

From Fragmentation to Interoperability in the Citiverse

The Role of ITU-T Study Group 20

HYOUNG JUN KIM

Chair, ITU-T Study Group 20

"IoT, Digital Twins and Smart Sustainable Cities and Communities"



OPENING REFLECTION

Why This Conversation Matters — Now

“

The citiverse is no longer a distant vision. Cities are building it today — and every day without alignment, we risk locking in fragmentation for a generation.



Cities can't wait

Local digital twins and citiverse pilots are already being procured, deployed and scaled worldwide.



Standards must converge

ITU, ISO/IEC, IEEE, CEN-CLC and industry fora are all producing deliverables — overlap is today's real risk.



People must stay at the centre

Interoperability is not only technical; it is about inclusion, accessibility and public value.

WHERE SG20 SITS

ITU – The UN Specialized Agency for Digital Technologies

ITU brings together governments, industry, academia and civil society to develop consensus-based international standards that make digital technologies interoperable and trusted.



194

Member States



1000+

Companies, universities,
research institutes and
international organizations



10

ITU-T Study Groups
developing ICT standards



4000+

ITU-T Recommendations
freely available



Within ITU-T, SG20 is the lead group for IoT, digital twins and smart sustainable cities and communities — the natural home for citiverse standards anchored in urban realities.

LEAD GROUP ON IoT, DIGITAL TWINS & SMART SUSTAINABLE CITIES AND COMMUNITIES

ITU-T Study Group 20 at a Glance

SG20 is ITU-T's lead Study Group for all matters related to IoT, digital twins and smart sustainable cities and communities — Including AI-enabled citiverse and virtual worlds for cities.



**Internet of
Things and digital
twins**

and digital services



**Smart
Sustainable Cities**

energy management



**Digital
Health**

related to IoT and SSC&C



**Digital
Agriculture**

farm to consumer



**AI-Enabled Citiverse &
Virtual Worlds**

and AI for cities

200+ international standards for cities — freely available to all. SG20 is where urban practice meets global consensus.

HOW OUR WORK IS ORGANIZED

SG20 Structure – Three Working Parties, Eleven Questions

The 2025–2028 structure is designed to bring coherence across the full citiverse stack: from people-centred requirements, through architectures and interoperability, to data, security and decentralization.



REQUIREMENTS, HUMAN-CENTRIC SOLUTIONS, EVALUATION

WP1/20 — Putting People at the Centre

WP1 defines what cities actually need, how we measure progress, and how inclusion and accessibility are built into digital services from day one.

**Q2**

Requirements, Capabilities & Architecture Framework across Verticals

Defines the building blocks every vertical — mobility, energy, health, environment — can reuse. Q2 is where citiverse platform requirements are taking shape.

**Q7**

Evaluation & Assessment of Smart Sustainable Cities and Communities and Digital Services

Home of the U4SSC Key Performance Indicators, now extended to assess the maturity, sustainability and people-centredness of citiverse deployments.

**Q8**

Human-centric Digital Services

Digital health, accessibility and inclusion — making sure the citiverse is not just for the digitally privileged few, but delivers for all citizens.

ARCHITECTURES & EMERGING TECHNOLOGIES

WP2/20 — Interoperability as the Core Promise

If WP1 tells us why, WP2 tells us how the pieces fit together — across platforms, across digital twins, and across the emerging agentic and AI-enabled layer.

**Q1**

Interworking between Smart City Platforms & Digital Twins

Home of Recommendations ITU-T Y.4238/Y.4239/Y.4240 — integrating virtual and physical worlds through digital twins. The technical spine of the citiverse.

**Q3**

Architectures, Functionalities and Protocols

Where vertical use cases become reusable architectures — including interoperable identity of IoT devices across metaverse platforms (Recommendation ITU-T Y.4812).

**Q5**

Terminology And Definitions, Study And Research Of Emerging Digital Technologies

A shared vocabulary is the first act of interoperability. Q5 pins down what we actually mean by citiverse, digital twins, Internet of agents, and more.

**Q10**

IoT for Effective Energy Management

The citiverse must be energy-aware. Q10 ensures our virtual worlds do not grow at the expense of the planet.

