U4SSC Deliverable on Building Digital Public Infrastructure for Cities and Communities

A Strategic Framework for City Leaders, Ministers, and Policymakers

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Why Do We need DPI

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Urban Challenges & Opportunities	• Rapid urbanization & technological progress create complex challenges: inclusivity, sustainability, equitable access. • Poorly planned urbanization → congestion, exclusion, sprawl, environmental degradation. • Cities are adopting ICT & data-driven solutions to enhance planning, governance, and service delivery.
Smart City Transformation	• 2.8B lack adequate housing and 2.6B lack affordable Internet; digital divides persist across income, gender, and geography. • Need a holistic, people-centred smart city design: participatory governance, collective intelligence, bottom-up innovation.

Supply vs. Demand Gap and Absorptive Capacity	• Supply-side: ICT infrastructure, broadband, market liberalization, spectrum allocation.
	• Demand-side: Digital Public Goods (DPGs), inclusive services, digital skills, meaningful applications.
	• Challenge: Unequal adoption, vendor lock-in, privacy, sovereignty & regulatory risks.
	• Benefits of ICT depend on capacity of citizens, governments, businesses to use, adapt, and integrate technologies productively.
	    o Availability of broadband-enabled services & applications.
	    o Capacity to assimilate & exploit ICT for productivity and inclusion.

Critical Missing Piece – Digital Public Infrastructure	• Foundational components that support sustainable digital transformation, addressing market gap and reaching the bottom of the pyramid. • Trustworthy, secured and interoperable engagement between people, processes, and technologies. • Foundational, holistic, and inclusive digital layer for societies to engage effectively and efficiently with systems and services.

Key Research Questions

Building digital public infrastructure for cities and communities

A strategic framework for city leaders, officials, ministers, and policymakers

- *What are the key components of DPI deemed necessary and sufficient to achieve an effective and efficient sustainable digital transformation at the city level, to achieve the SDGs?*
- *What are the necessary tools, frameworks and requirements to guide stakeholders (e.g., city leaders) in deploying an effective DPI for cities to achieve cities' sustainability agenda (e.g., to enhance their socio-economic and environmental metrics, supporting their journey towards a sustainable deployment and fostering public trust)?*

Methodology

Framing DPI Conceptually
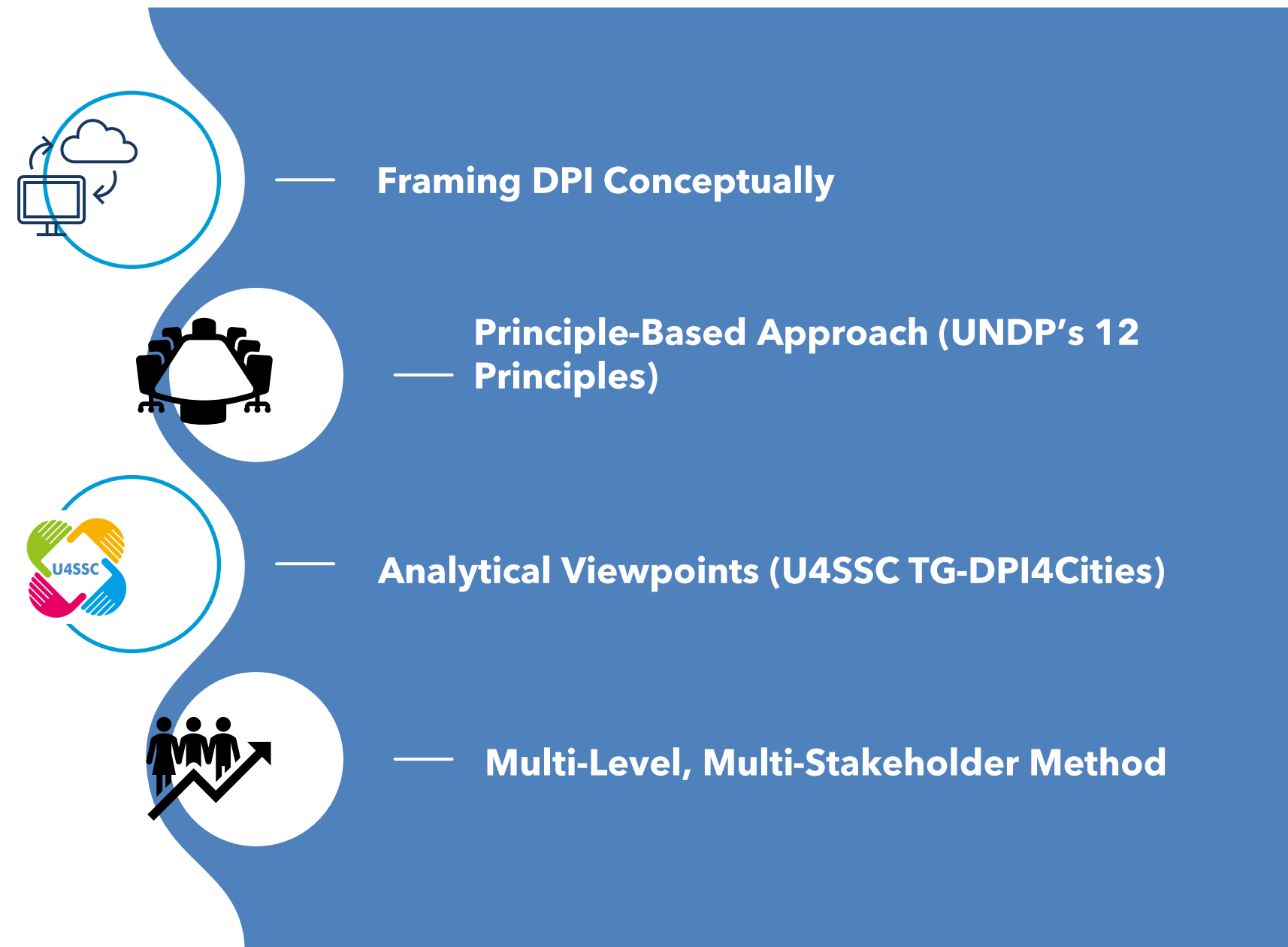
- Understand DPI as foundational, interoperable digital systems (digital ID, payments, data exchange, AI).
- Position DPI as a shared digital layer bridging national frameworks with city-level needs.
- Benchmark definitions: World Bank, OECD, UNDP, U4SSC.

