

The Future Geospatial Information Ecosystem - How We Get There!

**UN-GGIM Secretariat, United Nations Statistics Division,
under the United Nations Development Account Project
11th Tranche Project 1819D, March-June 2022.**

Presented by Dr Lesley Arnold



UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

Positioning geospatial information to address global challenges

ggim.un.org

Terminology



Ecosystem

An ecosystem evolves – it is an environment consisting of component parts that interact with one another



Infrastructure

An infrastructure is built – it consists of the physical and organizational structures and facilities needed for an operation. Examples SDIs and System of Systems.



UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

Positioning geospatial information to address global challenges

ggim.un.org

Outline

- **SDIs Achievements and Limitations**
- **Beyond SDIs – what the experts are saying**
- **From Data to Knowledge**
- **The future geospatial information ecosystem**
- **Making the step change**



Current SDI Capabilities



Data sharing



Analytics



Policy Setting



Integrated data



Applications



Benefits accruing



Reuse / repurpose



Decision-making



So why change?



SDI Limitations



Human accessible



Knowledge Delay



Push data vs get answers



Limited integration



Professional users only



Lack opportunity



SDI Catalogues are not machine friendly



Drivers for Change



Unified solutions to global problems

- Harness geospatial intelligence from a local to global level
- Integrated solutions to address common challenges
- Benefit of ripple effect
- Leverage global Innovation



Equitable access to knowledge on-demand

- Societal expectations for knowledge on-demand
- Designed for general users
- Innovation will require data to can be processed and contextualised for the individuals in real time.



Bridge the geospatial digital divide

- An ecosystem accessible and usable to all
- Knowledge' available to everyone
- Design the future ecosystem with a priority on putting developing nations at the centre of everything we do



Future Ecosystem

A shift from data to insight, knowledge and understanding enable by:

- A digital world - interconnected through flows of information
- Total convergence of digital and human worlds
- Democratize Knowledge
- 4IR technologies enabling unprecedented advances in data collection and geoanalytics



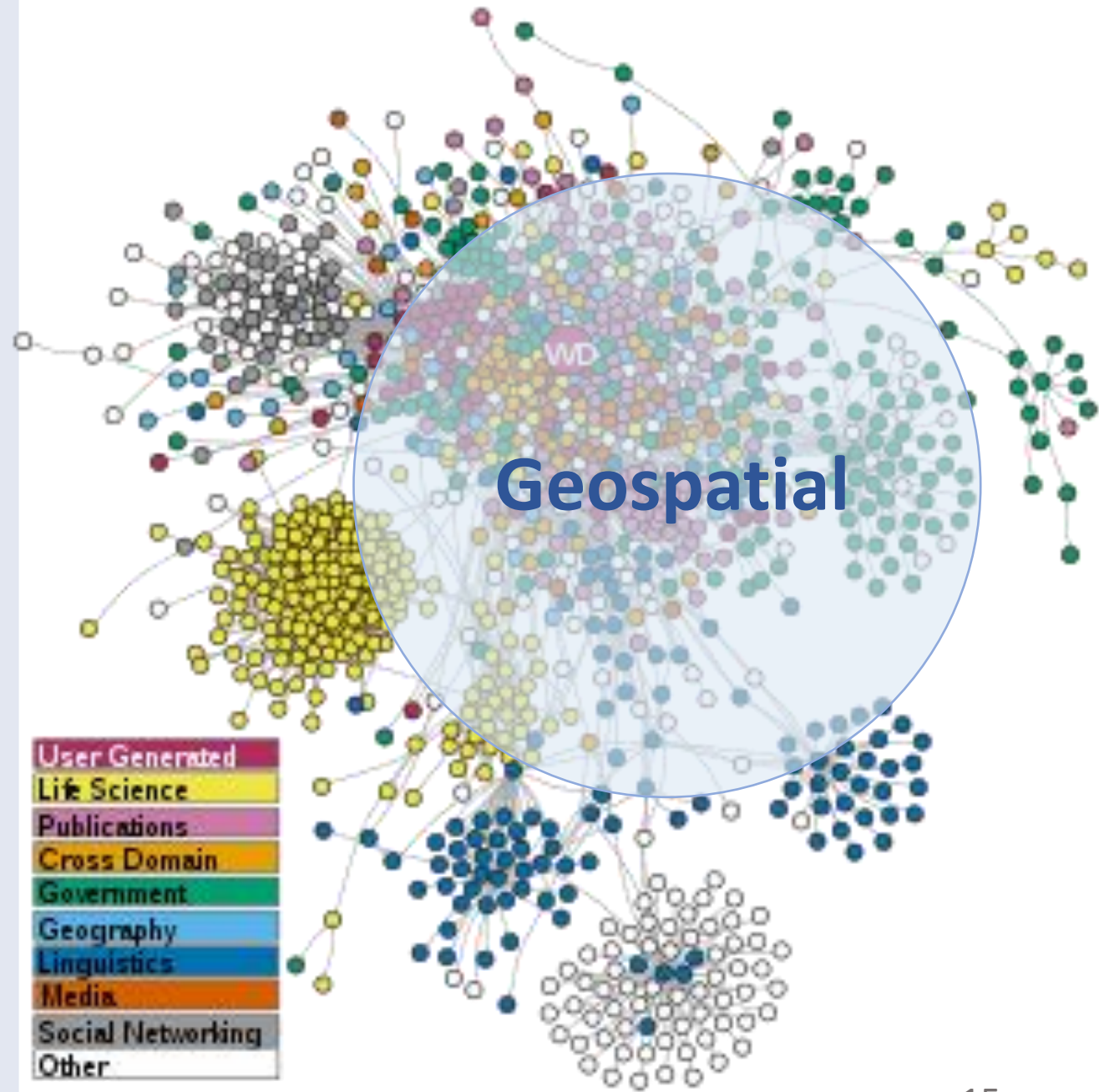
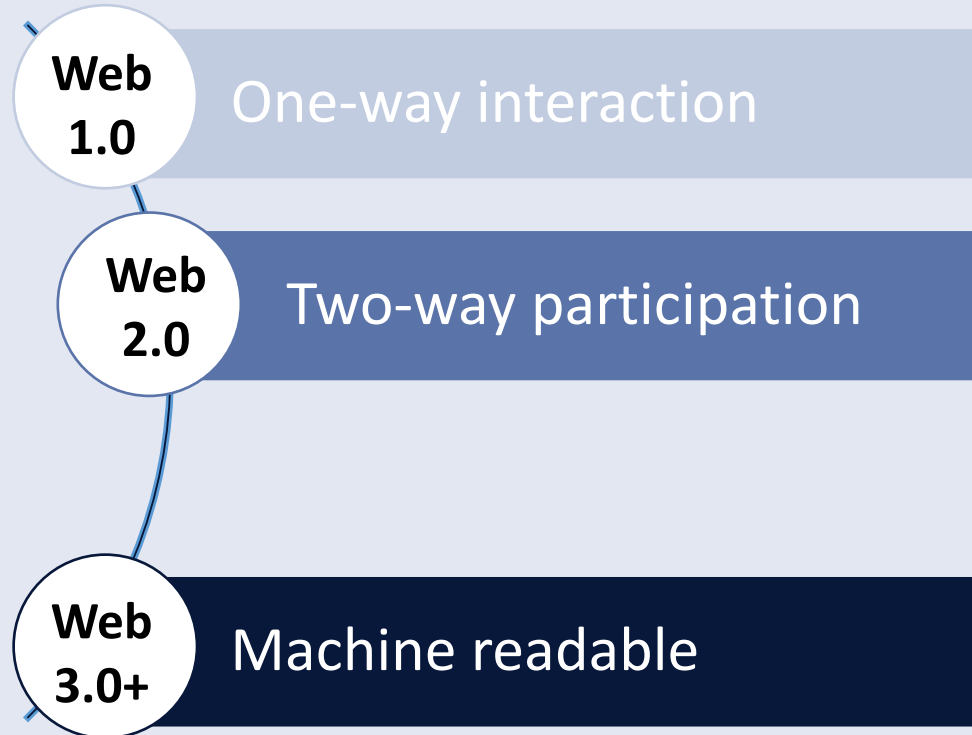
4IR Technology are ready to be leveraged

- Artificial Intelligence
- Machine learning / deep learning
- Natural Language Processing
- IoT – smart devices collect and share data
- Intelligent algorithms – insights from disparate BIG data
- Blockchain – distributed ledgers
- Digital identities
- Cloud and edge computing
- Autonomous vehicles
- 5G Network powerful cellular networks
- Quantum computing



The Web of Data

3 Stages of Evolution



Future Ecosystem – 3 concepts



SDI: A server-based geoportal for organising and making geospatial data and services available and consumable.



