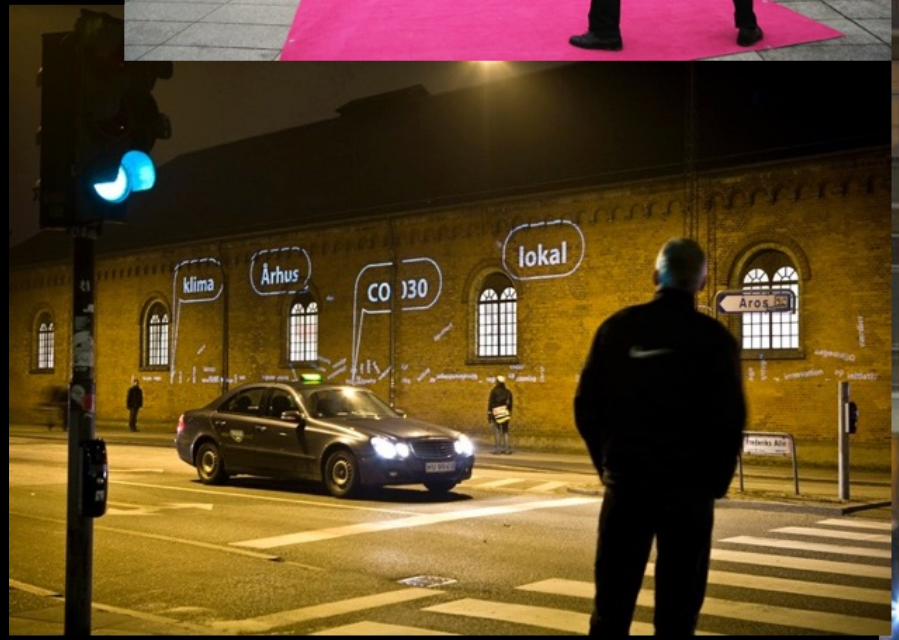
When AI takes your place

Martin Brynskov
@brynskov

Image credit: boerse-global.de


klima
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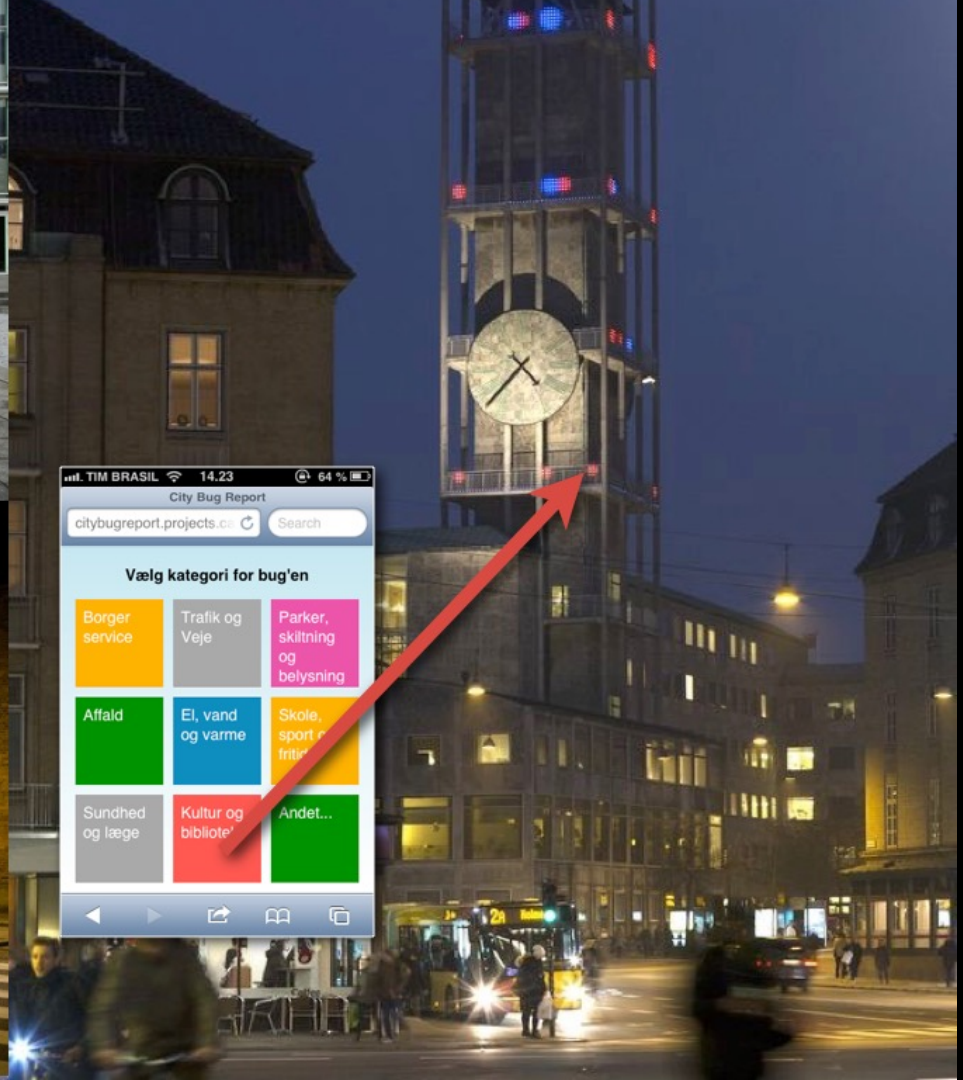
Åros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City Bug Report
citybugreport.projects.
Search
Vælg kategori for bug'en
Borger service
Trafik og Veje
Parker, skiltning og belysning
Affald
El, vand og varme
Skole,
Sundhed og læge
Kultur og
Andet...

Data Spaces and Local Digital Twins towards Citiverse

Martin Brynskov
@brynskov

Martin Brynskov

Kingdom of Denmark

Scientific Director AI & Digital, KU INNO, University of Copenhagen
Researcher Connecting Communities, TU Denmark/DTU Compute
Assi/o Prof Digital Transformation in Cities and Communities, Aarhus Uni
Postdoc Centre for Advanced Visualisation and Interaction (CAVI), Aarhus Uni
PhD Computer Science, mobile/IoT, Aarhus Uni, LEGO
MSc “Digital Habitats”, Information Studies, modeling (AI/IoT/STS), Aarhus Uni

Founding Director & Standards Lead, Open & Agile Smart Cities (OASC)

ITU/SG 20 IoT, Digital Twins and Smart Sustainable Cities and Communities
ISO/TC 268 (JTC 4) + **CEN/TC 465** Sustainable and Smart Cities and Communities
CEN-CLC/JTC 25 Data management, Dataspaces, Cloud and Edge
DS/S-491 Data Spaces and Data Management, Smart Cities


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3 – 4 November 2025

AIS25

AI in Science Summit 2025
EU2025DK

UCPH

Register now and stay tuned for program updates www.ais25.eu.

We look forward to welcoming you to Copenhagen.

AI in Science Summit: Launching the Resource for AI Science in Europe (RAISE)

An event of the Danish Presidency of the European Council

For centuries, science has been a cornerstone of Europe's progress, driving advancements from medical breakthroughs to renewable energy. Today, Artificial Intelligence (AI) is transforming this legacy, reshaping research across disciplines and accelerating discoveries to address technological and societal challenges. By embracing AI, science can enhance Europe's global competitiveness and continue its tradition of innovation.

Join us at the AI in Science Summit to explore AI's transformative impact on scientific discovery and how Europe can lead this transformation with a unique approach.

Who Should Attend

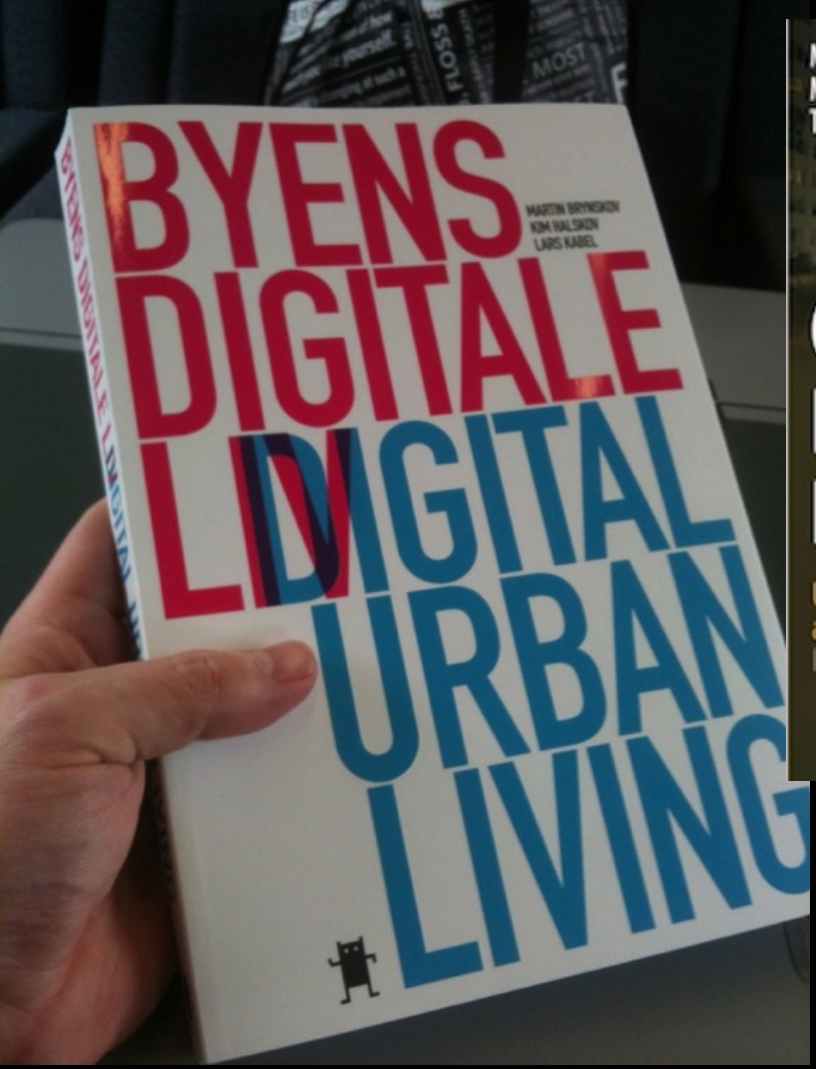
- AI and domain scientists: Demonstrate research, exchange ideas, form interdisciplinary teams and work on challenges together
- AI industry leaders: Showcase solutions, gain fresh ideas, and affirm commitment
- Investors: Discover projects, pledge support,







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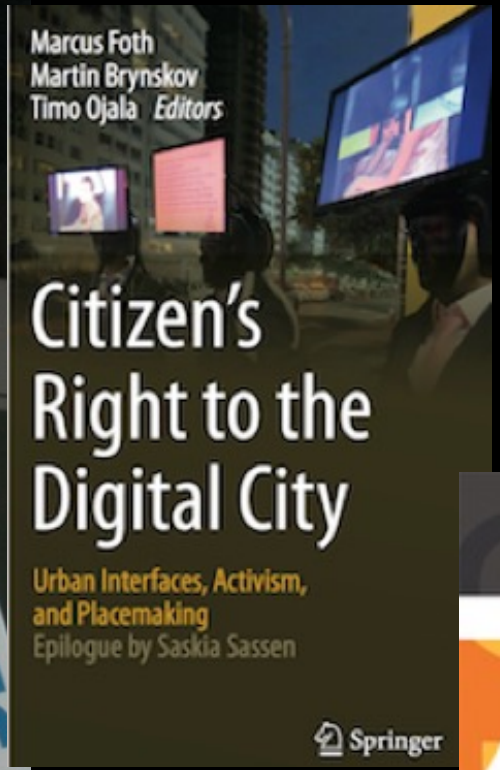
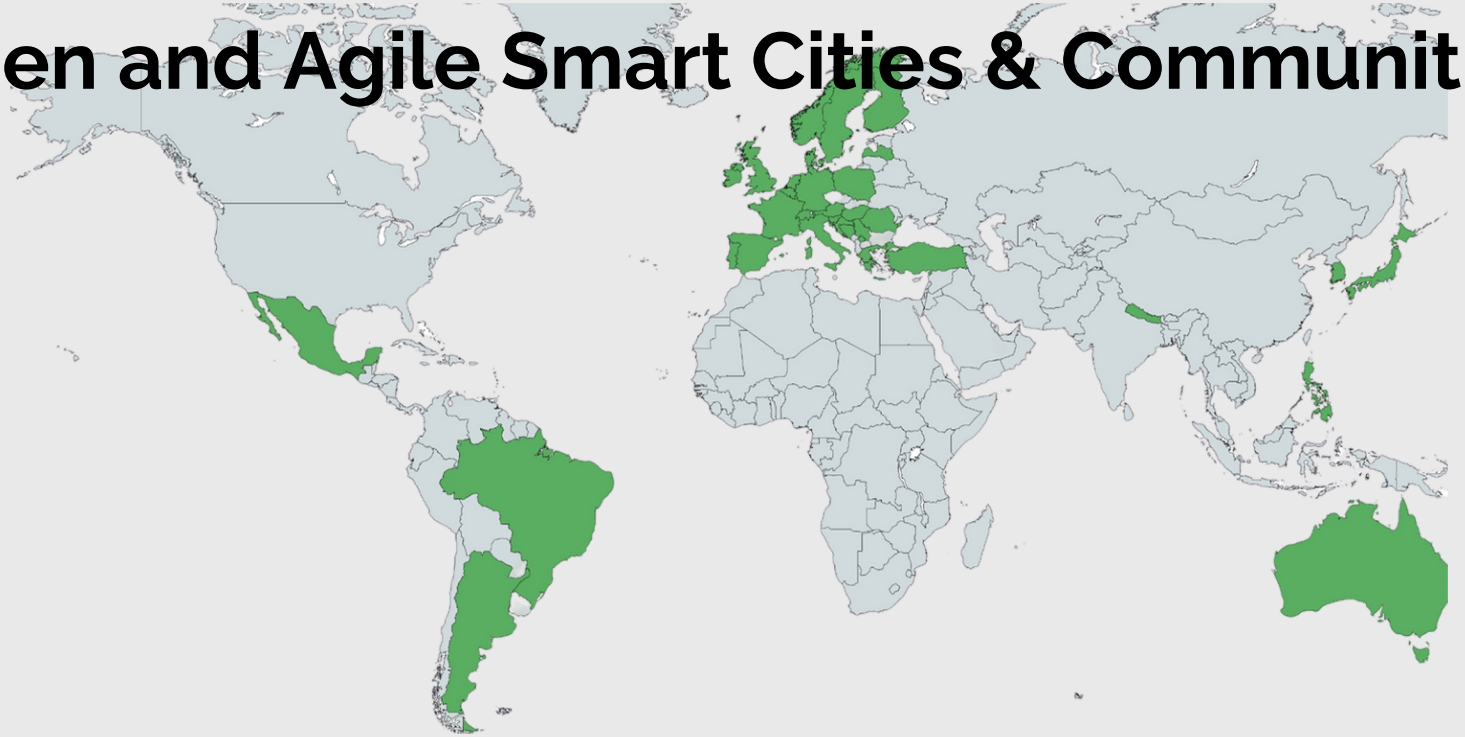
URBANE
LIVING
MARTIN BRYNSKOV
KIM HALSKOV
LARS KABEL


Marcus Foth
Martin Brynskov
Timo Ojala Editors
Citizen's
Right to the
Digital City
Urban Interfaces, Activism,
and Placemaking
Epilogue by Saskia Sassen
Springer


WHAT
URBAN
MEDIA
ART
CAN
DO
WHY
WHEN
WHERE
&HOW
Susa Pop
Tanya Toft
Nerea Calvillo


CIVIC
MEDIA
CIVIC MEDIA
TECHNOLOGY | DESIGN | PRACTICE

Open and Agile Smart Cities & Communities



193 cities and communities in
43 countries around the world

OPEN & AGILE SMART CITIES & COMMUNITIES

Our mission & vision

We are a **global network of communities** that supports local and regional administrations of all sizes and digital maturity levels in their **digital transformation journey**.