Principle-Based Approach (UNDP's 12 Principles)

- Inclusivity, interoperability, modularity, scalability.
- Privacy & security by design.
- Governance for trust, grievance redress, sustainability, human rights.
- …

Analytical Viewpoints (U4SSC TG-DPI4Cities)

- Integrated dimensions for sustainable, people-centred urban transformation:
- Secure & climate-resilient infrastructure.
- …...

Multi-Level, Multi-Stakeholder Method

- Merge top-down frameworks (national/federal) with bottom-up local needs.
- Involve city leaders, residents, private sector, and civic-tech actors.
- Ensure alignment with SDGs & New Urban Agenda.

Conceptualization of DPI

TG-DPI4Cities defines Digital public infrastructure (DPI) for cities as:

*"**Necessary and sufficient digital ICT systems that improves quality of life, efficiency of urban operation and services, and competitiveness, by supporting city level sustainable digital transformation at scale through trustworthy, secured, and interoperable engagement between people, and the city's processes, and its underlying technologies. DPI for cities provides a foundational, holistic, and inclusive digital layer for societies to engage effectively and efficiently with smart cities' systems and services. DPI for cities includes critical systems such as digital identity, digital payments, data exchange, artificial intelligence (AI), and other foundational infrastructure, needed to support the interworking, interoperability, scalability and adaption of systems and processes, to wide range of varying city conditions, challenges, and risks, to achieve an inclusive, open, sustainable, fair, safe and secure digital adoption for all.*"

Implementation Challenges

Accessibility and digital inclusion

- Persistent digital divide: connectivity, affordability, literacy & gender gaps.
- Refugees, rural/indigenous communities & persons with disabilities face systemic barriers.

Governance models promoting sustainable development

- Fragmented institutions hinder coordination.
- Weak legal safeguards & limited participation erode trust.
- Growing need to align DPI with climate & sustainability strategies.

Funding models and public-private partnerships

- PPPs can mobilize resources & expertise but may carry high costs, risks & complexity.
- Effective structuring needed: risk-sharing, transparency & accountability.
- Case: São Paulo telecentres show PPP potential for digital inclusion.

Legacy systems

- Ageing IT is costly, insecure & inflexible.
- Outdated codebases and scarce maintenance expertise from retiring personnel.
- Modernization improves agility, cost-efficiency & citizen experience.
- Transition to cloud & microservices eases maintenance burdens and strengthens cyber defences.

Vendor Lock-in

- Overdependence on proprietary platforms threatens digital sovereignty.
- Nordic cases show high costs, limited competition & weak exit strategies.
- Even open-source can create "soft lock-in" without proper documentation & capacity building.

Successful Implementations

- To ground the discussion in real-world context, we examine several leading cities (**case studies**) that have pioneered effective governance and regulatory frameworks for their digital infrastructure, with key sustainability and people-centricity at their core processes.

