Roadmap for Smart City Initiatives*

— Aiming for further development and implementation of smart cities

March 29, 2024

Secretariat of the Science, Technology and Innovation Policy, Cabinet Office, Japan

*: The Japanese version shall take precedence if there is a discrepancy between the Japanese and English versions.

1. Background of the Establishment of the Roadmap

(1) Past smart city initiatives

Regarding smart city initiatives, from 2017 to 2018, individual ministries and agencies separately implemented model projects in their respective fields, but there were problems in terms of project coordination and data collaboration between fields.

For this reason, a Smart City Task Force was established under the Innovation Policy Strengthening Promotion Team, with the ministries and agencies involved in smart city initiatives, and the relevant ministries and agencies were to work together to promote smart city initiatives, with the Cabinet Office Science, Technology, and Innovation Department (currently Secretariat of the Science, Technology and Innovation Policy, Cabinet Office, Japan; hereinafter, Cabinet Office Science and Technology Secretariat) acting as the control tower.

In March 2020, the Cabinet Office Science and Technology Secretariat compiled the Smart City Reference Architecture White Paper, a standard design concept that outlines how to create a smart city, so that it would be reflected in the specific projects of individual ministries and agencies.

In December 2020, the following objective was set out in the reform time schedule for the New Plan to Advance Economic and Fiscal Revitalization, and the relevant ministries and agencies were to work together to achieve the objective: as the target and KPIs for smart city initiatives, the number of regions to implement the technology by FY2025 was set at 100 where the number of municipalities and local organizations that implement the technology is counted.

In March 2021, the Science, Technology, and Innovation Basic Plan was approved by the Cabinet, and smart city initiatives were positioned as part of the science, technology and innovation policy aimed at achieving Society 5.0, as urban and regional development that will form the foundation for the next generation.

(2) Current status and issues of smart city initiatives

From FY2021 onwards, as part of initiatives to systematically implement smart cities nationwide, the relevant ministries and agencies are working together to hold joint review meetings on smart cities, and to publicly solicit, adopt and implement proposals for smart city-related projects.

In particular, in the Basic Policy for the Vision for a Digital Garden City Nation, which was approved by the Cabinet in the same fiscal year, and in the Comprehensive Strategy for the same concept, which was approved by the Cabinet in FY2022, smart cities are positioned as one of the model regional visions for promoting inter-regional and inter-policy collaboration that contributes to the realization of regional visions, and play a role in the concept.

As a result of promoting smart city initiatives while also working to link smart city-related projects with the Grant Project of the Vision for a Digital Garden City Nation, the number of smart cities (the number of regions where the technology has been implemented) - a KPI - reached 107 by the end of FY2022, with the number of implementations for each project reaching the target ahead of schedule.

On the other hand, through the promotion of smart city-related projects to date, issues have been identified in the creation of business models, monetization, stakeholder understanding, collaboration between services, and the utilization of data, etc., and it is necessary to further promote initiatives to facilitate PDCA cycles and the spread of EBPM in terms of smart city initiatives.

Furthermore, from the perspective of expanding the base of municipalities that are working on smart cities, it is also necessary for local branch offices of the national government to provide support (close support) — by taking advantage of various opportunities — for identifying needs and forming projects when municipalities use digital technology to work on solving local issues and improving their appeal.

(3) Future smart city initiatives

In order to respond to issues that have been clarified through the promotion of smart city initiatives to date and to make smart cities sustainable, the following are required from the perspective of urban management, with reference to smart city initiatives in other countries: to improve the regional economic cycle, municipalities use various data as decision-making tools and provide services from the perspective of residents and other users, while optimizing the overall performance of multiple services.

To achieve this, it is necessary to develop and secure sufficient digital experts who contribute to smart cities, and to create appropriate conditions for data utilization.

It is also necessary to link the data platform — that has been used to provide so-called smart city services — with various other data (as a City OS) by utilizing other accompanying functions, and to use it as a tool for municipalities to make decisions (deepening EBPM) based on the results of analysis with data science methods.

From now on, with the points above taken into account, the following will be performed to ensure the initiatives towards the early achievement of Society 5.0 and the realization of the Vision for a Digital Garden City Nation: compiling a roadmap for smart city initiatives; promoting smart city initiatives while sharing information on initiatives with relevant parties; and working to spread smart cities nationwide, where people can experience the convenience of digital technologies.

