

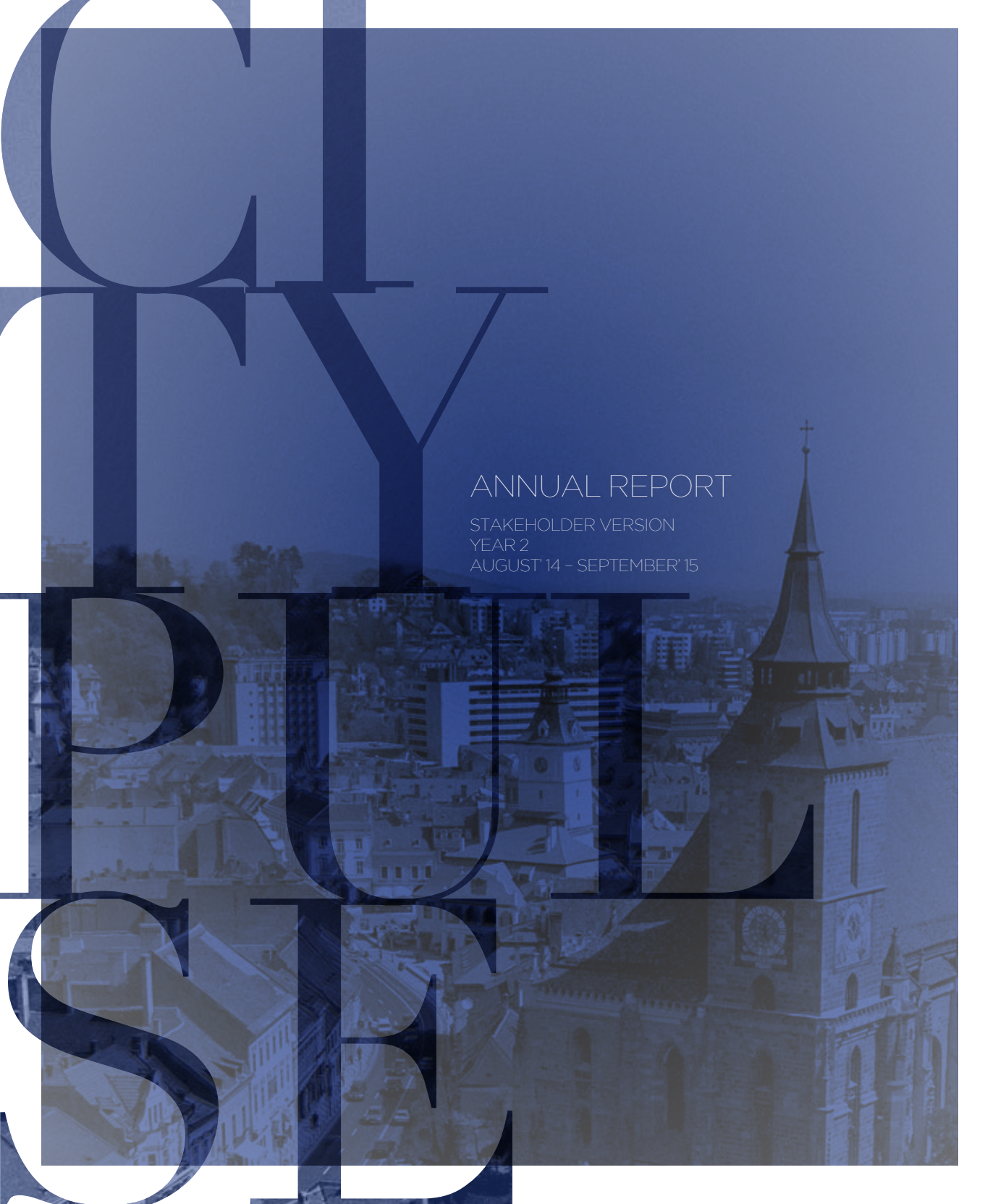
# CITY

## ANNUAL REPORT

STAKEHOLDER VERSION  
YEAR 2  
AUGUST 14 – SEPTEMBER 15

# REPORT

# START





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European Commission's 7th Framework Programme.*



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## WORDS FROM THE COMMISSION

Over the past six years, the European Commission, in cooperation with Member states and third countries, has focused its efforts on funding pioneering research to develop the most dynamic and agile Internet of Things (IoT) ecosystem in the world. To achieve such an ambitious goal, the European Commission initiated the Internet of Things European Research Cluster (IERC) in 2010. The purpose is to bring together IoT projects to offer ready-to-use solutions and best practice, and not least solutions that are free and open source.

This year, the Commission has been working towards a Digital Single Market strategy: this context is now a unique opportunity to boost a vibrant EU-wide IoT market. In the Horizon 2020 programme, the Commission is preparing to launch IoT large-scale pilots matching technology and its applications.

To raise awareness of the potential of using IoT to support this deployment, the European Commission initiated this year the Alliance for Internet of Things Innovation (AIOTI), whose overall goal is to strengthen links and to build new relationships between the different IoT players (industries, SMEs, start-ups, stakeholders) and sectors. It aims at promoting interoperability and convergence between standards, and facilitating policy debates.

We consider that European projects like CityPulse contribute to the Commission's initiative to support European excellence in the technical ability to provide IoT services and to make sure that European citizens benefit from those services.

*Eric Gaudillat  
Programme Manager at the European Commission  
Oversees the CityPulse project*

# WELCOME TO CITYPULSE, YEAR 2

CityPulse is a research project on innovative smart city applications. Here, CityPulse project coordinator, Dr. Payam Barnaghi, introduces the project's progress and further plans.