- The **core analytical viewpoints** for cities have been used to frame the analysis of the case studies. These case studies – including Singapore, Estonia, Barcelona, Egypt's New Administrative Capital, New York City – highlight diverse approaches shaped by different legal systems and priorities.

- Each offers insight into **how cities can leverage policy and regulation to foster innovation while safeguarding public interest in the digital age**.

Successful Implementations
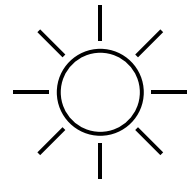
Secured, resilient infrastructure and climate adaptation

- Aveiro: 5G + IoT + open-source data (FIWARE) for live urban mobility & climate resilience.
- Copenhagen: Cloudburst Management System with GIS & hydrological models for flood prevention.
- Egypt (New Capital): Command & Control Centre integrates IoT + AI for emergency response.

Urban environmental sustainability and biodiversity

- Nature ID (Brazil): Integrates remote sensing + Indigenous knowledge for ecosystem services & climate finance.
- Oasis: Green infrastructure + IoT sensors for biodiversity monitoring.
- Smart grids (Germany): AI-enabled energy management for emission reduction.

Urban economic transformation and industrial innovation

- Porto Digital (Brazil): Tech hub with 17k+ jobs, gov–acad–private partnership.
- Irembo (Rwanda): Digital platform for 100+ public services, financial inclusion.
- Traffy Fondue (Thailand): AI-based civic engagement platform, uses AI to route and address complaints.
- Pix (Brazil): Real-time interoperable payment system driving financial inclusion.
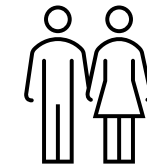
Gender equality, social inclusion and human rights in urbanization

- Decidim (Barcelona): Open-source platform for participatory governance.
- Nigeria: Digital ID enrolling 48M+ women for financial/public services access.
- Nairobi Braiding App: Links informal women workers to digital markets.
- Indonesia (IKD): Digital ID integrating services with healthcare, education, financial services while upholding data protection laws.

Successful Implementations

Smart digital governance and data-driven urban management

- Lisbon/Bristol: Cloud City Operation Centre unifying city operations.
- Amsterdam: IoT + open data for adaptive traffic & energy use.
- Egypt (New Capital): Collaborative smart governance with third party services operation and digital governance processes and platforms.
- Sydney Digital Twin: Predictive urban simulation for climate resilience.

Sustainable urban mobility, tourism and cultural preservation

- Amsterdam: IoT-enabled multimodal transport (bikes + public transit).
- Turkey: VR/AR for heritage preservation & tourism, digital platforms to democratize access to cultural sites, alleviate environmental strain, and preserve fragile heritage.
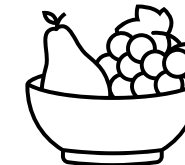
Sustainable urban food systems and rural-urban linkages

- Telangana ADEx (India): Open agriculture data exchange for farmers (open-source interoperable platform, discoverability and accessibility of data assets).
- Estonia: Integrated registries and X-Road APIs for precision agriculture.
- Belém (Brazil): Beckn protocol-based network opens digital marketplace, transaction protocol that allows discovery, ordering, fulfilment and payment between buyers and sellers.
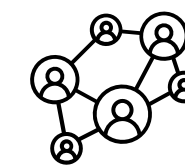
Multilateral cooperation and regional urban strategies

- Kazakhstan: Fused government Digital ID + private fintech APIs enabling 89% digital transactions, standardized payment and identity → regional integration.
- Brazil: Unified and interoperable national registries linking welfare, land & ID enabling vertical cooperation.
- SOURCE Platform: Institutional multilateralism, standardizing infrastructure project governance across nations.

Strategic Benefits

Service access and equity

- Expands access to essential services: ID, health, welfare, finance, utilities.
- Bridges digital divide, supports inclusion (gender, rural, low-income groups).
- Cases:
  - **PhilSys (Philippines)** – 80M+ registered;
  - **M-Pesa (Kenya)** – 85% internet penetration;
  - **Egypt InstaPay** – 90M+ transactions in Q1 2024.
- Empowers communities through participatory digital design (e.g., citizen-led air quality monitoring).

Efficient and responsive governance

- Cuts bureaucracy, accelerates processing times, boosts service reliability.
- Cases:
  - **Rwanda Irembo** – 50%+ services digitized; 42% rise in applications.
  - **Estonia** – 100% services online; saves 2% GDP annually.
- Enhances local service delivery & citizen satisfaction (Makassar, Indonesia, 75% of surveyed residents reported improvement in government responsiveness).