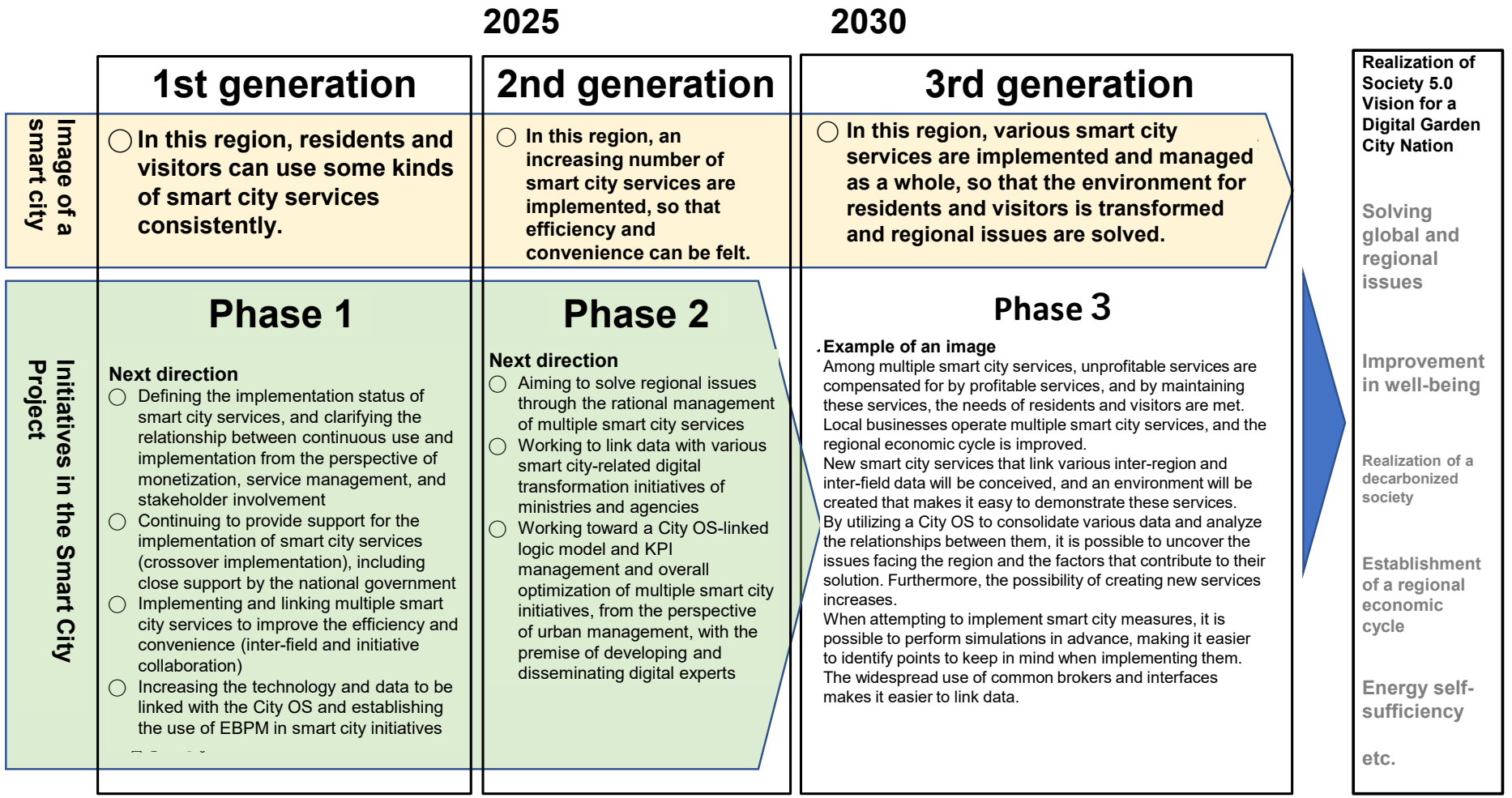
2. Roadmap Overview

(1) Approach to preparing a roadmap

The extent to which a smart city is implemented depends on the status of the realization of initiatives and technology in various fields at the time. For this reason, in the roadmap for smart city initiatives, the time period was divided into around 2025, around 2030, and beyond, and the measures required in the following period were sorted out from the perspectives of urban management, data collaboration, and crossover implementation, and the measures to be implemented in stages and the status of the smart city to be achieved at each time point were shown: from the stage of verifying the technology used in smart cities to the implementation of smart cities.

(2) Image of initiative implementation positioned in the roadmap

In the roadmap, the extent of implementation of smart cities is expressed as the first to third generations, depending on the status of realization of initiatives and technology in various fields at the time, and the corresponding phased initiatives are expressed as Phase 1 to Phase 3.



(3) Initiatives positioned in the roadmap

Some of the initiatives positioned in the roadmap cannot be achieved by discretely promoting the existing initiatives of the relevant ministries and agencies. Therefore, in promoting the initiatives, the Cabinet Office Science, Technology, and Innovation Promotion Secretariat will act as the control tower, and as necessary, it will respond while coordinating and collaborating with the relevant ministries and agencies.

However, the implementation level of a smart city will not reach the third generation simply by promoting the initiatives listed in this roadmap.

3. Initiatives Positioned in the Roadmap

(1) Urban management

1) Definitions of a smart city and City OS

Approach and Direction of Initiatives

The meaning of citizen perspectives in smart cities is described in ISO 37106. Before the implementation of smart cities, conventional services had a data platform for each field, and users accessed services in each field directly: this is called a functional perspective. To date, the development of a data platform for each field has been promoted as a technological element of smart cities. In a smart city, services must be provided from the perspective of citizens, crossing over fields, rather than from a functional perspective.

Phase 1

Clarify the definitions of a smart city and a City OS needed for cross-field services for citizens, and position them in the Smart City Reference Architecture White Paper (hereinafter, SCRA)

Phase 2

Regarding projects related to smart city initiatives based on the SCRA, promote projects that contribute to work reform, such as reducing the workload of municipalities, before considering the improvement in convenience. Reorganize the system development that has been performed for each field discretely to reduce costs and reducing duplicate work to promote work reform.

Phase 3

Treat the business applications proven to work in conjunction with a City OS as the de facto standard, and spread them with an eye to international expansion

2) Improvement in well-being

Approach and Direction of Initiatives

When promoting initiatives to improve well-being, it is important to keep in mind that there are two perspectives: a welfare perspective and a perspective of improving convenience. First of all, with the aim of reducing the number of people facing problems to zero, solutions to the problems faced by those people are to be prioritized. This will help to prevent the widening of disparities within municipalities caused by the development of smart cities.

In smart city initiatives also, priority is to be given to policy areas that should be addressed by the administration, such as measures for families with children and households with elderly or disabled people and measures to address educational disparities.

From the perspective of improving convenience, there have been many projects that have improved convenience to the extent that people would not be inconvenienced if the service did not exist, and the problem of monetizing these projects has not been solved. Furthermore, there were questions about whether municipalities should provide financial support for the business activities of service providers to develop data platforms.

When introducing projects to improve convenience, it is necessary to be careful that regional public services will not be abolished due to the sales strategies of major vendors. The attraction for major vendors, etc. to attend events also leaves little know-how in the region. In order to avoid these risks, when starting a new project, it is necessary to ensure that the municipality and its residents have control over the operation of the project.

Phase 1

From a welfare perspective, prioritize the implementation of initiatives that contribute to solving problems faced by people, in policy areas that should be addressed by the administration. To achieve this objective, it is necessary to investigate excellent leading-edge services and consider how services should be in cases where there are no precedents. Furthermore, for applications that reduce the burden (cost and human resources) on municipalities in providing these services, consider turning them into open source software (OSS) and put the results in the SCRA.

