Secure Resource-Sharing in High-Density Smart-City Networks

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A good presentation
should be about an idea,
not about a paper!

Research Funding Proposal

NWO Application - Main Applicants

Eindhoven University of Technology

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- Bauke de Vries
- Ton Koonen
- Ignas Niemegeers
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Where innovation starts

Tilburg University

- Spyros Angelopoulos
- René Schalk
- Reinout Wibier
- Ksenia Podoynitsyna
- Stéphanie van Gulijk

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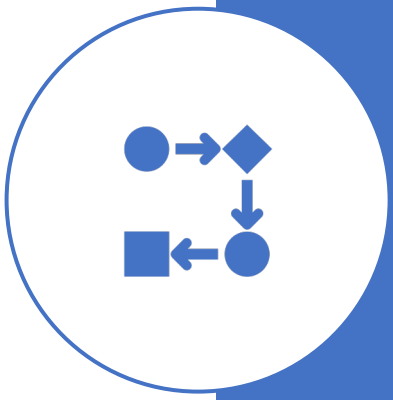
The Process

- ✓ Indication of Interest
- ✓ Pre-Proposal
- ✓ Reviews
- ✓ Response
- Full Proposal
- Reviews
- Response
- Do stuff



The Title

City2Share:

Secure **Resource-Sharing** in

High-Density Smart-City Networks

Smart City

An urban area that uses IoT sensors to collect data and use them to manage assets and resources efficiently, to optimize the efficiency of city operations and services.

This includes data from citizens, devices, and assets to monitor and manage traffic and transportation systems, power-plants, water-supply, waste-management, crime-detection, schools, libraries, hospitals, and other services.

High Density Networks

Serve various and many clients and achieve good and complete supply, without the need of many access points.

5G networks are digital cellular networks in which the service area covered is divided into geographical areas (cells). Analog signals are digitized, converted by an analog to digital converter and transmitted as a stream of bits

Resource Sharing

A shared resource is available from one host to other hosts in a network. It can be a device or piece of information that can be remotely accessed transparently as if it were a local resource. Resource sharing is made possible by inter-process communication over the network.

The Context

Within the context of a smart city, there is a wealth of physical as well as digital private resources that could be shared for the benefit of a community and its members in terms of security and safety (e.g., sensors), energy neutrality (e.g., solar panels), material neutrality (e.g., recycling materials), environment (e.g., sharing cars), well-being (e.g., health care aids), and more.

The Problem

How to assure access to resources and services in a sustainable and equitable way, through sharing with ICT?

How and where ICT can be effective, what infrastructure is required, the privacy concerns, the legal and regulatory framework, the business models, and their implications?

The Idea

Provide smart cities with a private resource sharing platform, to enable participation of residents and government bodies in decision-making, self-management and community initiatives, and empower facilitation and stimulation of contact among residents and entrepreneurs.

Project Management

The project will be organized in 7 work-packages: The ICT infrastructure, 3 use-cases, an economics activity on potential business models, a legal and regulatory issues activity, and 2 PoC demonstrator cases. The ICT research encompasses methods and techniques for communication, computation, IM, and data science in PNs/PN-federations.

Communication and Computing Infrastructure (1)

Ultra-low latency communication, ultra-low latency configuration, and ultra-reliable self-healing of 5G networks will demand new solutions.

We will address these by a flexible and future-proof mixed optical-wireless infrastructure, complemented by an edge-computing architecture to provide the services which PNs and PN-federations rely on.

Communication and Computing Infrastructure (2)

Primary concern: the safeguarding of “own control” of personal resources, privacy, and security.

We will investigate, design, and realize communication system technologies based on quantum key distribution high-security techniques, and employ these for the fiber-based and wireless parts of the network which connect to the user devices and ensure secure private communication.

Data science, ML, and IM

Can we devise scalable deep learning models which can be exploited directly on low-resource devices?

- How can we efficiently map a neural network in multiple computing nodes and parallelize its algorithm?

Can we devise neural networks models able to be trained on multimodal data using few labelled data?

- How can we decentralize the learning algorithm?