DATA, SECURITY & DECENTRALIZATION

WP3/20 — Trustworthy Data as the Foundation

No city will build its digital twin on untrusted foundations. WP3 secures the civerse — with data governance, security, privacy, identification, and decentralized architectures.

**Q4****Data Analytics, Sharing, Processing, Management of IoT and SSC&C**

Big data, data spaces, and interoperability with European and global data-sharing frameworks.

**Q6****Security, Privacy, Trustworthiness, Identification of IoT and SSC&C**

Citizen trust is non-negotiable — security and privacy are designed into the civerse, not bolted on later.

**Q9****Decentralized / Distributed IoT**

Decentralized architectures that avoid single points of failure and support digital sovereignty.

**Q11****Digital Agriculture: From Smart Farm And Production To Safe And Secure Consumption**

Extending SG20's smart-city principles beyond urban cores as civerse use cases expand.

THE FG-MV LEGACY FEEDING SG20

From Exploration to Standardization

Between December 2022 and June 2024, the ITU Focus Group on metaverse (FG-MV) delivered 52 pre-standardization technical specifications and technical reports. That body of work is now the raw material for SG20's civerse Recommendations.



52

Pre-standardization technical specifications and technical reports delivered

Freely available · itu.int/metaverse

Selected Themes Now Feeding SG20



Definition and framing of the civerse



People-centred civerse principles



Generative AI in metaverse services



Reference framework for industrial metaverse



Cross-platform interoperability architecture



Accessibility of metaverse products and services



Cyber risks, threats and harms in the metaverse








Methodology for GHG emissions assessment

SG20 FLAGSHIP CITIVERSE DELIVERABLES

Shaping the Standards Landscape for the Citiverse

A concrete set of Recommendations is already in place or close to approval — giving industry and cities something to build on, not just talk about.

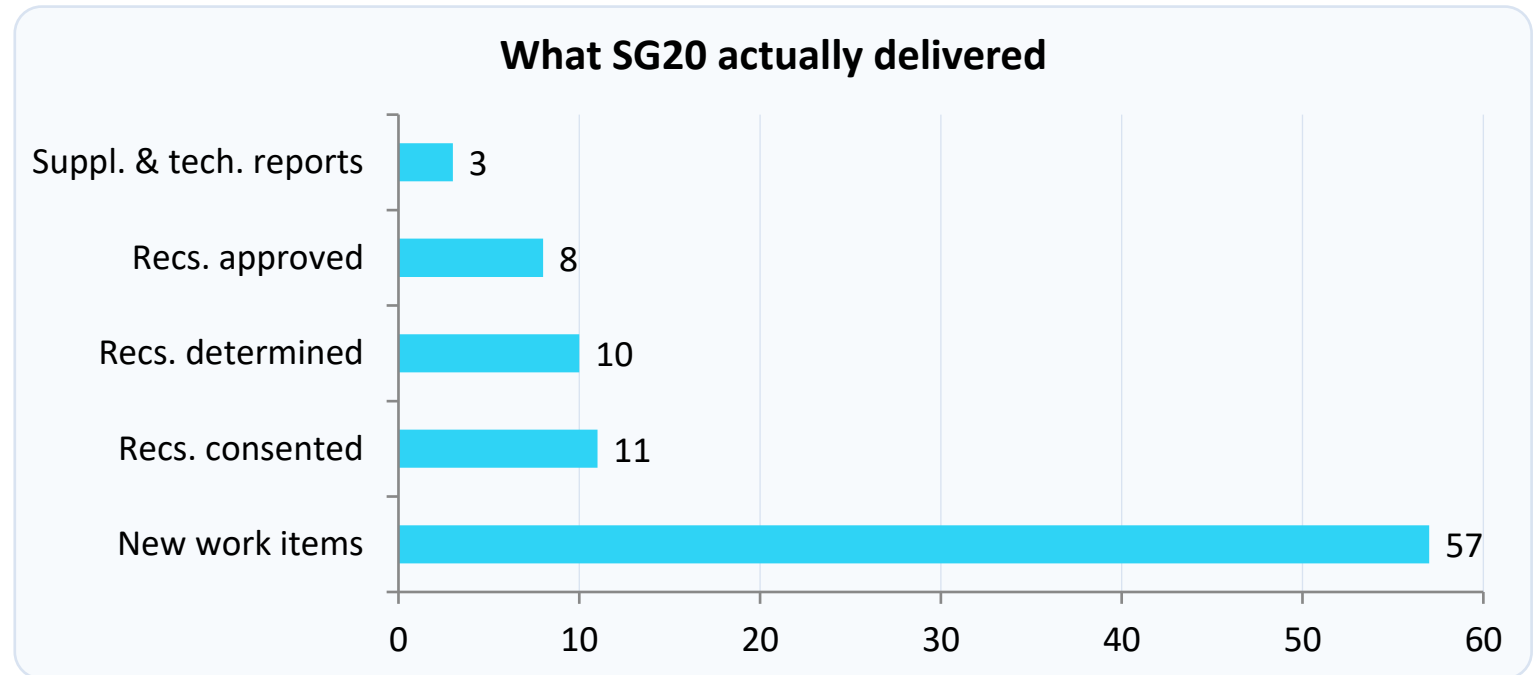
	ITU-T Y.4812	APPROVED	Interoperability of IoT devices' identity across metaverse platforms
	ITU-T Y.4238	APPROVED	Requirements for integrating virtual and physical worlds through digital twins
	ITU-T Y.4239	APPROVED	Reference model for integrating virtual and physical worlds through digital twins
	ITU-T Y.4240	APPROVED	Interoperability framework for integrating virtual and physical worlds through digital twins
	ITU-T Y.citiverse-reqts	DRAFT	Requirements of citiverse platform for smart sustainable cities and communities