From the perspective of improving convenience, it is necessary to consider how to improve the convenience of cross-sector services from the perspective of citizens, rather than services siloed by sector and provided by function, while keeping in mind the improvement in the regional economic cycle, with reference to objective opinions from experts, and it is necessary to review this approach in the SCRA, based on the results of surveys of past good practices.

Phase 2

Based on the SCRA, start demonstration experiments to develop services and applications that contribute to solving problems faced by people and improving convenience (across fields) from the perspective of citizens. In this context, it is necessary to encourage the development of applications that can be used by municipalities that have introduced the City OS, to improve the compatibility of applications between regions, and to establish an environment that enables regional vendors to make business plans targeting the nationwide market. It is also necessary to conduct case studies on good practices and applications among those developed and to put the results of the studies in the SCRA.

Phase 3

The aim is to have applications implemented and used mutually between municipalities, and furthermore, to make the applications part of services that are associated with and linked to the export of the City OS overseas.

3) Work reform through digital transformation in municipalities

Approach and Direction of Initiatives

As the birthrate declines and the population ages, it is becoming increasingly difficult to pass on work within individual municipalities. It is important to promote the passing on of work and efficiency improvements using large-scale language models (LLM).

Phase 1

For the utilization of LLM, follow the security policy of the relevant municipality and consider not only the use of cloud computing but also the use of LLM in on-premise local environments, in order to promote work efficiency. Furthermore, it is necessary to consider server virtualization using a hyper-converged infrastructure (HCI) that spans multiple municipalities, as well as network configuration, so that even in an on-premises environment, business continuity can be quickly achieved in the event of a disaster: the output or the outcome is to be put in the SCRA.

Phase 2

Regarding services such as maternal and child health handbooks and disability certificates, for which support measures differ depending on municipalities, customization depending on the relevant municipality is needed. In order to ensure that individuals with such diverse needs can enjoy optimal well-being wherever they are, promote the standardization of data collaboration with Individual Number Cards and perform verification of the mechanism that allows people to receive services from municipalities promptly even after moving to a new location. In particular, it is important to consider push-type services, to prevent service applications from being overlooked, and to utilize IT technology to create a city where people who have moved in can feel that they are accepted by the community.

Phase 3

The aim is to improve the workload of municipal employees through the utilization of IT technology and to improve the level of services for citizens, as well as to promote cooperation between municipalities.

4) Promoting EBPM for smart city initiatives

Approach and Direction of Initiatives

Guidelines for Setting KPIs for Smart City Initiatives (Second edition) for smart city initiatives recommend that the creation of logic models and KPI settings be performed by multiple members (through discussion). However, in order to further promote EBPM, it is important to promote the development of an environment in which municipal employees can easily perform trend and cause analyses based on numerical data by using IT technology to address each issue.

Phase 1

Investigate cases where quantitative hypothesis testing can be performed by utilizing data science (more easily) such as no-code analysis methods using LLM, and put the results in the SCRA and promote them. Furthermore, investigate examples of the use of data analysis regarding smart cities overseas and put the results in the SCRA.

Phase 2

Regarding applications for smart city-related projects, consider giving preference to projects — in the selection process — for which a logic model has been created using data science.

Phase 3

Consider a method that can be applied to regional economic cycle analysis — in a developmental way — using invoices (qualified invoices) and that can quantitatively analyze improvement in the regional economic cycle that contributes to national land reinforcement.

5) Domestic human resource development

Approach and Direction of Initiatives

In higher education institutions that play an important role in the development of digital experts, it is important to promote the initiatives of universities and technical colleges with the following and to promote the development of human resources with practical problem-solving skills that utilize digital technology, etc.: as part of the promotion of education in mathematics, data science and AI, the national government certifies outstanding educational programs in mathematics, data science and AI at universities and technical colleges. The number of people to be trained for the applied basic level should be 250,000 per year.

Phase 1

With regard to the curriculum for education in mathematics, data science, and AI at higher education institutions, etc., conduct a survey of educational programs that contribute to smart cities from the perspective of improving the regional economic cycle. In addition, sort out the roles, knowledge and skills that contribute to smart cities, based on the definitions of the human resource categories in the “DX Promotion Skills Standards”.

Phase 2

Introduce and provide the following information, which was surveyed or sorted out in Phase 1, in the SCRA and Smart City Guidebook: information on educational programs and human resource categories that contribute to smart cities.

Phase 3

The aim is to create a state where digital experts who contribute to smart cities are widely active in third-generation smart cities.

6) Summary of policy trends, initiatives, and technological trends related to urban management

Initiatives	– 2025	2026 – 2027	2028 – 2030	2031 –
Image of a smart city	**1st generation** In this region, residents and visitors can use some kinds of smart city services consistently.	**2nd generation** In this region, an increasing number of smart city services are implemented, so that efficiency and convenience can be felt.	**3rd generation** In this region, various smart city services are implemented and managed as a whole, so that the environment for residents and visitors is transformed and regional issues are solved.	
Policy trend	Promotion of decision-making based on EBPM by utilizing digital technology; visualization of well-being; refinement of indicators; information sharing Publicizing SC human resource development programs; providing information Promotion of the development and implementation of cutting-edge services in the national strategic special zones Utilization of the local startup support system, support through the Grant Project of the Vision for a Digital Garden City Nation			
• Simulation, AI technology implementation • EBPM/ KPI • Human resource development, data literacy improvement	• Standardization of analysis and AI algorithm functions • Guidelines for Setting KPIs for Smart City Initiatives • Converting to advanced utilization-type statistical data (New Economy) • Expansion of economic, financial and lifestyle indicators and visualization database; functional improvement (New Economy) • Verification system for municipalities' initiatives, through the promotion of data utilization; promotion of environmental improvement (Strengthening of RESAS collaboration) (New Economy) • Recurrent educational program for professional human resources (New Economy)	• Generation AI x Open data provision scheme (AIAP) • Development of an environment for entrepreneurship education for 10,000 elementary, junior high, and senior high school students (Integration) • Formulation of AI guidelines at school education sites (Priority)		

