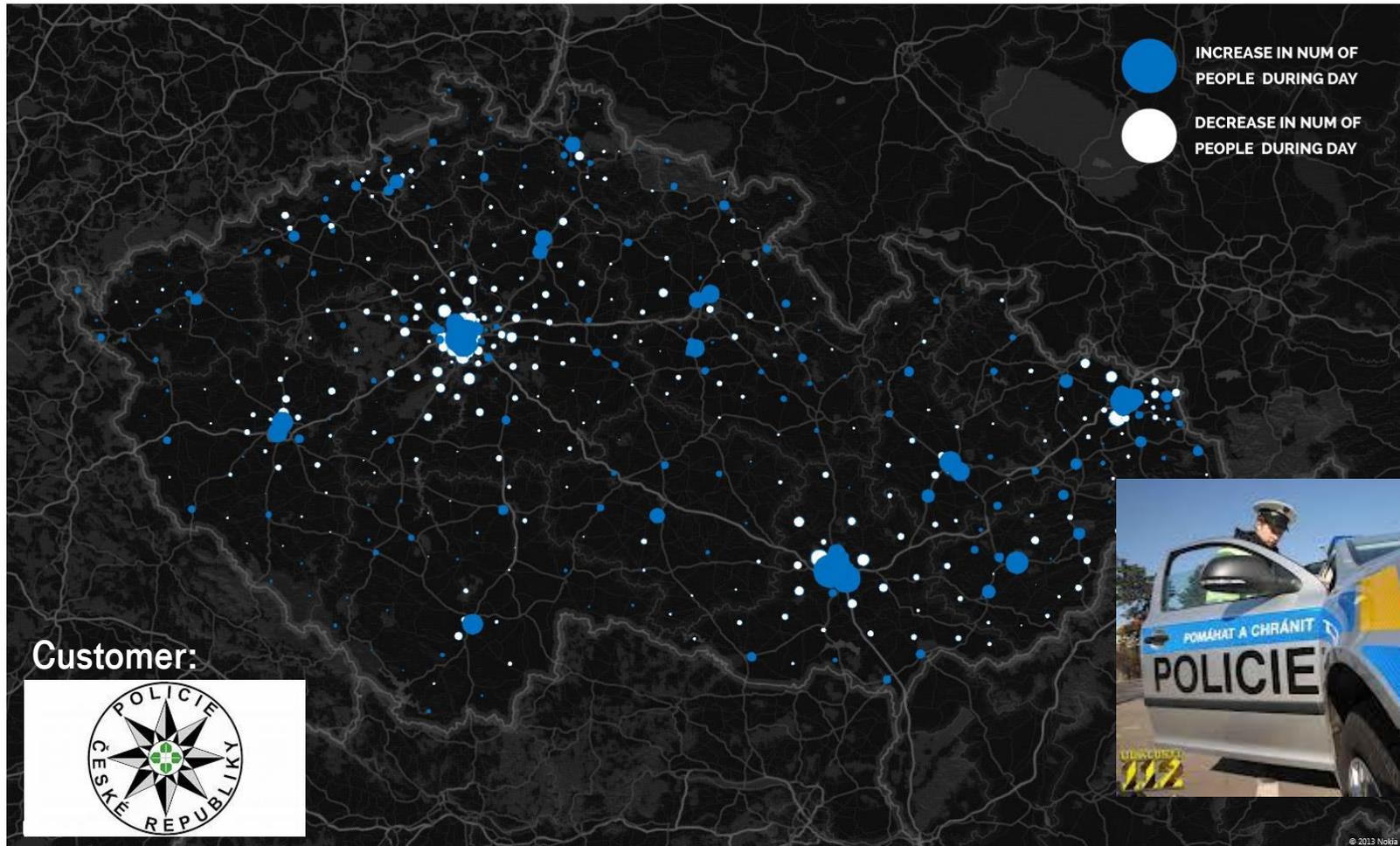


UNIVERZITA KARLOVA V PRAZE  
Přírodovědecká fakulta  
katedra sociální geografie a regionálního rozvoje



