



Smart city concepts in Curitiba

Low-carbon transport and mobility in a digital society

NEWSLETTER, December 2020



This newsletter aims at disseminating information on the on-going collaboration between Swedish and Brazilian partners in the City of Curitiba. The cooperation started in 2013 and involves multiple partners in various projects.

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Swedish Brazilian collaboration on urban sustainability

New project addresses mobility challenges in Curitiba

A consortium of Swedish and Brazilian universities and companies has been developing studies and demonstration activities to promote sustainable urban mobility since 2013. A new project brings together ten partners to address new challenges, having Curitiba as living-lab.

Smart City Concepts in Curitiba – low-carbon transport and mobility in a digital society explores the transformational change needed to make urban transport and mobility energy efficient, low-carbon and sustainable.

The key objectives of the project are:

- (i) to develop innovative and smart solutions for promoting low-carbon transport pathways for citizens and goods;
- (ii) to identify ways to improve resource and service efficiency in the urban context; and
- (iii) to explore how digitalization can catalyze system transformations for improved sustainability in transport and energy service provision, while also promoting emissions reduction and prosperity.



The project develops data and technology sourcing and analysis, energy and emissions balances for different transport solutions and fuels, and enhanced engagement of the public. Scenarios for smart mobility of people and goods and a 3D digital reality platform will provide decision support for transport and mobility planning.

On the Swedish side, the project is led by Chalmers University of Technology and Sustainable Vision AB, and funded by VINNOVA, Sweden's Innovation Agency. On the Brazilian side, the project is led by UTFPR – Federal Technology University of Paraná. Altogether, there are ten partners involved.

The new project strengthens the innovative agenda defined by Sweden and Brazil in the context of smart cities. The transdisciplinary approach adopted promotes co-creation of solutions, and facilitates the transition towards sustainable and smart mobility of people and goods in the urban environment. The research and demonstration activities proposed are aligned with the global sustainability agenda and the goals defined by the City of Curitiba.

For more information, visit the homepage

<https://smartcityconcepts.chalmers.se/>

Urban mobility challenges in the digital era

Kick-off seminar in the Swedish Innovation Weeks in Brazil

Urban transport and energy services are key enabling functions for mobility and urban development. At the same time, digital infrastructure is increasingly central for innovation in all sectors of society.

An event organized on the 9th November as part of the Innovation Weeks 2020 in Brazil discussed how Sweden and Brazil are addressing the challenges of urban mobility using expertise in transport, energy and information technology to provide safe, efficient and low-carbon mobility. The seminar was the official kick-off of the new project in Curitiba.



The innovation weeks are organized annually by Team Sweden in Brazil to promote innovation in smart cities, bioeconomy, mining and materials and health. Multiple actors join the discussions every year

Watch the presentations from 2020 at:

<https://inovacaosueciabrasil.com.br/en/home/>

Watch the presentation/kick-off of the project Smart City Concepts, and learn about some of the challenges addressed in the project

<https://www.youtube.com/watch?v=hrHI88fTI-k&feature=youtu.be>

Availability-Guaranteed Service Function Chain Provisioning with Optional Shared Backups

Project conference paper published in March 2020

Traditional infrastructure providers commonly deploy telecom services (f. ex., Web Service, VoIP, and Video Conference) using dedicated middle-boxes. The latter is equipment designed to run a given set of network functions. This approach has the advantage of guaranteeing the desired performance.

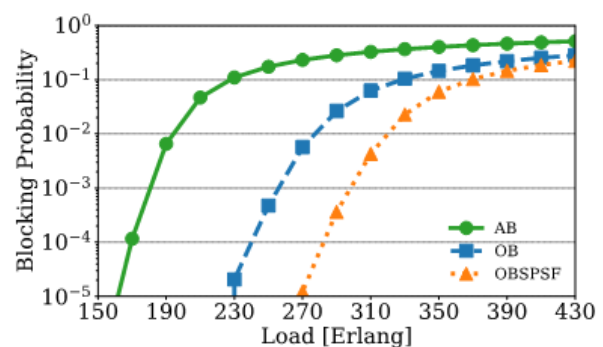
However, the cost of using dedicated hardware does not scale well in 5G scenarios in which infrastructure providers might have to over-provide middle-boxes to account for worst-case scenarios when providing services. This means hardware resources are often underutilized.

One solution to this problem is to deploy Commercial-Off-The-Shelf (COTS) hardware over which Virtual Network Functions (VNFs) can be run, following the Network Function Virtualization (NFV). Traditional telecom services can then be re-defined in terms of Service Function Chains (SFCs) where virtualized network functions are dynamically composed and provisioned to accommodate the requirements of the service, be it connectivity, processing or availability. This allows more cost-efficient use of the connectivity and compute resources in the network infrastructure.