Policy trend	• Innovation creation and industry creation • Industry-government-academia collaboration system and business scheme • Visualization of a regional economic cycle • Support system, deregulation	• Startup ecosystem hub city; promotion of the SBIR system; promotion of PFS dissemination (New Economy) • Study on PHR medical data collaboration using information banks (Priority)	• Research and development outcomes from the 3rd SIP/BRIDGE (New Economy) • Review of the information bank certification system (Priority)		
Initiatives		**Phase 1**	**Phase 2**		**Phase 3**
	• Definitions of a smart city and City OS	• Clarification of the definition of a City OS	• Promotion of projects that contribute to work improvement within municipalities		• Making business applications the de facto standard
	• Improvement in well-being	• Priority implementation of initiatives that contribute to solving problems faced by people • Consideration of improving convenience from citizen perspectives across various fields	• Development and demonstration of services and applications that contribute to solving problems and improving convenience		• Mutual utilization of applications between municipalities
	• Work reform through digital transformation in municipalities	• Work efficiency improvement through the utilization of LLM	• Standardization of data collaboration with Individual Number Cards		• Balancing the improvement in work practices for municipal employees and the improvement in services for citizens
	• Promotion of EBPM for smart city initiatives	• Case study of hypothesis testing using data science	• Construction of a logic model using data science		• Consideration of quantitative analysis methods for improving regional economic cycles
	• Domestic human resource development	• Research into educational programs that contribute to smart cities and the sorting-out of human resource categories from the perspective of improving regional economic cycles	• Provision of information on educational programs and human resource categories that contribute to smart cities		• Aiming for wide-ranging activities of digital experts who contribute to smart cities

Technology trends and activity status	• EBPM progress • Simulation, AI technology dissemination • Human resource development, data literacy improvement • Information distribution business • Finance • Marketing that utilizes big data and changes in pricing • On-demand business	• For AI literacy, 500,000 students at all universities and technical colleges; 250,000 people with mathematical and data science skills (2025) (AIAP) • KPI/event monitoring function • Number of organizations working on smart cities (Number of public-private partnership PF members and observers): 1,000 organizations (Basic Plan on Transport Policy) • Percentage of passenger facilities to be equipped with public wireless LAN (Wi-Fi): 100% (Basic Plan on Transport Policy) • Percentage of logistics companies that have achieved digital transformation regarding logistics: 70% (Logistics Master Plan)	• Startups and small businesses working to solve social issues: 900 regions (Digital Garden) • Registered DMOs with tourism digital transformation strategies: 90 organizations (Digital Garden) • Growth in productivity of small and medium-sized enterprises that drive the regional economy: 2% or more per year (Geometric average for FY2023 – FY2027) (Digital Garden)	• Development of regional data center sites (More than 10 locations) (Digital infrastructure development)	

<Reference>

- New Economy: Cabinet Office “New Economy and Fiscal Revitalization Plan Reform Timetable 2023”
- Priority: Digital Agency “Priority Plan for the Realization of a Digital Society” June 2023
- AIAP: Digital Agency “Action Plan for the Preparation and Coordination of Public and Private Data in the AI Era” December 2023
- Integration: Cabinet Office “Integrated Innovation Strategy 2023” June 2023
- Digital Garden: Cabinet Secretariat “Comprehensive Strategies for the Vision for a Digital Garden City Nation” December 2022
- Basic Plan on Transport Policy: MLIT “Second Basic Plan on Transport Policy” May 2021
- Logistics Master Plan: MLIT “Comprehensive Logistics Master Plan (FY2021 – FY2025)” July 2021
- Digital Garden: Cabinet Secretariat “Comprehensive Strategies for the Vision for a Digital Garden City Nation” December 2022
- Digital infrastructure development: MIC “Digital Garden City National Infrastructure Development Plan” April 2023

*Please note that the English titles of the reference materials may not always be accurate.

(2) Data collaboration

1) Standardization of communication lines and securing of lines in regions

Approach and Direction of Initiatives

To date, there has been a lot of discussion about the development of data platform and the release of APIs in terms of data collaboration for smart city initiatives. On the other hand, the foundation for data collaboration is network infrastructure. For example, if a disaster occurs and communication lines are cut, disabling communications, terminals may not work even if the City OS is running on the cloud. The more mission-critical the application, the more important the network design, but to date it has not been given much importance. Furthermore, when a disaster occurs, a large number of trap reports are generated, and in order to monitor the disaster situation accurately without missing anything, a trap buffer is also needed. Furthermore, to date, a data platform has been constructed for each field, and it has become siloed. A communication network was set up for each silo individually, and a contract for a communication network was made for each IoT device in each silo. It is necessary to improve these conditions and standardize and secure communication lines in regions.

Phase 1

Review the siloed system related to the data platform, and consider measures to reduce costs by sharing communication lines across fields. In addition, consider specifications for securing communication lines for use in times of disaster, as well as a mechanism for ensuring that no traps are missed in the event of a disaster and a mechanism for active monitoring, and post the results in the SCRA.

Phase 2

Based on the specifications of the SCRA, proceed with the demonstration of securing a regional communication network — for the event of a disaster — that will also contribute to the national land reinforcement. In addition, put good practices in the SCRA and promote standardization.

Phase 3

The aim is to create a state where, in third-generation smart cities, regional telecommunications carriers play a role in improving the regional economic cycles by becoming the main players in the communications of the region's public services.

Another aim is to create a state where business models for telecommunications businesses that contribute to regional economic cycles and national land reinforcement — rather than just telecommunications system configurations like this — are also deployed overseas in line with the overseas implementation of a City OS.

2) IoT edge standardization

Approach and Direction of Initiatives

To date, while the development of a City OS has progressed, data collection has required linkage with individual IoT devices. Since there are few IoT devices that support the NGSI, conversion to the NGSI format using an IoT agent was necessary. In this case, an IoT agent had to be created for each IoT device, and also only a limited number of vendors were able to develop these. For this reason, it is necessary to create an environment that promotes the development of IoT devices by standardizing the IoT edge.

Phase 1

Consider a method of using an IoT device as an edge computer and supporting NGSI conversion at a standardized IoT edge. Furthermore, even if NGSI conversion is not to be performed on the IoT edge side, consider the ideal form of the IoT agent that supports the standardized IoT edge. From these, summarize the results of considering the structure and ideal form of standard IoT edge, which makes it easier to collect data, and put the outcomes in the SCRA.