System of Systems (SoS): A collection of systems that consume geospatial from SDI data catalogues or from other sources available on the Web. Each system is capable of independent operation, but also interoperates with other systems to achieve additional capabilities.

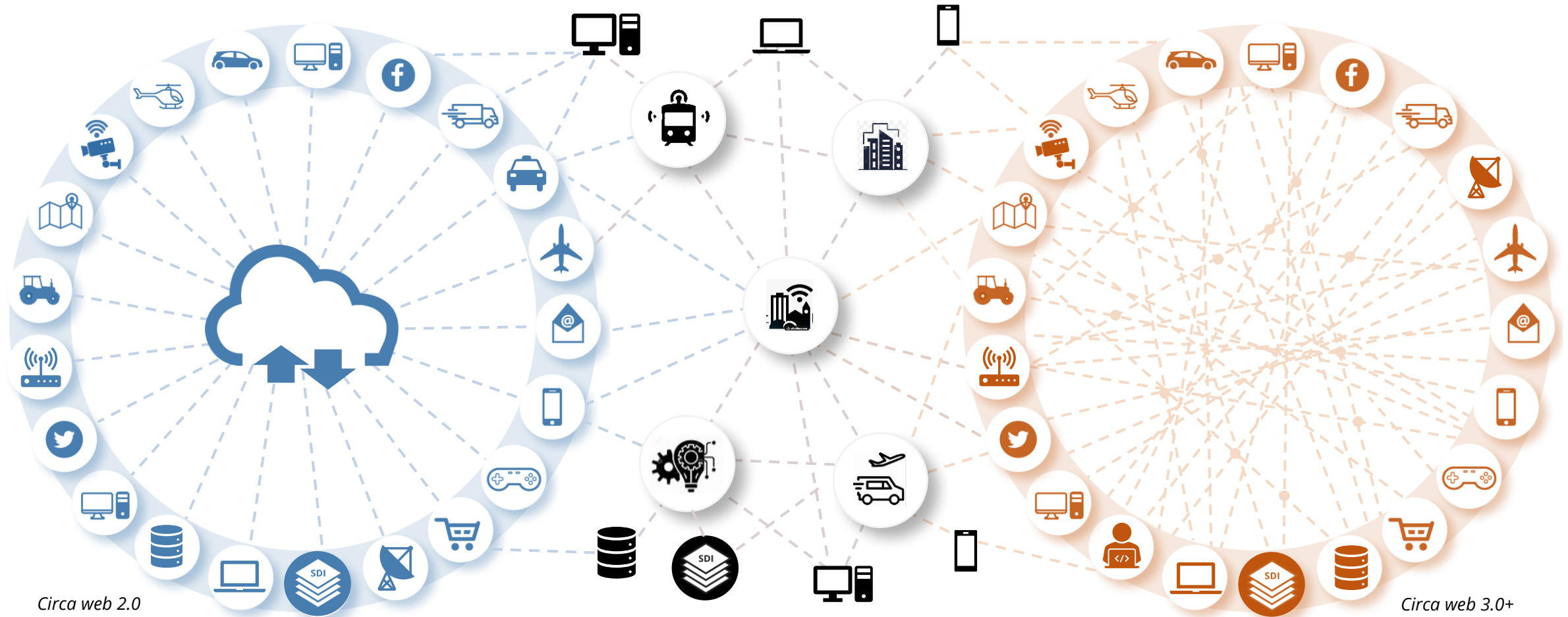


The Geoverse: An aspirational globally interconnected geospatial information ecosystem; one that permits intelligent interactions between SDI web portals, systems, sensors, applications and devices etc. using machine facilitated technologies such as AI, ML, NLP, data mining, virtual assistants, digital identities, blockchain and a broad range of communication interfaces etc.

*Geoverse
belongs to
everyone*



Geospatial Information Ecosystem

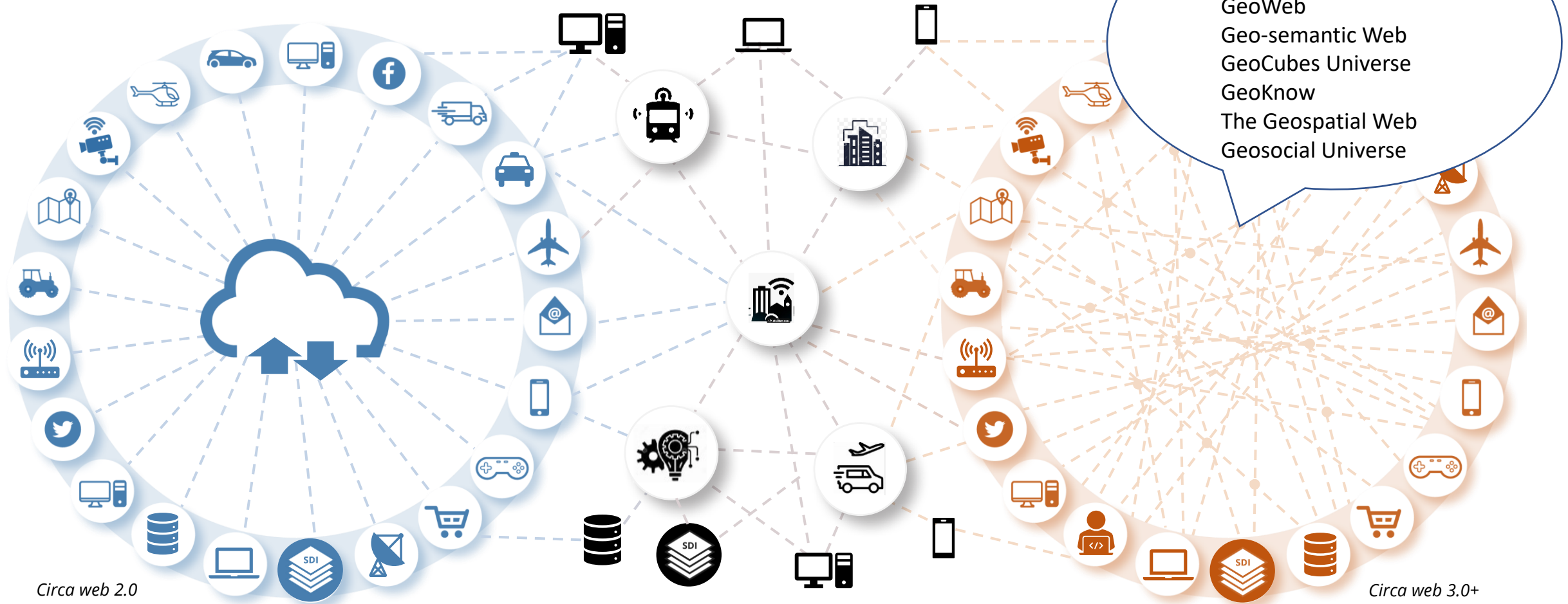


Spatial Data Infrastructures
Human centered – A person searches, retrieves, processes and analyses data via a web catalogue to obtain knowledge.

System of Systems
Distributed/federated interconnected systems managed under the control of humans and include advanced machine analytics and AI

The Geoverse
Machined centered – AI searches, retrieves, processes and analyses data to deliver knowledge direct to a person's device or another machine.

Geospatial Information Ecosystem



Spatial Data Infrastructures

Human centered – A person searches, retrieves, processes and analyses data via a web catalogue to obtain knowledge.

System of Systems

Distributed/federated interconnected systems managed under the control of humans and include advanced machine analytics and AI

The Geoverse

Machined centered – AI searches, retrieves, processes and analyses data to deliver knowledge direct to a person's device or another machine.