The interconnected networks of devices and information communication technologies are changing the way we live and interact with our surrounding world. In the past few years, the amount of collected and published data is greater than ever seen in human history. The Internet of Things (IoT) and new communication technologies, such as 5G, enable us to collect and process even more data from the physical world. Real-world data is becoming more accessible in (near)-real-time, and powerful storage and processing of hardware and software allow us to handle very large volumes of data. However, we still face the problem of analysing and transforming large volumes of raw data into actionable information that can be used for decision-making. IoT and smart cities are full of innovation potential. But, like the web in its early days, they are still in their infancy. The smart city systems are often fragmented and are usually vertical systems aimed for specific environments and applications.

The key to overcome this fragmentation is to provide an open ecosystem capable of integrating and processing data from various sources and supporting different applications and services. This requires several key enablers such as real-world data stream publication and processing,

adaptive and scalable data analytics methods, privacy and security mechanisms, combined with real-world and large-scale demonstrations that are driven by innovative use case scenarios and new business models. In the CityPulse project we try to address these issues and provide an open framework for large-scale smart city data analytics.

This second edition of the CityPulse annual stakeholder report focuses on the current progress and views of the project team and the stakeholders on the success stories and lessons learned over the past two years of the project.

The first year of the project was mainly about creating awareness, collecting the requirements, defining use cases and building the technical infrastructure. In collaboration with citizens, the stakeholder group and the technical team, the project team defined over 101 smart city use case scenarios that were published and made available online. The project team also defined the key components and architecture of a smart city framework that was designed based on the Architecture Reference Model (ARM) for the IoT.

The efforts in the second year were mainly focused on implementing, integrating and testing the

proposed smart city framework. Working with the city partners in Aarhus and Brasov, the project team developed software components for real-time data stream publication and annotation, accesses and query interfaces, semantic reasoning and information processing mechanisms, adaptive analysis methods for pattern recognition and correlation analysis, and social media data analysis.

The integration of these components in the framework is currently being undertaken as a smart city event analysis application. Showcasing the results and working with our project partners and receiving feedback at the development stage, helped us to understand the priorities of the citizens and city authorities. The dependability and reliability of the proposed solutions, as well as privacy and simplicity, have been the key issues that we needed to take into account. We also learned several valuable lessons by involving a multi-disciplinary team in our development efforts.

The third year of the project will focus on trials/evaluations, open-source and open framework development and third-party uptake and impact. The success of the project is ultimately measured on the effectiveness of the developed smart city framework and the demonstrators. This will involve demonstrating the economic and societal impacts and improving the quality of life and services around the cities. The dissemination and exploita-

tion activities will also focus on engaging with a wider group of stakeholders to create long-term impact.

I hope you will enjoy reading the second annual report of the CityPulse project. Please send us your feedback and any suggestions that will help us to improve the project and the report.

*CityPulse project coordinator  
Dr. Payam Barnaghi  
Institute for Communication Systems (ICS), University of Surrey, UK  
Email: p.barnaghi@surrey.ac.uk*





# MEET THE CITYPULSE PARTNERS

We set out to ask the partners in CityPulse what is the best thing in the CityPulse project?



## DR. NAZLI FARAJIDAVAR

**Research Fellow, University of Surrey**

*I personally believe that the final goal of the project is to present open-for-all applications that will enhance the general quality of life of citizens. The project also aims to provide real-time analytical tools that can help city authorities to better handle potential problems and organise the city more efficiently.*

## MICHELLE BACH LINDSTRØM

**Project manager, CityPulse coordinator for Aarhus Municipality**

*For me, one of the best features about CityPulse is that I get to work together with a bunch of experts with different fields of expertise; some are strong in various branches of technical development, others are experts in user involvement. Combined, we are a strong IoT and smart city team. So it's a privilege to communicate this project and its results to the different stakeholders.*



## JOÃO FERNANDES

**Specialist Software/ICT Engineer,  
The Alexandra Institute**

*CityPulse is a very challenging project that deals with complex and advanced research topics, while at the same time addressing the needs of the city and its stakeholders by providing innovative solutions and tools to improve the quality of life of citizens. Personally, I think this balance is the key value of the project. Add to that that we have a very passionate and engaged consortium whose members are constantly looking for ways to improve the work they are carrying out, be it software development, engagement with the stakeholders, or scientific paper writing.*



## DR. ALESSANDRA MILEO

**Senior Research Fellow & Adjunct Lecturer  
INSIGHT Research Center, NUI Galway**

*Being able to unlock the potential hidden in this torrent of data would open unprecedented opportunities to improve our daily lives that were not possible before. What data can bring if the relevant pieces are identified and interpreted correctly and in a timely manner is an incredible source of knowledge available at the right place at the right time.*

*No human can achieve this task, not with the vast amount of digital information available; information that is constantly changing. Hence, it is of key importance to materialise the vision that we enable machines to do that for us and help us make better decisions. This is what CityPulse aims to do: enable machines, connected through the internet, to discover, process, link and understand huge and fast-changing amounts of data in order to answer our questions when we need it, and support us in making better decisions. This would save us time and money, improve our health, promote sustainable growth, and, in essence, give us a better life as citizens, businesses and public administrators.*



## SORIN GANEA

**Programme Manager, CityPulse coordinator  
Municipality of Brasov**

*CityPulse has a multi-level impact in Brasov. First of all, it raises the issue of embedding technology into the urban fabric to make the city "talk back" to us, respond to everyone's needs in a particular manner, and make the city more "user-friendly". I know CityPulse is only one step along the way but every step is important for the journey. And Brasov is on a journey to become more attractive, more competitive. All the potential scenarios that were discussed have sparked the interest of various city stakeholders. There is a certain buzz in the city about technology and how it can make our lives easier. People are beginning to wonder what is actually needed to make these scenarios come true, and they are actually taking steps to make that happen.*

## DR. JOSIANE XAVIER PARREIRA

**Senior Research Scientist, Siemens AG Austria**

*Siemens is in close contact with different smart city stakeholders (city administrators, citizens, utilities providers). The great thing about CityPulse is how its goals align with the stakeholders' needs. Also, the consortium is made of very talented people who are eager to collaborate, which makes the work a lot of fun.*



# CITYPULSE – ENABLING SMART CITY USE CASES NEAR YOU

CityPulse provides innovative smart city applications by adopting an integrated approach to the Internet of Things and the Internet of People. Here, the technical coordinator for CityPulse, Dr.-Ing. Ralf Tönjes, elaborates on the motivation for the project and the need for an integrated platform.