Phase 2

The aim is to establish standard specifications that will enable regional startups and local companies to develop IoT devices, and to create a state where IoT edge development can be performed within individual regions using general-purpose single-board computers (SBCs) with an NGSI interface(IF).

Phase 3

The aim is to make excellent IoT edge devices developed in any region available in other regions as well, and also to create an environment that allows regional startup companies — that have developed such IoT edge devices — to operate businesses with a nationwide market.

Another aim is to create a state where excellent IoT edge devices developed in Japan are deployed overseas in line with the overseas expansion of a City OS.

3) Standardization of data

Approach and Direction of Initiatives

To date, the way data is handled in terms of the SCRA has been limited to listing only general items, and has not progressed to data standardization. For this reason, even though there was infrastructure that could link data, in reality, there was no consistency in the data when linking the data between cities, and data collaboration between cities did not progress. In order to improve this situation, it is necessary to promote initiatives related to data standardization, while taking into account the state of development of the base registry and the digitization of the quasi-public sector.

Phase 1 Phase 2

Establish a system for considering the concrete standardization of IDs and codes (classifications), etc., and reflect the results of consideration to the SCRA as they become available.

Phase 3

With the data now standardized, the aim is to enable local companies and startups to develop applications that run on a City OS that utilize the data, and to enable applications developed by any municipality to run on a City OS in other regions.

4) Standardization of data specifications for geospatial information

Approach and Direction of Initiatives

To date, the linkage between a City OS and GIS has not progressed, and the use of separate maps has been promoted for each field and service in areas such as disaster prevention, welfare, and urban policy. In order to promote the distribution of various geospatial data on a City OS that provides services across multiple fields, it is extremely important to clarify the data specifications (geospatial data content and structure, terminology definitions, quality and format) on the premise of utilizing the base registry “Basic Geospatial Data”, so that both data creators and users can correctly understand the geospatial data. Furthermore, in order to prevent the proliferation of similar data specifications, it is necessary to promote the standardization of the existing data specifications.

Phase 1

In order to promote the digitization of geospatial information (such as paper maps) held by municipalities, consider digitization measures that include the utilization of the base registry “Basic Geospatial Data” and private-sector data.

Phase 2

Confirm the effectiveness of the digitalization measures through demonstration experiments (e.g., utilization of Basic Geospatial Data, public survey results, and private-sector data), and standardize the data specifications.

Phase 3

The aim is to create a state where various geospatial data flow on a City OS in third-generation smart cities.

5) Application development that utilizes geospatial information

Approach and Direction of Initiatives

To date, regarding City OS-involved GIS utilization, maps have been created discretely for each field and service in areas such as disaster prevention, logistics, transportation, and drone operations. As a result, data platforms have been linked to siloed map data in each field and have been siloed for each field. Therefore, it is necessary to improve the situation where the development of cross-field services from the perspective of citizens — which is what smart cities should aim for — is difficult.

Phase 1

In order to realize expected cross-field services for citizens, unify the maps of all fields to enable the mutual use of various data. Specifically, as standard specifications, put in the SCRA excellent initiatives that can be achieved at low cost and the ideal form of applications on the City OS linked to this. Furthermore, by actively putting information about a City OS — that can be built at low cost — as good practices in the SCRA, create an environment where such cross-sector services for citizens can be implemented with a small start-up.

Phase 2

Based on a standardized geospatial data infrastructure, promote the development of GIS-linked, cross-field services and applications from the perspective of citizens. Applications developed under this framework can be used in other regions, as well. Prevent a situation where there are many oligopolistic applications with unique specifications, and promote inter-region cooperation, such as complementing services for citizens between regions. In the case of good applications and services, it will be possible for vendors to expand into other regions without additional development. It can also be expected to reduce the burden on users due to cost reduction, and even a venture company from a local area will be able to expand its business nationwide.

Phase 3

Link cross-field City OS data, City OS applications, and centralized map data, and consider cross-field simulation functions from the perspective of citizens. Specifically, consider the best way to provide an early warning function that notifies the Integrated Command and Control Centers (ICCC) of accidents and other risks, and also consider and standardize how to handle personal data in such cases, put the results in the SCRA.

6) Linking with the energy and environmental fields

Approach and Direction of Initiatives

In the past, solving environmental issues has not been a major focus of smart cities. In the future, there will be a growing awareness of the environment, energy prices will rise, and this will lead to an increase in spending outside the region. In addition to dealing with these issues, it will also be necessary to take security measures. These are common issues for smart cities (across the country), which aim to achieve carbon neutrality and improve regional economic cycles using renewable energy. The utilization of IT is required to manage the progress of these initiatives to solve environmental issues in smart cities.

Phase 1

Consider and conduct demonstration experiments on visualization of utilization of locally produced and consumed energy using IT and visualization of CO2 emission amount, using a City OS, which are cross-field data platforms.

Phase 2

Even if a City OS is simply added with visualization functions, there is a concern that development and maintenance costs will be incurred, putting pressure on municipal finances, so it is also necessary to introduce a monetization system. The shift from a time-based fee to a metered fee for the amount of electricity used will make it possible to visualize CO2 emission amount and the ratio of renewable energy, so promote this as a smart city initiative. In addition, consider the utilization of renewable energy that contributes to improving the regional economic cycle that the municipality is working on, and also consider the ideal form of electricity and charging fees and cost sharing that makes it possible to balance monetization related to the City OS of the municipality. In this, also consider implementing carbon pricing using a City OS as a data platform, by utilizing digital technology. Regarding regional economic cycles, take into consideration the use of local new power companies, etc., and consider a mechanism that encourages people to change their behavior so as to suit the region.

Phase 3

The aim is to create a state where, in third-generation smart cities, the best practices from phase 2 are widely spread across each region, and decarbonized charging infrastructures for inclusive personal mobility, such as electric wheelchairs and specified small motorized bicycles, are widely used in public facilities as well as private facilities.