A recent paper of the project team presents a strategy called Optional Backup with Shared Path and Shared Function (OBSPSF). It is a

resource-efficient algorithm that can be used to dynamically provide availability-guaranteed SFCs.

A cost function is also introduced. For each candidate SFC provisioning solution, it will: (i) assign backup resources only when strictly needed, and (ii) reduce the resource consumption of the backup SFCs by encouraging re-



source sharing of both the connectivity and the VNFs backup resources.

Service Blocking Probability as a function of network load

Performance results can be seen in the Figure above. It shows that OBSPSF can drastically reduce the service blocking probability in low-to-medium loads compared to traditional benchmark heuristics taken from the literature, for example, Always Backup (AB) and Optional Backup (OB).

Meireles de Araújo, C. Natalino, H. Chen, M. De Andrade Jardim, D. Cardoso, P. Monti, "Availability-Guaranteed Service Function Chain Provisioning with Optional Shared Backups," in Proc. International Con-



The question of water has received increased attention in the context of access to clean water and sanitation. However, there are also other aspects to the issue. Water floods can cause disruptions in urban services and multiple impacts. In the project *Smart City Concepts*, we look at ways to monitor floods digitally to better manage mobility in a context of crisis.



<https://www.youtube.com/watch?v=ASv-UMFdEfE&t=4326s>



Prof Selma Cubas, UFPR, member of the organization committee, led the webinar on Bioeconomy and Water Reuse in which Semida Silveira, Sustainable Vision made a presentation including examples from Sweden

Smart cities and their relationship with water

3rd International Symposium on Water Reuse

Water scarcity is an increasing problem in Brazil and around the world. The problem is also related to the lack of sanitation. There is no smart city without water and sanitation. The reuse of water is an intelligent and sustainable way to support access to clean water and sanitation.

According to the director of the Brazilian Association of Sanitary and Environmental Engineering of Paraná (Abes-PR), Karen do Amaral, Brazil lacks tradition and incentives for water reuse. *“There has been little evolution in Brazil since the 1997 legislation and we still do not have a policy for reuse”* – she explains.

In this context, Abes-PR and partner institutions organized the *3rd International Symposium on Water Reuse - Smart Cities and their Relationship with Water*. The symposium was digital and streamed live, November 16 to 23, 2020. National and international experts discussed this fundamental issue in the management of water resources. In addition to expert meetings, Abes-PR created an educational campaign to raise public awareness on the rational use of water.

The question of water reuse is broad and involves many challenges including the demand & supply of water for various purposes, the need to minimize impacts on the environment, and the importance of guaranteeing public health. It requires technological improvements to change the way water flows are engineered, services are provided and the use of resources optimized. Public poli-

cies can help create incentives for water reuse, while research and development will support implementation of integrated systems.

In the context of the circular bioeconomy for smart cities, there is need for alignment among different sectors to promote sustainable solutions across the border. Clearly, water treatment systems will need technological innovation not only to clean water but also to recover nutrients and generate energy. This will require incentives for water reuse, new management practices, and investments in infrastructure.

The 3rd International Symposium on Water Reuse helped shape and strengthen the debate on water reuse. It offered inspiration on management practices to public managers, legislators, technicians, engineers, researchers and experts. Moreover, by opening the digital event, the whole population was invited to engage. There were 2,500 registrations across Brazil, and the webinars had more than 10,000 visualizations during November only. Webinars available at www.youtube.com/channel/UC0GbTGofTG_Nk983GDutS2Q/videos

The discussions on water reuse will continue in the 31st ABES 2021 Congress to be organized in Curitiba. The key theme is: Intelligent Cities connected with sanitation and the environment – challenges of the new times. Coming at :

<http://abes-dn.org.br/abeseventos/31cbesa/>

How can public participation help improve mobility services?

Exploring the role of citizens in the 156 channel used in Curitiba

The Project *Smart City Concepts* aims at exploring implementable solutions for sustainable mobility in cooperation with multiple stakeholders. This includes the participation of the community at large.

The team is examining different models for citizen interactions with city planners and service providers. The idea is to improve or enhance existing services using digital platforms. Ultimately, information provided by citizens can be integrated with various data and monitoring tools, and serve to improve the provision of mobility services.

The **156** is Curitiba's main online communication channel for citizens in Curitiba. The Citizen Service Center offers a telephone number, an application for mobile phones and a digital platform, all managed by the Municipal Secretariat. Through this channel, citizens can register requests for traffic inspection, waste collection, tree pruning, social street approach, repairs to sidewalks, among others.

The **156** channel is well known and used by the citizens. In October alone, the municipality received 438,000 requests. The demand for services has been stable since 2018 according to statistics provided by the site (<http://www.central156.org.br/>).