We work with our members, partners and independent experts to create **sustainable impact** for our communities via their digital tools and systems.

We focus on **interoperability** (technical, semantic, organisational and legal).

This facilitates **seamless sharing and re-use** of digital, data-driven solutions and helps to avoid vendor lock-in, to reduce costs and resources, improve efficiency and the ability to use technology to solve local and global societal challenges.

OPEN & AGILE SMART CITIES & COMMUNITIES

OASC Council of Cities

The Council of Cities represents the member cities and communities of OASC and is one of the governing bodies of the network. It is headed by the Council of Cities Coordinator who is elected every two years.

Bo Fristed
Coordinator, City of Aarhus, Denmark

Anni Joela
Deputy Coordinator, City of Tampere, Finland

OASC Technology Council

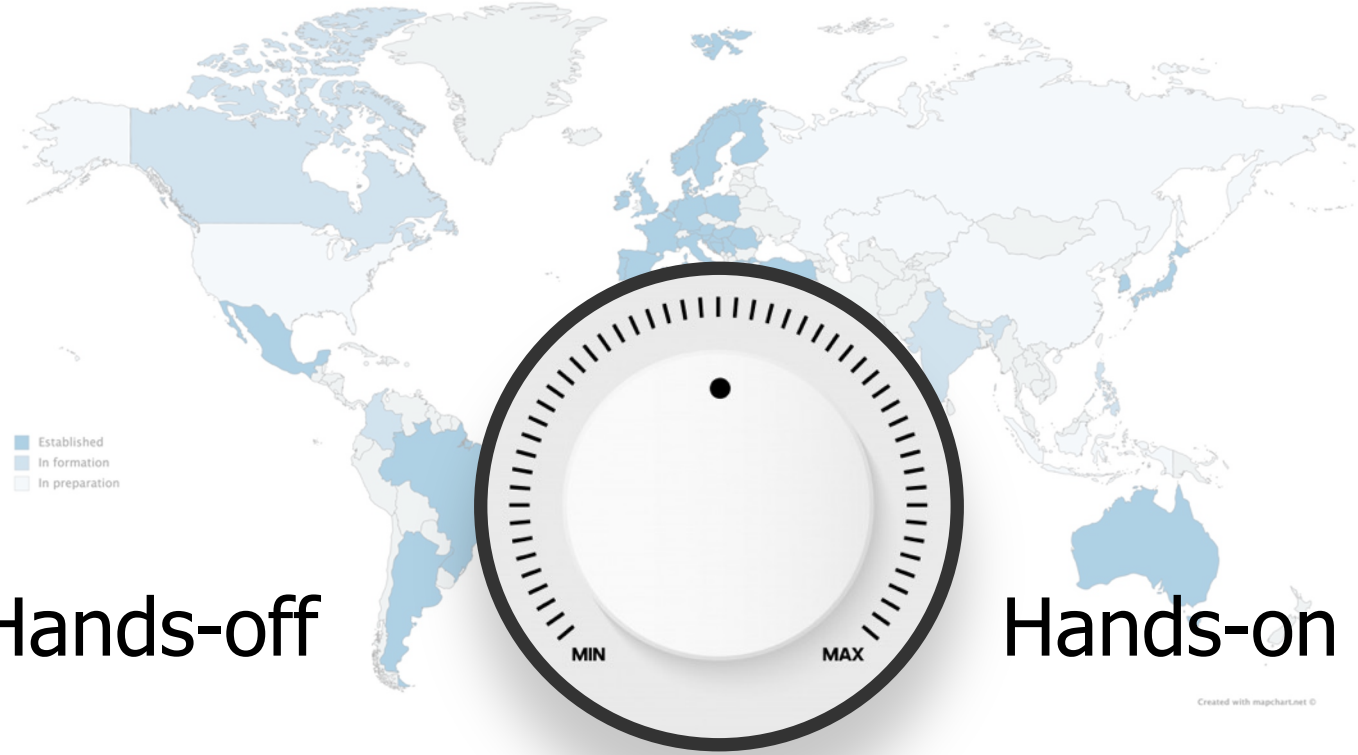
The purpose of the OASC Technology Council (TC) is threefold:

1. To oversee the overall roadmap of the Minimal Interoperability Mechanisms.
2. To support the technical development of existing MIMs and explores the technical possibilities for proposed MIMs.
3 To provide the OASC network and its members with impartial technical advice and guidance on relevant technologies and standards that underpin the MIMs.

OPEN & AGILE SMART CITIES & COMMUNITIES

Balanced market approach

OPEN & AGILE SMART CITIES

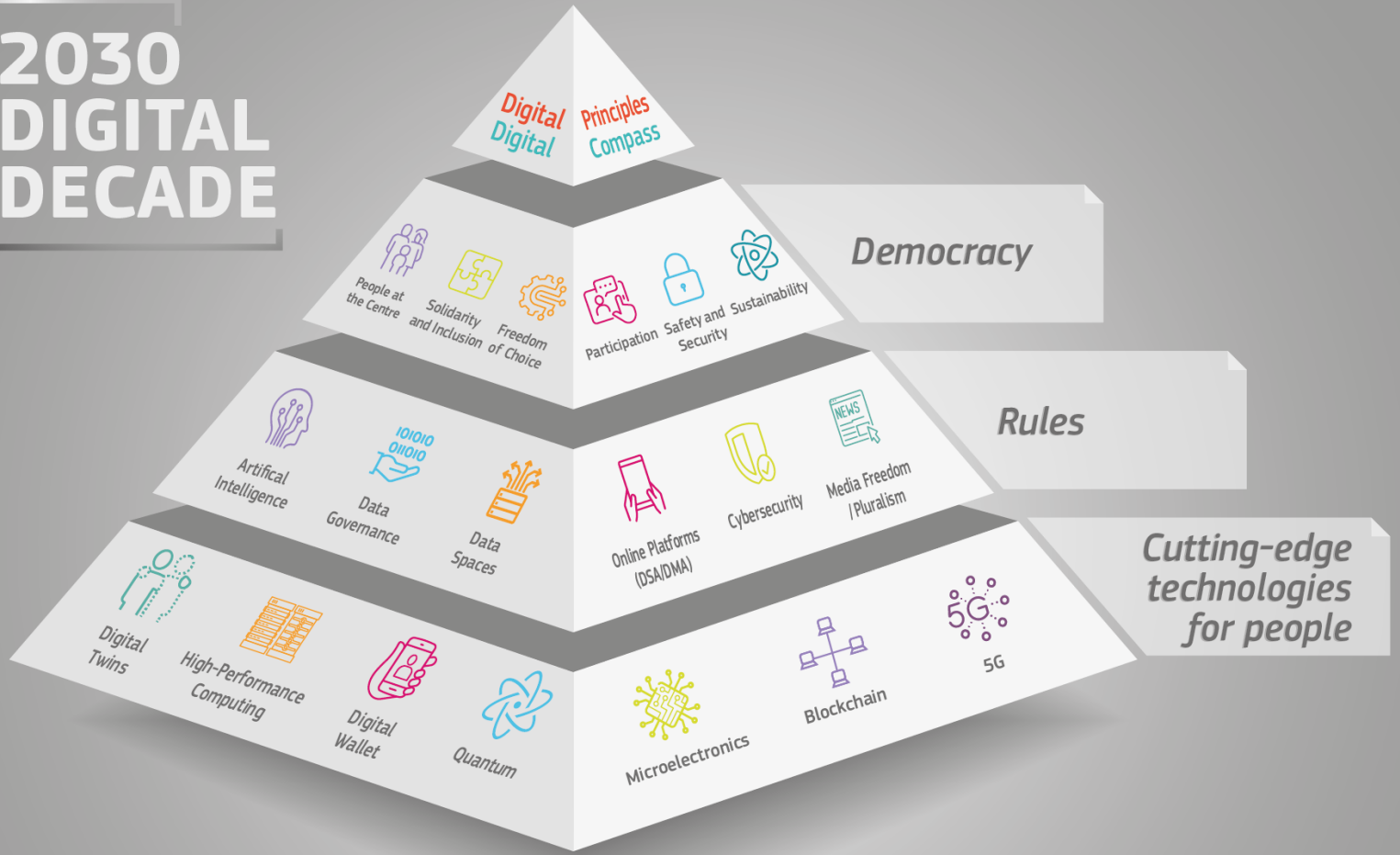


Hands-off

Hands-on

REGULATION

2030 DIGITAL DECADE



#DigitalEU

LEGITIMATE AGENCY

PROTECTION
+
INNOVATION

Directives > Acts > Standards

National guides

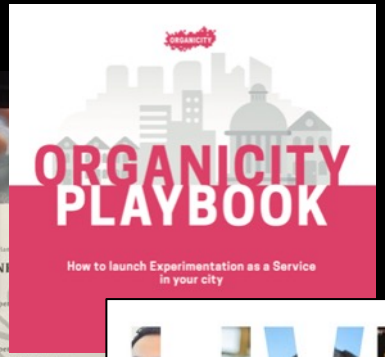
- Denmark → DS/KL
- Sweden → RefARK/SKR
- Netherl. → NEN/VNG
- Flanders → VLOCA/DF
- Japan → Society 5.0
- USA → GCTC

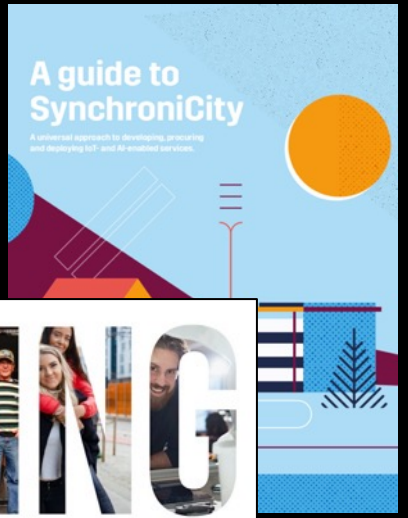
EU/Global

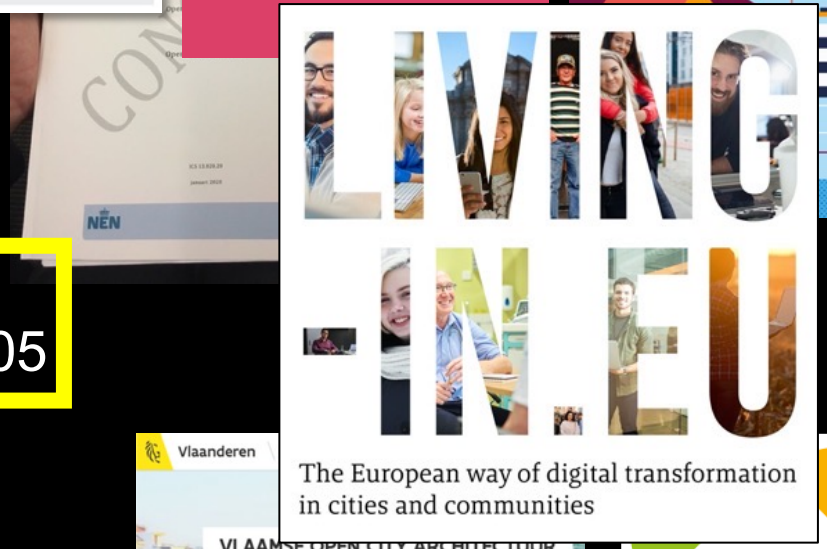
- Living-in.EU → MIMs Plus
- UN SDGs → Y.MIM / Y.4505

Commercial

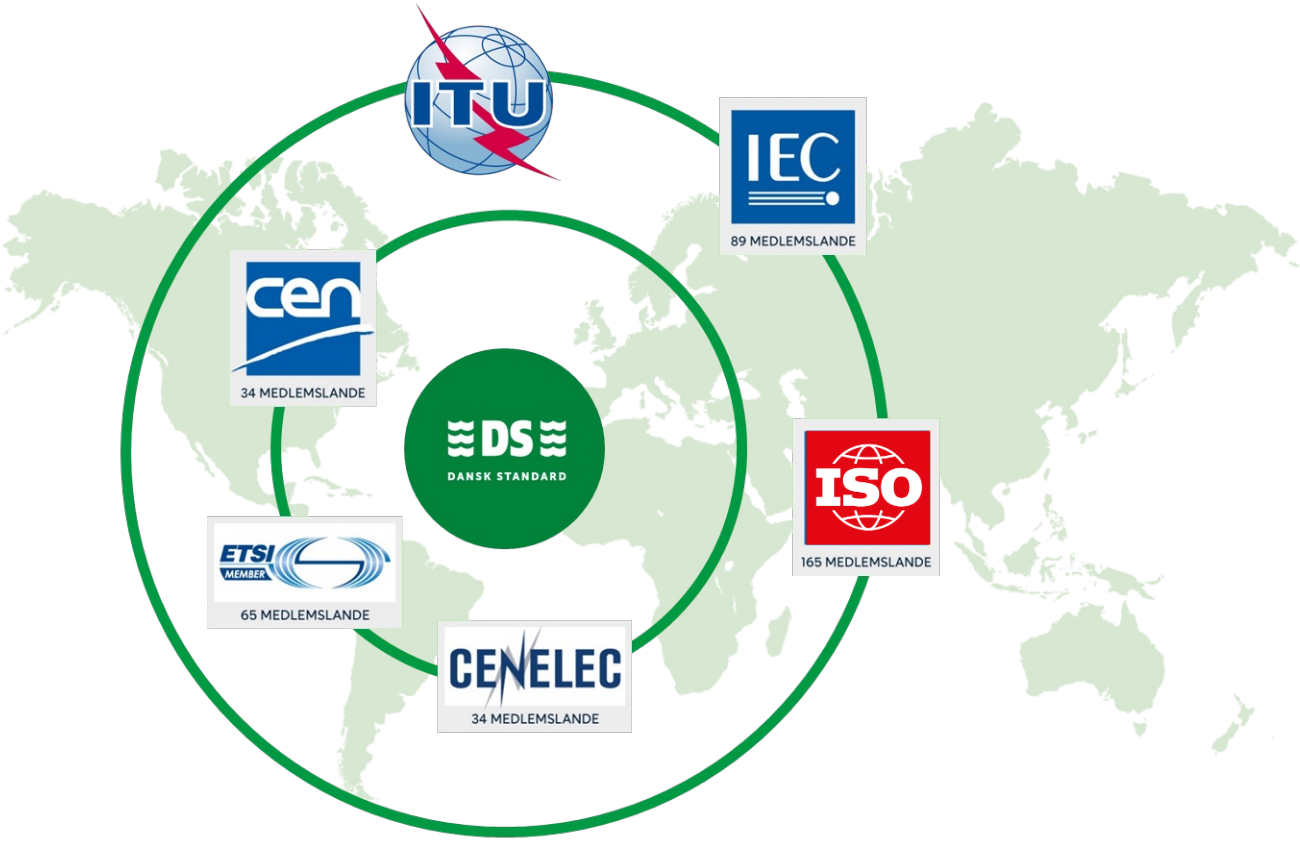
- National
- Global region
- Global / hyperscalers