GENEVA · 15-25 SEPTEMBER 2025

September 2025 Plenary — Momentum Is Real

SG20 is not a talk shop — it is a delivery engine. These numbers reflect the work of hundreds of experts from every region, converging on consensus-based outputs.

226
CONTRIBUTIONS RECEIVED
a decisive signal of global engagement



A large share of these items touches citiverse, digital twins and interoperability directly.

ROADMAP TOWARD 2026 AND BEYOND

Ongoing Citiverse Work — What Comes Next

The citiverse work programme within SG20 is not static — it is expanding in three directions that matter for this room.

TIMELINE · NOW → MAY 2026 PLENARY → 2027+

NOW — 2026



Platform Requirements

Finalize Y.citiverse-reqts — the baseline requirements document cities, vendors and evaluators can all reference.

Clear linkage to U4SSC KPIs so the citiverse becomes measurable, not just aspirational.

MAY 2026 PLENARY



Agentic AI & Internet of Agents

New Focus Group proposal — targeting approval at the May 2026 SG20 plenary.

Scope carefully defined to complement, not duplicate, SG13, SG21, JTC 1/SC 42 and IEEE.

ONGOING



Joint Coordination — JCA-MV

The Joint Coordination Activity on Metaverse Standardization, meeting since October 2025.

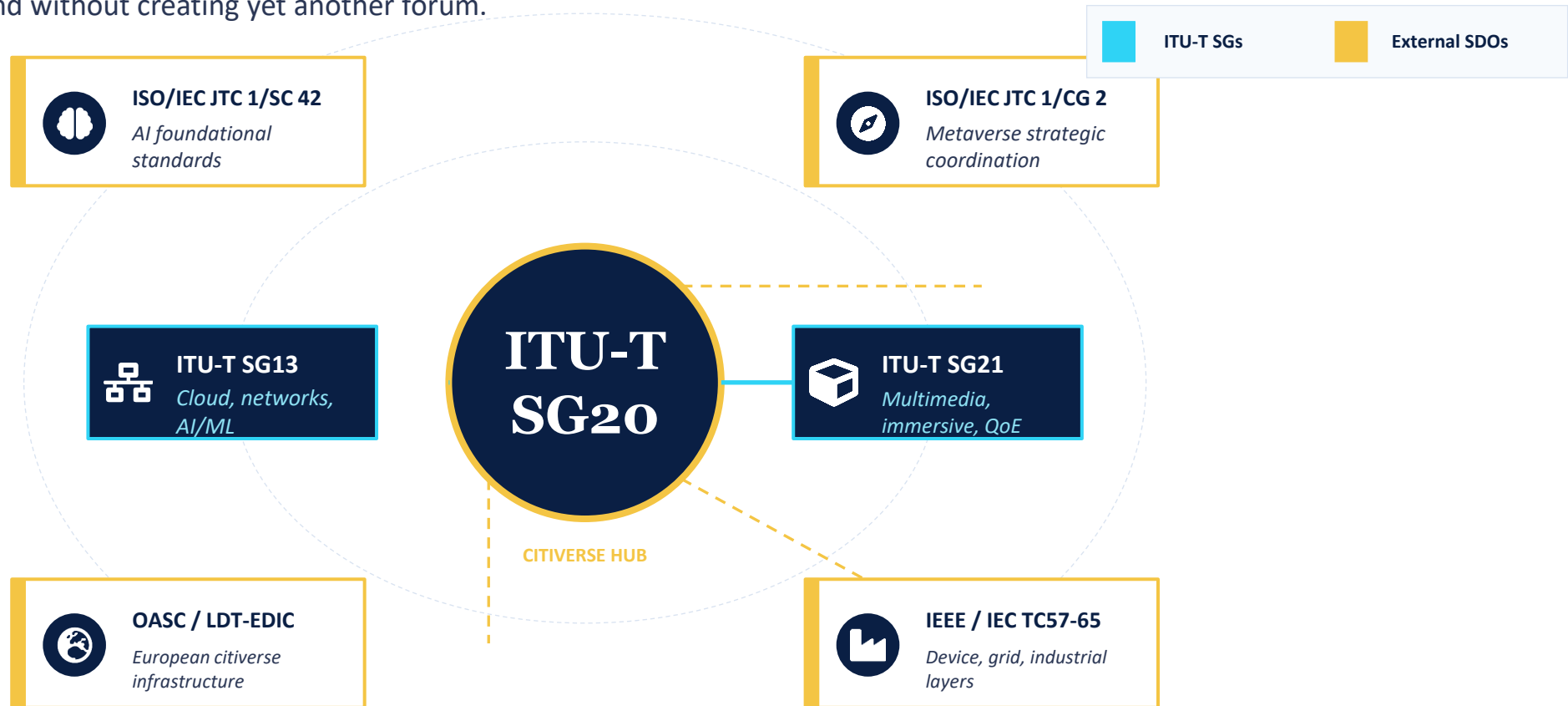
Ensures SG20 speaks with one voice across ITU-T and with external SDOs on citiverse matters.

SG20's citiverse pipeline is open, transparent, and deliberately designed for alignment with partners.

WHERE SG20 SITS IN A CROWDED ECOSYSTEM

The Coordination Landscape Around the Citiverse