7) Advancement of smart city services (ICCC)

Approach and Direction of Initiatives

To date, there has been no discussion in Japan about ICCC, which can aggregate and monitor the status of various services in smart cities.
On the other hand, advanced smart cities overseas have been introducing such advanced services, and some domestic vendors have been selected overseas as one of the few certified businesses. It is important to promote initiatives to introduce and implement the technology — that these domestic vendors have established for overseas markets — in smart cities in Japan as well.

Phase 1

Regarding ICCC, reflect the knowledge of domestic vendors with advanced technology in the SCRA as standard specifications.

Phase 2

While referring to examples of smart cities overseas, consider a standard ICCC (by a domestic vendor) that would allow municipal employees to perform integrated monitoring across fields using a GUI-based system. In addition, consider adopting OSS and methods that allow municipalities to perform implementation and maintenance at an appropriate cost. In addition to cloud computing, consider HCI configurations between regions, and also consider and test methods for implementation at appropriate costs according to services.

Phase 3

Regarding the ICCC in third-generation smart cities, consider the ideal form of a pre-warning alarm function, etc. In addition, consider how to handle personal data in such cases, promote standardization, and put the results in the SCRA. In addition, regarding overseas expansion of ICCC linked with a City OS, consider measures to support as the national government.

8) Utilization of FIWARE in various fields

Approach and Direction of Initiatives

To date, the use of FIWARE in Japan has been limited to a City OS. As a result, there were few engineers familiar with FIWARE, and service development was not progressing. In Europe, for example, FIWARE is being used not only as a City OS, but also as an energy management system (EMS), as an infrastructure for automating smart agriculture, and as an infrastructure for automating smart industry. It is being utilized as a control infrastructure rather than a data platform. This has made FIWARE itself highly versatile software, and the number of people using FIWARE has increased. As a result, the scope of smart cities has broadened, and the development of smart city services has progressed.

Phase 1

In the third phase of the Cabinet Office's Strategic Innovation Program (SIP), FIWARE is being used to promote inter-field linkage between energy and transportation in cities, and also advanced activities are being conducted to build an EMS, a control system, with FIWARE. In order to promote the widespread use of FIWARE as OSS in general-purpose control systems, put examples of such advanced activities in the SCRA. Furthermore, in order to promote the use of FIWARE for OS other than a City OS, put examples of its use in the SCRA.

Phase 2 Phase 3

The aim is to create a state where the use of FIWARE in fields other than a City OS is promoted, and where regional startup companies that have developed City OS services go into various fields using the technology, and the outcomes cultivated there are fed back into smart cities.

9) Summary of policy trends, initiatives, and technological trends related to data collaboration

Initiatives	– 2025	2026 – 2027	2028 – 2030	2031 –
Image of a smart city	**1st generation** In this region, residents and visitors can use some kinds of smart city services consistently.	**2nd generation** In this region, an increasing number of smart city services are implemented, so that efficiency and convenience can be felt.		**3rd generation** In this region, various smart city services are implemented and managed as a whole, so that the environment for residents and visitors is transformed and regional issues are solved.
Policy trend • City OS, API, module, SCRA, standard specifications, ID linkage, base registry, open data • Optical/5G (etc.) equipment, spatial information • Governance, security • Administrative digital transformation • Inter-field linkage • Digitization of quasi-public sectors • Regional decarbonization policy-related	Promotion of public-private data collaboration through SCRA, Smart City Guidebook, etc. Promotion of activities through the dissemination of guidelines related to data governance and facilitation of system development Promotion of security measures through the dissemination of smart city security guidelines Implementation of cross-field aggregation functions from the perspective of citizens to build a data ecosystem, and awareness-raising Interoperability and expansion of a City OS, and inter-municipal linkage triggered by digitization			
	• ID dissemination (Turning Individual Number Cards into citizen cards, spatial ID, real estate ID system completion) (Priority) • Start of full-scale operation of the base registry (Priority) • CRSA system construction (Priority) • Promotion of administrative digital transformation through measures such as the government interoperability framework and digital marketplace for public procurement. (Priority) • Implementation of digital services in quasi-public sectors through the release of service catalogs and model specifications (Priority) <Regional decarbonization-related> • Selection of at least 100 decarbonization pilot regions by FY2025 and creation of smart city linkage models	• 3D city model completion cities: 500 cities (Digital Garden) • Making the Basic Geospatial Data three-dimensional (Digital Garden) • Public service mesh operation, nationwide expansion of Individual Number Card linkage (AIAP)	• Public-private data collaboration with BIM/PLATEAU via real estate IDs (New Economy) <Regional decarbonization-related> • Realization of zero CO2 emissions from electricity consumption in the commercial sector in the selected decarbonization pilot regions (Decarbonization)	

Initiatives

	Phase 1	Phase 2	Phase 3
• Standardization of communication lines and securing of lines in regions	• Consideration of sharing communication lines across fields and securing communication lines for use in times of disaster	• Demonstration of securing communication lines for use in times of disaster	• Regional telecommunications carrier contribution to improving regional economic cycles
• IoT edge standardization	• Consideration of support for the NGSI through the standardized IoT edge	• Consideration of standard specifications for the development of IoT devices	• Formation of a nationwide market for the development of IoT devices
• Standardization of data	• Consideration of support for the NGSI through the standardized IoT edge	• Consideration of support for the NGSI through the standardized IoT edge	• Development of applications that use standardized data and mutual use in other regions
• Standardization of data specifications for geospatial information	• Consideration of digitization measures, including the use of private-sector data	• Standardization of data specifications through the verification of digitization measures	• Promotion of the flow of various geospatial data on a City OS
• Application development that utilizes geospatial information	• Standardization of the mutual use of various data through the centralization of maps in all fields	• Development of cross-field services and applications linked with a standardized geospatial data infrastructure and GIS	• Consideration of the handling of personal information data in an ICCC system and the advancement (standardization, etc.) of services and applications
• Linkage with the energy and environmental fields	• Consideration of City OS-use energy utilization and visualization of CO2 emission amount	• Consideration of a cross-field integrated monitoring system using technology from domestic vendors	• Crossover implementation of excellent renewable energy systems
• Advancement of smart city services (Integrated monitoring system)	• Consideration of standard specifications for an integrated monitoring system linked with a City OS	• Development of cross-field services and applications linked with a standardized geospatial data infrastructure and GIS	• Consideration of measures for the overseas implementation of an integrated monitoring system linked with a City OS
• Utilization of FIWARE in various fields	• Survey of cases where FIWARE is being used as OSS in control systems other than a City OS	• Promotion of the use of FIWARE in fields other than a City OS and expansion of City OS service vendors into various fields	• Promotion of the use of FIWARE in fields other than a City OS and expansion of City OS service vendors into various fields

