

Optimization of Entire Urban Areas Using IOWN

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Abstract

NTT is advancing the Innovative Optical and Wireless Network (IOWN), NTT's vision of creating a *smart world* using innovative technologies. The aim is to accelerate digital transformation in collaboration with its partners and solve social problems. This article introduces NTT's activities to optimize urban areas with a focus on mobility and how it can be used to address current social problems. Essentially, this will be done by achieving both individual/local and group/global optimization on the basis of various types of information using IOWN and other technologies and assets of the NTT Group.

Keywords: IOWN, smart cities, digital transformation

1. Activities of Japan and NTT to address current social problems

Economic development and technical innovation have led to the advent of many different services, which have enriched our lives, and people's priorities and values have become diverse. The aging population, which has resulted from improvements in quality of life and medical care, and global economic and political changes are making social problems more complex. The current social system is not conducive to achieving both economic development and resolving social problems.

In light of these circumstances, the government of Japan has proposed, in the 5th Science and Technology Basic Plan, Society 5.0 [1]. This is the government's vision of the type of society that should be aimed at in the coming years. Society 5.0 is a human-centered society that balances economic development with the resolution of social problems using systems that closely integrate cyberspace and the physical space.

In Society 5.0, a huge amount of information sent from sensors in the physical space is accumulated in cyberspace. In cyberspace, artificial intelligence (AI), which exceeds human capacity, analyzes the accumulated information. The analysis results are fed back to

people in the physical space in a variety of ways, including by robots, bringing hitherto unknown value to industry and society.

To solve the diverse social problems mentioned above, i.e., achieving both individual/local and group/global optimization based on various types of information and creating a better society more receptive to diversity, NTT has announced its vision of the Innovative Optical and Wireless Network (IOWN) [2]. IOWN is a network and information processing infrastructure, including terminals, that exploits innovative technologies centering on photonics to provide high-speed, high-capacity communication and massive computing resources, both of which surpass the limits of the conventional infrastructure. NTT aims to define its specifications in 2024 and start commercial use in 2030 (**Fig. 1**).

2. Social problems related to urban areas and mobility

Urban areas are characterized by population concentration, which gives rise to long-standing and unresolved social problems, ranging from traffic problems, such as commuter rush hours, to environmental and energy problems. In contrast, rural areas are characterized by a decline in the productive

What is IOWN?

Innovative Optical and Wireless Network (IOWN)

Creating a *smart world* by using the 3 elements of All-Photonics Network, Digital Twin Computing, and Cognitive Foundation

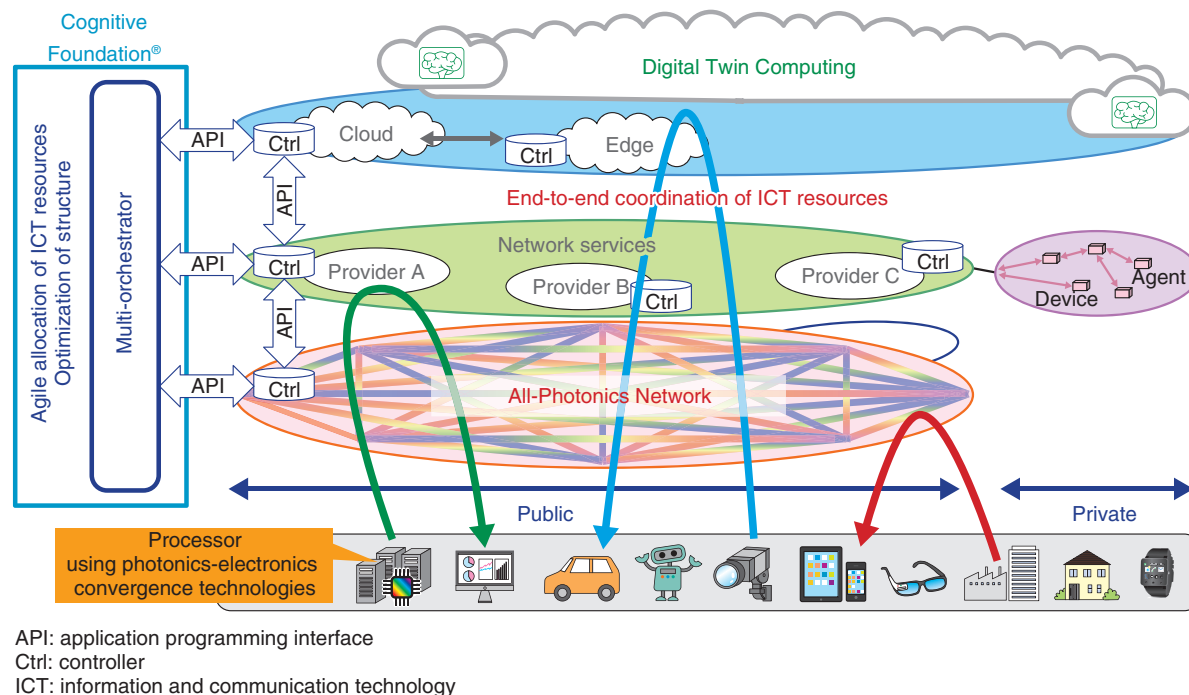


Fig. 1. Overview of IOWN.