Characteristics

- Multimodal and distributed - interaction between devices, users, and services
- Block chain – secure peer to peer communication
- Data belonging to the user will be protected - smart contracts, digital identities
- Machines read data and also process and interpret data
- AI used translate human language into machine understandable language



The Geoverse

Positioning geospatial information to address global challenges

ggim.un.org



UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

SDI will be part of the future ecosystem

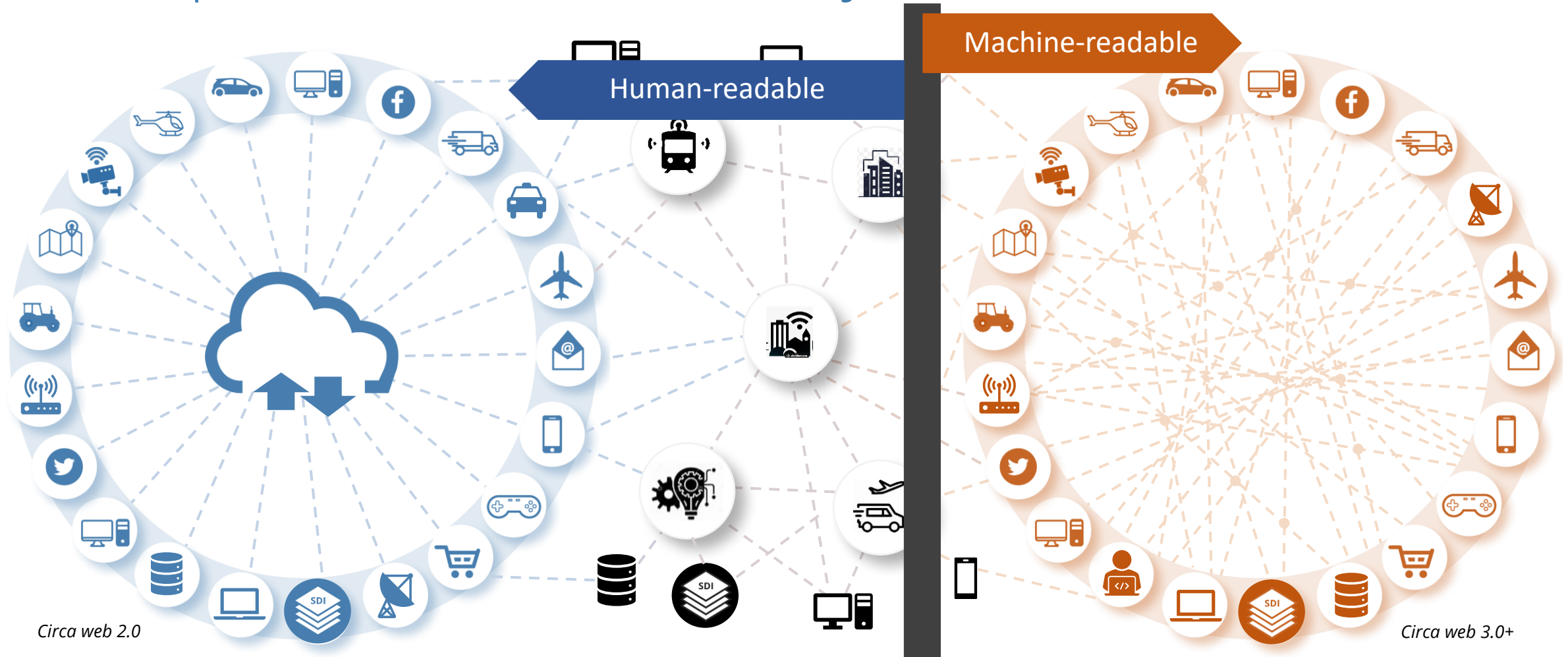
- SDIs are an important step in the evolutionary process
- SDI will exist in the future ecosystem with SoS
- SDIs crucial to strengthening geospatial information management
 - data governance frameworks
 - enact geospatial policy and laws
 - implement data technology and standards
- IGIF provides the guidance

“

SDIs are the foundation for the step change required to move to an ecosystem centred on delivering knowledge.”



Geospatial Information Ecosystem



Circa web 2.0

Circa web 3.0+

Spatial Data Infrastructures

Human centered – A person searches, retrieves, processes and analyses data via a web catalogue to obtain knowledge.

System of Systems

Distributed/federated interconnected systems managed under the control of humans and include advanced machine analytics and AI

The Web of Data

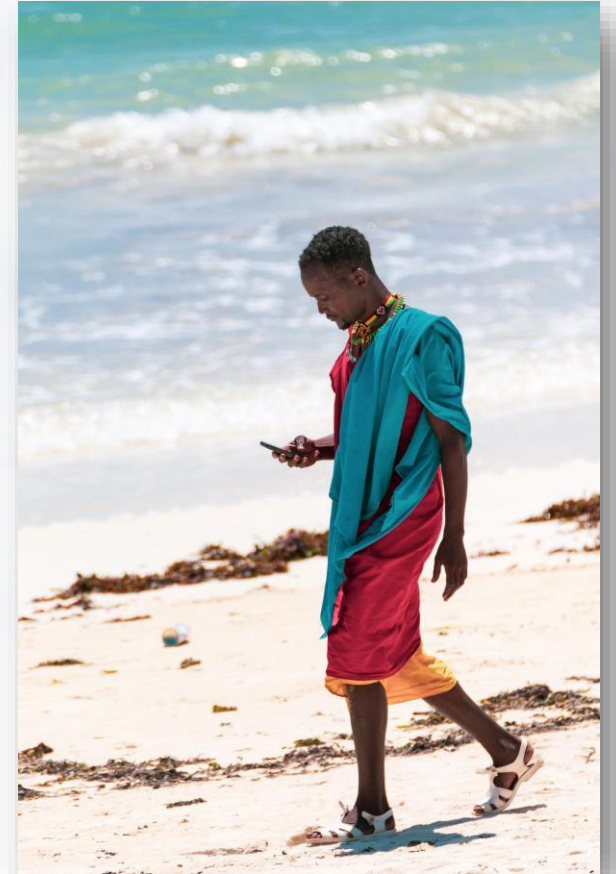
Machined centered – AI searches, retrieves, processes and analyses data to deliver knowledge direct to a person's device or another machine.

Democratising Knowledge



New knowledge-based services will evolve to operate via a range of commands (voice, touch, keyboard) and devices.

Scientists can compare their data to millions of datasets worldwide within seconds by running a query (script) – that traverses data linkages



UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

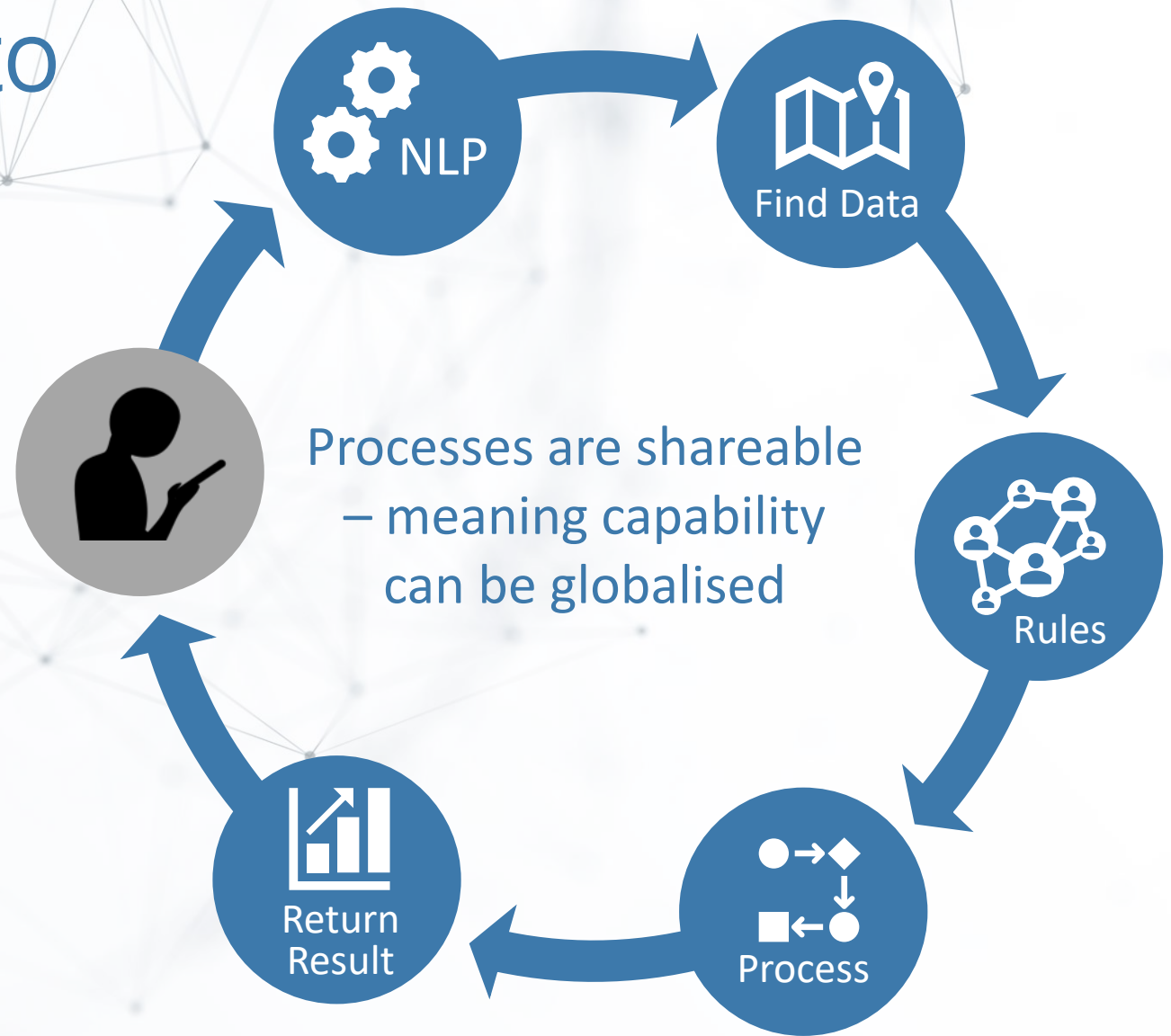
Positioning geospatial information to address global challenges