National standards – in a European and global context



UN / WTO

Market

DE JURE STANDARDS

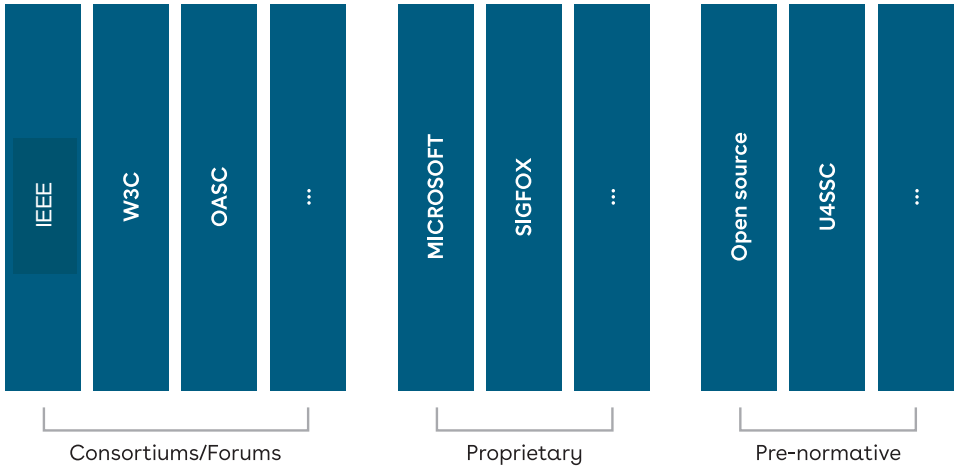
National standardisation organisations

e.g. DS, DKE, UNI

CEN | CENELEC | ETSI

ISO | IEC | ITU

DE FACTO STANDARDS



Guide for sustainable, digital transformation

1 Focus on data

2 Build with interfaces

3 Secure a minimum of interoperability

4 Keep an open mind when choosing technology

5 Prioritise partnerships and ecosystems

6 Take maturity and complexity into consideration

7 Start small, think big

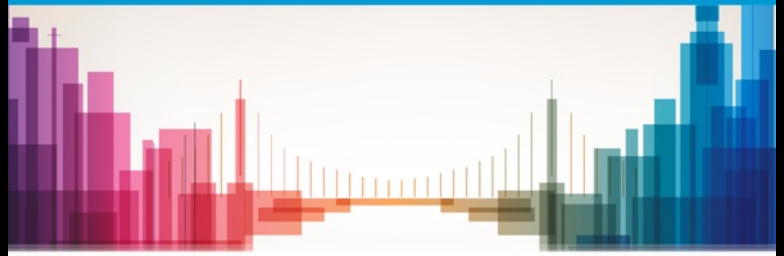
Available for free in English (and Danish)

https://webshop.ds.dk/en-gb/subjects/standard/ds-inf-1762021

United 4 Smart Sustainable Cities

Redefining smart city platforms: Setting the stage for Minimal Interoperability Mechanisms

A U4SSC deliverable on city platforms



Convention on Biological Diversity

ECLAC

Food and Agriculture Organization of the United Nations

ITU

UNDP

United Nations Economic Commission for Africa

UNECE

UNESCO

UN environment programme

FINANCE UNEP INITIATIVE

United Nations Framework Convention on Climate Change

UN HABITAT FOR A BETTER URBAN FUTURE

UNIDO

UN 4 PARTNERSHIPS

UNITED NATIONS UNIVERSITY UNU-EGOV Operating Unit on Policy-Driven Electronic Governance

UN WOMEN

WORLD METEOROLOGICAL ORGANIZATION

https://u4ssc.itu.int/city-platforms/

Why you need standards

To pursue **political goals**.

Compliance to

trust and **cybersec** requirements

at **production scale**.

Without **forever contracts**.

Support **innovation** and **agile pilots**.

Why you need OASC

A **voice** of cities and communities

towards **big tech**

and **big regulators**.

Very **focused**

partnering with sister **networks**.

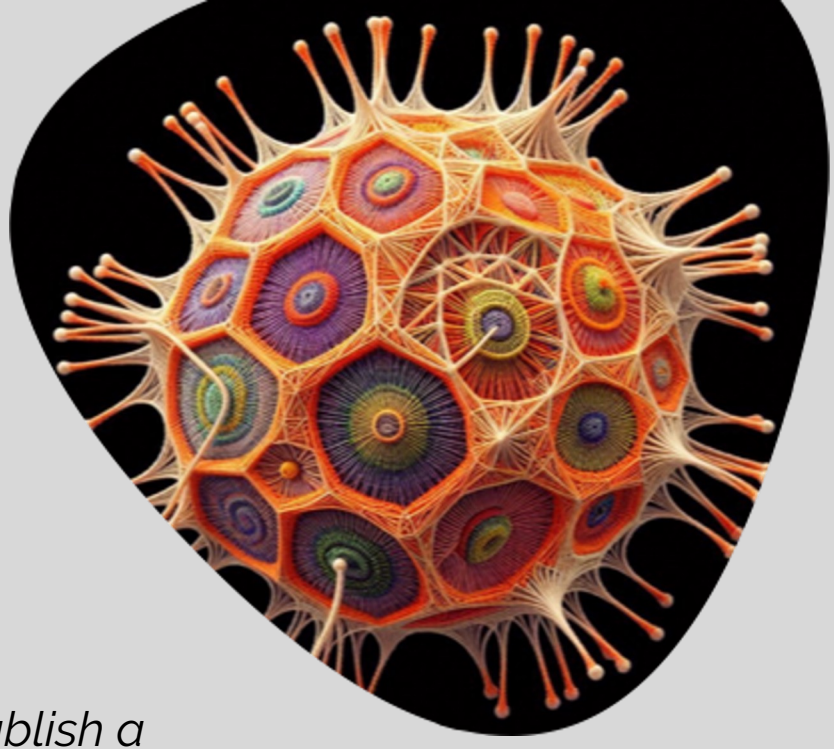
standards ·de facto ·MIMs

Standards ·de jure ·Global

·EU

·National

What is a MIM?



“MIMs are the mechanisms that allow to establish a minimal yet sufficient interoperability between systems in order to create value”

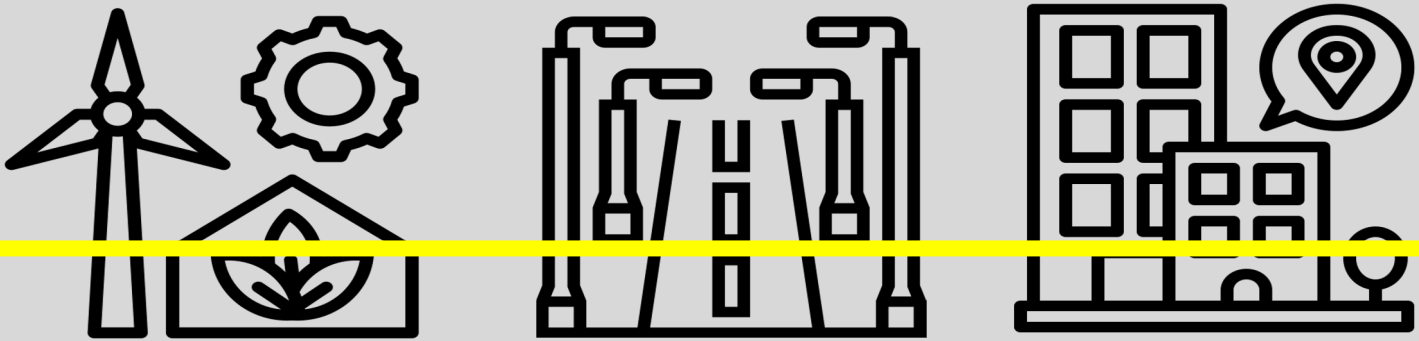
How MIMs enable collaboration

Services

Applications

Solutions

From across domains



ESTABLISHING A MINIMAL LEVEL OF INTEROPERABILITY

Minimal Interoperability Mechanisms (MIMs)

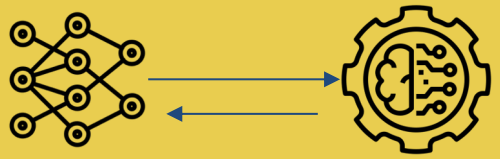
Value Proposition

Common list of standards & technical specifications

Key Enablers - Available for all

Common Marketplace

How To Use MIMs



You want to procure different technologies while maintaining the same capabilities and data

You work with a mechanism and want to access/exchange with different mechanisms

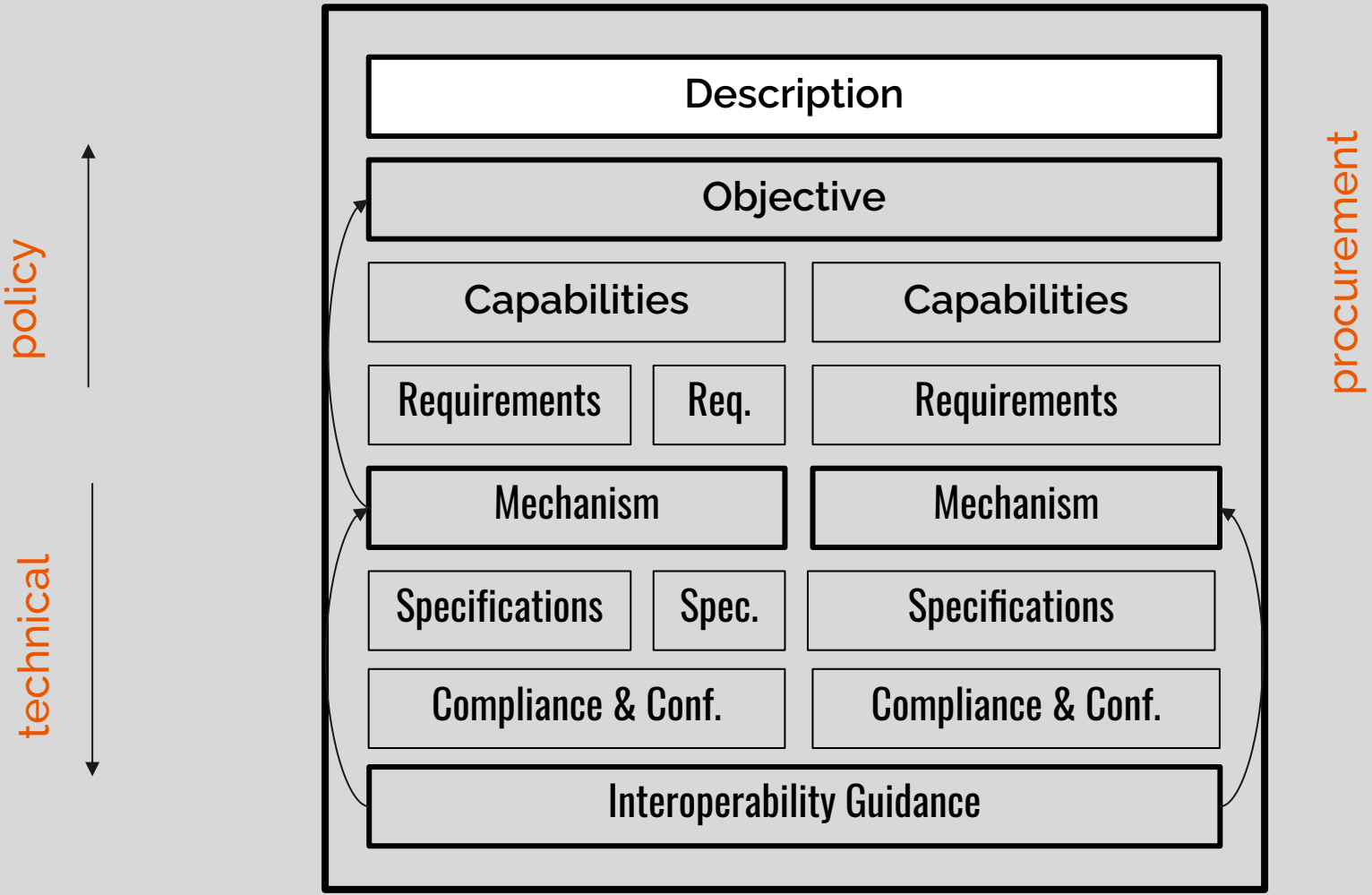
You want to build and use interoperable solutions

How do we structure a MIM?

To streamline knowledge exchange we need a common language / format to describe our experiences:

ITU Y.4505 or “Y.MIM”

OPEN & AGILE SMART CITIES & COMMUNITIES


policy
technical
Description
Objective
Capabilities
Capabilities
Requirements
Req.
Requirements
Mechanism
Mechanism
Specifications
Spec.
Specifications
Compliance & Conf.
Compliance & Conf.
Interoperability Guidance
procurement

ITU-T Recommendation Y.4505:
Minimal interoperability mechanisms (MIMs) for smart and sustainable cities and communities

How to develop tools that enable cities and communities to put in place "good enough" mechanisms that will get them started in gaining value from potential smart solutions and that address differing types of legacy infrastructure and standards ecosystem

Approved July 2024

Interoperability for Smarter Public Services: An Introduction to MIMs Plus

Less than an hour Beginner

Enrol

Course details

This course will help you understand and use the concept of Minimal Interoperability in public sector ICT procurement, as well as learn how you can contribute to the European ecosystem of interoperable data and services.

Target audience

Public sector innovators, CIOs, Public buyers, ICT vendors/suppliers, standardisation professionals.