# CASE STUDY – DAILY POPULATION PROFILES

## NUMBER OF PEOPLE PRESENT IN POLICE REGIONS AT EACH HOUR OF AN AVERAGE WORKING DAY



© 2013 Nokia

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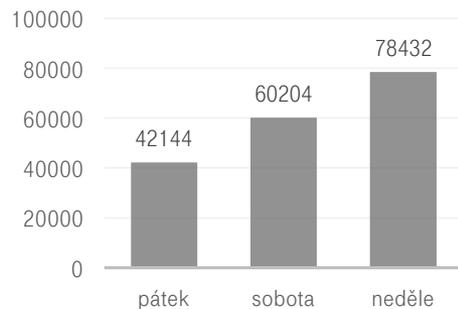
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# CASE STUDY: ANALYSIS OF THE EVENT

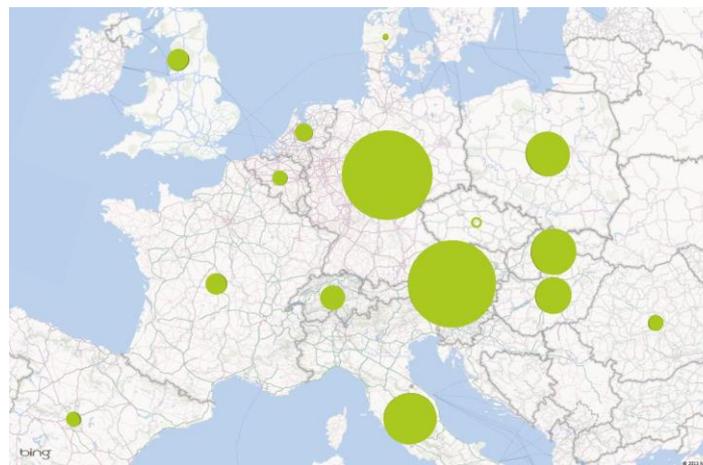
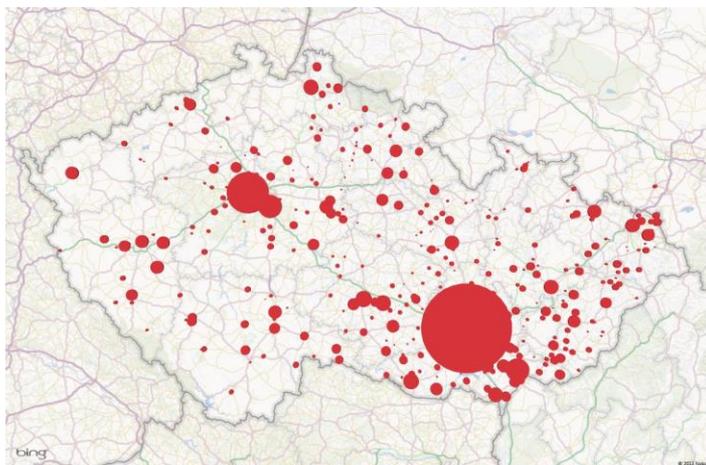
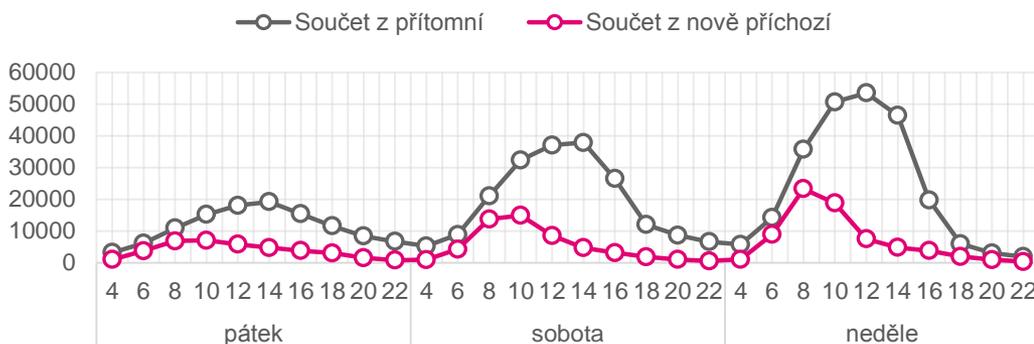
## MOTO GP BRNO, 2014



**Number of visitors per day of the event**



**Number of people present and „newcomers“ during the event**



Customer:

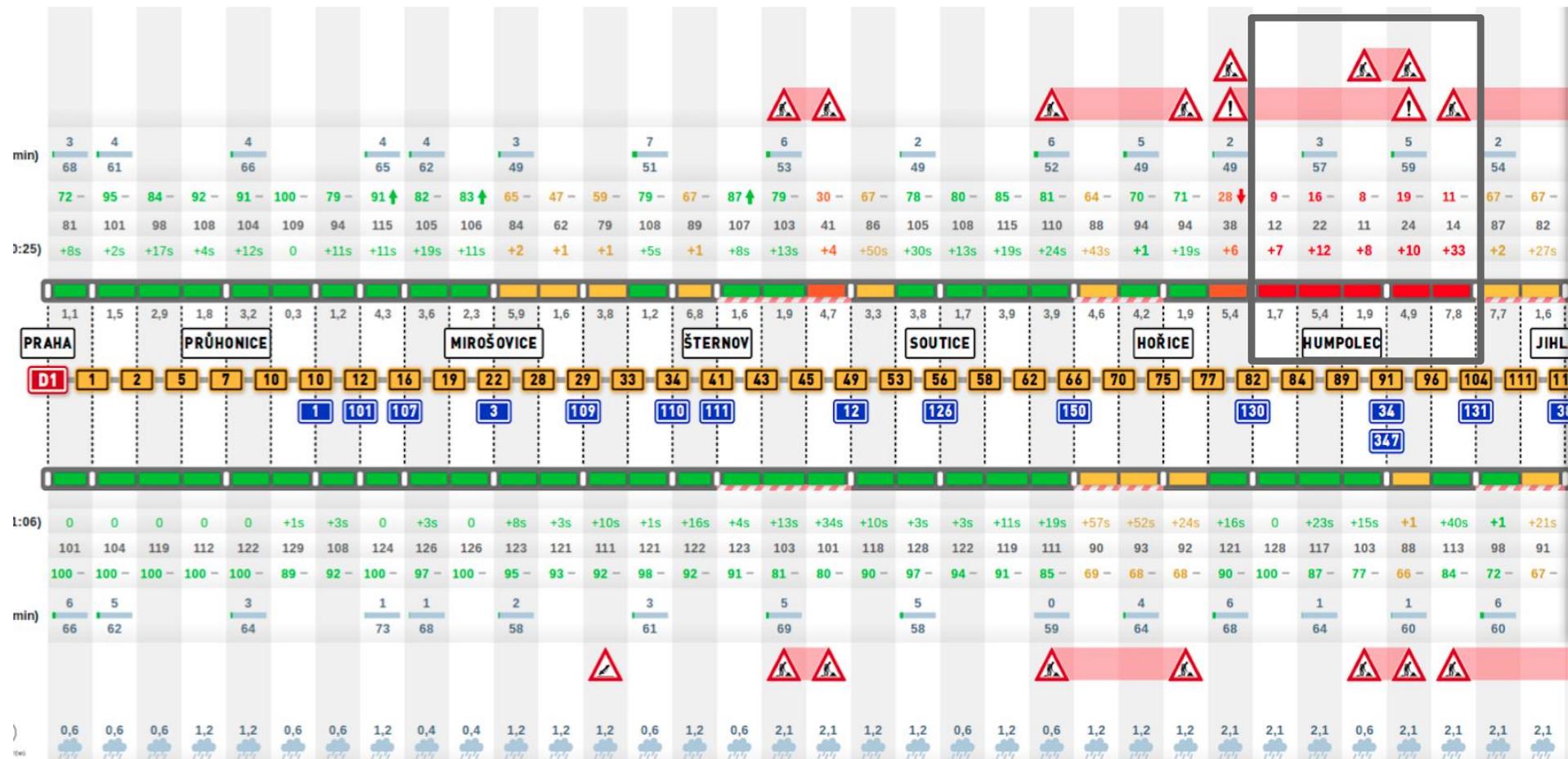


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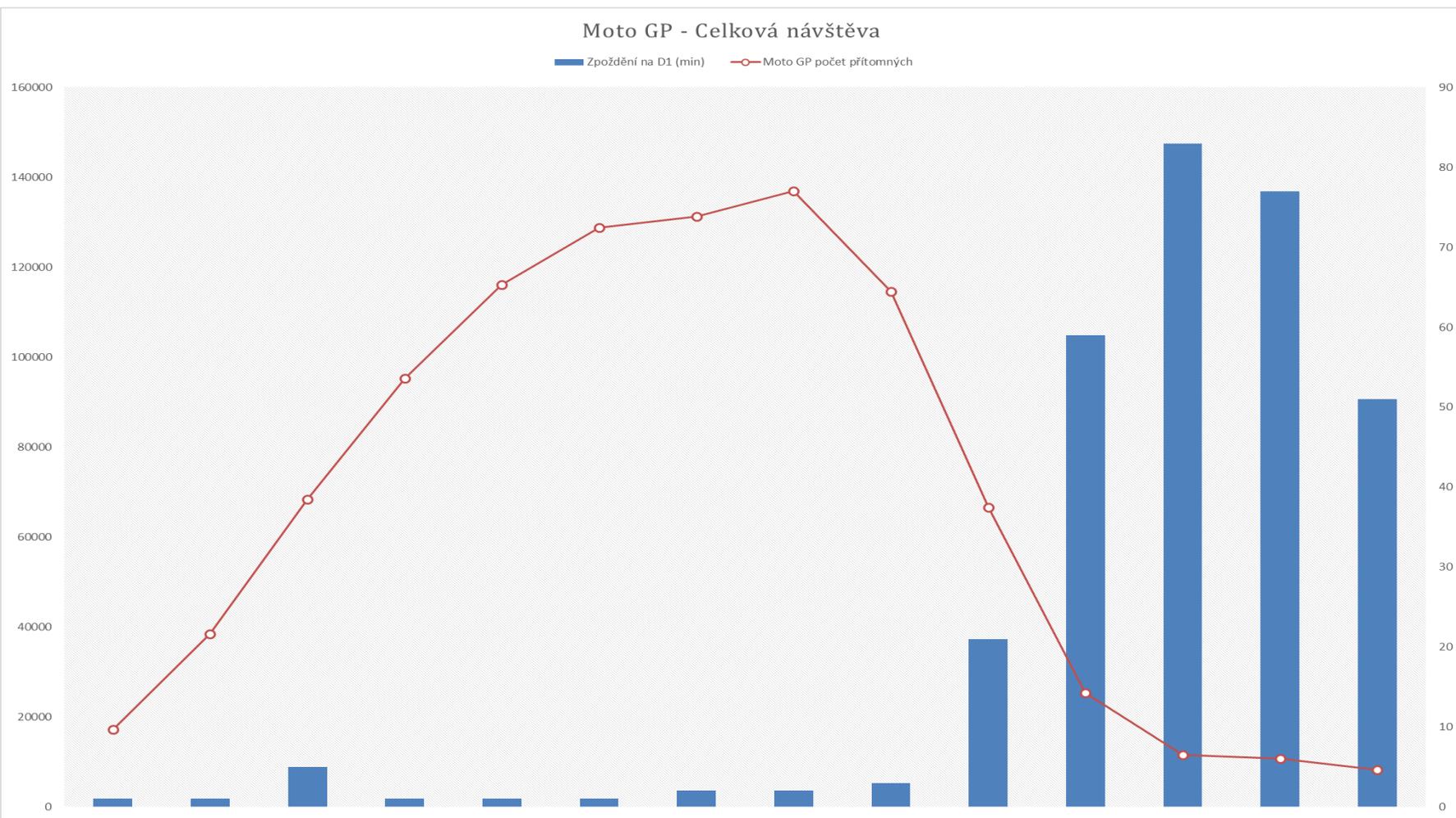
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# 2013 MOTO GP 2013: 25 KM LONG CONGESTION ON D1



# 2013 MOTO GP: COMPLEX EVENT ANALYTICS

## TRAFFIC AND MOBILITY MONITORING COMBINED!



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# RODOS STEPPING INTO EU BIG DATA – SLOVAK NATIONAL TRAFFIC INFORMATION SYSTEM

**System dopravných informácií dodá štátu Slovak Telekom za 14,2 milióna eur**

Cenu za vybudovanie systému ministerstvo pôvodne odhadovalo vo výške 15 miliónov eur bez DPH.