## What was your motivation to start the CityPulse project?

Today, cities collect large amounts of valuable data and sensor information. However, this data is not widely used for several reasons: The variety of formats and technologies hinders the use in other domains, which results in specific silo solutions. Moreover, the provided information (e.g. printed timetables) is mainly static and does not reflect the dynamics in a city. And if data is available, it often just resembles big useless data graves because raw data without intrinsic explanation remains meaningless, which hinders automated processing. Hence, we started this project to overcome these obstacles and to enable smart city services.

## Why is CityPulse relevant for the citizens?

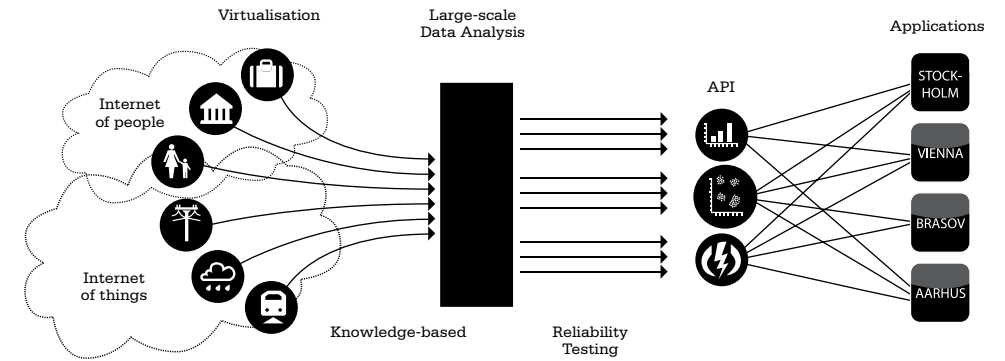
CityPulse supports an open data approach which makes data available to citizens, thus fostering the development of innovative applications that meet people's needs. CityPulse will provide city authorities and citizens with tools for developing and providing real-time cross-domain smart city services. These services will ease urban living by making it easier to find a parking space or

facilitate multimodal transport, to mention but a few examples.

## What has been challenging in the project? Have you learned or experienced something you didn't expect?

The collection of complex multi-domain reference data sets covering the same time period turned out to be more difficult than expected. In fact, cities don't have big data yet in terms of volume. Furthermore, the other "v's" of big data are also a challenge: Variety, which requires dynamic integration of new formats, and velocity, which requires real-time processing of data. The heterogeneity of the data sets and the interpretation in real-time have been challenging. The introduction of an abstraction layer and the iterative top-down bottom-up approach for interpretation, where intelligent reasoning controls the big data processing pipe, has demonstrated good results.

Another issue is the semantic gap between data and meaningful information. The key to overcome this gap was semantic annotation of data that is exploited by knowledge-based reasoning. However, the descriptions of data in native



*CityPulse brings together the Internet of Things and the Internet of People, i.e. social media, thus allowing a better understanding of the dynamics in the city and providing more accurate information that meets people's needs.*

languages resulted in unexpected complications. People's smart phones provide valuable sensor information. To exploit this data, we need to be able to guarantee privacy and provide means for evaluating the accuracy and trustworthiness of the data.

## What can other projects learn from CityPulse?

The close cooperation between the cities, particularly their IT departments, and academic and industrial research environments has fostered a better understanding of the critical issues and the production of tangible results received in both communities: research and cities. To provide information in real-time requires automated processing. CityPulse showed that semantic annotation and knowledge-based reasoning can extract meaningful information from large data sets in time. CityPulse will provide such tools for knowledge-based data analytics in smart city scenarios. Moreover, CityPulse brings together the Internet of Things and the Internet of People, i.e. social media, thus allowing a better understanding of the dynamics in the city and providing more accurate information that meets people's needs.

The fast introduction of smart city services requires reusable building blocks with standard interfaces. A joint effort across domains is required to avoid fragmentation and to ensure a stable basis for long-term investments from city authorities.

*Technical Coordinator for CityPulse  
Prof. Dr.-Ing. Ralf Tönjes  
Chair of Mobile Communications  
University of Applied Sciences Osnabrück, Germany  
Email: r.toenjes@hs-osnabrueck.de*



# EVALUATION TOOL AS THE VOICE OF THE CITIZENS

CityPulse is all about developing smart city use cases based on the CityPulse framework. But how are the smart city use cases chosen? And which of them will be implemented? João Fernandes, responsible for use case evaluation, elaborates on the process.

## **You have created an evaluation tool where citizens and other stakeholders could evaluate 101 scenarios. How did that go?**

The tool has been envisioned as the “voice” of the city stakeholders expressing their interests and perceived value of different smart city scenarios. It has allowed the consortium to select the most relevant scenarios for implementation by collecting the feedback from the stakeholders’ rankings, thereby increasing the expected impact of the prototypes and services developed. Until now, the tool has been used by a considerable number of users who have ranked the different scenarios. Moreover – and also relevant – the tool has captured the attention of the research community, mainly other research projects that would like to further collaborate to enhance the current tool with new scenarios and new functionalities.