ggim.un.org

Teaching Machines to Think Geospatially

Open Query Apps use Artificial Intelligence and Semantic Web Technologies

1. Interpret the question using NLP
2. Find data by location and theme
3. Apply rules - concepts, relationships
4. Run geoanalytics process
5. Return a result and communication quality and relevance



Knowledge needs to be individualized



Emergency Responder



Home Buyer



Insurance Broker



Urban Planner

Will this property be flooded?

People have similar questions of data content.....asked in different contexts



UN-GGIM

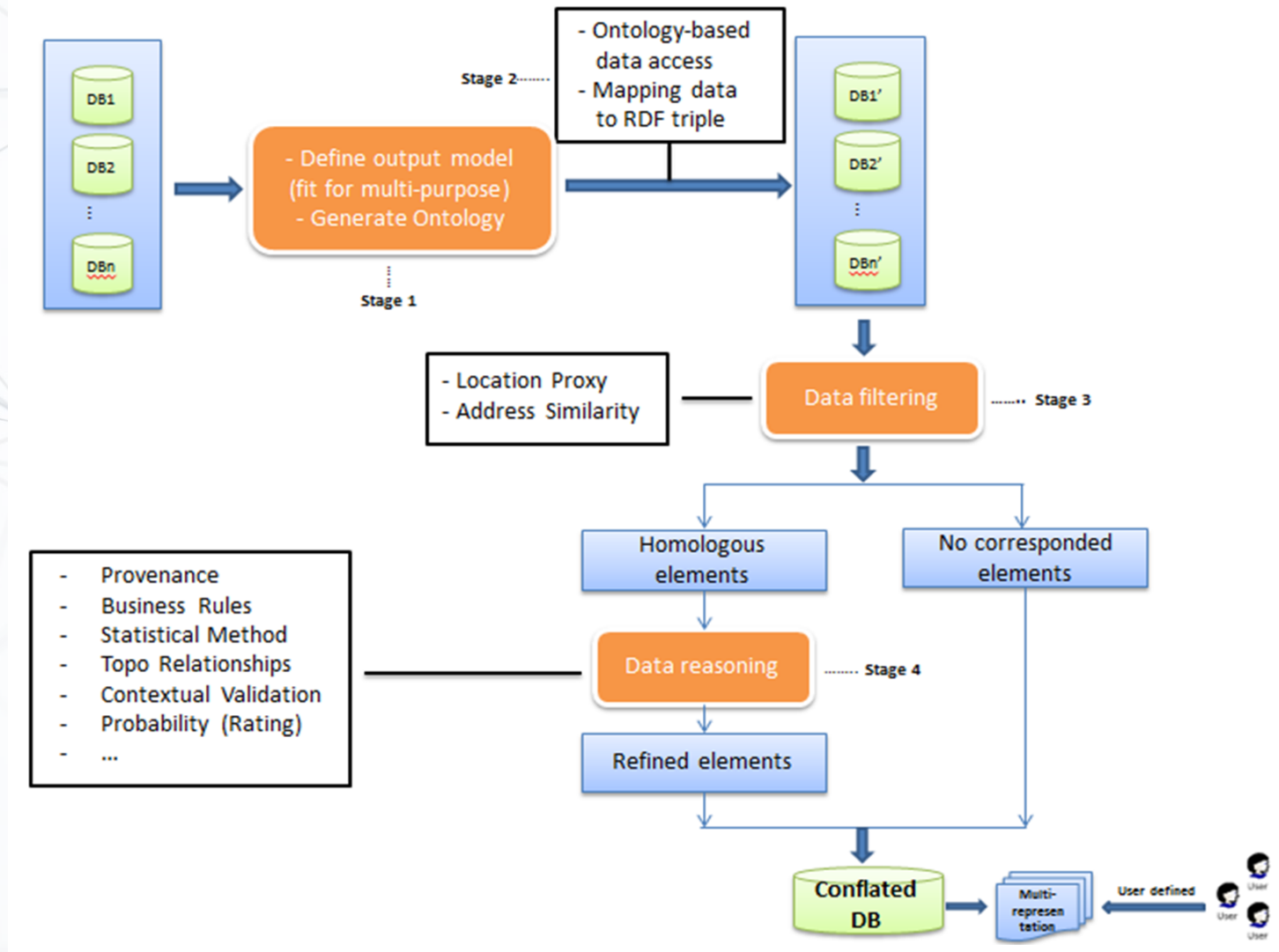
United Nations Secretariat
Global Geospatial Information Management

Positioning geospatial information to address global challenges

ggim.un.org

One process at a time

- Dealing with duplicate data on the fly
- Data Conflation
- Human logic in design



Unique starting points



Analog
Mapping

Paper

Production of
maps by hand



Digital
Cartography

GIS

Geospatial data
compiled, analyzed
and formatted into
a virtual image



Spatial Data
Infrastructures

Data Hub

An infrastructure
for organising and
making data and
services accessible



System of
Systems

Network

Systems that
interoperate and
consume
geospatial data



Geoverse

Ecosystem

Global ecosystem
permitting intelligent
interactions between
data and services



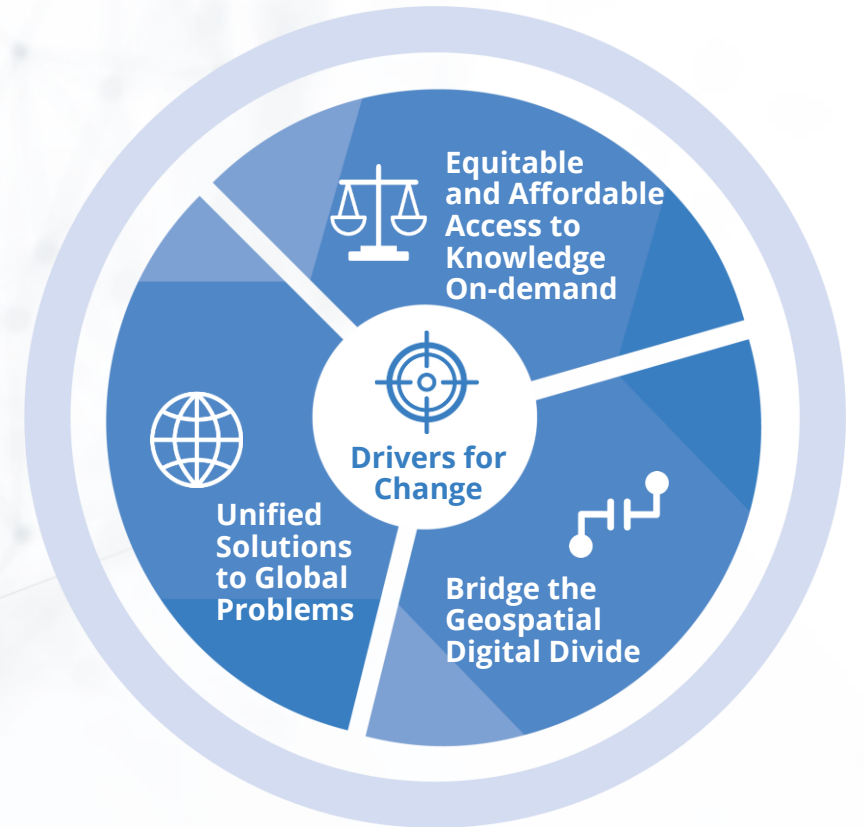
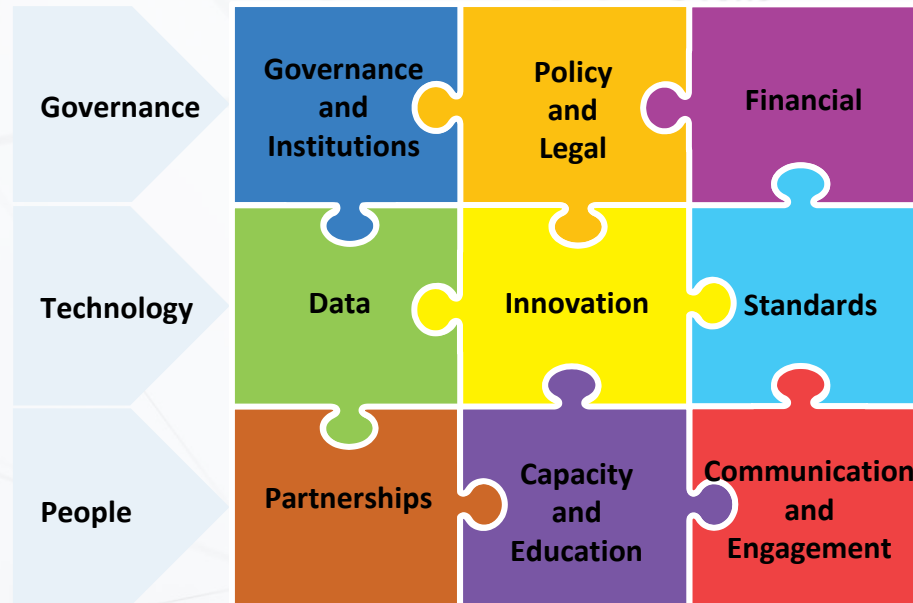
UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