30.01.2015 Autor: TASR

Národný systém dopravných informácií (NSDI) zabezpečí pre ministerstvo dopravy spoločnosť Slovak Telekom za cenu 14,2 milióna eur bez dane z pridanej hodnoty (DPH). Spolu s daňou to predstavuje takmer 17 miliónov eur. Rezort dopravy podpísal zmluvu s vŕchom súťaže 21. januára tohto roku a o výsledku tendra informoval vo vestníku verejného obstarávania.

Cenu za vybudovanie systému ministerstvo pôvodne odhadovalo vo výške 15 miliónov eur bez DPH. „Cena za zhotovenie diela je nižšia, ako bola pôvodne plánovaná,“ skonštatoval hovorca ministerstva dopravy Martin Kóňa. Súťaž ale prebiehala formou súťažného dialógu, takže ešte počas tendra sa tvoria a upravovali predmet zákazky.

Uchádzači tak navrhovali do služby rôzne ďalšie zdroje dopravných informácií, ktoré poskytnú vo svojej reži. Ide napríklad o dáta z flotilových vozidiel či dáta mobilného operátora. Ministerstvo muselo preto podľa Kóňu obmedziť rozsah takto poskytovaných služieb. Stanovilo maximálne obdobie dva roky a sumu, ktorá sa môže, ale nemusí na tieto dodatočné služby vyčerpať. Ide o 4 milióny eur bez DPH, čiže 4,8 milióna eur aj s daňou. Počíta s nimi aj zmluva so spoločnosťou Slovak Telekom.

**ODPORÚČAME**

1. V obehu sú falošné procesory AMD. Podvodníci preznačili staršie modely
2. Orange a O2 zrejme spoja siete. Dohoda je na spadnutie
3. Tip na valentínsky darček: Zlatý iPhone 6 za 3,1 milióna eur
4. **KOMENTÁR** Televízory zmenia herný biznis. Už tento rok
5. Recenzia Samsung Galaxy Note Edge: Až za okraj