## **You aimed for 11 scenarios. Which scenarios are ranked highest at the moment?**

Currently, the highest-ranked scenarios include for example the Smart Elderly Care System. It helps home carers to dynamically optimise their driving routes between homes according to the real-time needs of the elderly. By collecting data from sensors

installed in each home (light switches, water taps, etc.), the system notifies the home carer in case of any emergency. In this way, the system helps municipalities to provide better planning and care for the elderly, as well as security and safety for the elderly and their relatives.

Another high-ranked scenario is the Sustainable Urban Planning Scenario where sensors placed around the city measure meteorological parameters, including noise levels. Using data from these sensors, city officials are able to make better decisions relating to city development. The information helps them to plan new residential areas, more green areas, industrial zones, etc. Moreover, the system is able to alert the authorities in case of pollution and increased levels of harmful substances.

Finally, the users have found the Smart Events Scenario relevant. In this scenario, sensors detect anomalies during big events (for example by means of smoke detectors). Once the location is known, an evacuation of the area is prepared. Transport routes are modified to prevent people from accessing the incident area and to free up capacity to absorb the sudden surge in load on the network if the evacuation is carried out. The system invokes the appropriate emergency plan and requests data feeds



from relevant sensors to monitor the effects of the plan in real time in order to assist with decisions around the timing and method.

## **So what happens now? Are the scenarios going to be implemented in some cities? What will the citizens experience now?**

We are following an iterative process for the implementation of the scenarios where we have a look at the highest ranked scenarios and analyse the feasibility of developing them in the cities of Aarhus, Brasov or Vienna. In our analysis, we check the availability of the required data sources, as well as some other constraints, such as privacy or legislation. Depending on which specific stakeholders a scenario addresses, we will try to involve them in the process of validating and evaluating the effectiveness of the implemented service and application prototypes.

## **What are the plans for the survey and this methodology now? What have you learned from the process?**

It has been a quite positive experience to use such an innovative methodology for involving the city stakeholders. However, it is a learning process and we would like to increase stakeholder participation even more. We might investi-

gate the possibility of using different forms of incentives (intrinsic or extrinsic) in order to motivate citizens to participate even more in the process. Moreover, we are planning to extend the current functionalities of the evaluation tool by enabling citizens to add new scenarios to it. Thus, we will be addressing the use case scenarios that reflect the actual needs of the citizens.

João Fernandes  
Responsible for use case evaluation  
Specialist Software/ICT Engineer  
Smart City Lab, The Alexandra Institute, Denmark  
Email: joao.fernandes@alexandra.dk



# CITYPULSE WILL HELP CITIZENS FIND THEIR WAY IN THE CITY

Dan Puiu shares the details of the first prototype based on the CityPulse platform.

## You have created a prototype based on the CityPulse platform. What does it do?

Yes, with the help of the CityPulse team, we have developed a fully functional prototype, which leverages the data processing power of the CityPulse platform. Our prototype has two main features. First, citizens can use the application to find ideal routes based on the current context. Imagine that you want to go by bike to the local market. You can then use the prototype to find the least crowded and polluted route. The recommendations are very accurate because the prototype analyses, in real time, the traffic and pollution data generated by the sensors deployed in the city. In a similar way, the second feature of the prototype allows the citizens to find the parking garages closest to their point of interest.

## Why are prototypes like this relevant at all for the citizens?

With a platform like CityPulse, the city administrators can very easily create new custom-made applications for the citizens, maybe with some help from third-party development companies. Even citizens with a bit of IT background can use the platform to develop applications based on their needs.

In conclusion, the CityPulse platform is designed to be used by application developers, and ultimately, citizens will receive a wide range of new custom-made applications that deliver new services by processing the data generated in the smart cities.

## What were your experiences when you created this first prototype?

This prototype is important because it drove, in parallel, the development and integration activities of the CityPulse platform components. Since the CityPulse partners are scattered across Europe, we had to organise a lot of video conferences to drive the integration process. We have even met for a whole week in Galway (Ireland). Now the platform is ready, and I expect the development of the following prototypes to go very smoothly.

## What has the response been on the prototype?

We have demonstrated the features of the prototype at several conferences and city stakeholder workshops. In general, the feedback we received on the platform and prototype was very positive. Everybody is attracted by the flexibility and ver-

*The first prototype based on the CityPulse platform, the "context-aware multimodal real time travel planner" was tested in Aarhus. It's an app that helps citizens to find ideal routes through the city.*

satility of the platform. The parking feature of the application proved to be useful. During the Aarhus stakeholder workshop, an end-user mentioned that there already exist similar applications that provide route recommendations, maybe not as advanced and accurate as ours. The feedback from Brasov was very positive for both prototype features, and now we are working to migrate the application for this city too.

## What are your next plans? Will the prototype be further developed? Will you create new prototypes and test those as well?

As I already mentioned, we are working to migrate the prototype for the city of Brasov. At this moment in time, the prototype is not mature enough to be left to run alone. In the near future, we plan to increase the stability of the platform and actually consider making the application available in Android Store. The next year of the project will mostly be dedicated to developing new prototypes using the CityPulse platform, and now we are working to define the best scenarios based on citizen needs, open data availability and platform features. We also consider organising a hackathon workshop where the participants can use the CityPulse platform to develop new applications.