Citiverse standardization is not happening in one room. The honest challenge is to connect these efforts without duplicating them — and without creating yet another forum.



WHAT WE ARE DOING, CONCRETELY

Addressing Fragmentation — SG20's Four Commitments

Fragmentation will not be solved by declarations. It will be solved by discipline.

01

Clear scoping

Every new SG20 citiverse work item is scope-checked against other ITU-T SGs, ISO/IEC and IEEE before approval.

02

Formal liaison

Active liaison statements with SG13, SG21, JTC 1/SC 42 and CG 2 — not only at the end of a project, but during drafting.

03

Open participation

Experts from the European Commission, OASC, StandICT TWG and city networks are welcome as Associate Rapporteurs and editors.

04

Anchored in cities

Citiverse Recommendations must be anchored in real city use cases and SG20 will ensure this principle is upheld.

Discipline, not declarations. Four habits that keep coordination real.

WHAT I WANT THIS ROOM TO TAKE HOME

Alignment Messages for This Session

Three things I would like every person in this room — from cities, from SDOs, from industry — to remember after today.

1

OPEN · CONSENSUS · DEFAULT

Interoperability is a public good

The citiverse will only deliver value if it is interoperable by default.

Open specifications, anchored in consensus bodies like ITU, ISO/IEC and IEEE — not proprietary stacks rebranded as ecosystems.



2

LANES · LIAISONS · LEVERAGE

Alignment beats duplication

SG20 will do its own lane well — IoT, digital twins, smart cities — and connect formally to JTC 1/SC 42 on AI, CG 2 on metaverse, StandICT on the European landscape.