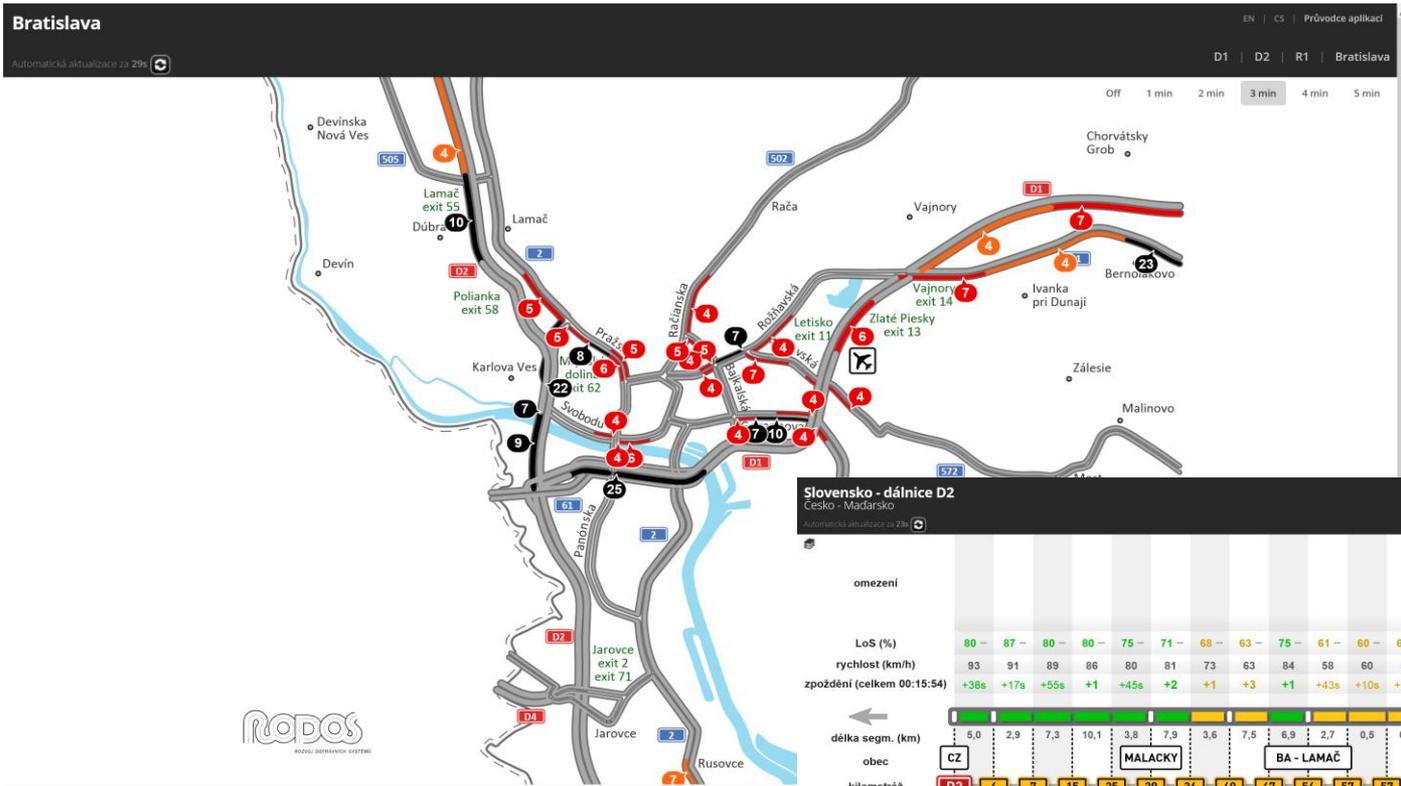


- 30.12.2015 - **The National traffic information system** will be delivered to **Slovak government** by Slovak Telekom for **€ 14.2 million\*** powered by RODOS

\* <http://www.zive.sk/clanok/102046/system-dopravných-informácií-doda-štátu-slovak-telekom-za-14-2-miliona-eur>

# TRAFFIC MONITORING FOR SLOVAKIA

## TRAFFIC BASED ON CELLULAR + GPS PROBING



**Slovensko - dálnice D2**  
Česko - Maďarsko

Automatická aktualizace za 29s

Všechny segmenty    Agregovat na jízdy

omezení																					
LoS (%)	80	87	80	80	75	71	68	63	75	61	60	63	79	71	67	66	43	92	92	100	
rychlost (km/h)	93	91	89	86	80	81	73	63	84	58	60	56	66	66	54	50	34	106	97	106	
zpoždění (celkem 00:15:54)	+38s	+17s	+55s	+1	+45s	+2	+1	+3	+1	+43s	+10s	+19s	+8s	+36s	+28s	+18s	+2	+12s	+5s	0	
délka segm. (km)	5,0	2,9	7,3	10,1	3,8	7,9	3,6	7,5	6,9	2,7	0,8	0,8	0,4	1,7	1,8	0,8	1,2	4,7	1,3	9,9	
obec	CZ				MALACKY				BA - LAMAČ								BA - PETRŽALKA			HU	
kilometr	D2	4	7	15	25	29	36	40	47	54	57	57	58	59	60	62	63	64	69	70	80
sjezdy/nájezdy		2			503		2		505			2		2							
zpoždění (celkem 00:48:14)	+9s	+48s	+19s	+22s	0	+2	+44s	+48s	+4	+16	+57s	+46s	+3	0	+2	+7	+10	0	0	0	
rychlost (km/h)	96	71	104	107	96	84	81	86	49	7	17	20	20	91	20	11	5	114	107	114	
LoS (%)	95	66	92	94	100	72	72	87	44	8	17	24	20	100	24	15	6	100	100	100	
omezení																					

# CASE STUDY – TRAFFIC MONITORING FOR CZECHIA

## TRAFFIC BASED ON GPS PROBING – SERVICE FOR CZECH TV



Customers:



Also: FCD traffic monitoring project for the City of Prague



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# LEVERAGING 5 YEARS OF EXPERIENCE

## RODOS OFFERS A VARIETY OF USE CASES FOR DTAG

- National /regional **traffic management and planning**
- **SMART CITIES** – urban planning, public transport
- Metropolitan and **crisis situation management and planning**
- **Tourism** analysis/applications
- **Retail**– shop network optimisation
- DTAG own use cases – e.g. LTE network coverage vs. LTE devices in network
- Variety of Big Data business intelligence research projects