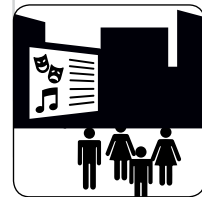


*Dan Puiu  
Responsible for development of smart city services  
Research engineer  
Siemens, Romania,  
Email: dan.puiu@siemens.com*

# THE 101 SCENARIOS OF CITYPULSE



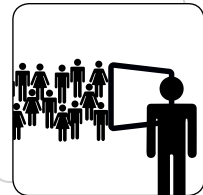
**SECTOR: TRANSPORT**  
**Scenario 20: Efficient public transport:**  
<http://www.ict-citypulse.eu/scenarios/scenario/20>



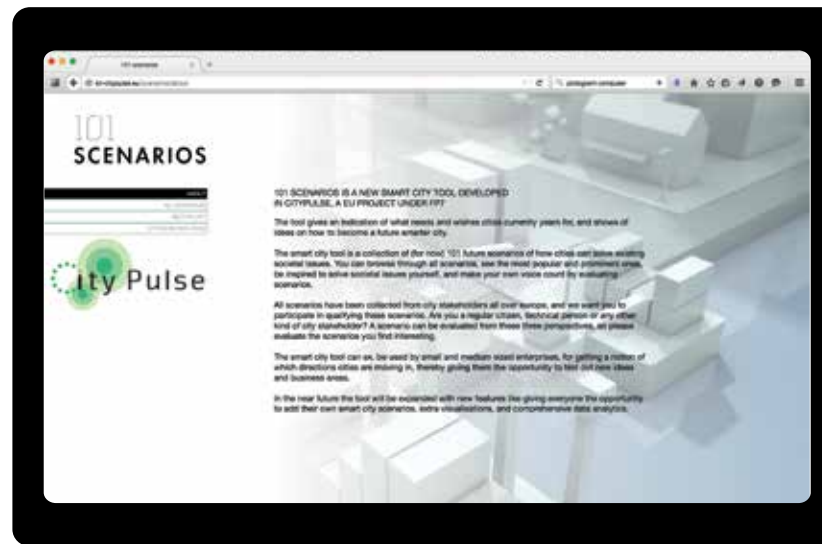
**SECTOR: CULTURAL**  
**Scenario 68: Cultural information**  
<http://www.ict-citypulse.eu/scenarios/scenario/68>



**SECTOR: RETAIL**  
**Scenario 88: Intelligent shopping application**  
<http://www.ict-citypulse.eu/scenarios/scenario/88>



**SECTOR: ENVIRONMENT**  
**Scenario 72: Smart events**  
<http://www.ict-citypulse.eu/scenarios/scenario/72>



**SECTOR: TRANSPORT**  
**Scenario 20: Efficient public transport:**  
<http://www.ict-citypulse.eu/scenarios/scenario/20>



**SECTOR: PUBLIC**  
**Scenario 22 : Improvement of GIS real time information through smartphone apps**  
<http://www.ict-citypulse.eu/scenarios/scenario/22>



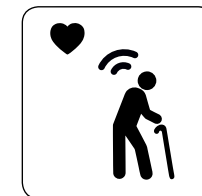
**SECTOR: ENERGY**  
**Scenario 40: Smart/green buildings**  
<http://www.ict-citypulse.eu/scenarios/scenario/40>

**WOULD YOU LIKE TO READ MORE ABOUT THE CITYPULSE SMART CITY SCENARIOS?**

Go to:  
<http://www.ict-citypulse.eu/scenarios/>  
 and see all 101!



**SECTOR: AGRICULTURE**  
**Scenario 5: Urban crowd sourced collective micro agriculture**  
<http://www.ict-citypulse.eu/scenarios/scenario/5>



**SECTOR: HEALTHCARE**  
**Scenario 78: Ageing population – Alzheimers disease**  
<http://www.ict-citypulse.eu/scenarios/scenario/78>

