

1

# Smart city concepts in Curitiba

## Low-carbon transport and mobility in a digital society

## **NEWSLETTER, September 2021**



Curitiba, Carlos Gomes Square. Image of Daniel Castellano

Newsletter of the ongoing collaboration between Swedish and Brazilian partners in the City of Curitiba. The cooperation started in 2013 and involves multiple partners in various projects.

Newsletter managing editor: Semida Silveira Contact: <u>Semida.silveira@svision.se</u>



2

### Missed our webinar on June 15?

Watch the video https://www.youtube.com/watch?v=apTOuzMQjDA





https://smartcityconcepts.chalmers.se/

## Total Cost of Ownership of Digital vs. Analog Radio-over-Fiber Architectures for 5G Networks

The fifth generation (5G) of mobile networks sets high goals of scalability, reliability and energy efficiency. Meeting these requirements at reasonable cost requires significant technological advances in both the wireless and the optical transport segments.

Moreover, wireless and optical technologies must be seamlessly integrated to leverage on the complementary advantages that each segment presents (i.e., huge bandwidth, long range and low maintenance on the optical side, high mobility and ubiquity on the wireless side). The integration of these two technologies gives birth to a hybrid Fiber-Wireless (FiWi) network infrastructure.

If the integration takes place at the physical (PHY) layer only, the technique is referred to as Radio-over-Fiber (RoF). RoF-based architectures present some limitations (e.g., susceptibility to transmission impairments, cost, and energy efficiency) that might prevent their wide application. Despite a considerable number of studies addressing various aspects of RoF architectures, the impact of RoF solu-

tions on the total cost of ownership (TCO) of 5G networks remains an open question, which answer would help determine the best RoF alternative for each specific condition.

A recent paper by our project team answers these questions by presenting a thorough TCO assessment of the mobile fronthaul (MFH) segment of a 5G mobile network. This work is carried out for a few MFH deployment scenarios (i.e., intermediate frequency (IF) analog RoF (IF-A-RoF), digital signal processing (DSP)-assisted analog RoF (DSP-A-RoF), or digital RoF (D-RoF)).

Contrary to expectations, fiber trenching has a minor impact on the CAPEX regardless of the RoF architecture. On the other hand, fiber leasing is cost-ineffective when MFH networks are based on D-RoF architectures.

Read the whole paper to know more:

A. Udalcovs et al., "Total Cost of Ownership of Digital vs. Analog Radio-Over-Fiber Architectures for 5G Fronthauling," in IEEE Access, vol. 8, pp. 223562-223573, 2020, doi: 10.1109/ACCESS.2020.3044396.



Scenarios under exam for the TCO assessment: (a) D-RoF, (b) IF -A-RoF and (c) DSP-A-RoF. Acronyms: ME – metro edge, BH – backhaul, BBU – baseband unit, MFH – mobile fronthaul, RRU – remote radio unit, MIMO – multiple-input and multiple-output, LO – local oscillator, TX – transmitter, RX – receiver, AMP – amplifier.

## Policy Tools for the Decarbonisation of Urban Freight Transport in Brazil A Total Cost of Ownership Analysis

Global transport accounts for approximately 23% of total energy-related CO2 emissions. Decarbonisation of the transport sector is thus imperative when addressing climate change. One important measure in this direction is the introduction of electric vehicles to reduce dependence on fossil fuels. In fact, many countries have policies in place to promote electrification of the transport sector.

Few studies have addressed the competitiveness of electric vehicles in the Brazilian context. In a quantitative study, we have looked into the total cost of ownership (TCO) of light commercial vehicles (LCVs) in the context of Curitiba and the state of Paraná in Brazil. Two diesel vans currently used in the city, and their electric counterparts, were considered in the analysis - the Sprinter van by Mercedes-Benz and the Master van by Renault.

The results showed that the TCO of the electric LCVs is between 1.6 to 1.7 times higher than their diesel versions mostly due to larger investment costs. The Mercedes-Benz Sprinter had a higher TCO than the Renault Master for both the diesel and electric versions, with a difference around 7.5% for the diesel version and approximately 13% for the electric version.

However, fuel costs also play an important part in the TCO. Interestingly, a sensitivity analysis indicated that the TCO for the electric and diesel vans were similar when using the highest price of diesel and the lowest price for electricity (i.e. off-peak tariff charged by COPEL, the electricity company in Paraná).

Although the promotion of electro-mobility is ongoing in the city of Curitiba – and the rest of Brazil – there is still a long way to go before high penetration of electric vehicles is achieved. This study contributes an important finding. It suggests that policies designed to promote the adoption of electric vehicles for commercial purposes should carefully consider diesel and electricity prices.

The study was carried out as a master thesis by Raghav Somayya MANDANA at KTH. The thesis can be download from



Image of Curitiba by Maria do Carmo Duarte Freitas in Pixabay.



Passaúna reservoir in Curitiba-PR on May, 2019

Passaúna reservoir in Curitiba-PR on May, 2020

5

#### Water and Sanitation Issues

#### Discussing challenges and opportunities for innovation in Paraná

Risks of water shortage are increasingly underlining the debate on water and sanitation services, motivating research and actions to save and reuse water. How can universities and service providers cooperate to address the challenges of water and sanitation?

Our project partners joined SANEPAR in a webinar in June 6<sup>th</sup> 2021 to discuss challenges and ideas for joint projects. SANEPAR (<u>www.sanepar.com.br</u>) is the company that provides water services in Paraná State. It is responsible for acquisition, treatment, storage, and distribution of water to several cities in Paraná.

Topics of discussion between the 40 participants that joined the discussion included operational issues such as water leakages and flood detection, sustainability and water security concerns, and technological innovation, for example for water plant automation.

In Paraná, considerable changes have been observed in water reservoirs due to long dry periods. The figures above show the reservoir of Passaúna in 2019 and 2020, respectively, illustrating significant reduction in water levels.

By now, the use of artesian wells is widespread in Paraná as illustrated in Figure 3. As surface water scarcity increases, the use of underground water intensifies. There is reason to research the implications of intensified use of underground water as much as variations in surface water particularly as climate change may exacerbate extreme weather conditions and water scarcity.



https://smartcityconcepts.chalmers.se/

## SAVE THE DATE: Webinar 4<sup>th</sup> of June 2021

## SMART CITY CONCEPTS

Low carbon transport in a digital society

The city of Curitiba in Brazil aims at carbon neutrality in 2050. This *Project* supports the overarching sustainability goals of the municipal government and brings technological system innovation to the forefront as a way to enhance planning capabilities and the quality of the urban services.

https://smartcityconcepts.chalmers.se/

## Opportunities for cooperation between Sweden and Brazil

Call announcement by VINNOVA, EMBRAPII and SENAI

## VINNOVA

Sweden's innovation agency building innovation capacity and contributing to sustainable growth www.vinnova.se

# EMBRAPII

Brazilian agency supporting technological research to foster innovation in the Brazilian industry. https://embrapii.org.br/en/

wannuno SENAI

Brazilian institutes connecting academic and business communities to promote innovation. http://institutos.senai.br/english.html The cooperation between Sweden and Brazil is growing in many different areas. There are opportunities and funding to start new projects. 6

A new call for proposals was announced by VINNOVA in cooperation with EMBRAPII and SENAL

VINNOVA can grant up to SEK 3 million per project. The total budget in this call for proposals is SEK 24 million, so the idea is to fund some 7-8 innovation projects. The support from VINNOVA applies to compensation for the Swedish actors, while Brazilian partners will receive support from EMBRAPII or SENAL