Circular Building

Circular building calls for reduction of resource depletion. PNs can help in the development of smart technology for creating a digital twin of the building and its occupants.

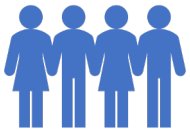
We aim at : context/situational awareness, adaptation, resource management, and personalization. These need research on the building process from design to re-use, and on user behaviour in built environments using PNs for construction of digital twins.

Inclusive Society

Sharing contributes to an inclusive society, allowing for better options to support people in vulnerable positions, i.e. informal support systems for frail elderly or lonely people.

Poverty can be alleviated by increased participation and prevention of non-take-up benefits poor people fail to receive.

It is crucial to involve intended users in the design and implementation. knowledge on specific innovations, will be a breakthrough that would facilitate the implementation of other innovations in the fields of health and wellbeing.



Data Vault

Users are sensitized to how their data are used across various aspects of their lives and beyond their control, to build a frighteningly accurate picture articulating individuals' behaviour, preferences, and identities.

The principles of PN and PN-federation can enable users to exercise more control over their digital resources. We include both sides in our design, shifting from a user-provider relationship to a more symbiotic one, liberating organizations from maintaining costly infrastructures, and resolving tensions associated with leveraging user data.

Economic Aspects

- Controlled sharing enables a rich set of possible applications. What are those applications? Which business models are optimal? How they fit into an innovation ecosystem?
- This requires digital-markets, and platforms for valuation, negotiation, and brokering, automated or user-driven. All cases have their specifics, and we need to generalize to all PN resources, exploring the boundary conditions of prominent business model designs.
- We will investigate the role of trust: PN owners do not necessarily trust each other. DLT, such as blockchain, may help together with inclusive and responsible platform governance choices.

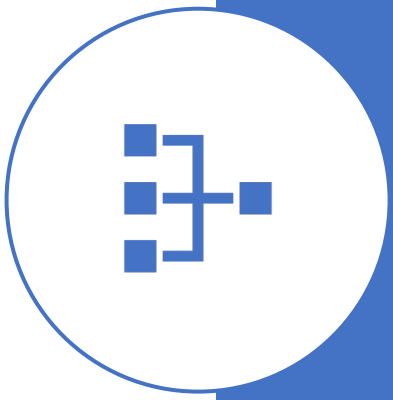
Law and Regulation

Shared resources require legal solutions different from private ownership concepts. Does the law offer instruments to ensure continued availability to the other users in the network? We seek to analyze the legal situation under Dutch law for PN and, propose changes to Dutch property and insolvency law that are necessary to accommodate these networks.

Regarding contract law, smart buildings require innovative private law models to contribute to sustainable cooperation, as well as legislation for ownership and sharing of building data in network cooperation.

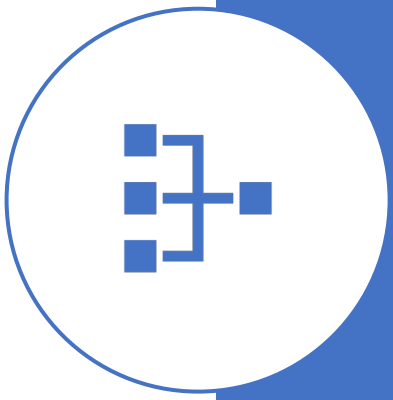
Proof-of-Concept Demonstrator (1)

- The PoC demonstrators will implement, test and validate the key functionalities of the PN and PN-federated solutions that are going to be investigated.
- Candidates: social inclusion, and circular building case, aiming to showcase the implementation and validation of all the cyber-physical, personal, and privacy resource-management solutions researched in the project.



Proof-of-Concept Demonstrator (2)

- The first will focus on social isolation of people in vulnerable situations, where cyber-physical services and resources can improve their quality of life and foster their social inclusion.
- The second will focus on the resource and privacy management of cyber-physical buildings through the creation of a digital twin solution for waste and resource depletion management, and real-time building context awareness, in the proposed secured, controlled, and shared PN solution.



Thank you

Questions and Feedback