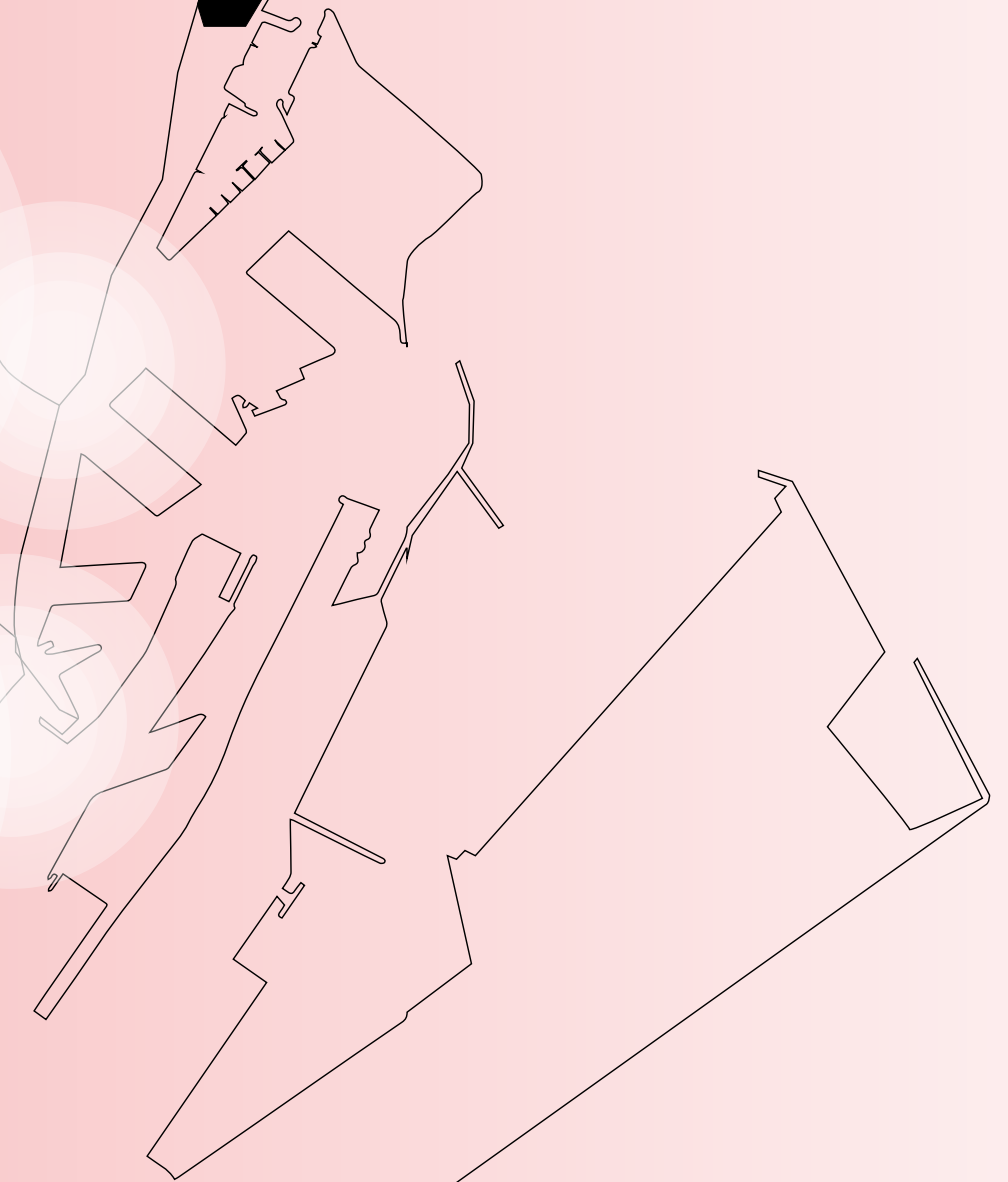
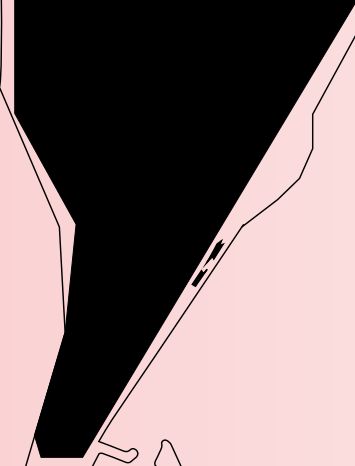
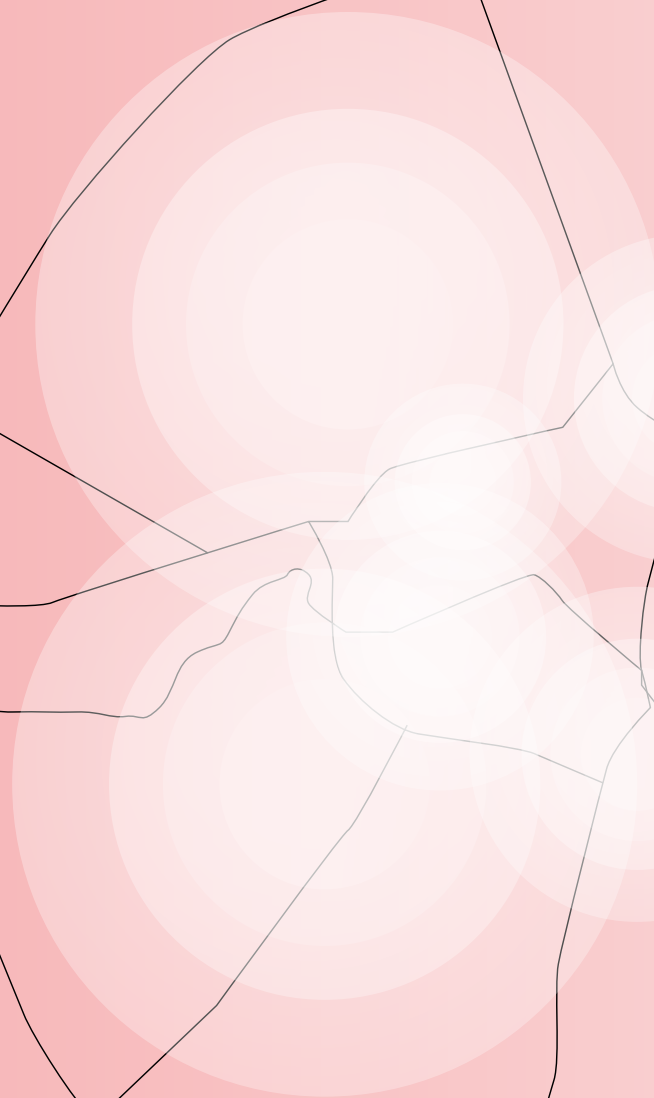
CITYPULSE IS CENTRED AROUND THREE CITIES ACROSS EUROPE: AARHUS IN DENMARK, BRASOV IN ROMANIA AND VIENNA IN AUSTRIA. WE ASKED THREE CITIZENS FROM EACH CITY WHICH CITYPULSE SMART CITY SCENARIOS THEY WOULD LIKE TO SEE IMPLEMENTED IN THEIR CITY. READ ON TO SEE THEM



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BB  
CC

SS



CITY:  
AARHUS  
NAME:  
MARIANNE KROGBÆK  
AGE:  
35 YEARS  
PROFESSION:  
DESIGNER



### SMART CITY USE CASE CAN HELP ME TO GET INVOLVED IN MY NEIGHBOURHOOD

*My neighbourhood is one that some people might see as less desirable to live in. From an outside perspective, it may seem bleak with its many blocks of flats and all kinds of people who are different from me and all strangers. However, having lived here for five years now, it has revealed itself as a place with an interesting diversity of people and homes. Both teenagers and elderly people are now my friends that I have talked to and visited.*