Positioning geospatial information to address global challenges

ggim.un.org

Step Change in relation to Drivers for Change



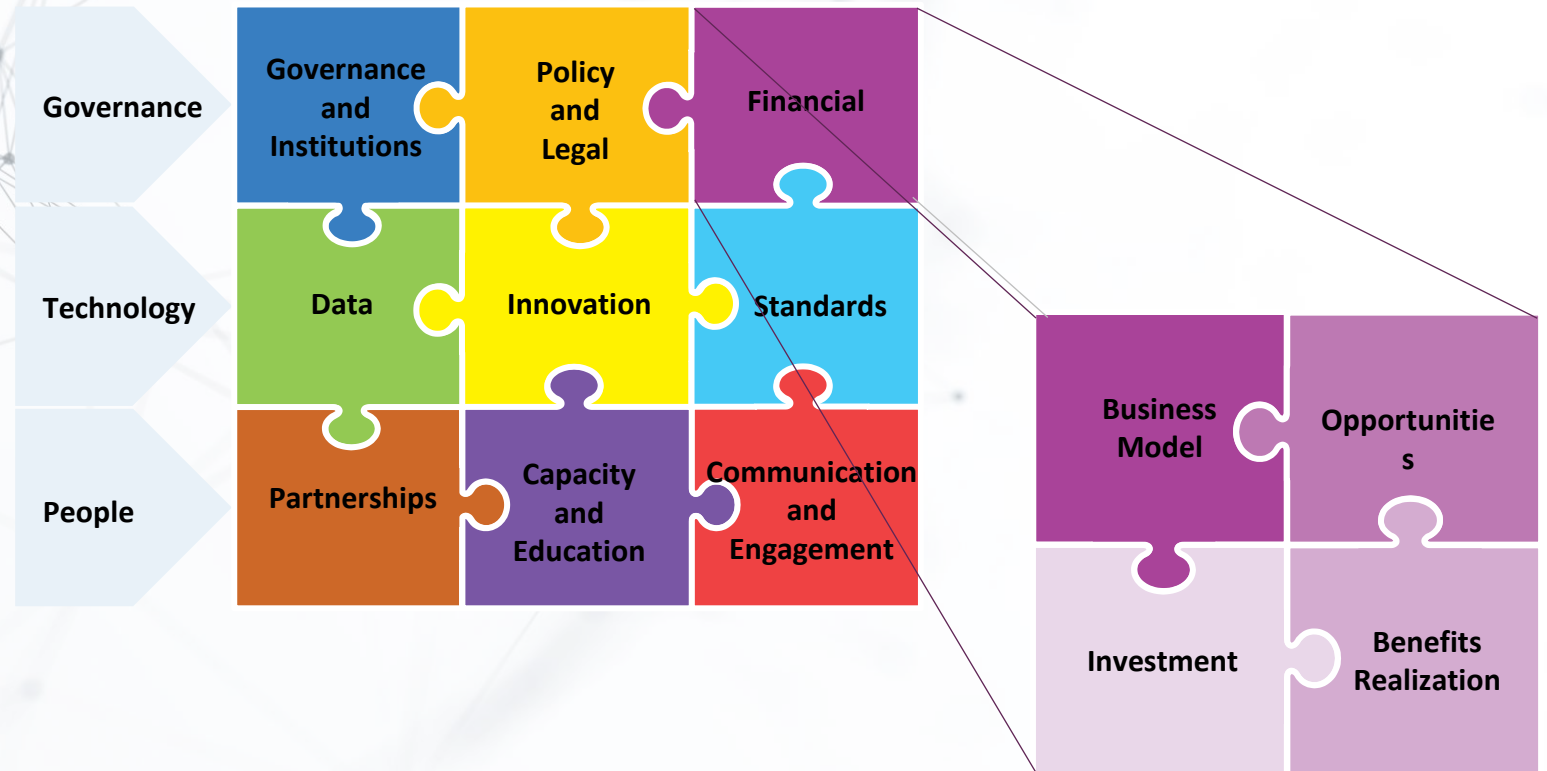
The following slides capture the major strategic actions (centred on the nine IGIF strategic pathways), which are required to make the step change needed to address the drivers for change.



The Step Change

IGIF provides a 360 degree view for what needs to change to move to a future ecosystem

- 3 areas of focus
- 9 strategic pathways
- 4 elements in each pathway



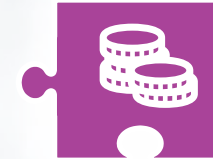
Actions



Global Knowledge Management Framework



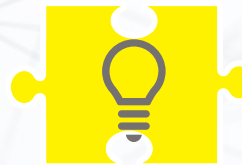
Geospatial Policy and Legal Framework



Scope new 4IR business models



Global Use Case Framework to prioritise data and geoanalytics for SDGs



Road Map for knowledge-sharing



Knowledge representation standards



Partnerships in multimodal ecosystem



Workforce ready skills development framework



Consistent brand and messaging



What can be done now!

- Strengthen integrated geospatial information management nationally
- Make geospatial data available in a machine-readable form to stimulate innovation in knowledge creation straightaway
- Share knowledge representations, rule bases and geoanalytics to support reuse and local to global adoption
- Broaden stakeholder engagement to consider diversity of views and needs



Call for submissions

UN-GGIM Secretariat invites your comments on this discussion document. Your feedback will help the geospatial community to make informed decisions on what the future geospatial information ecosystem will look like, and how we can achieve the transition to this new future.

Please let us know:

- Are we moving in the right direction?
- What do you think the main challenges will be?
- What are we doing now that works well and will contribute to the future?
- What is the best thing we can achieve moving forward?
- What will be the most valuable outcome for you?

Submissions can be made via email to the UN-GGIM Secretariat (ggim@un.org) with the subject 'Determining the future geospatial information ecosystem'. Contributions are welcome from all interested member states, organisations and individuals. The closing date for submissions is 31 October 2022.

We look forward to your contribution.

UN-GGIM Secretariat
July 2022



Thank you

Dr Lesley Arnold



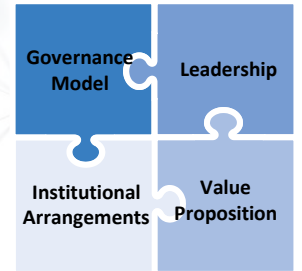
UN-GGIM

United Nations Secretariat
Global Geospatial Information Management

Positioning geospatial information to address global challenges

ggim.un.org

Governance and Institutions



Global Geospatial Knowledge Governance Framework: to guide how data is to be created, managed and processed to ‘democratize knowledge’ in the interest of individuals’ needs, developmental interests, and humanitarian and global crisis management.