Learning objectives

- Understand the role of interoperability ;
- Discover Minimal Interoperability Mechanisms (MIMs) Plus;
- Learn what a MIM is;
- Explore key MIM components;
- See MIMs Plus in action;
- Join the MIMs community

★★★★★ 5 (1)

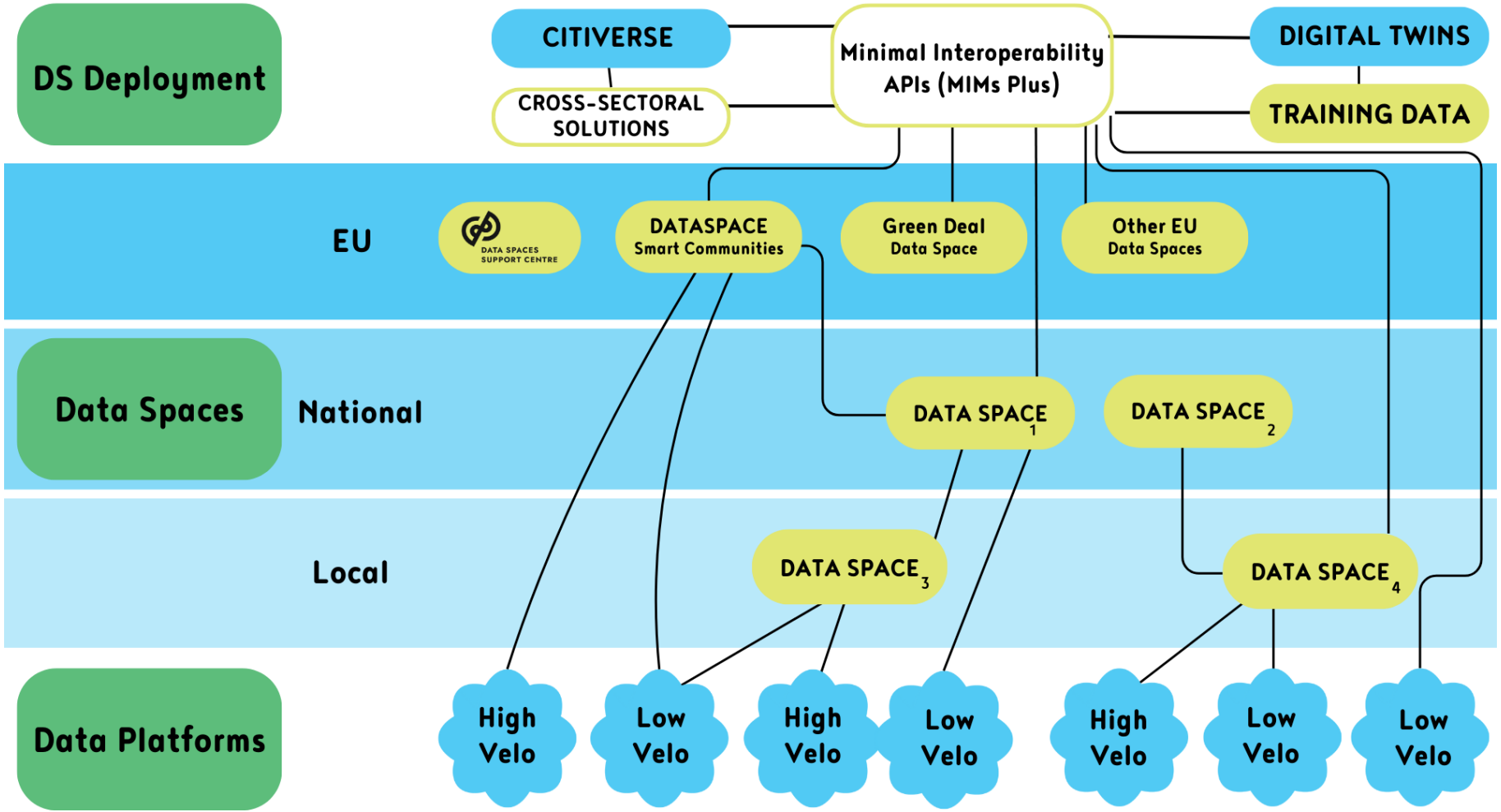
Schedule

Course an quiz

Feedback

Certificate

DATA SPACES


DS Deployment
CITIVERSE
CROSS-SECTORAL SOLUTIONS
Minimal Interoperability APIs (MIMs Plus)
DIGITAL TWINS
TRAINING DATA
EU
DATA SPACES SUPPORT CENTRE
DATASPACE Smart Communities
Green Deal Data Space
Other EU Data Spaces
Data Spaces
National
DATA SPACE 1
DATA SPACE 2
Local
DATA SPACE 3
DATA SPACE 4
Data Platforms
High Velo
Low Velo
High Velo
Low Velo
High Velo
Low Velo
Low Velo

European Data Spaces: Trusted Data Transactions

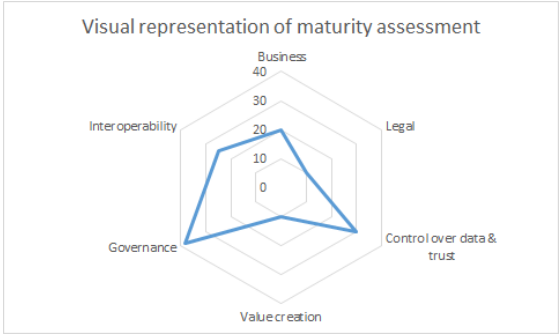
Standards for

- Trust
- Interoperability
- Data quality
- Maturity

	Reference information	Deadline for the adoption by the ESOs
1.	Harmonised standards on Trusted Data Transactions Part 1: Terminology, concepts and mechanisms	1 June 2026
2.	Harmonised standards on Trusted Data Transactions Part 2: Trustworthiness requirements	1 November 2026
3.	Harmonised standards on Trusted Data Transactions Part 3: Interoperability requirements	1 May 2027
4.	Technical specification(s) on a data catalogue implementation framework	1 March 2026
5.	Technical specification(s) on an implementation framework for semantic assets	1 September 2026
6.	European standard on a quality framework for internal data governance	1 March 2027
7.	Technical specification(s) on a maturity model for Common European Data Spaces	1 September 2026

Measuring Data Space Maturity

DIMENSION	DSMI	Metrics	Weigth	Score	Weigthed Result (weigth x score)	TOTAL per DSMI	TOTAL per DIMENSION
Governance	DSMI 1	M1	20%	10%	2%	20,5%	38%
		M2	40%	25%	10%		
		M3	10%	10%	1%		
		M4	30%	25%	7,5%		
	DSM2	M5	50%	25%	12,5%	17,5%	
		M7	30%	10%	3%		
		M7	20%	10%	2%		



Business	20
Legal	10
Control over data & trust	30
Value creation	10
Governance	38
Interoperability	25

Explanation:

- The governance framework is established at 20,5%
- The participation management level is at 17,5%
- Overall Governance dimension is at 38% maturity

European data space
for smart communities

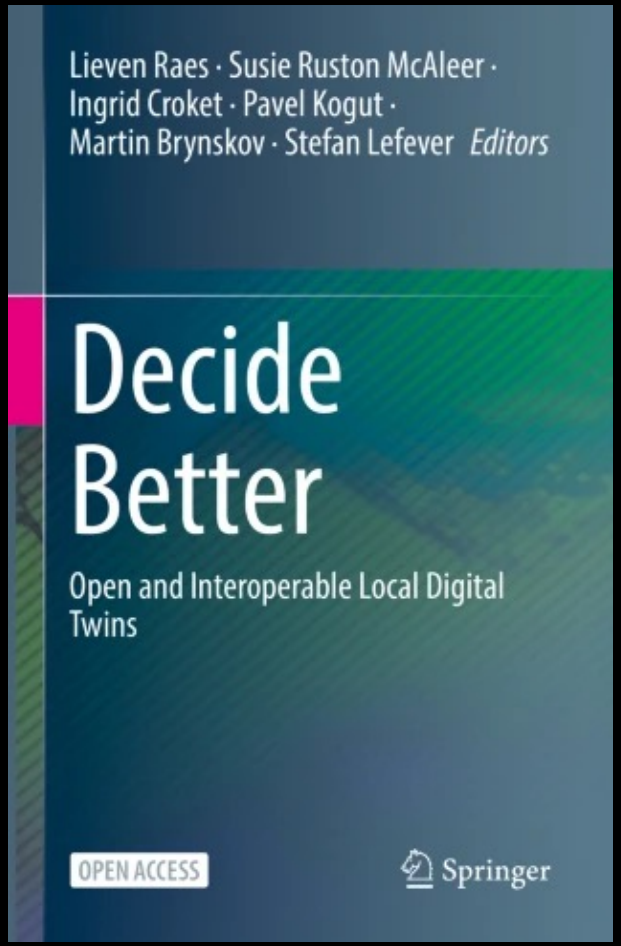
DS4SSCC &
DS4SSCC-DEP

Digital Twin as a Common Good (DT a CoGo)

The aim of the European Data Space for Smart Communities and its Call for Pilots, is to validate in practice an EU-wide cross-sectorial data space, and to advance its development and implementation to support policy priorities of cities and communities within the European Union, including the green-digital transformation based on secure and sovereign data infrastructure.

OPEN & AGILE SMART CITIES & COMMUNITIES

LOCAL
DIGITAL TWINS

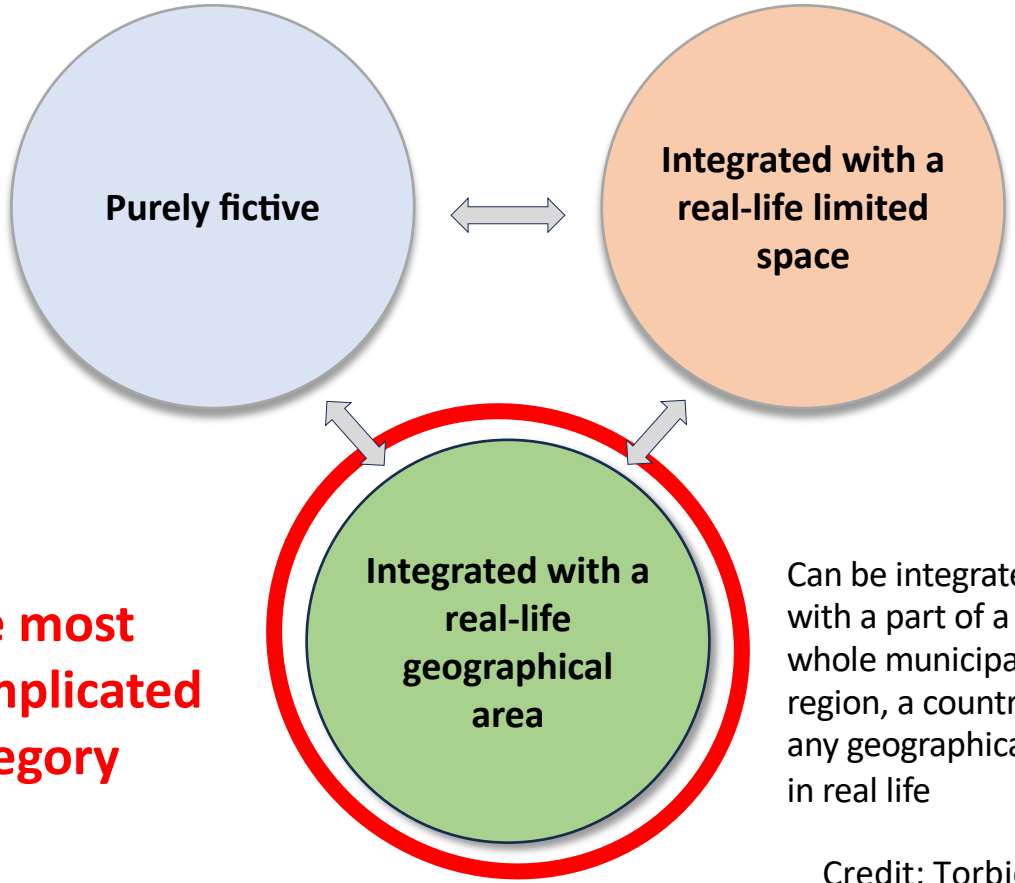


- Showcases practical and innovative LDT implementations from pioneering cities and regions
- Combines urban planning, ICT, legal, and ethical perspectives for a holistic approach
- Introduces frameworks for governing and scaling Local Digital Twin initiatives for maximum impact, including minimal interoperability mechanisms (MIMs)

This book is open access, which means that you have free and unlimited access

3 main types of Virtual World / Metaverse Categories

The characteristics will depend on what it is supposed to reflect



Can be a fantasy or looking like something from real life

Can be integrated with a limited and well-defined real-life space, like a room, a house, a vehicle, a shop, an office, a factory or similar

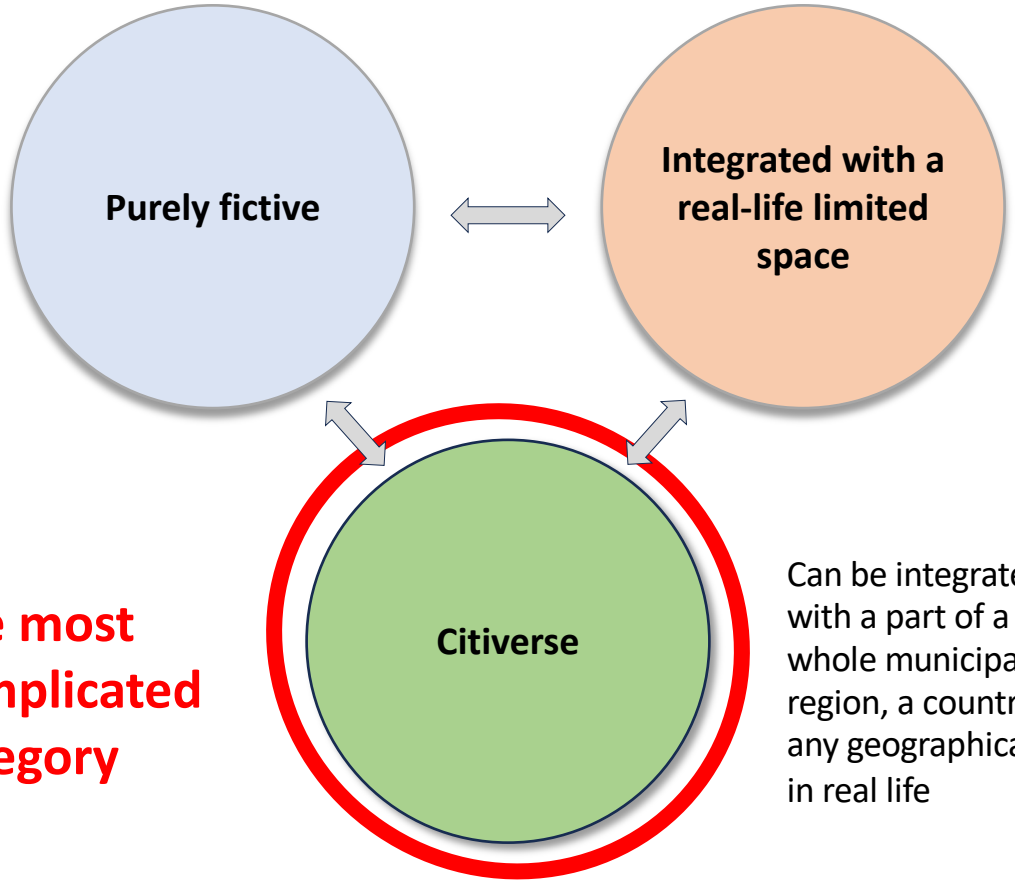
The most complicated category

Can be integrated with a part of a city, a whole municipality, a region, a country or any geographical area in real life