population owing to a sinking birthrate, increase in the aging population, and decrease in the working-age population, making it difficult to maintain public and other services.

It is difficult in rural areas to maintain transport systems, such as trains, buses and taxis, at the same level as in urban areas. Therefore, it is important to provide diverse and sustainable mobility services capable of supporting the lifestyles and workstyles of people in these areas by considering a variety of mobility means in an integrated manner, including future use of automated driving.

3. Considerations in solving mobility problems

Conventionally, both economic growth and population growth have been taken for granted, and means of transport and mobility services have been designed and provided in a manner that achieves efficiency from a macroscopic viewpoint.

However, services needed in the coming years are those that use various mobility means adapted to

users' purposes, usage situations, and health conditions. The aim is to solve diverse social problems while encompassing diverse values and needs of an individual/local in a timely manner. As well as mobility optimization for individuals, as mentioned above, it is also important to design and operate infrastructures and services from the perspective of group/global optimization to ensure that services are sustainable. For example, maintenance costs should be reduced by minimizing the requirements for human labor and energy resources in real time.

If we are to provide the aforementioned services, it is necessary to integrate cyberspace and the physical space to collect massive amounts of data about people, things, and events, such as geographical space information, mobility information, and information on people's behavior, tastes and history of their actions on the Internet, which have conventionally been managed and used separately for individual purposes. Such data should be integrated at high speed and used in cyberspace so that both individually/locally and statistically/globally optimal solutions