Challenges

Opportunities

Complex Collaboration

Shared vision- global scale

Multimodal Data Flows

Broader stakeholder groups

Knowledge Value Proposition

Global strategy and actions agendas

Rapidly evolving landscape

Agile governance

Need for Integrative Data

Multidisciplinary geoanalytics



Policy and Legal



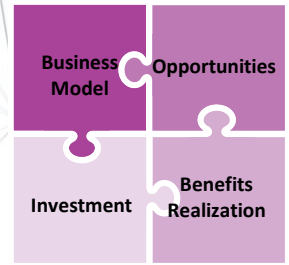
Geospatial Policy and Legal Framework: to guide and globally stimulate technical innovation and achieve democratization of knowledge; deliver public confidence in how information is used and protected, and communicate reliability of information.

Challenges	Opportunities
Cybersecurity	Block chain – secure ledgers
Data privacy and other sensitivities	Encryption and role-based controls
Safeguard markets / respected rights	Digital Rights Management
Protect vulnerable people	Digital Identities
Human non-compliance	Machine-enabled self-compliance



Financial

A scoping document on **4IR new business models** with a view to supporting developing countries.

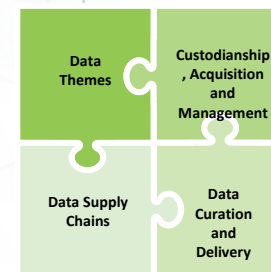


Challenges	Opportunities
Lack of funds for 4IR technologies	Smart economy business models
Difficult to attract financing	Content tribes
Traditional business models to evolve	Token economy
	Geopolitical asset sharing
	Freemium Models



Data

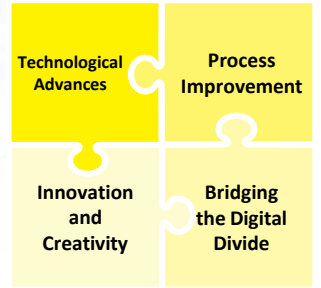
Global Use Case Framework: to identify, prioritize and specify data collection, quality improvements, geoanalytics, and the policies and standards needed to transform data inputs into knowledge outputs



Challenges	Opportunities
Where to focus effort	Knowing the priority use cases
Data is not accessible	Expose SDI catalogues to the Web
Data is human readable	Machine Readable Data
Convolutated supply chains	Make use of multimodal interfaces
Manual processes	Shared real-time geoanalytics



Innovation



A **Road Map of knowledge-sharing interventions** that deliver inclusivity and digital equity for communities.

Challenges	Opportunities
Exacerbate digital divide	G2G Knowledge Sharing
Hard copy maps and plans	Modern Data Digitization
Stimulating innovation	Global Social Innovation
How to trust knowledge	Process improvement - metadata



Standards



Knowledge representation standards and governance framework - vocabularies, ontologies, FAIR and semantic web etc.

Challenges	Opportunities
Data conversion not understood	Machine readable data standards
Data and knowledge integration	Knowledge representation standards
Quality and reliability	Metadata / rank and rate results
Lack of knowledge and awareness	Community of practice
Hesitation	Regulatory sandboxes



Partnerships

Guidance for establishing partnerships in a decentralized multimodal digital ecosystem founded on AI, block chain, Internet communication interfaces and other 4IR technologies .



Challenges

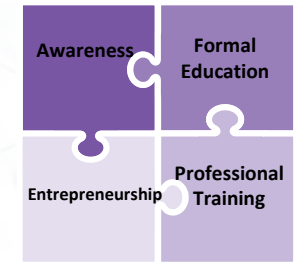
Traditional partnership models
unsuitable

Opportunities

Role reversal – private sector led
Opensource community
Direct peer to peer networks
Local to global partnerships
New financing models



Capacity and Education



Workforce Ready Skills Development Framework to include foundational concepts in computer, Internet science and 4IR technologies.

Challenges	Opportunities
Educate undergraduates	Fundamentals in computer science
Attract new talent	Diversity and inclusivity
Foster imagination and creativity	Emerging paradigms / agile development



Communication and Engagement



A **common brand**, uniform terminology and consistent messaging to spark conversations, generate interest and attract funding.

Challenges

Communication

Inconsistent terms

No recognizable brand

A united journey

Opportunities

Key messaging

Time to take stock

Conversation starters

Why and how conversations



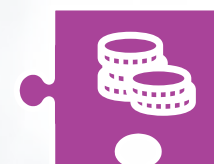
What needs to be done in the future



Global Knowledge Management Framework



Geospatial Policy and Legal Framework



Scope new 4IR business models



Global Use Case Framework to prioritise data and geanalytics for SDGs



Road Map for knowledge-sharing



Knowledge representation standards



Partnerships in multimodal ecosystem



Workforce ready skills development framework



Consistent brand and messaging



- There is an urgent need to address ‘local to global’ needs of the SDGs, the global pandemic, climate change, disaster resilience, and the environmental impacts on our land and oceans. To do this, our future geospatial information ecosystem needs to be more technically and scientifically responsive - providing answers to the questions needed to address these challenges. This requires a major change in how we think, manage and use geospatial information, and a well formulated brand to stimulate the ‘change’ journey for all involved.
- “Welcome to the Geoverse: a global digitally connected geospatial world that supports humanitarian and sustainable development.”
- In the Geoverse, the entire global community has access to new insights for social, economic and environmental decision-making. The Geoverse can only be realised by transitioning from human-readable data catalogues; to machine readable data and automated geospatial analytics, which provide the opportunity to generate unparalleled knowledge for everyday decision-making.
- Our journey has already begun with BIG data, AI, IoT sensors and the social web - playing a key role in data acquisition. The big question is “what’s the next step”? In this presentation, the IGIF is used to illustrate how to deliver the analytics to better answer our major challenges”.



Drivers for Change



Unified solutions to global problems

- Harness geospatial intelligence from a local to global level
- Integrated solutions to address common challenges
- benefit of ripple effect
- Leverage global Innovation



Equitable access to knowledge on-demand

- Societal expectations for knowledge on-demand
- Designed for general users
- Innovation will require data to can be processed and contextualised for the individuals in real time.



Bridge the geospatial digital divide

- An ecosystem accessible and usable to all
- Knowledge' available to everyone
- Design the future ecosystem with a priority on putting developing nations at the centre of everything we do



Clarification of terms



Ecosystem

Evolves

An environment consisting of component parts that interact with one another



Infrastructure

Built

The physical and organizational structures and facilities needed for an operation



Framework

Guides

A conceptual structure of ideas, conditions and assumptions that guide an approach