Credit: Torbjörn Lahrin, tobbe@lahrin.se

Integrated with a real-life geographical area => Citiverse

Can be a fantasy or looking like something from real life

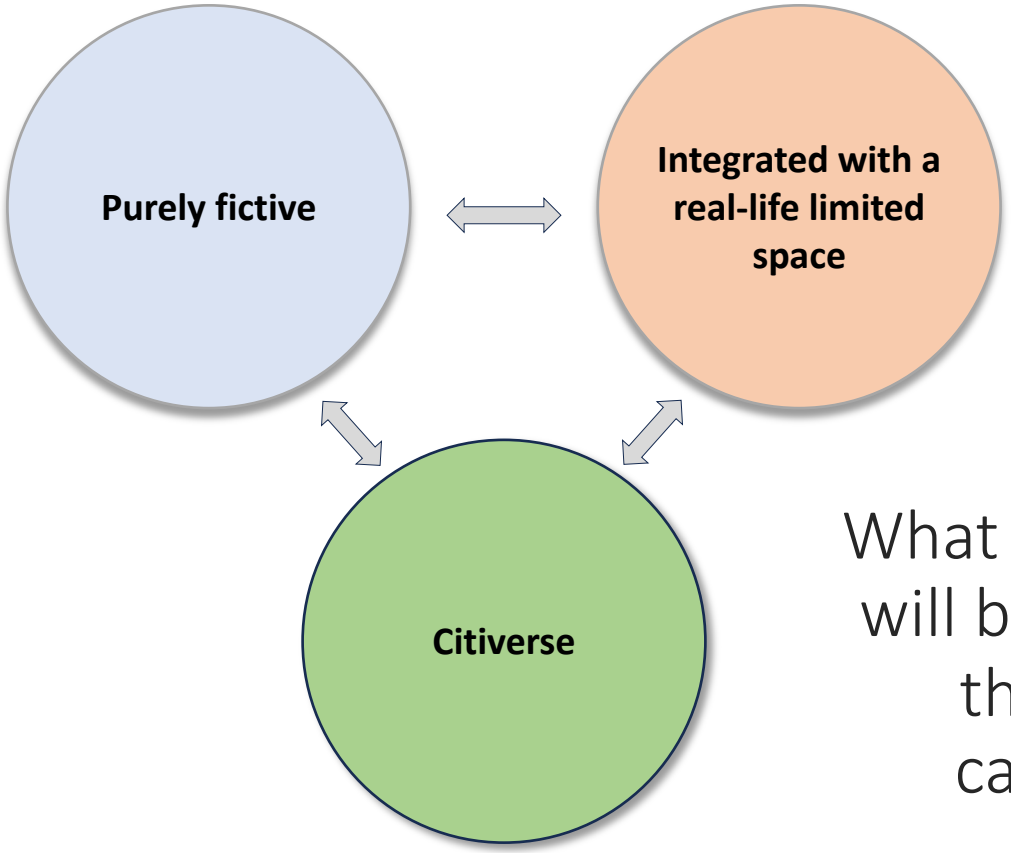


Can be integrated with a limited and well-defined real-life space, like a room, a house, a vehicle, a shop, an office, a factory or similar

The most complicated category

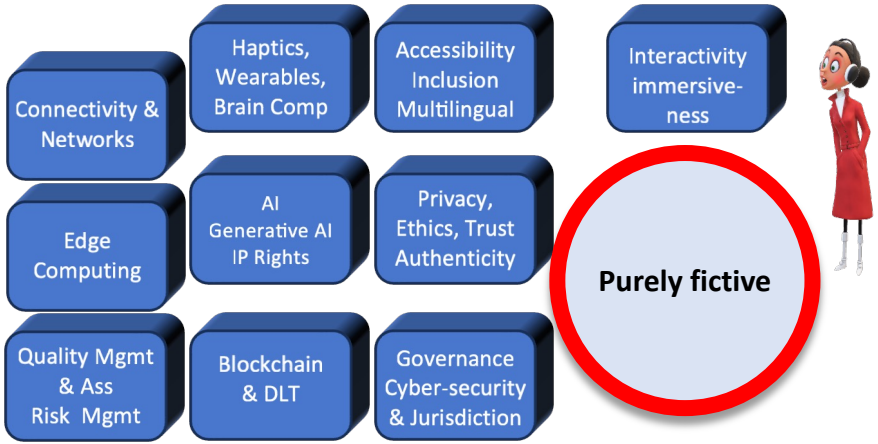
Can be integrated with a part of a city, a whole municipality, a region, a country or any geographical area in real life

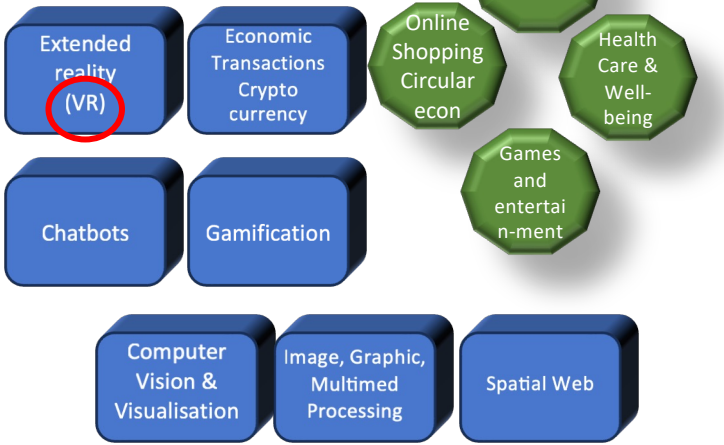
What puzzle pieces?



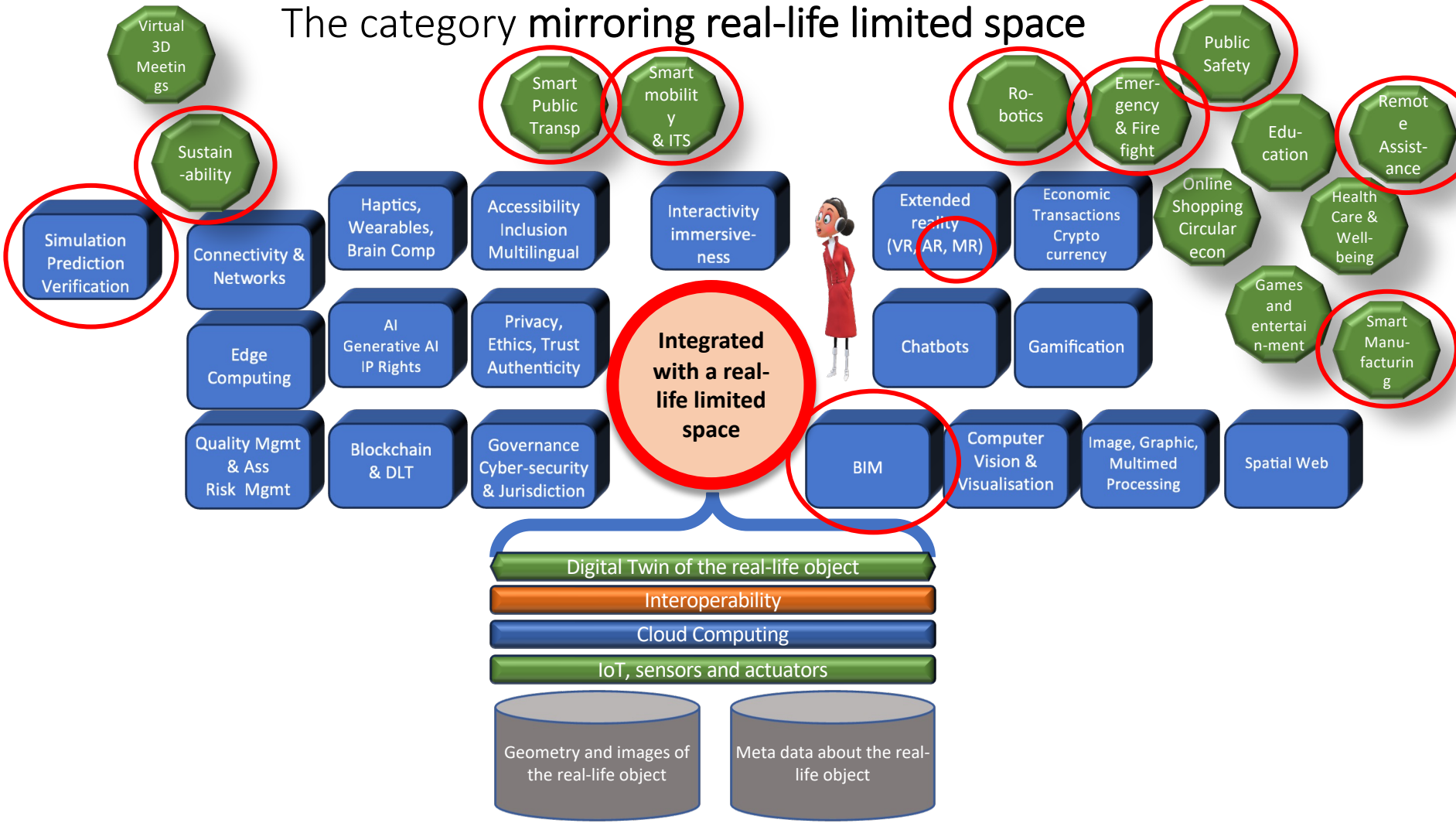
What puzzle pieces will be needed for the various categories?

Draft standardisation landscape for the **purely fictive** category





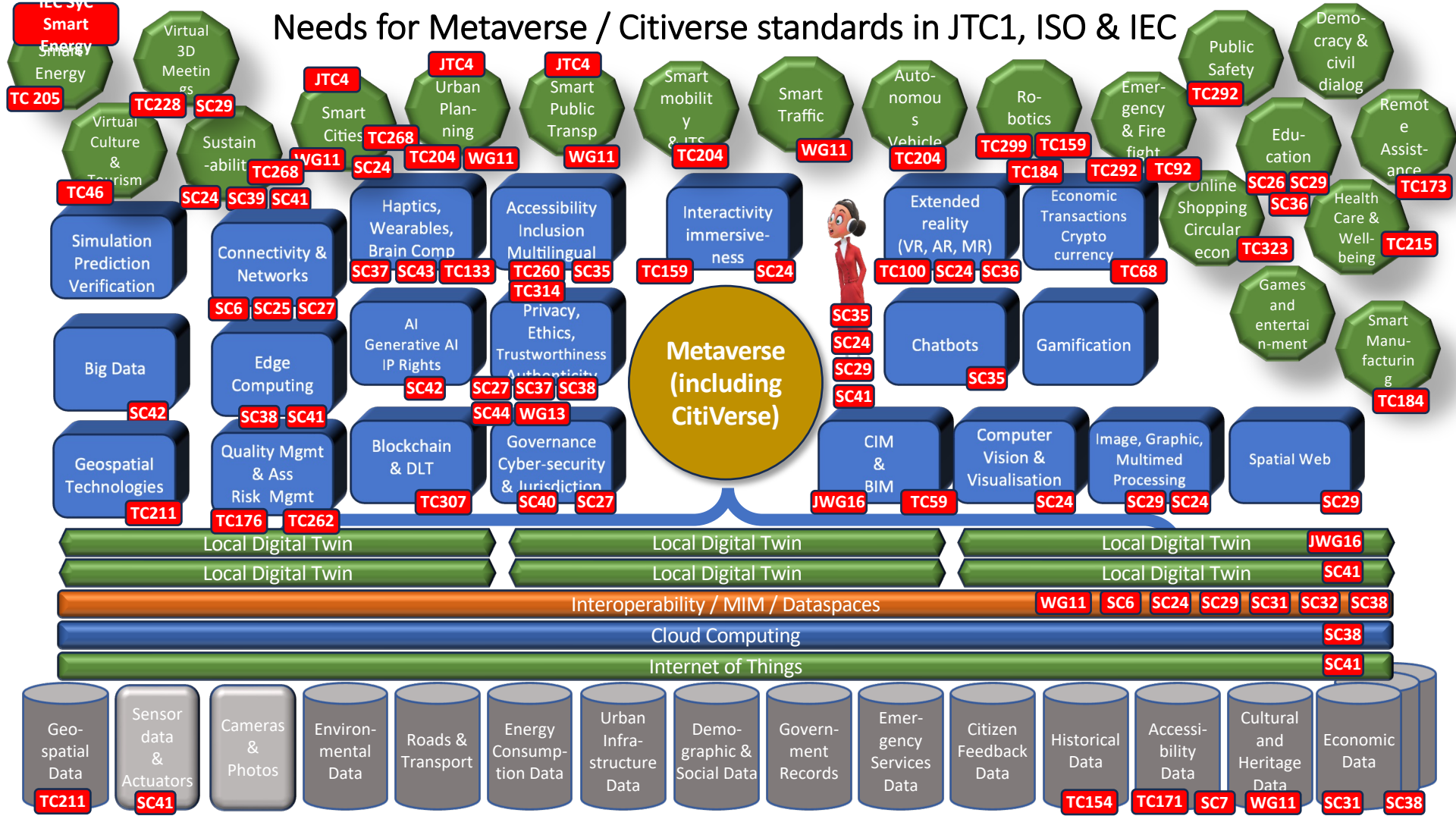
The category **mirroring real-life limited space**