Team members of the *Smart City Concepts* recently (Nov 2020) met Curitiba's 156 service managers and data analysts. The idea was to discuss the current model of operation of the 156 channel, and explore potential improvements to boost its usage as a tool for dialogue.

Data classification and methods for linking other open data from the city database will be studied to better understand the 156 users (citizens and city managers), improve the channel usage, and enhance citizen participation.

For example, another platform "Fala Curitiba" allows citizens to provide inputs to the city budget. Data integration with "Fala Curitiba" as well as joint data analysis could provide new insights. Studies on data management, presentation models for information acquired from collected data as well as data provenance techniques are issues that the group agreed to explore.

One specific study of interest would be a comparison of data gathered in previous analysis with data from the current pandemic period. This would serve to set possible meta-scenarios for challenges to be addressed in the current project, particularly regarding low carbon transportation goals.



Microscopic traffic model with cooperative driving for energy savings

Exploring the role of citizens in the 156 channel used in Curitiba

Microscopic traffic models simulate the behavior of vehicles and drivers during events of start/stop motion in urban traffic, as close as possible to the real-world behavior. For instance, the *Car-Following Model* (CFM) is used in the microscopic traffic simulator SUMO. Basically, such models are composed of dynamic models of vehicles, and the drivers' reactions when facing traffic events. For instance, a driver's reaction to red light at an intersection relates to the proximity of other vehicles, and is subject to the vehicle's dynamics.

A new generation of *Connected Vehicles* is coming up which involves communication with the road infrastructure and with other vehicles. This opens new possibilities to improve the behavior of drivers and vehicles in traffic events. The new approach is synthesized in *Cooperative Driving Systems* (CDS) that have the potential to enhance traffic flow efficiency by sharing traffic information through *Vehicular Ad-hoc Networks* (VANET).

However, the analysis and assessment of CDS, particularly when it comes to energy efficiency, requires a combination of vehicular communication and traffic models. This combined approach still requires further development.

Alvaro Amaya* has proposed an approach to embed a modified car-following model (CFM) into a network simulator, and evaluate

potential energy savings in electric vehicles. The customized software allows an evaluation of energy savings, for example at a scenario of two-crossing roads, where vehicles can share information about their positions and speeds through a VANET. Preliminary results indicate potential energy savings in the batteries amounting to 22.2 % when compared with the basic CFM.

Given these promising energy efficiency improvements, we consider the adaptation of the same approach applied to goods transport in urban areas, where truck fleets operate in dense traffic requiring constant start/stop movements. The initial ideas were discussed with professors Ricardo Lüders and Alexandre Pohl from UTFPR, and professor Erik Jennelius in the scope of the project Smart City Concepts. Alvaro Amaya's work could therefore be connected to the project soon.

Read more at:

Y. Li, Z. Zhong, K. Zhang, and T. Zheng, "A car-following model for electric vehicle traffic flow based on optimal energy consumption", *Physica A: Statistical Mechanics and its Applications*, vol. 533, p.122022, nov 2019.

* Álvaro Maya is a Colombian PhD student registered in the Graduate Program in Electrical and Computer Engineering at UTFPR, Curitiba. His work is funded by CAPES (Brazil) through the program PEC-PG that brings students mainly from Latin America and Africa to study in Brazil.



Mayor Rafael Greca re-elected

Rafael Greca was re-elected mayor of Curitiba in the 2020 municipal elections held in Brazil on 15th November. He received 60% of the votes in the first round, which gave him a strong mandate. Rafael Greca has a well-defined program for his next period, which includes issues related to health, education, mobility and the environment.

We congratulate Mayor Rafael Greca and look forward to continued collaboration with his administration to develop innovative solutions in Curitiba.



Mayor Rafael Greca, Curitiba. He was mayor 1993-1996 and 2017-2020. This will be his third mandate to lead the City.



Mobility pos-pandemic – designing models for sustainable mobility

Sustainability Turn-over 2020 (Virada Sustentável) was a series of panels discussing sustainability promoted in the State of São Paulo. At this occasion, Scania organized a webinar to discuss models for sustainable mobility.

Scania is a major player in mobility solutions and we have explored potential cooperation through the **Smart City Concepts** in Curitiba.

To watch the discussions (in Portuguese)

https://www.youtube.com/watch?v=gaX_5o8p2eM (1:18)



Local politician Dudu Moreira coordinated a live discussion on cooperation between public entities and academia. **Smart City Concepts** served as illustration of a successful partnership achieved in Curitiba. Prof. Keiko Fonseca, UTFPR; Prof. Semida Silveira, KTH; Rosane Kupka, former secretary of international affairs Curitiba, three pioneers of the cooperation, participated in the discussions, reviving the process. Watch here:

www.facebook.com/watch/live/?v=1147476985629505&ref=watch_permalink