3

MAYOR · CIO · CITIZEN

Cities are the customer

Every deliverable must pass the city test. If a mayor, a CIO or a citizen cannot see the benefit, we are optimizing for committees, not for people. That is the single discipline that keeps this field honest.



COORDINATION IN PRACTICE, NOT ON PAPER

A Direct Word to My Fellow Panelists

Rather than repeating each other, here is a specific handshake offered to each co-panelist.



To Martin Brynskov

OASC · Moderator

- *Let us use OASC's city network as the reality check for every SG20 citiverse Recommendation.*
We will formalize a standing feedback loop between SG20 Q1/Q2 and OASC.



To Torbjörn Lahrin

ISO/IEC JTC 1/CG 2

- *SG20 commits to exchange liaison statements with CG 2 at every plenary on metaverse scoping.*
So that ITU-T and ISO/IEC clearly divide and combine, rather than compete, on the citiverse stack.



To Christoph Runde

StandICT TWG Virtual Worlds

- *We welcome StandICT expert contributions directly into SG20 Questions.*
And we will align our citiverse deliverables with the TWG's European gap analysis.

AN HONEST MAP OF RESPONSIBILITIES

Dividing the Work Cleanly — Who Does What

A working proposal for discussion. Better to argue about the map here than to duplicate work for two years.

This mapping is lead roles, not exclusive ownership. Interfaces always need joint work.

BODY	PRIMARY LANE IN THE CITIVERSE	LINK WITH SG20
HOME	ITU-T SG20 Citiverse platform requirements · digital-twin integration · city KPIs	Home base
ITU-T	ITU-T SG21 Immersive media · coding · QoE for virtual worlds	Coordination via JCA-MV
ITU-T	ITU-T SG13 Network & cloud enablers · AI/ML infrastructure	Liaison on architectures
ISO/IEC	ISO/IEC JTC 1/SC 42 AI foundational standards · trustworthiness	Mutual reference · scope check
ISO/IEC	ISO/IEC JTC 1/CG 2 Strategic metaverse coordination across JTC 1	Formal plenary-level liaison
IEEE/IEC	IEEE / IEC TC57-65 Device · grid · industrial protocols	Use cases flow into Q3, Q10
CITIES	OASC / LDT-CitiVERSE EDIC City adoption · deployment · reality check	Standing feedback loop with Q1, Q2
EU	StandICT TWG Virtual Worlds European gap analysis · expert contributions	Contributions welcomed into Questions

HOW TO ENGAGE WITH SG20 STARTING TOMORROW

A Practical Invitation to Everyone in This Room



For Cities

- 1 Bring your citiverse use case to SG20 Q1 or Q2 — it will directly shape the requirements Recommendation.
- 2 Join U4SSC to benchmark your digital twin deployments against global KPIs.



For SDOs & Fora

- 1 Send a liaison statement to SG20 before the next plenary — we read them, we answer them, we track commitments.
- 2 Nominate experts to co-author citiverse Recommendations as editors.



For the European Ecosystem

- 1 LDT-CitiVERSE EDIC and SG20 must move from occasional contact to standing coordination.
- 2 StandICT TWG outputs can be formally referenced in SG20 work — let's do that in 2026.



For Industry

- 1 Become an ITU-T Sector Member or Associate.
- 2 Citiverse standards written without industry implementation feedback will not survive contact with the market.

SG20 is not a closed club · the door is open — the question is whether we walk through it together in 2026.



From fragmentation to interoperability is not a slogan — *it is a discipline.*



MANDATE

rooted in cities



DELIVERY

200+ Recommendations



OPEN DOOR

to every partner here

ONE commitment from this Citiverse Assembly in Geneva · one coordination cycle between SG20, CG 2, StandICT TWG, OASC, EDIC and the Global Citiverse Initiative — before the ITU-T Study Group 20 Plenary to start on 11 May 2026.

Thank you.



Hyoungh Jun Kim

Chair, ITU-T Study Group 20

IoT, Digital Twins and Smart Sustainable Cities and Communities



Study Group 20

itu.int/go/tsg20



ITU Smart Sustainable
Cities and Communities

itu.int/cities



ITU AI-Powered Virtual
Worlds & Metaverse

itu.int/metaverse



Contact

tsbsg20@itu.int

The citiverse will be built with or without coordination. Let us make sure it is with.