Technology trends and activity status					
	• All Photonics • IOWN • NTN • IoT device • Edge computing • NW IoT Platforms	• Ultra-high-speed, low-latency cloud computing development (IOWN) • High-capacity, low-latency data communication method (IOWN) • Realization of a data-centric ICT infrastructure (IOWN) • Dramatic improvement in energy efficiency in ICT infrastructure (IOWN) • Number of DPF-linked data with respect to the Ministry of Land, Infrastructure, Transport and Tourism: 1.5 million (Basic Plan on Transport Policy) • Smart city: 100 regions (Digital Garden) • Updating to the next-generation comprehensive disaster prevention information system (Priority) • Implementation of flying cars at the World Expo (Transportation) • Three-dimensional geospatial information infrastructure (Operation in local cities and suburbs) (Transportation) • Automated driving services in co-existing spaces in limited areas (Transportation) • MEXCBT utilization (Education) • In 2025, launch of next-generation smart meters (METI) • Implementation of agriculture (by 2025) in which almost all of the people involved in agriculture utilize data (Digital Garden) • Operation of an agricultural data platform and construction of a smart food chain platform (Priority) - Automated driving services in co-existing spaces, etc. in limited areas (Transportation) - New mobility services through cross-industry cooperation and data utilization (Transportation)	• External chip connection speedup (All Photonics) • Early domestic implementation of satellite mobile direct, satellite IoT (NTN), and NTN (HAPS, satellite communications, etc.) from FY2025 onwards (Digital infrastructure development) • High altitude platform (HAPS) technology (NTN) • Fiber-optic cable household coverage rate by the end of FY2027: 99.9% (Digital Garden) • Edge infrastructure market: 730 billion yen (R5 Information and Communications White Paper) • Start of operations for the Japan Sea-side domestic submarine cables (Digital Garden)	• Direct chip-to-chip optical connection (All Photonics) • Basic function verification of quantum internet (Quantum innovation) • 5G population coverage at the end of FY2030: 99% nationwide and individual prefectures (600,000 base stations in total) (Digital Garden) • Three-dimensional geospatial information infrastructure (Operation in urban areas) (Transportation) • Turning new homes and buildings into ZEH and ZEB (GX) • Domestic manufacturing infrastructure for 150 GWh storage batteries (GX) • Intra-data center photonic integration and disaggregated computing (GX)	• 6G implementation (Wireless) • Intra-chip optical-signal use (All Photonics) • Full-scale practical application of all-solid-state batteries (GX) • Electric vehicles in new passenger car sales: 100% (GX) • Self-driving level 3 for private cars (Transportation) - Mobility services that meet the needs of self-driving level 4 for commercial vehicles (Transportation)

<Reference>

- Priority: Digital Agency “Priority Plan for the Realization of a Digital Society” June 2023
- IOWN: NTT “Technology Development Roadmap for Realizing the IOWN Concept” April 2020
- Basic Plan on Transport Policy: MLIT “Second Basic Plan on Transport Policy” May 2021
- New Economy: Cabinet Office “New Economy and Fiscal Revitalization Plan Reform Timetable 2023”
- All Photonics: NTT Science and Core Technology Laboratory Group “Photonics-Electronics Convergence Technology Roadmap (Photonics-Electronics Convergence Technology for Realization of All Photonics Network)”
- NTN: Beyond 5G Promotion Consortium “NTN Technology Roadmap” May 2022
- Digital Garden: Cabinet Secretariat “Comprehensive Strategies for the Vision for a Digital Garden City Nation” December 2022
- Digital infrastructure development: MIC “Digital Garden City National Infrastructure Development Plan” April 2023
- 2023 Information and Communications White Paper: MIC “2023 Information and Communications White Paper”

- Wireless: MIC “Technology Roadmap for the Wireless Field” January 2020
- Transportation: Digital Agency “The Future of Transport Society Using Digital 2022” August 2022
- AIAP: Digital Agency “Action Plan for the Preparation and Coordination of Public and Private Data in the AI Era” December 2023
- Education: “Roadmap on the Utilization of Data in Education” (January 2022) by the Digital Agency, MIC, MEXT, and METI
- GX: METI “The Basic Policy for the Realization of GX” February 2023
- Digital Garden: Cabinet Secretariat “Comprehensive Strategies for the Vision for a Digital Garden City Nation” December 2022
- METI: “Summary of the Next-Generation Smart Meter System Study Group” May 2022
- Smart mobility: MLIT “How To Create Smart Mobility: A Guidebook for Everyone” March 2024
- Recharging infrastructure: METI “Guidelines for Promoting the Development of EV Charging Infrastructure” October 2023
- Green Growth: METI “Green Growth Strategy Through Achieving Carbon Neutrality in 2050”
- MLIT Green: MLIT “MLIT Green Challenge”
- MAFF Green: MAFF “Green Food System Strategy”
- Decarbonization: Council for National and Local Decarbonization “Regional Decarbonization Roadmap” June 2021

*Please note that the English titles of the reference materials may not always be accurate.

(3) Crossover implementation

1) Standardization of applications

Approach and Direction of Initiatives

To date, initiatives have been made to promote data collaboration through the release of API catalogs, but in reality, even when APIs for data in other regions were released, there was no clear way to use them, and as a result, interregional linkage did not progress. Furthermore, simply releasing APIs results in the customization of user-side applications to match them, so it was not possible to fully use the relevant applications in other regions. For this reason, it is important to promote standardization at the application level and consider the spread of services through the crossover implementation of the relevant applications.

Phase 1

While continuing to release the conventional API catalogs, consider creating a situation where applications that run on FIWARE can be commonly used among municipalities.