Blueprint

Instructs

A design that can be followed



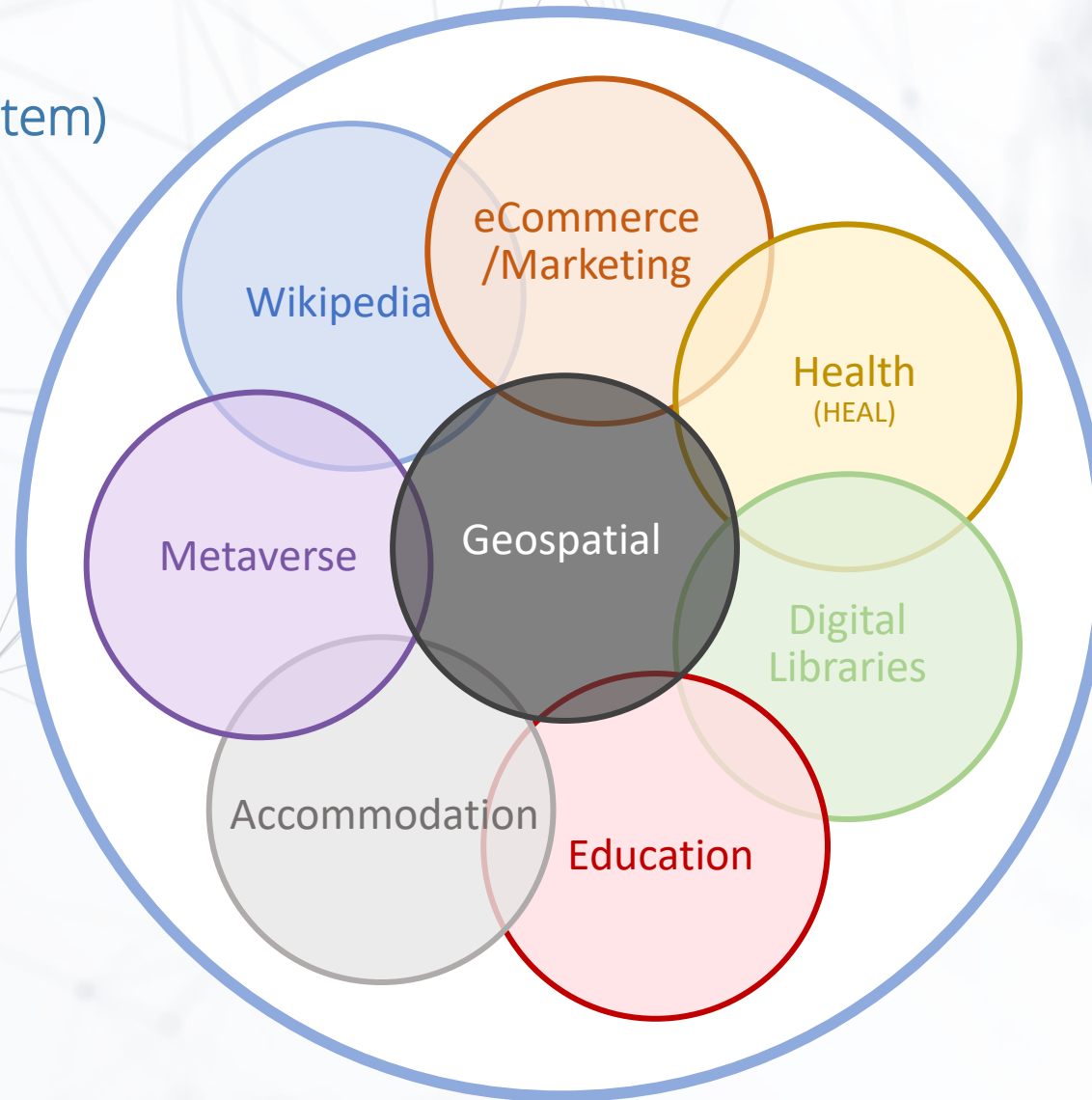
Why Geoverse?

- Geoverse is NOT a new name for SDI and NSDI – all coexist in the future information ecosystem
- Geoverse is not a business name; it is a dictionary meaning
- Need a brand to attract new workforce and start conversations, and for all to get behind the ‘change journey’
- Many ‘web’ digital ecosystems exist (e.g. libraries, health, encyclopedias, shopping) but have no recognisable name
- Geoverse leverages the metaverse brand, but is more than the metaverse
 - Integrate geospatial information – 2D to 4D
 - Predictive analytics
 - Integrated data from a wide-range of disciplines – no finite boundary
 - Delivery of real-time knowledge in all its forms
- A name must endure the journey - Geoverse will not happen overnight



Web of Data

(Global Digital Ecosystem)



This is the slide where I tried to capture the different names people are already using to articulate a geospatial information ecosystem in the Web of Data with data sources from IoT.

GEOINT COMMUNITY FORUM MARCH 9-10 virtual event

TITLE SPONSOR PRESAGIS MAKE IT REAL

The Geospatial Metaverse – Infrastructure, Tradecraft and Applications

A Semantic Web- Geo System

November 2008

Conference: 3rd International Conference On Advanced Computing & Communication Technologies · At: ASIA PACIFIC INSTITUTE OF INFORMATION TECHNOLOGY [First International Engineering College Approved by AICTE, MHRD, Government of India and Department of Technical Education Govt. of Haryana]

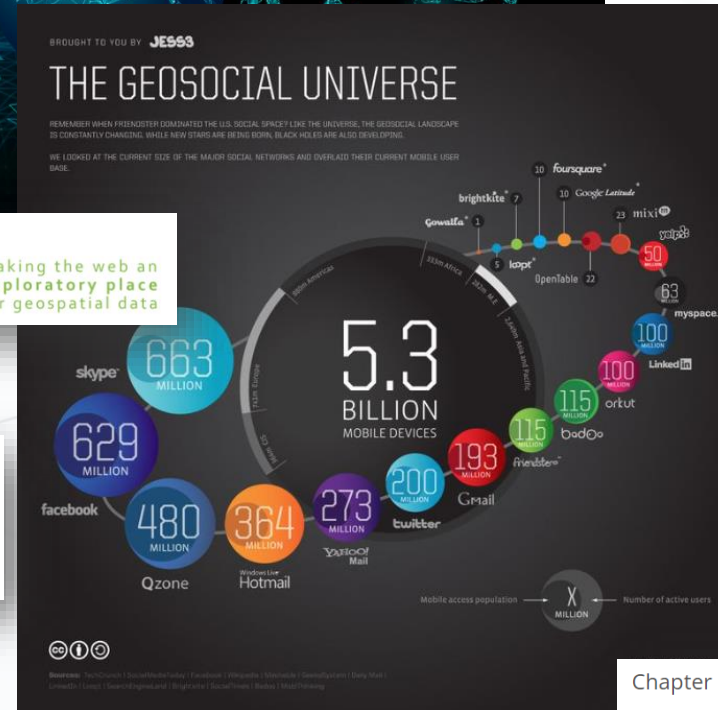
Anna Schaal Klaus Todtermann (Eds.)

The Geospatial Web

How Geobrowsers, Social Software and the Web 2.0 are Shaping the Network Society

GeoKnow

Making the web an exploratory place for geospatial data



GeoCubes Universe

Explore the Real World with your mobile phone or through geolocated positions and discover Gates to multiple VRE (Virtual Reality Experiences), three-dimensional spaces owned by users, where you can live or show different realities.

Chapter 13: Geo-Semantic Web

By: Peter L. Pulsifer & Glenn Brauen

In: [Understanding Spatial Media](#)

Chapter DOI: <https://dx.doi.org/10.4135/9781526425850.n13>

Subject: [Communication and Media Studies](#), [Geography](#), [Engineering](#)

Keywords: [interoperability](#); [ontologies](#); [semantic web](#)

CALL FOR ABSTRACTS

2022 VICTORIAN SURVEYING & SPATIAL SUMMIT

Geospatial metaverse: positioning for the future

Thursday 27 October 2022 | Pullman Albert Park

Browsing the Geo Web Metaverse: Weekly Update #21

March 23, 2021

Public comment requested: OGC Geo for Open Metaverse Domain Working Group Draft Charter

What is geo metaverse?

GEO METAVERSE is a mobile app. It uses a geo reality user interface on your mobile device. It does not require any additional hardware.

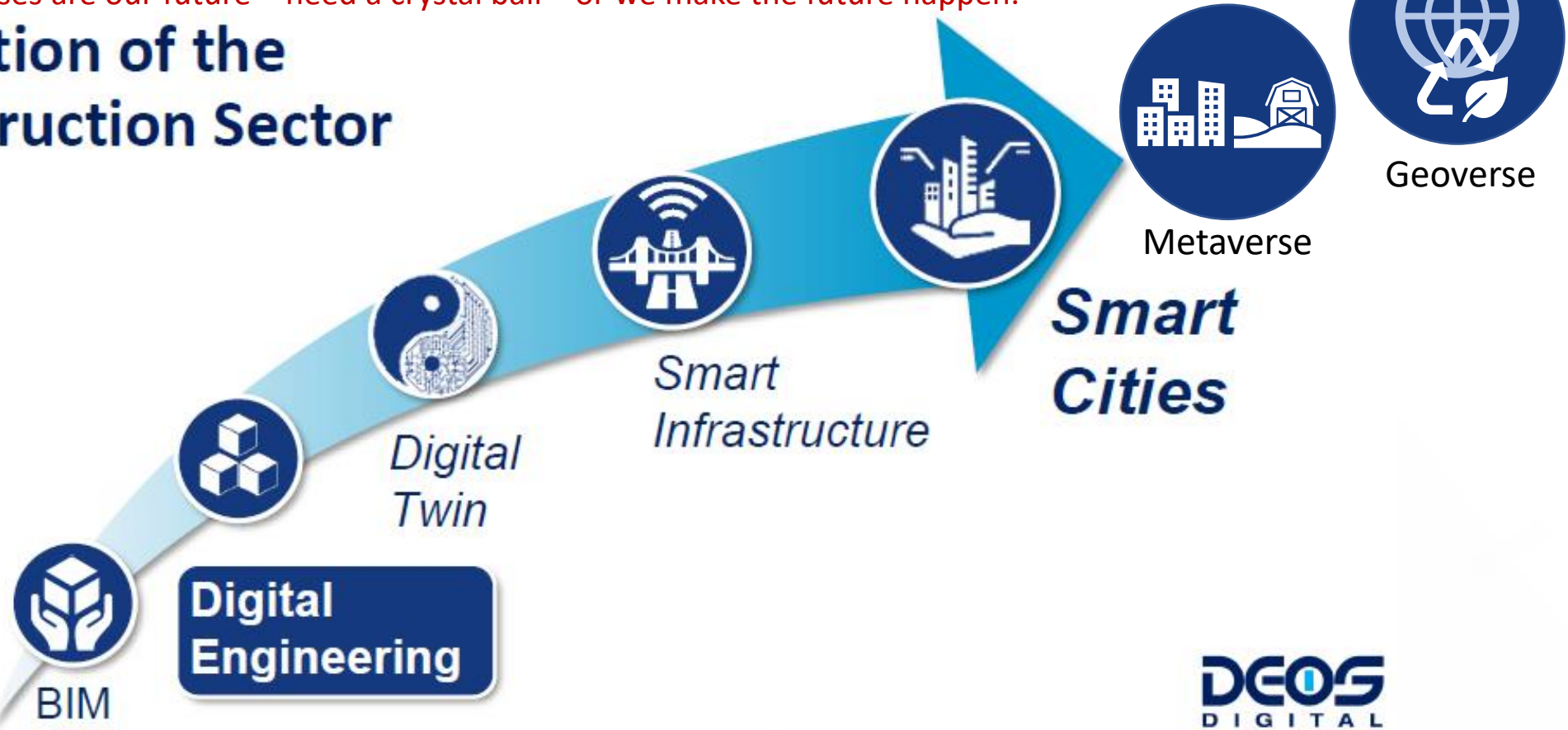
Open the app and discover treasures and Meta Malls in the augmented reality near you.