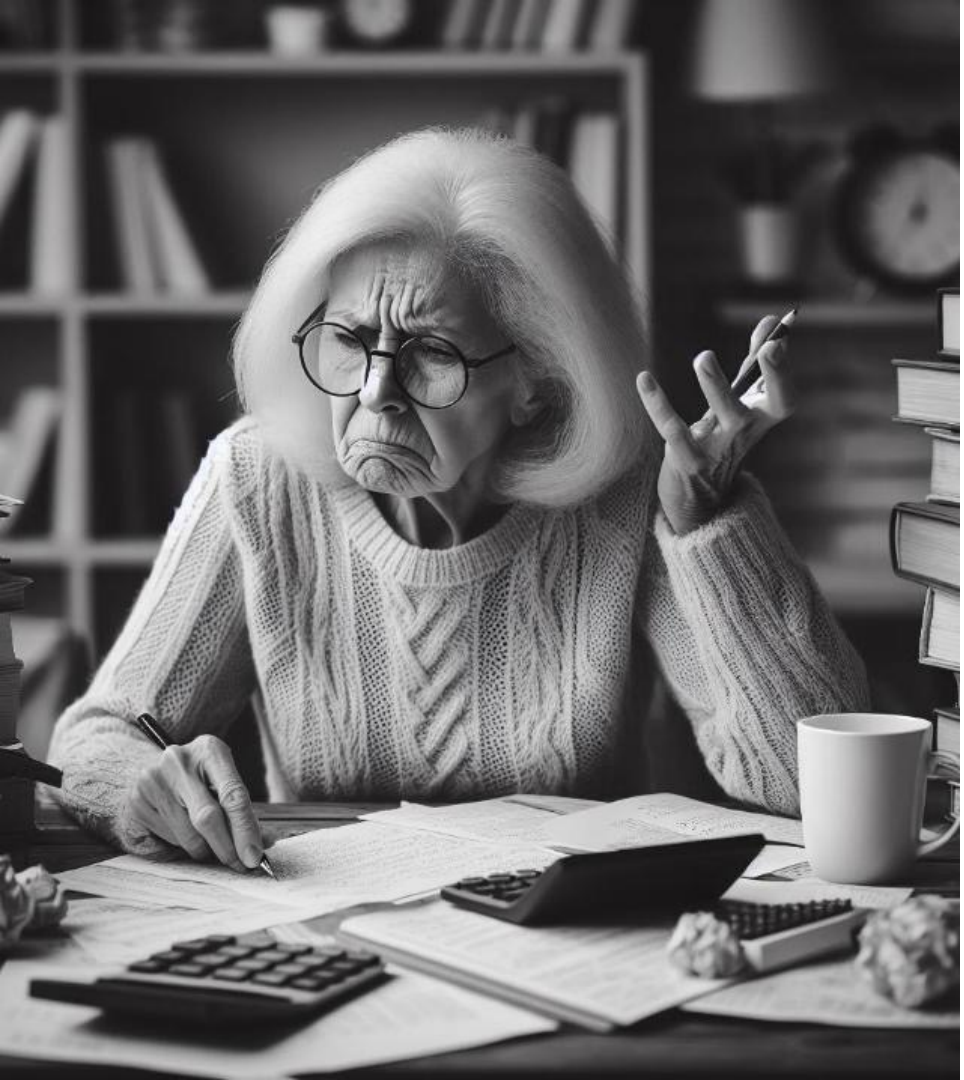


Metaverse category based on a geographical area

Smart Energy
Virtual 3D Meetings
Virtual Culture & Tourism
Sustain-ability
Smart Cities
Urban Plan-ning
Smart Public Transp
Smart mobility & ITS
Smart Traffic
Auto-nomous Vehicle
Ro-botics
Emer-gency & Fire fight
Public Safety
Demo-cracy & civil dialog
Edu-cation
Remote Assist-ance
Health Care & Well-being
Online Shopping Circular econ
Games and entertai n-ment
Smart Manu-facturing
Simulation Prediction Verification
Connectivity & Networks
Haptics, Wearables, Brain Comp
Accessibility Inclusion Multilingual
Interactivity immersive-ness
Extended reality (VR, AR, MR)
Economic Transactions Crypto currency
Big Data
Edge Computing
AI Generative AI IP Rights
Privacy, Ethics, Trust Authenticity
Citiverse
Chatbots
Gamification
Geospatial Technologies
Quality Mgmt & Ass Risk Mgmt
Blockchain & DLT
Governance Cyber-security & Jurisdiction
CIM & BIM
Computer Vision & Visualisation
Image, Graphic, Multimed Processing
Spatial Web
Local Digital Twin
Local Digital Twin
Local Digital Twin
Local Digital Twin
Local Digital Twin
Local Digital Twin
Interoperability / MIM / Dataspaces
Cloud Computing
Internet of Things
Geo-spatial Data
Sensor data & Actuators
Cameras & Photos
Environ-mental Data
Roads & Transport
Energy Consump-tion Data
Urban Infra-structure Data
Demo-graphic & Social Data
Govern-ment Records
Emer-gency Services Data
Citizen Feedback Data
Historical Data
Accessi-bility Data
Cultural and Heritage Data
Economic Data

Needs for Metaverse / Citiverse standards in JTC1, ISO & IEC





Citiverse will mostly be based on Local Digital Twins

There are several challenges with Local Digital Twins

These will influence Citiverse standardization

Matchmaking Platform: Registration process at a glance

LDT4SSC

ETSI STF 704

Home | View archived projects

← Back

- Description
- Who we are
- What we do
- Why we do it
- How we do it
- Terms of Reference
- Deliverables
- Milestones
- Useful links

LDT and MIMs

Ref. Body: DATA - Project No: 704

From 2025-12-01 to 2028-04-30

Open

Who we are


Benoit Orihuela
Expert

Monika Heyder
Expert

Franck Le Gall
Project Leader


Martin Bauer
Expert


Martin Brynskov
Expert


Mauro Dragoni
Expert

Michael Mulquin
Expert

Thimo Thoeye
Expert

Vincent Demortier
Expert

thomas Bousselin
Expert

- Two European standards
  - EN 304 181: LDT Reference Architecture
  - EN 304 182: MIMs 1, 2 & 7
- One Technical Report
  - TR 104 183: Companion Document and Technical Guidance

Delivery target: H1/2028

The three deliverables

1. **One European standard (EN) for an interoperable and AI-based EU Local Digital Twin reference architecture** depicting components and specifications, based on on-going works supported by the EC and EDIC on CitiVerse. *[Editor: Martin Bauer, NEC Europe]*

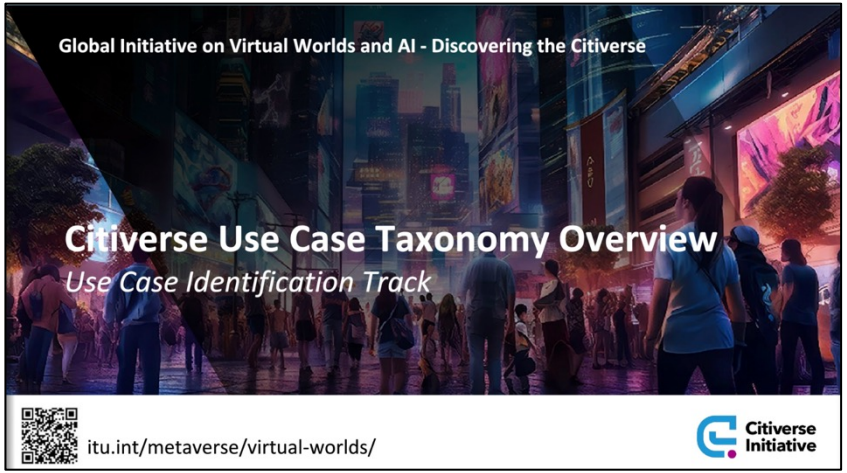
2. **One European standard (EN) of MIM key specifications** (interoperable components underpinning Smart City platforms and Local Digital Twins MIMs 1, 2, and 7) based on on-going works in Living-in.EU technical subgroup and standardisation efforts of the MIM framework at ITU-T (Y.4505).
[Editor: Mauro Dragoni, FBK]

3. **A Companion Document and Technical Guidance**, This entails creating comprehensive guidance material that extends beyond formal standards requirements, providing implementation practices, and integration examples with existing city systems. This document will synthesize stakeholder feedback from both workshops to address practical application challenges of the Local Digital Twin reference architecture and MIM specifications. The document must present detailed technical guidance MIMs integration into systems. Its development requires collaboration with on-going initiatives such as the Local Digital Twin toolbox.
[Editor: Vincent Demortier, OASC]

CITIVERSE*

Metaverse for Smart Sustainable Cities and Communities

*CITI = CITIZEN



- European priorities in a global agenda
- Standardisation of Data Spaces and Local Digital Twins + IoT + AI
- Based on Minimal Interoperability Mechanisms (MIMs)
- Specified in ITU-T Recommendation Y4505 (Y.MIM) and EU MIMs Plus (ETSI TC Data)
- Global initiative on Virtual Worlds and AI

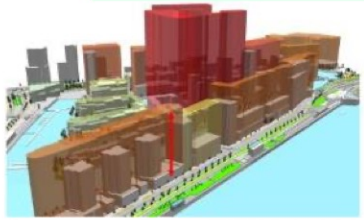
Generic, scalable, maintainable & FAIR datasources

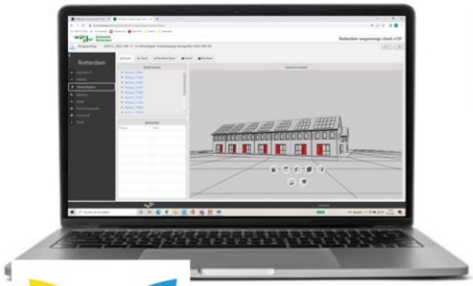
DigitaleStad

Demo omgeving

Building permit check service

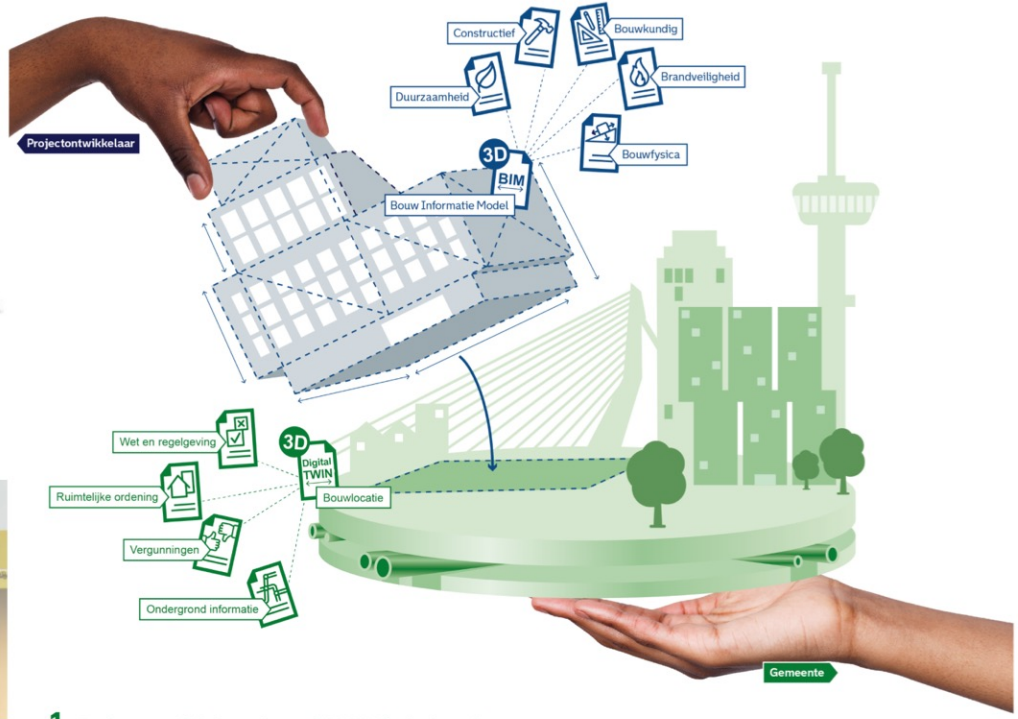
DigitaleStad





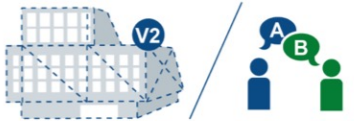
DigiDare Award 2022

Meerwaarde 3D in het vergunningentraject



1. Projectontwikkelaar plaatst 3D BIM in de door de gemeente digitaal beschikbaar gestelde 3D omgeving

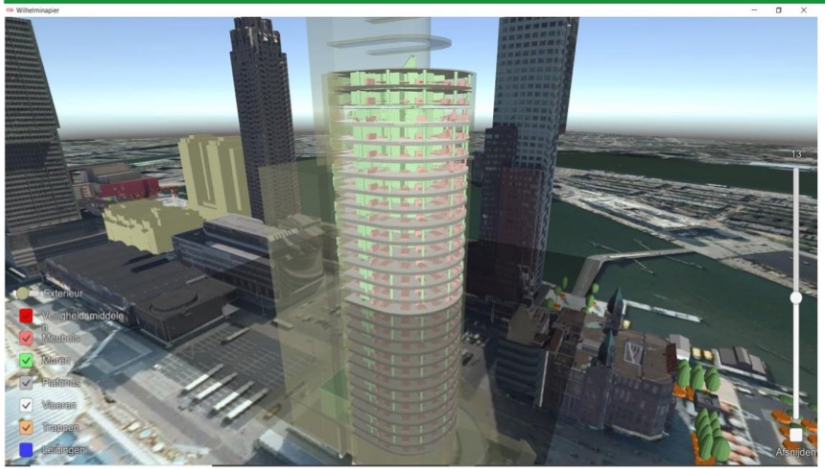
2. Detectie van conflicten tussen BIM, ondergrond en regelgeving