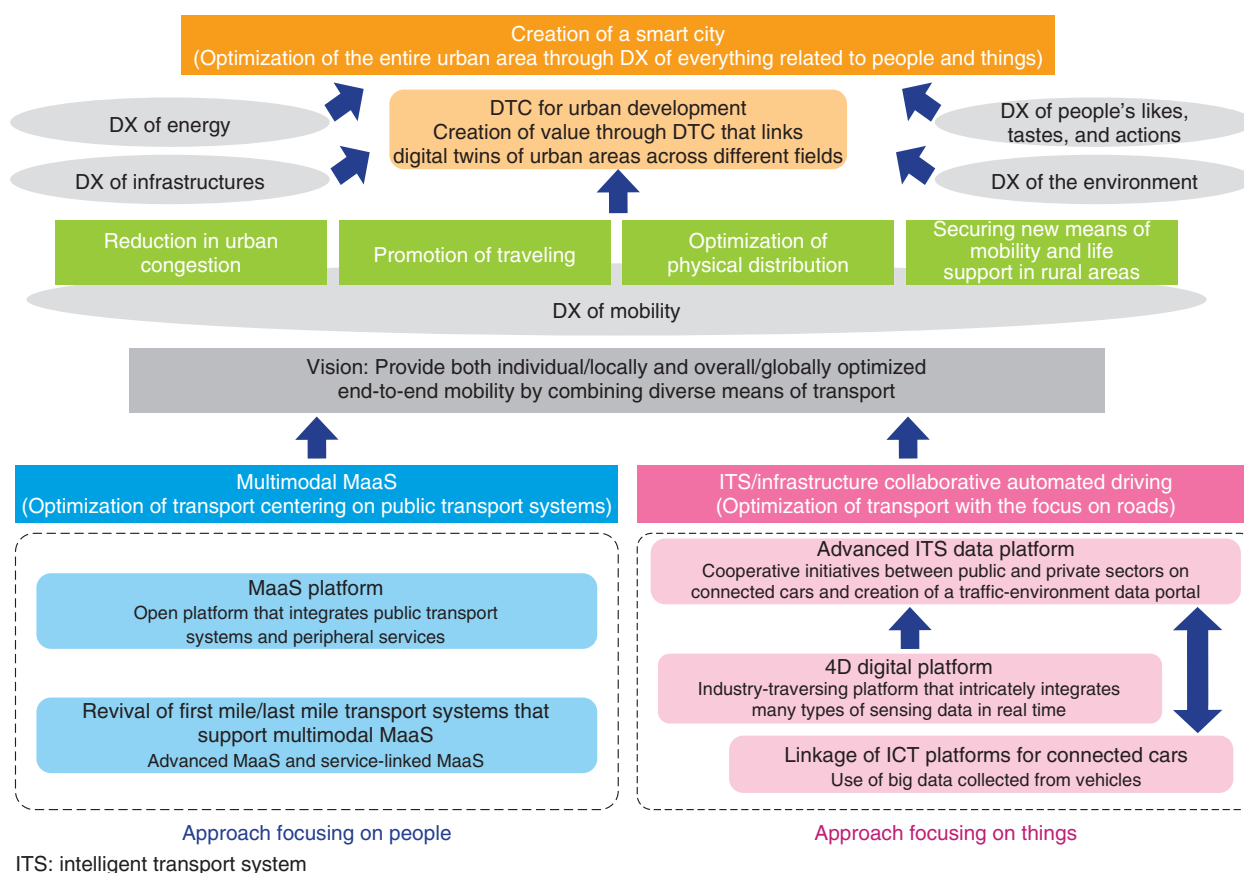


Fig. 2. Activities for optimizing entire urban area with a focus on mobility.

can be achieved and used for controlling devices and encouraging people to change their behavior.

Using the All-Photonics Network (APN) [3], Digital Twin Computing (DTC) [4], and other technologies under IOWN, NTT aims to achieve real-time collection and feedback of diverse data and implement services that help solve social problems while minimizing large-scale and complex computation in cyberspace and demands on energy and time.

4. Current activities of the NTT Group on optimizing mobility and urban areas

The NTT Group advocates a vision whereby both individually/locally and statistically/globally optimized end-to-end mobility are provided by combining different forms of transport. Through digital transformation (DX) of mobility, the group aims to solve a broad spectrum of social problems and create new value. It further seeks to optimize entire urban areas and achieve a smart city through DX of a wide

range of business fields, including mobility.

The following Feature Articles in this issue introduce the NTT Group's activities for DX of mobility and urban areas, as shown in **Fig. 2**, as well as prospects for the age of IOWN.

(1) Open MaaS platform that supports multimodal MaaS

The first article [5] discusses future public transport systems from the perspectives of solving social problems, such as the declining birthrate, aging population, and global environmental problems. It also presents the NTT Group's activities for an open mobility as a service (MaaS) platform that supports multimodal MaaS, which integrates public transport systems and peripheral services.

(2) Activities on multimodal MaaS to solve the first mile/last mile problem

The second article [6] introduces NTT DOCOMO's activities involving AI and cross-industrial collaboration to achieve sustainable communities and smart cities and revive public first mile/last mile transport

systems, the shortage of which is seriously impacting transport systems for both residents and tourists.

(3) Use of the 4D digital platform™ for mobility

The third article [7] presents activities for achieving smooth transport using a four-dimensional (4D) digital platform. The 4D digital platform collects many types of sensing data about people, things, and events in real time, integrates four dimensions of information (latitude, longitude, altitude, and time) with a high degree of precision, and provides data useful for predicting the future of various industrial infrastructures.

(4) Technical developments and verification of connected cars

The fourth article [8] describes NTT's collaboration with Toyota Motor Corporation regarding connected cars. Using big data collected from vehicles, NTT and Toyota are jointly developing technologies needed for the provision of new mobility services.

(5) Cooperative initiatives between public and private sectors on connected cars and creation of a traffic-environment data portal

The fifth article [9] introduces NTT DATA's activities on a traffic-environment-information portal and data-platform architecture, which are being studied to create a social infrastructure that facilitates collaboration among different traffic infrastructures needed in the coming age of automated driving.

(6) Data-driven and optimized smart cities using urban DTC

The sixth article [10] presents activities on DTC for urban development. It is intended to provide new value using a number of digital twins created by sensing environments, things, and people with sensor devices, such as cameras and smartphones, to predict the future in accordance with services provided in urban areas and link them across different fields. The goal is to optimize entire urban areas.

5. Future prospects

This article introduced current activities intended to optimize mobility and entire urban areas as well as prospects for the coming IOWN era. Remarkable advances in information and communication technology (ICT) as well as the technologies and assets of

NTT and its partners are making it possible to create services that span diverse technical fields. However, before implementing these services, it is necessary to study their implications from several perspectives: protection of personal information and security; assignment of responsibility for future prediction made by and behavioral changes induced by computing systems that integrate cyberspace and the physical space; legal systems; social receptivity; and economic effects. NTT will carefully take these disparate challenges into account and work together with its partners to contribute to a better society using ICT.

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