Geolocal AR: The Metavearth Materializes

Address global challenges
ggim.un.org

Love this Diagram....I have added Metaverse and Geoverse where I see it – the Metaverse (by current definition) is an expansion of the digital twin into a machine-readable Web environment, and the Geoverse is the integration of data across all the ...verses – metaverse, health, libraries, weather, e-commerce, etc – on the Web. Geostatistical integration across disciplines is the key differentiator btw Geoverse and Metaverse, where location is the integrator. But this is all debatable without a definition of the Geoverse. It think it comes down to “what’s in and what’s out” of the Metaverse e.g. is spread of disease (equine influencer, foot and mouth) in or out? Standards are required for all future ...verses – assuming that multiple verses are our future – need a crystal ball – or we make the future happen.

Evolution of the Construction Sector



SDIs, SoS, geoverse, metaverse and global digital ecosystem

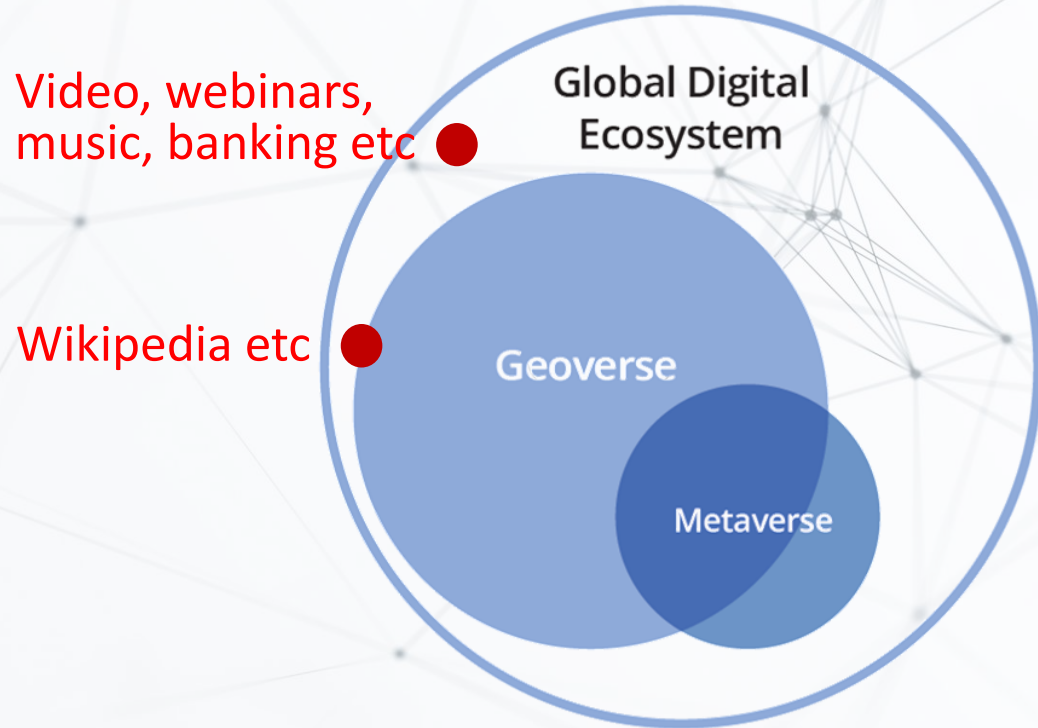


Figure 1: The geoverse is a subset of the global digital ecosystem, and participates in the metaverse. The Geoverse is anything that has or can have a location attribute.

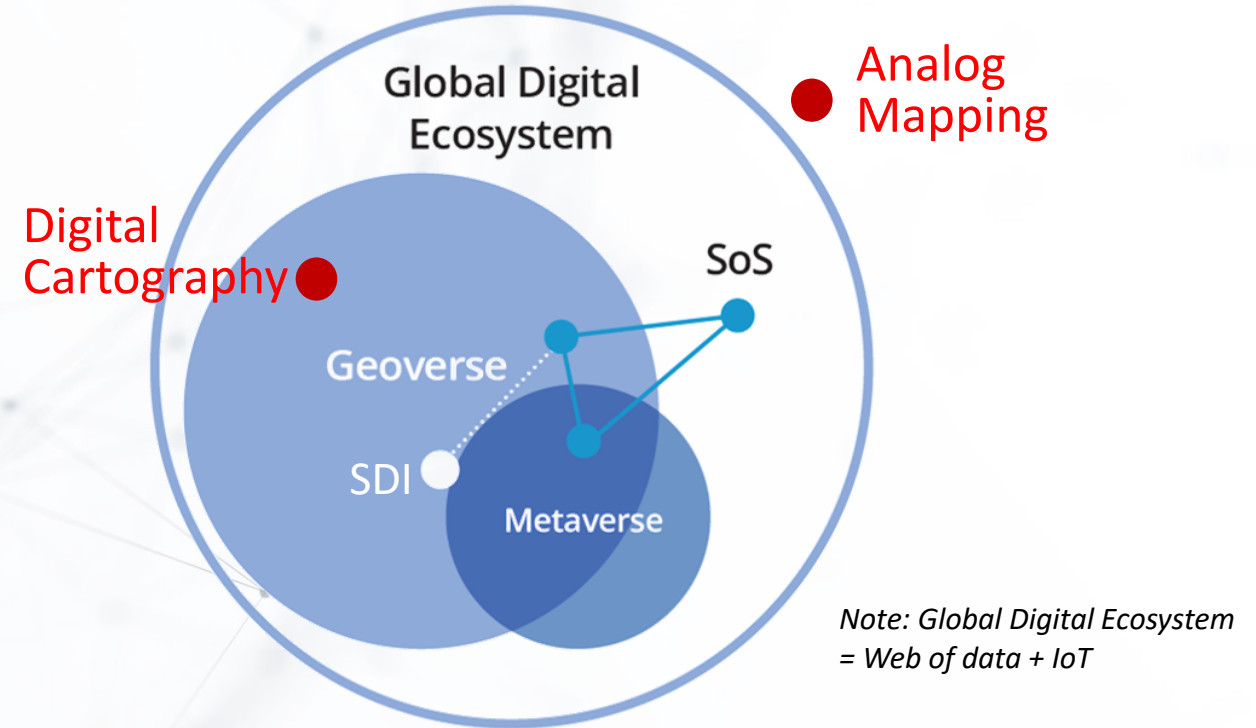


Figure 2: The SDI is a source of data for the geoverse, SoS and metaverse. SoS participate in global digital ecosystem, geoverse and metaverse.

Note: Global Digital Ecosystem = Web of data + IoT