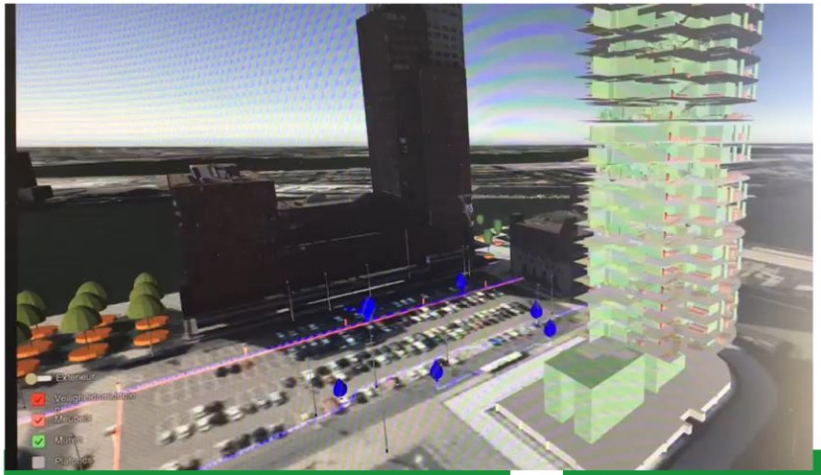


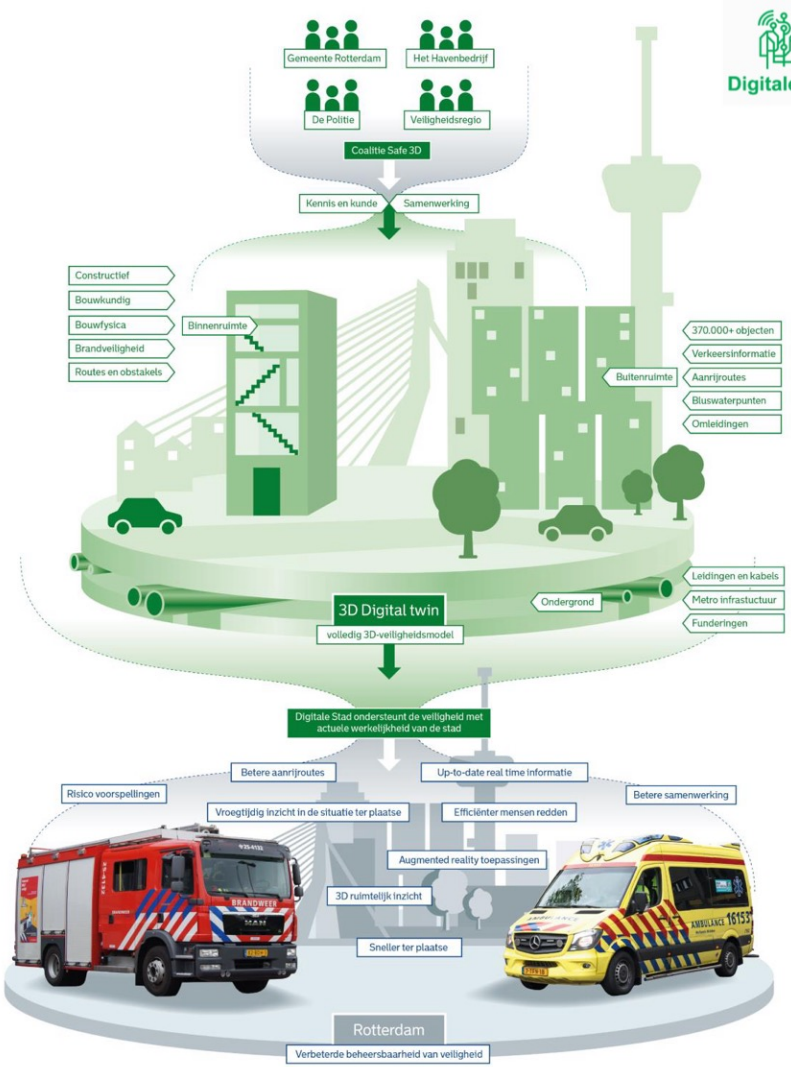
3. Aanpassingen en/of overleg

4. Passend ontwerp

SAFE Rotterdam 3D

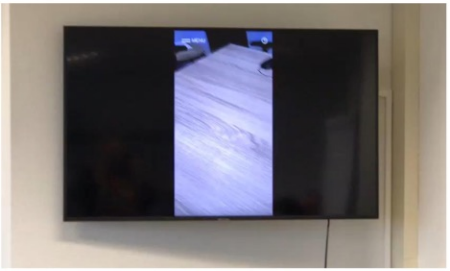


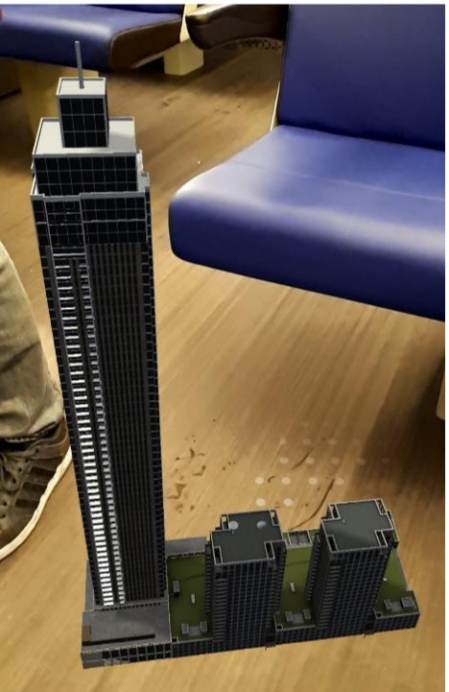


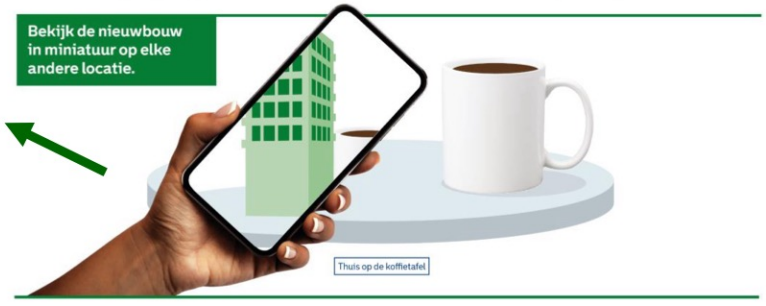


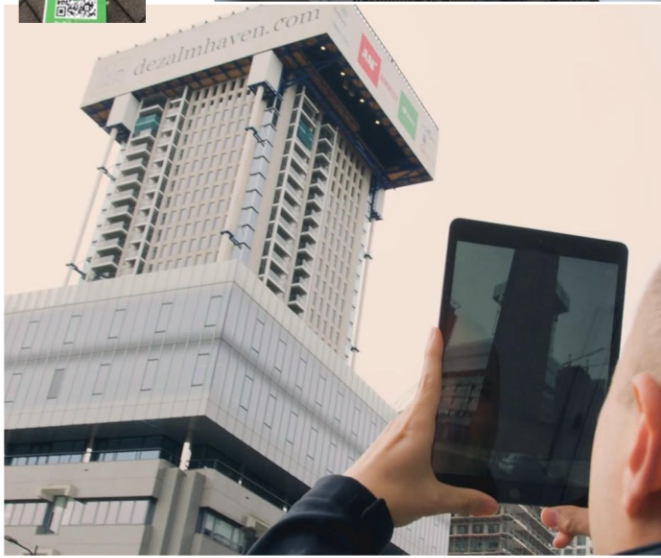
Visualisation new buildingplans with augmented reality

DigitaleStad

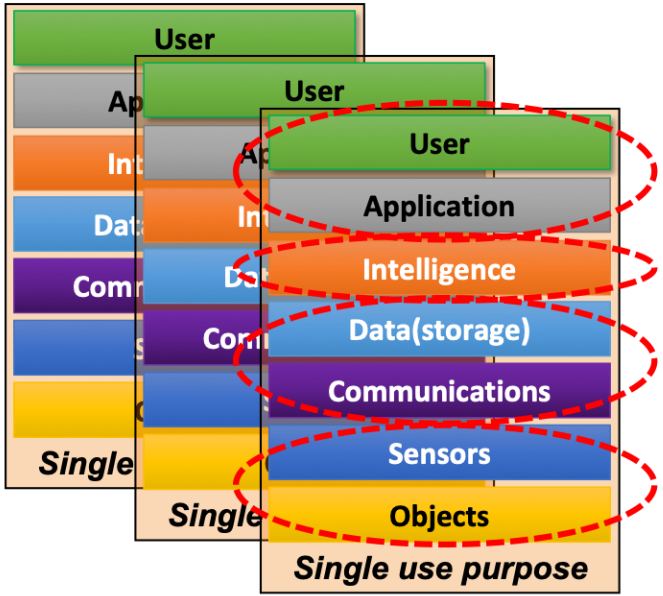






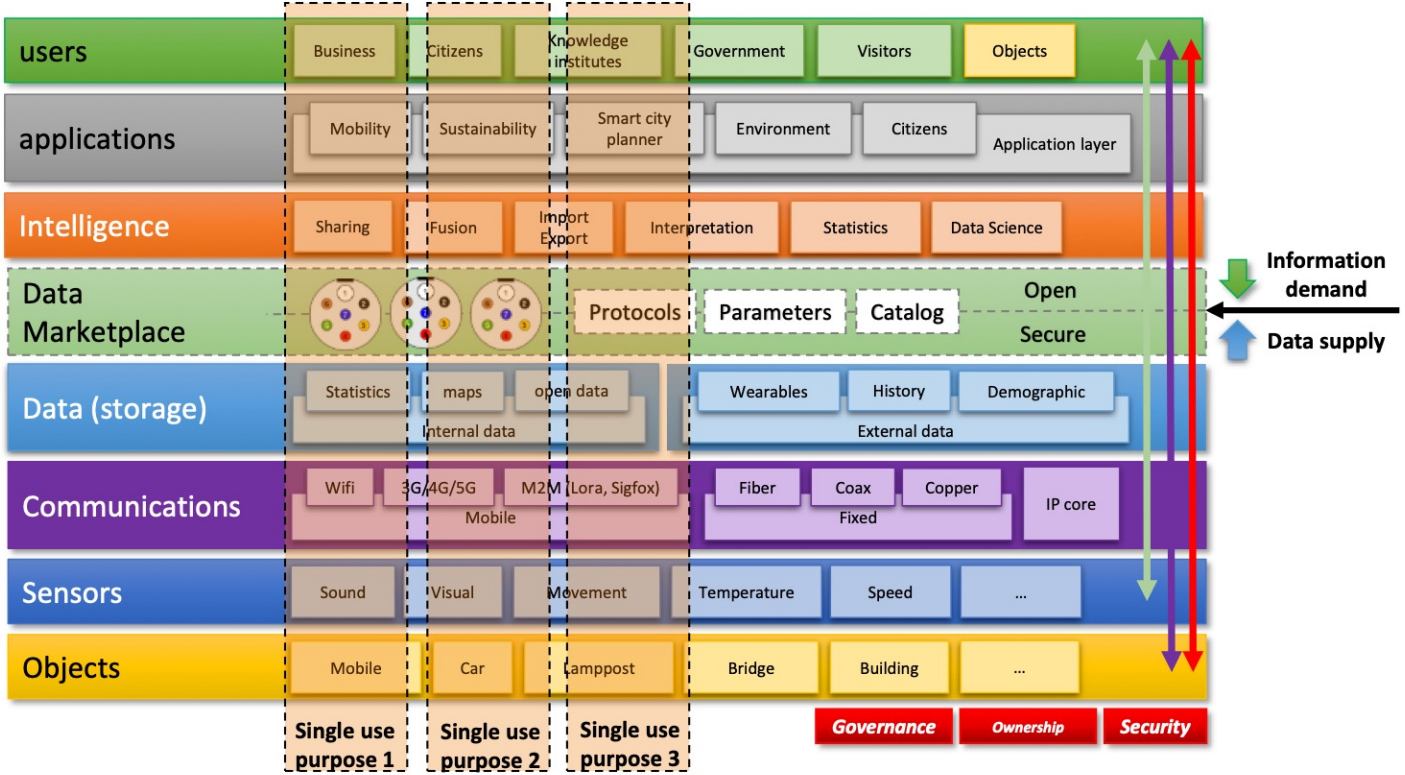


Current development ‘smart solutions’

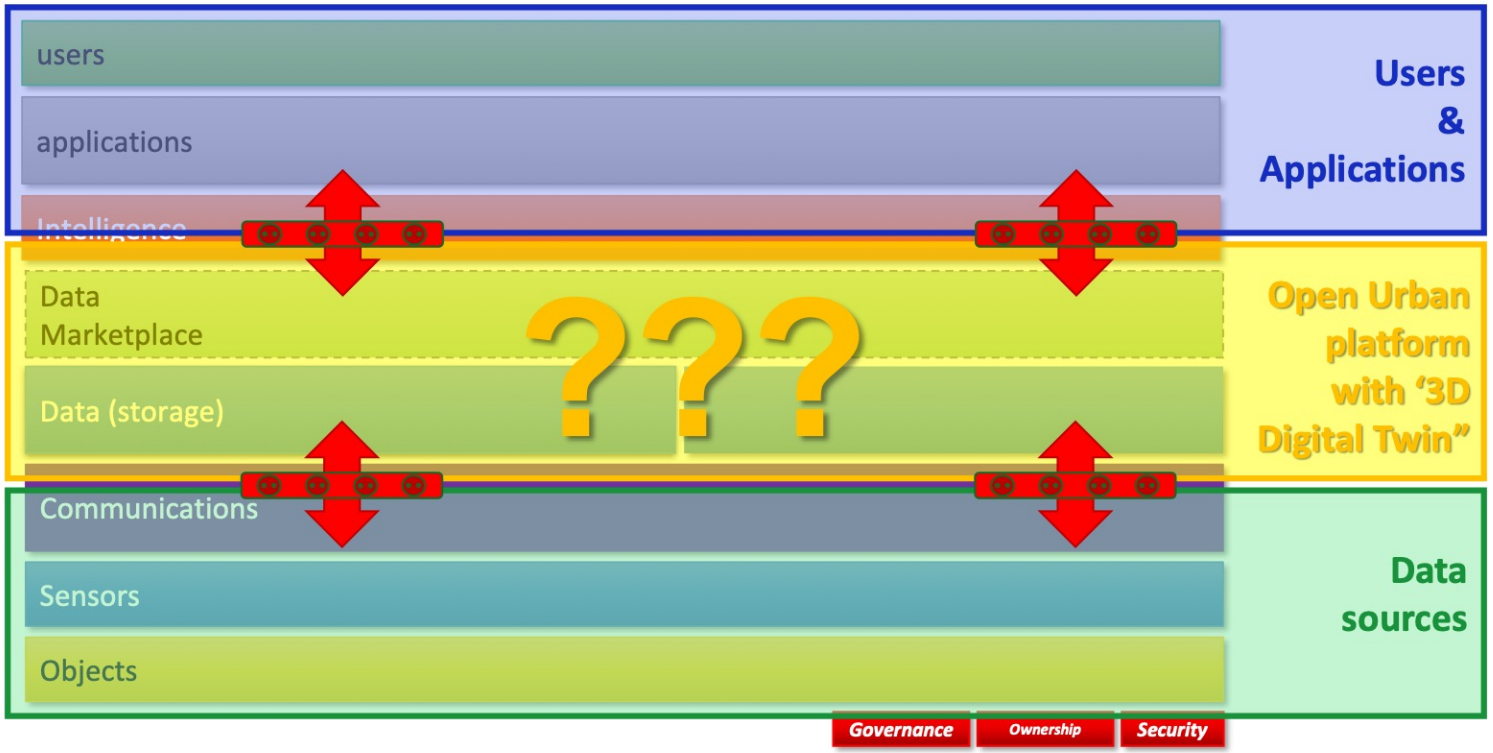


- ‘Silo’ developments
- Vendor lock-in
- No interaction/communication between applications
- Several infrastructures
- Exploding data management
- Suboptimal gains and higher (societal) costs
- No re use of data (except through connection with the ‘owner’)
- Data collection and development applications are connected to each other