Resilience, transparency and trust

- Ensures continuity during crises (health, climate, cyber).
- Real-time alerts: **flood warning** (Bengaluru, Singapore), health early-warning (Rio dengue model).
- Builds transparency via **participatory budgeting & digital platforms** (Zurich, Lucerne).
- Strengthens trust: Estonia's **secure digital ID**; Hong Kong's **e-participation**.

Digital innovation and sustainable economic empowerment

- Creates a foundation for entrepreneurship, fintech & innovation ecosystems.
- Drives inclusive growth:
  - India – **Aadhaar** + UPI = $31.8B in economic value (0.9% GDP in 2022).
  - Kenya – **M-Pesa** boosted resilience; economy rebounded 7.5% in 2021.
- Supports green innovation & sustainability (**China's Yangtze River Belt**).
- **Municipal broadband** (New York) bridges digital divide, spurs local growth.

Enabling Policies and Institutional Foundations

Governance models for sustainable DPI
facilitate collaboration and create a shared vision for design, management and promotion of DPI
- Centralized national platforms
- City-led or decentralized models
- Federated or networked models
- Public–private partnerships (PPPs)

Stakeholders' engagement and public trust
- Designing inclusive engagement mechanisms
- Building institutional mechanisms for trust
    - Digital ombudspersons
    - Data stewardship councils
    - Algorithmic transparency laws
    - Independent audits
    - Codes of digital conduct

Whole-of-government approach
coordinated policy design, implementation and oversight across all levels and sectors of government

Legal and regulatory frameworks
define its boundaries, safeguard fundamental rights and determine whether these infrastructures can be trusted, scaled and sustained across public and private domains

Role of International Standards and Cooperation

Interoperability and open standards

Open APIs, W3C, ITU, ISO/IEC standards prevent silos & vendor lock-in.

Privacy-by-design and data protection

Embed privacy/security from the outset (PbD, GDPR, ITU standards) to ensure trust & compliance.
- ITU-T X.1054, ITU-T Y.4810, ISO/IEC 27014 and ISO/IEC 27701

Ethics in AI, blockchain and emerging tech

Apply UNESCO/IEEE/OECD frameworks for fairness, transparency & accountability in AI/blockchain.
- (IEEE)'s P7000
- IEEE's Ethically Aligned Design and OECD's AI Principles
- W3C's decentralized identifiers

Accessibility and inclusion standards

Universal design & WCAG/ITU standards ensure DPI works for all, incl. persons with disabilities.
- ITU-T Y.4204, ITU-T Y.4211 and ITU-T Y.4219
- WCAG and ISO 30071-1

Trust and security mechanisms to prevent misuse

Strong encryption, identity federation (SAML, eIDAS), audits & breach protocols build trust.
- ITU-T Y.4810, ITU-T Y.4806, ITU-T Y.4500.3, ITU-T X.2050, ISO/IEC 27001, ISO 22301

Public procurement for scalable DPI

Embed open standards, modularity & vendor neutrality into procurement to drive innovation.
- World Trade Organization's Agreement on Government Procurement (GPA) and the European Union's Digital Markets Act (DMA)

Policy Recommendations

- Development of an integrated national and a municipal DPI strategy

- Invest in inclusive, scalable and interoperable infrastructure

- Promote human rights and digital trust

- Strengthen public-private partnerships and innovation ecosystem

- Development of an enabling regulatory and a business-friendly environment

- Measure impact and share best practices

Conclusion

The Urgency of Now

- Cities face converging crises: urbanization, climate change, inequality & digital divide.

- Legacy systems, vendor lock-in, and weak digital inclusion block progress toward SDGs & GDC.

- DPI is essential for resilience: enabling real-time crisis response (pandemics, floods, heatwaves) and adaptive governance.

- Time is running out – inaction disproportionately harms the most vulnerable.

The Opportunity for Global Leadership

- DPI+ (stack-agnostic, interoperable) avoids silos and ensures long-term adaptability.

- Pioneer cities show DPI is both a technical enabler & governance imperative.

- Leadership priorities:
  - *Collaboration* – shared standards & best practices (e.g., U4SSC, OASC).
  - *Innovation* – partnerships & civic-tech ecosystems.
  - *Equity* – inclusive by design, leaving no one behind.
  - *Resilience* – integrating DPI with climate adaptation & smart systems.

- Seizing DPI+ today = shaping inclusive, resilient, future-ready cities.

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Check the deliverable

U4SSC website:

https://www.itu.int/go/u4ssc

Thank you!

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