*And the reason for that is that I have chosen to get involved. I decided to start talking to people, to get involved in an urban garden project and to have my daughter in the local school.*

*To me the Urban Crowdsourced Collective Micro Agriculture Scenario is the most desirable for my city, and more specifically for my neighbourhood. Perhaps young people are not interested in agriculture as such, but a lot of (maker) activities around agriculture could be of interest to them. And working with gardening releases endorphins in the brain – that's a fact!*



SEE THE URBAN CROWD SOURCED COLLECTIVE MICRO AGRICULTURE SCENARIO HERE:  
[HTTP://WWW.ICT-CITYPULSE.EU/SCENARIOS/SCENARIO/5](http://www.ict-citypulse.eu/scenarios/scenario/5)

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**MY DAILY TRIPS CAN BECOME MORE EFFICIENT AND CONVENIENT. AT THE SAME TIME I PROTECT THE ENVIRONMENT.**

*I would love to see a scenario like Efficient of Public Transport implemented in Brasov. I think it would make a great contribution to the city traffic if the number of cars was reduced and more people were encouraged to use public transport.*

*I usually make two trips every day – to and from work. However, when going back from work, I usually need to go to various points in the city like the shopping mall, university, the city centre, etc. It is difficult to find a good parking spot. Also, I spend a lot of time in traffic at junctions or traffic lights. By improving the quality of public transport, I could use the time saved to connect to the Internet on the bus and read my emails; maybe learn about events in the city from panels at the bus station or even through the bus information system. I feel I could make better use of my time this way instead of being stuck behind the wheel looking for a decent parking space. And most importantly, most of the places I need to go to have*

*a bus stop in the vicinity, so it would be very convenient for me. Plus, with all the available data sources properly used, I would be able to check the bus schedule on my phone and buy the ticket in the same way.*

*Basically, technology would transform all the bad things related to public transport into something useful – perhaps even interesting. Waiting for the bus would not be a hassle anymore because I would have the possibility to check arrival times and navigate the Internet in the meantime. On top of all this, I would save money and protect the environment. What more could you ask for?*

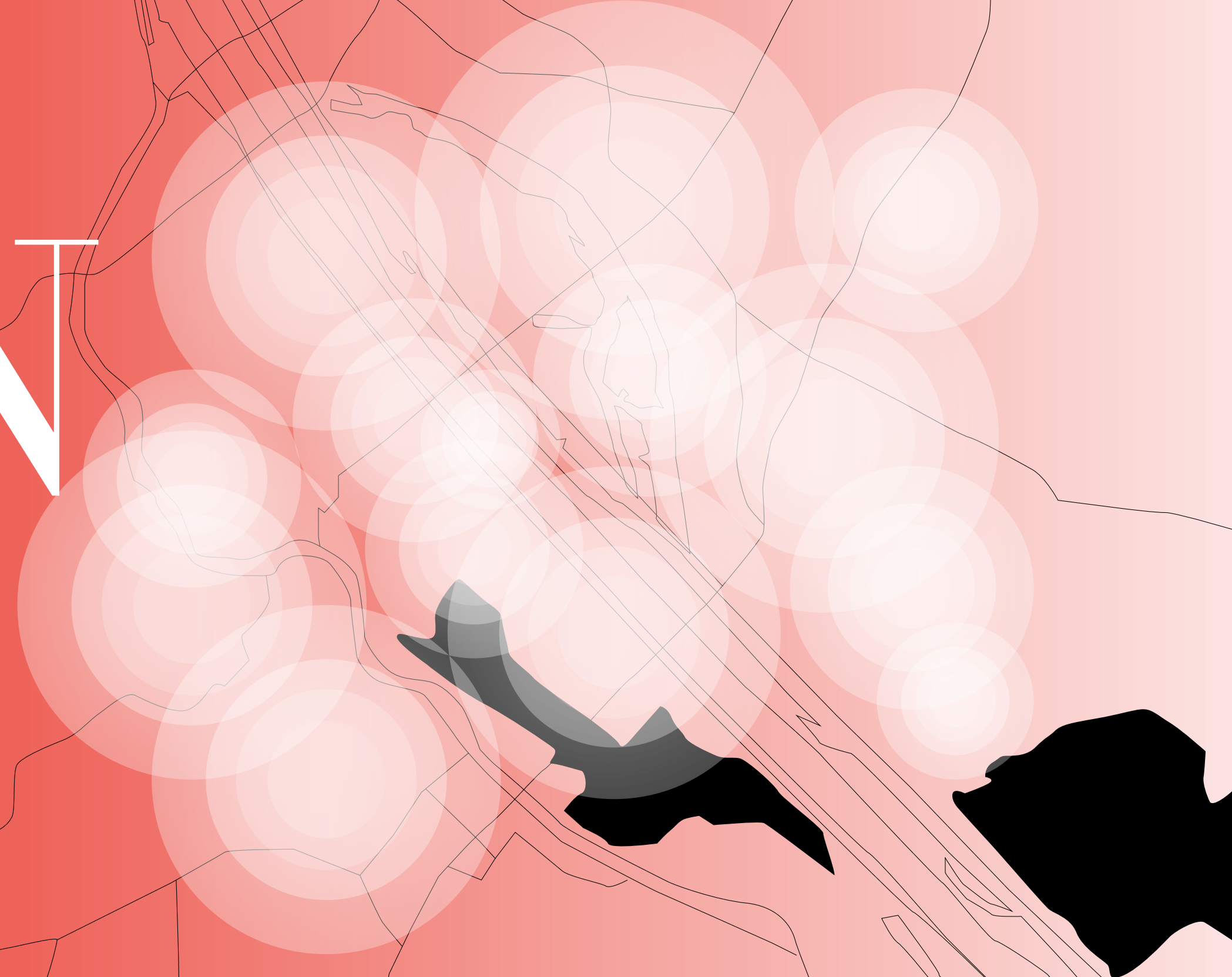


SEE THE EFFICIENT PUBLIC TRANSPORT SCENARIO HERE:  
[HTTP://WWW.ICT-CITYPULSE.EU/SCENARIOS/SCENARIO/20](http://www.ict-citypulse.eu/scenarios/scenario/20)