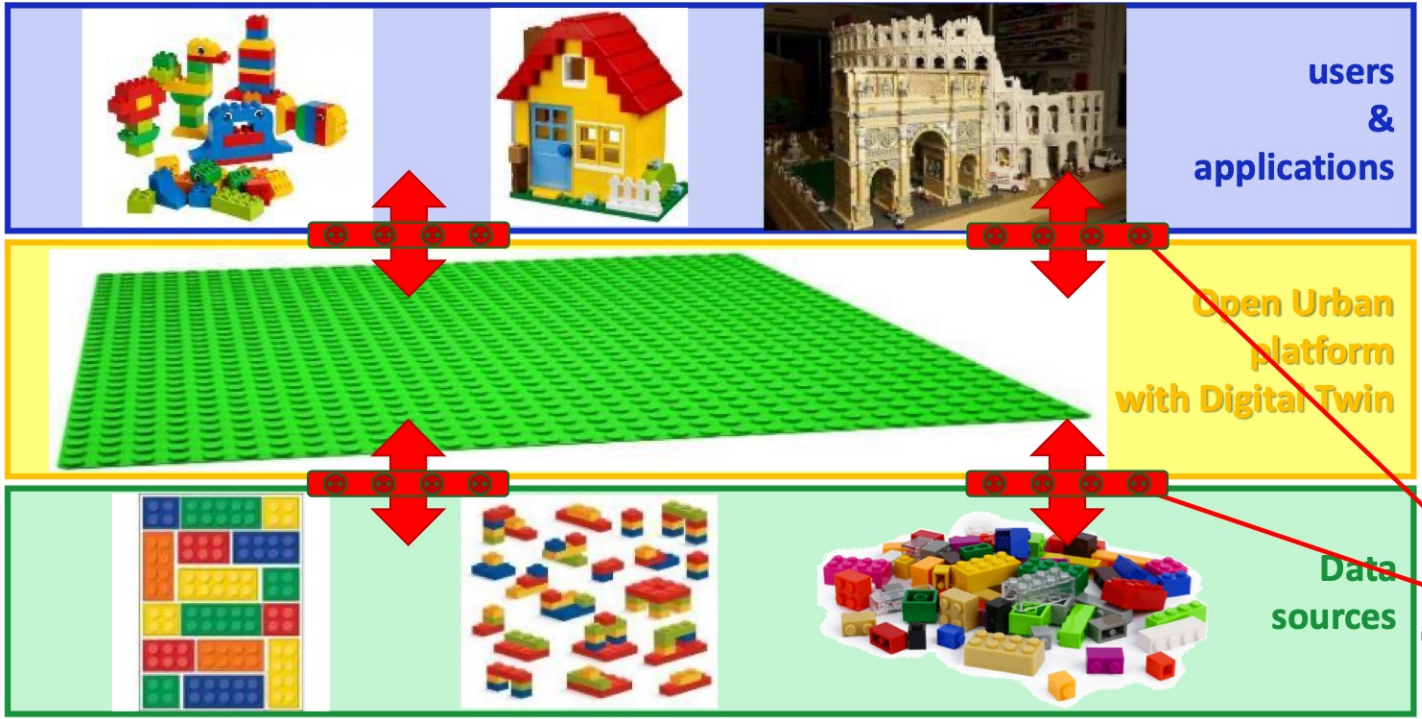
Desired data architecture



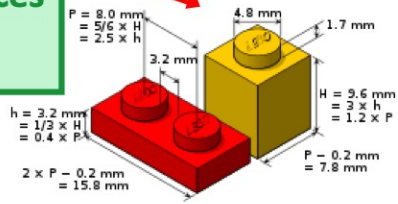
Data architecture and Digital City program

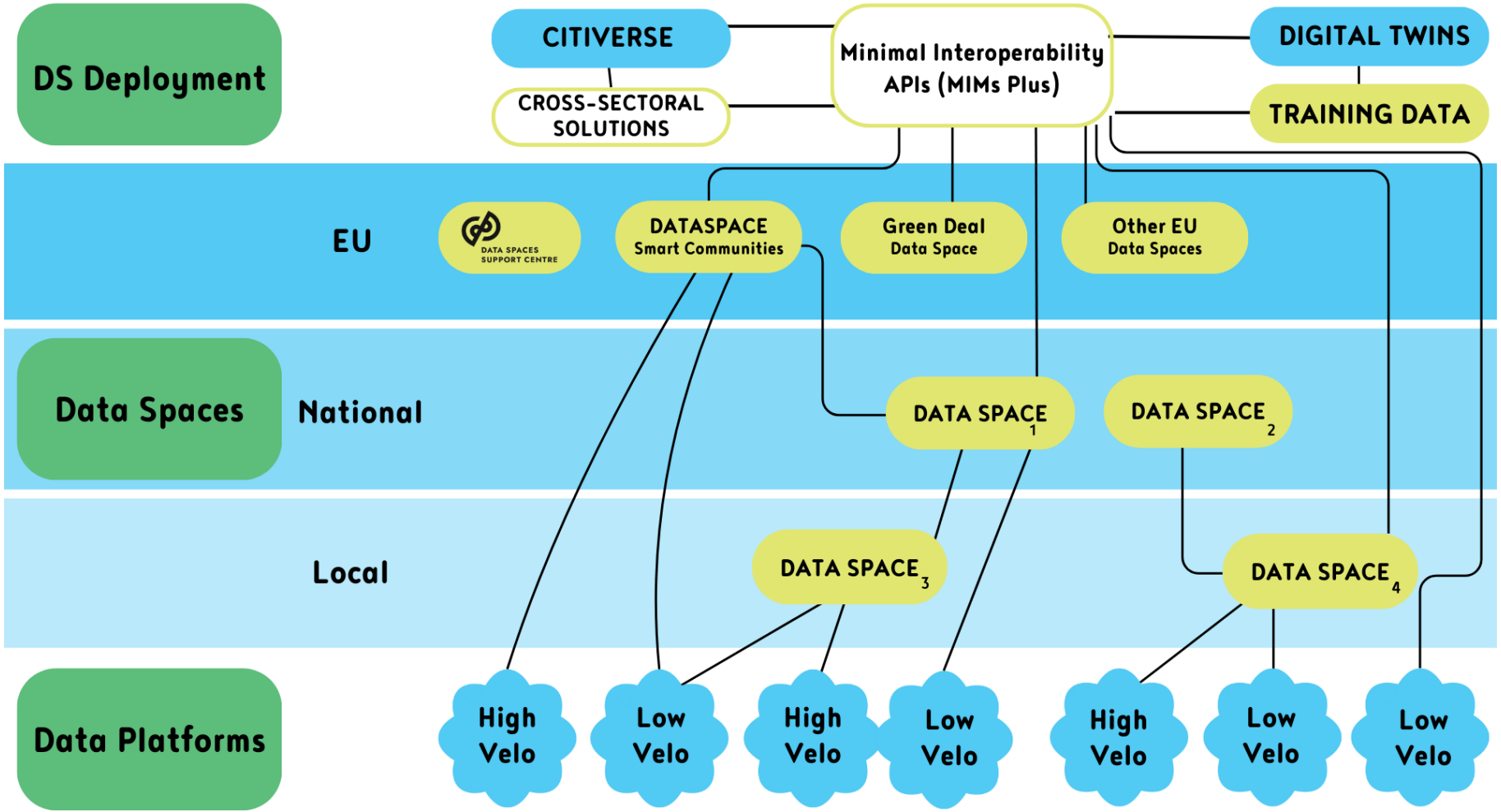


Open Urban Platform – design principles

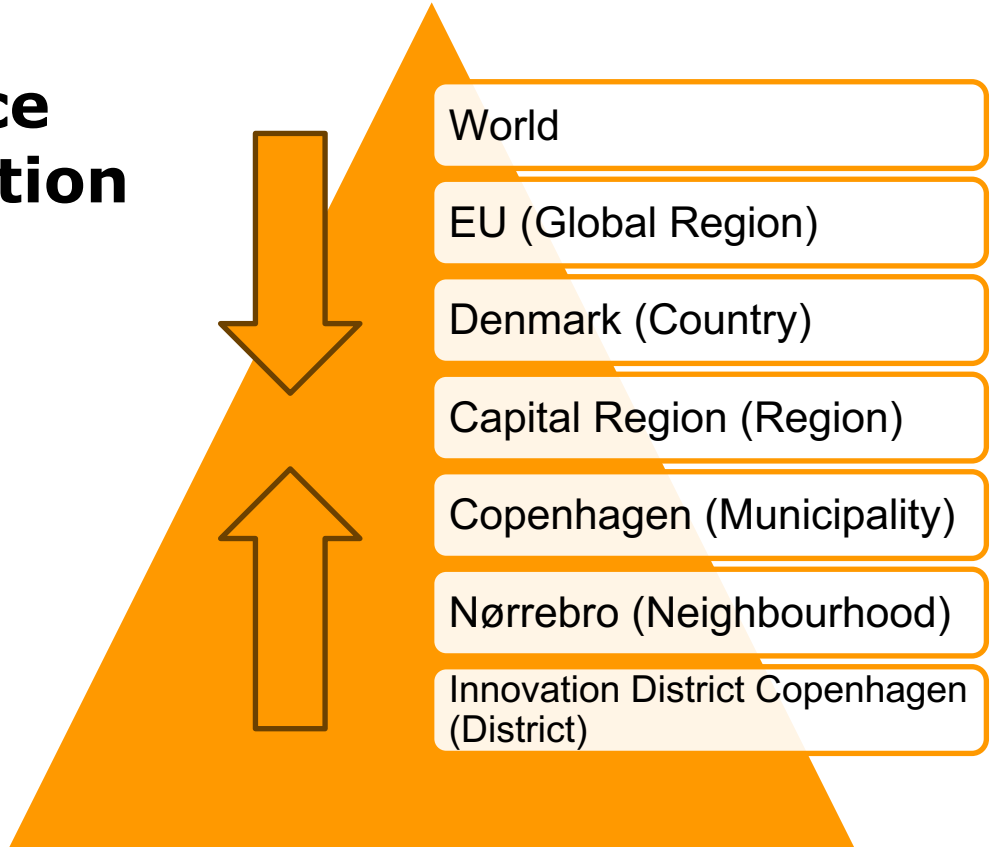


Pivotal Points of Interoperability (PPI's)




DS Deployment
CITIVERSE
CROSS-SECTORAL SOLUTIONS
Minimal Interoperability APIs (MIMs Plus)
DIGITAL TWINS
TRAINING DATA
EU
DATA SPACES SUPPORT CENTRE
DATASPACE Smart Communities
Green Deal Data Space
Other EU Data Spaces
Data Spaces
National
DATA SPACE 1
DATA SPACE 2
Local
DATA SPACE 3
DATA SPACE 4
Data Platforms
High Velo
Low Velo
High Velo
Low Velo
High Velo
Low Velo
Low Velo

Levels of governance and operation



Smart Communities Network

Facilitating the EU's green & digital transition of cities and municipalities

European Commission | Deloitte. | Capgemini invent | serendipity | EUROCITIES | imec | technopolis group | ICLEI Local Governments for Sustainability EUROPE | OASC OPEN & AGILE SMART CITIES & COMMUNITIES

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Learn more

Accessibility

2021 2022 2023 2024 2025 2026

LIVING-IN.EU

OASC MIMs
Go Li.eu
Living-in.EU MIMs Plus

#1 LDT Toolbox
Tech Specs

#2 LDT Advancing Initial Stages
Support services: SCN, procurement helpdesk and templates, MIMs Plus compliance testing and certification

LDT CitiVERSE EDIC

EU LDT TOOLBOX

#3 EU LDT Toolbox
Development of the Toolbox

European data space for smart communities

DS4SSCC – Data Space for Smart Communities blueprint

DS4SSCC DEP – Data Space for Smart Communities Deployment, validation

LDT4SSC
EU LDT Ecosystem
Common Interoperability Blueprint

LDT CitiVERSE **EDIC**

Developing CitiVERSE: x-CITE, SENSE, 3DxVERSE, CU-project

SENSE 3DxVERSE x-cite European Citiverses Uniting for Inclusiveness

AI
EU Artificial Intelligence

CitCom.ai

CitCom.ai
AI Testing & Experimentation Facility for SCC

DeployAI

AI

EU Interoperability Framework
EIF4SSC

ITB
Interoperability Test Bed

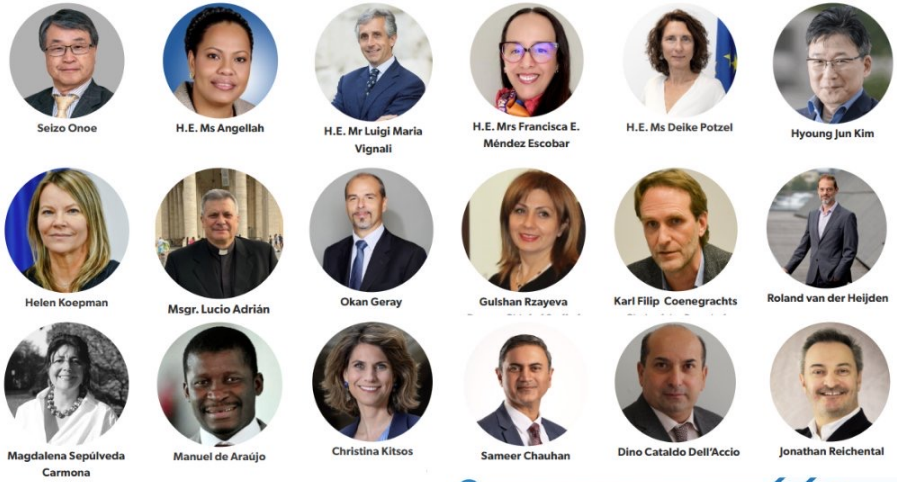
interoperable europe

UN Virtual Worlds Day

AI, spatial intelligence, and the citiverse: Shaping trusted digital futures

11–12 May 2026
Geneva, Switzerland

2nd Citiverse Assembly



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OASC — Open & Agile Smart Cities & Communities

UNICC

ITU

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Climate-Neutral and Smart Cities

REPORT

CEN/TC 465 on Sustainable Cities and Communites

Recommendations

1. Standards as Strategic Policy Instruments
2. Localisation, Practicality, and Capability Building
3. Stakeholder Collaboration and Inclusion
4. Better Bridging Between Research & Innovation Actions and Standardisation
5. Digital Infrastructure and Smart Public Services
6. International Alignment and Leadership

Recommendations on standards for:
Local Digital Twins
Positive Energy Districts
Free download (Zenodo)

SOLUTIONS

DILEMMAS

DIGITAL DILEMMAS

1. Flexibility, precision, productivity – for whom?
2. We don’t see the same city
3. Resilient or vulnerable?
4. Democratic immediacy or noise?
5. No-one left behind?
6. Overview or surveillance?
7. New public spaces without public authorities
8. Is planning possible?
9. Public institutions and their competences
10. Public service 2.0

Source: Danish government think tank ”Future digital cities – for and with people” (2015)