By ensuring compatibility between applications, traffic between FIWARE systems built on the same cloud will be smooth, and applications developed by citizens will be listed in catalogs and implemented, as in other countries. So, consider measures to broaden the base of application development by standardizing City OS, and put organized results in the SCRA.

Phase 2

In accordance with the SCRA, conduct activities to encourage citizens and regional startups to participate in application development. Develop applications that run on FIWARE, and promote turning the developed applications into OSS. In addition to these, by utilizing standardized data defined in the SCRA, promote the mutual use of applications between regions. Furthermore, while continuing to expand the API catalog, continue to expand the application catalog as well. In the course of these activities, put good applications in the SCRA and use them as standard applications.

Phase 3

With the data standardized, the aim is to enable local companies, startups, local universities, etc. to develop applications that run on a City OS that utilize the data, and to enable applications developed by any municipality to run on a City OS in other regions.

2) Close support for municipalities from the national government

Approach and Direction of Initiatives

From the perspective of expanding the base of municipalities that are working on smart cities, it is also necessary for local branch offices of the national government to provide support (close support) — by taking advantage of various opportunities — for identifying needs and forming projects when municipalities use digital technology to work on solving local issues and improving their appeal.

Phase 1

In promoting the digitization, etc. of their own policies, the relevant ministries and agencies utilize local branch offices to provide the concerned municipalities with close support for the formulation of projects and applications for support businesses. By having local branch offices of the national government provide close support to municipalities, the number of municipalities that use digital technology will increase, and the base of municipalities that work on smart city initiatives will expand.

Phase 2 Phase 3

While taking into account the level of implementation of smart cities, consider how to provide close support from the local branch offices of the national government, and continue to do so.

3) International standardization and international rollout

Approach and Direction of Initiatives

To date, with the aim of international standardization of evaluation indicators for smart community infrastructure, which supports smart cities, and to use this as a powerful tool to promote infrastructure exports, international standardization activities have been conducted for ISO/TC 268/SC 1 (smart community infrastructure). The indicators for comprehensive evaluation of “entire cities” in terms of urban infrastructures (water supply and sewage, transportation, energy, information communication, waste disposal, etc.) have been developed solely by ISO/TC268/SC1.
By taking the lead in international standardization of these indicators, Japan needs to create an environment in which Japan's excellent urban infrastructure is properly evaluated, and promote Japan's contribution and involvement in urban development around the world.

Furthermore, when promoting standardization in domestic smart city initiatives, it is important to ensure that they are consistent with international trends, and to link them to subsequent international standardization and international rollout initiatives.

Phase 1

Regarding the SCRA, which is a standard design concept that summarizes how to create smart cities in Japan, promote initiatives toward international standardization in terms of IEC/ SyC Smart Cities and ISO/ TC 268 JWG 14. In addition, consider the international standardization of smart city evaluations that emphasize the perspective of residents.

Phase 2

Make efforts to achieve international standardization at the conceptual, framework, and individual field/technology levels described in the SCRA of our country. In addition, promote initiatives to achieve the international standardization of smart city evaluations that emphasize the perspective of residents.

Phase 3

The aim is to implement Japan's smart city technology internationally and contribute to international society through the use of internationally standardized infrastructure procurement standards.

4) Summary of policy trends, initiatives, and technological trends related to crossover implementation

Initiatives	– 2025	2026 – 2027	2028 – 2030	2031 –
Image of a smart city	**1st generation** In this region, residents and visitors can use some kinds of smart city services consistently.	**2nd generation** In this region, an increasing number of smart city services are implemented, so that efficiency and convenience can be felt.	**3rd generation** In this region, various smart city services are implemented and managed as a whole, so that the environment for residents and visitors is transformed and regional issues are solved.	
Policy trend • Wide-area cooperation (Expansion of implementation areas) • International expansion (JASCA, Japan/ASEAN) • International standards (ISO/IEC/ITU-T)	Dissemination of concepts through activities such as the GSCA and the Japan-ASEAN Smart Cities Network Nationwide crossover implementation of initiatives through the Smart City Public-Private Partnership Platform, etc.			
	• ISO/IEC/JTC1SC41, WG11, ISO TC268 Smart city-related data collaboration standard task force activities (METI, TTC) (TTC)	• Enhancement of the IAP system and functions (Working group establishment, etc.) (AIAP)		

		Phase 1	Phase 2	Phase 3
Initiatives	• Standardization of applications	• Consideration of ensuring the compatibility of applications that run on FIWARE among municipalities	• Development of applications that run on FIWARE and promotion of mutual use between municipalities	• Development of applications that run on FIWARE and promotion of mutual use between municipalities
	• Close support for municipalities from the national government	• Extension of the base of municipalities working on smart cities with close support of the national government	• Continuation of the close support from the national government according to the level of implementation of smart cities	• Continuation of the close support from the national government according to the level of implementation of smart cities
	• International standardization and international rollout	• Consideration of the international standardization of the SCRA since 2026 • Consideration of the international standardization of smart city evaluations that emphasize the perspective of residents	• Aiming to achieve international standardization at the conceptual, framework, and individual field/technology levels described in the SCRA • Promotion of initiatives for the international standardization of smart city evaluations that emphasize the perspective of residents	• Aiming to implement Japan's smart city technology internationally and contribute to international society through the use of internationally standardized infrastructure procurement standards
Technology trends and activity status	• Expansion of wide-area cooperation • International expansion • Proposal for international standards	• Regarding the requirements definitions for IoT and smart city applications, proposal for ITU-T recommendation launch and U4SSC smart city KPI recommendation launch (TTC) • 2025: Japanese companies are expected to win orders worth 34 trillion yen for infrastructure systems (Infrastructure)		

<Reference>

- TTC: Telecommunications Technology Committee “Medium-term Standardization Strategy” 2023
- AIAP: Digital Agency “Action Plan for the Preparation and Coordination of Public and Private Data in the AI Era” December 2023
- Infrastructure: Infrastructure System Overseas Promotion Strategy 2025 (June 2023 Supplement) June 2023

*Please note that the English titles of the reference materials may not always be accurate.