**CITY:  
BRASOV  
NAME:  
ALEX TROFIM  
AGE:  
25 YEARS  
PROFESSION:  
SENIOR GRAPHIC  
DESIGNER  
(FREELANCE)**



W  
E  
N  
A





CITY:  
VIENNA  
NAME:  
JURGEN UMBRICH  
AGE:  
33 YEARS  
PROFESSION:  
ASSISTANT  
PROFESSOR



**A REAL-TIME UPDATED CITY MAP WILL IMPROVE THE DAILY LIVES OF CITIZENS**

*It's difficult to choose between the different scenarios since they cover different domains and stakeholders. Nevertheless, I would like to see the scenario Improvement of GIS Real-Time Information Through Smartphone Apps implemented, as I believe it would have the most impact on several domains, such as tourism, smart emergency, accessibility, and social life.*

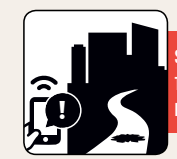
*A real-time GIS app that provides the newest and most accurate information about buildings, streets, parks, metro/elevator access, construction sites or other points of interest, such as toilets and sightseeing places, would improve my daily life and the lives of citizens and tourists. Such an app would help me to navigate through the city in the most convenient and safe way, whether I am on foot or wheels (e.g. bike, inline skates or wheelchair).*

*The app would for instance help me to safely navigate and cycle at night along routes with limited visibility (less light) or help me to create an inline skating route through the city past*

*many interesting landmarks and sightseeing spots. Furthermore, I could use the app to find shops (supermarkets, furniture store etc.) within walking distance, considering that I have a baby stroller.*

*Clearly, such an improved service would not only benefit myself but also others. In general, real-time GIS information would also help citizens and tourists in many situations, from providing more accurate, real-time information about barrier-free access and routing for disabled people, to helping emergency service people to access locations (e.g. parking places for fire trucks, evacuation routes, or finding the nearest defibrillator).*

*In my opinion, a service that provides accurate, real-time information about the landscape of a city can have a real impact on the daily lives of the citizens.*



SEE THE IMPROVEMENT OF GIS REAL TIME INFORMATION THROUGH SMARTPHONE APPS SCENARIO HERE:  
[HTTP://WWW.ICT-CITYPULSE.EU/SCENARIOS/SCENARIO/22](http://www.ict-citypulse.eu/scenarios/scenario/22)



# THE CITYPULSE PLATFORM: INTEGRATING THE INTERNET OF PEOPLE

The CityPulse platform will not only be able to integrate and annotate data sources from various city systems. It will also be able to integrate streams from Twitter. Dr. Nazli Farajidavar explains her thoughts on this feature.

## Can you explain what you have created?

– Our software, the Citypulse Social media NLP (Natural Language Processing) is currently designed to annotate tweets. The annotated tweets have been grouped into eight city-related categories: ‘Transportation Event’, ‘Environmental Event’, ‘Social Event’, ‘Cultural Event’, ‘Criminal Event’, ‘Sport Event’, ‘Food Event’ and ‘Health Event’ and are finally displayed on a Google map. The proposed categories are the general event classes, which on their own might in a way affect the cities’ daily pattern. They are also detected to be the main and most discussed Twitter topics contributing to urban and environmental changes within a city.

Upon request, these categorically annotated Tweets can be used in different ways. An example would be to use them for depicting user specific interests (constructing user profiles). Moreover, their cross-mutual correlations can affect city-specific patterns, i.e. a high volume of ‘Cultural Event’-annotated tweets in a specific location can infer the need for establishing public parking in the vicinity of that location. Another aspect would be to link them with other sources of sensor data, such as weather and traffic sensor data for a more comprehensive and closer to reliability to decision-making.

A more long-term goal would be to have an urban-specific social media where citizens can more efficiently contribute to organising and managing their environment by reporting events. In other words: an open platform, for example a mobile app, where people can share their views on the city and perhaps report environmental problems.

In practice, this can be launched as a city-specific social media app that passes people’s comments on to the authorities and helps to improve the quality of life. But this is just me gazing into the future – whether this use case is demanded by the citizens and stakeholders, we will see.

## What difficulties have you experienced when creating the CityPulse social media NLP?

– Currently, the CityPulse framework does not use the Twitter analysis tool for the following reasons:

- 1) The CityPulse data confusion algorithms are still to be studied and finalised.
- 2) The NLP Tweets annotation tool is designed for English text and its efficiency on Danish-to-English translated Tweets needs yet to be tested.



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3) The Twitter privacy setting does not allow us to collect enough data from cities with small populations such as Aarhus and Brasov, due to Twitter privacy policies. This can in fact affect the final fusion plan as the sensor streams have been collected from these two locations.

## Can companies, SMEs and other organisations benefit from your findings? And how?

– The live London tweet map is already open to the public at <http://iot.ee.surrey.ac.uk/citypulse-social/>.

The NLP tool will also become available as an open source tool by early 2016 and will most probably be integrated in KAT (Knowledge Acquisition Tool), which is the University of Surrey’s software platform (<http://kat.ee.surrey.ac.uk>)

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