# MARKET SEGMENT USE CASES 1/5

## BIG DATA FOR METROPOLIES AND REGIONS

- **Big Data Business Intelligence for (smart) cities**
  - Expectation: hoped to be huge and long term business
  - Our current experience:
    - Customers have to be educated first
    - Demonstrations and workshops is needed in pre-sales phase
    - Innovations is understood by some professionals only
    - The decision makers are afraid to change the paradigm of conventional methods
    - Collaboration with academic sphere very important to legitimize the approach
  - Our projects:
    - Delimitation of Prague metropolitan area to better optimize the integrated public transport of Prague and its wide suburban surrounding region
    - Other cities to be approached by „off-line sets of population dynamics“ packed in public budget software
    - The tender for mobility data in Prague cancelled due to formal issues of the tendering process

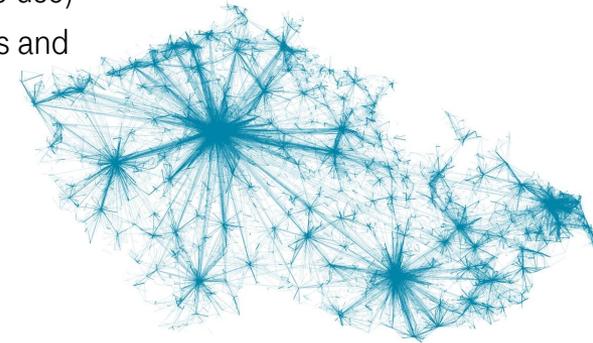


# MARKET SEGMENT USE CASES 2/5

## BIG DATA FOR CENTRAL GOVERNMENT(S)

- **Big Data Business Intelligence for (smart) central governments**

- Expectation: hoped to be very large and strategic segment
- Big Data Geodemographics is expected to:
  - Be the source of valuable data for management crisis (both off-line and on-line use)
  - Create demand for „mobility census“ complementing existing (people) census and traffic census
- Our current experience:
  - Customers have to be explained the benefits
  - Pilot operations proving the added value to be done first
  - Collaboration with local academic and professional sphere essential
  - Commercial project in initial stages
- Our projects:
  - Pilot project: on-line mobility monitoring during World ice-hockey championship – for crisis management unit police, fire brigades, ambulances
  - On-line visualisation of „deviations“ of the number of people per area as compared to „normally expected counts“ of people – for Czech Police
  - Off-line per-hour people counts for all police districts for a typical working day



# MARKET SEGMENT USE CASES 3/5

## TOURISM ANALYSIS/APPLICATIONS

- **Tourism**

- Expectation: needed by both governmental as well as corporate customers
- Our current experience:
  - interesting market already being formed with governments, only some corporate customers so far
  - currently a major revenue stream for us
  - large projects still ahead of us
- Done projects:
  - One year monitoring of major 40 locations in CZ for CzechTourism, governmental agency
  - Offers for two 2 tenders in 2014 for CzechTourism placed, winner not yet announced
  - Monitoring projects for several regions and several cities done already (Prague, Plzeň, Karlovy Vary, ...)
  - Events - Several festivals and events analyzed



# MARKET SEGMENT USE CASES 4/5

## BIG DATA FOR RETAIL

- **Retail market**
    - Expectation: hoped to be huge
    - Reality: not so easy to address (building level precision, social groups combined with rather low willingness to pay)
  - Our projects: CSOB (member of KBC group) No 1 Czech retail bank
- Local realstate developer



# MARKET SEGMENT USE CASES 5/5

## BIG DATA RESEARCH PROJECTS

- **Big Data Business Intelligence reserch projects**

- Expectation:

- Some topics require more than one country to address with optimum care
- There are financing instruments, e.g. EU Horizon 2020



- RODOS center is:

- ready to participate such a project
- able to bring an important contribution to the agenda
- able to bring some cross-industry and cross-sector partnerships in CEE region



# WRAP UP

## OUR VISION

RODOS AS EU HUB FOR DTAG GEO-DEMOGRAPHIC BIG DATA.

## WHY RODOS

- Leveraging **5 years of experience**
- More than **20 realized projects** in central EU
- Strong IT and analytic team located in CZ
- **Unique cooperation** between T-Mobile Czech, Universities and Commercial sector



# NEXT STEPS

- **Set up** common, winning **strategy for EU**
- Focus on **two NatCos** and **selected use cases** in 2015
- Precise technical model and **define business model**
- **Define teams** and **targets** on NatCo sides

**THANK YOU!**



LIFE IS FOR SHARING.