Intelligent Logistics and Mobility – Intelligent ICT to Optimize the Movement of People and Goods

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Abstract

Few modern industries are immune to the digital transformation (DX) engulfing the world today, and that includes the transportation industry that entails the movement of people (hereinafter referred to as transport) and the movement of goods (hereinafter referred to as logistics). In fact, these fields are poised to experience a momentous transformation as DX revolutionizes operations and technology. As in many fields, this transformation has been accelerated by the novel coronavirus (COVID-19) pandemic, which has compelled the world to transition to a "new normal" in which already extant trends have been pushed to the forefront. In this paper, we introduce representative case studies and technologies that illustrate NEC's efforts to leverage its next-generation digital technology to connect the real world with cyberspace and merge logistics and mobility to assure the safe, smooth, and reliable movement of people and goods. We also discuss how NEC's commitment to achieving these goals reflects its overall approach to realizing an abundant society in which everyone and every industry has equal access to services and opportunities.

1. Business Environment and Related Issues

The wave of digital transformation (DX) is sweeping across industries the world over and the transportation industry that entails the movement of people (hereinafter referred to as transport) and the movement of goods (hereinafter referred to as logistics) is no exception. This change has been accelerated by the COVID-19 pandemic which continues to stalk the planet, forcing changes in mindset and lifestyle as people are urged to adapt to the new normal. The impact of all this on transport and logistics has been nothing short of revolutionary.

Transport has been especially hard hit by the pandemic as people refrain from traveling and shift from commuting to telework, a shift accompanied by dramatic changes in social values in terms of lifestyle, the selection of residence, and the demand for safety during commuting.

In logistics, parcel delivery has been booming with online shopping spurred in part by an increasing number of people working from home. Meanwhile, manufacturing sectors like automotive has been experiencing a downturn in shipping due to stagnant freight volumes, which is forcing manufacturers to reassess their supply chains.

At NEC, we regard logistics as a means of achieving an optimum balance between supply/demand and resources coupled with economic activities. And we expect that a significant change will take place in this very area.

Yet there is something we should not forget. And that is the aggravation of the labor shortage in Japan. The transportation and warehouse industry that supports transport and logistics is very on-site labor intensive. And while the level of services demanded increases, the availability of manpower is decreasing, making it difficult to maintain even current levels of services. If it is to maintain and improve the level of services, while simultaneously promoting work style reform, the transportation and warehouse industry has no choice but to take advantage of the potential of digitalization and participate in industry-transcending co-creation projects.

2. The World Envisioned by NEC

In the post-pandemic world, we can expect the information society to progress ever more rapidly, while technologies such as AI, autonomous driving, and drones also continue to advance exponentially. Busi-

Fig. 1 Future of intelligent logistics and mobility.

nesses that focus on just extending the lifespan of existing infrastructure will soon be left behind as the world fast-forwards into the new age. While remaining closely attuned to the issues impacting people's daily lives and the activities of businesses, you need to find a way to come up with new solutions.

By integrating the real world with cyberspace and merging logistics with mobility, NEC aims to provide digital solutions to ensure the safe and secure movement of people and goods and thereby realize a society in which everyone and every industry has equal access to services and opportunities (**Fig. 1**).

2.1 Transport: Public transport services that facilitate the safe, secure and comfortable movement of people

All modes of transportation such as airplanes, railways, and buses are connected in a seamless web through the use of mobile devices, smart cards, and biometrics, achieving a stress-free mobility environment through Mobility as a Service (MaaS).

We also help achieve upgrading, efficiency improvement, and labor saving in operation and maintenance procedures by utilizing AI and IoT. In other words, we support safe, reliable, and comfortable transport by taking advantage of cutting-edge ICT.

2.2 Logistics: Innovating supply chains through business-to-business (B2B) collaboration to achieve safe, reliable, efficient logistics operations

By collecting information in real time and sharing it across organizations, we are able to help companies better understand the flow of goods through their entire supply chains, which in turn enables them to develop robust, dynamic supply chains that can efficiently adapt to supply-demand fluctuations. Moreover, to cope with labor shortages, AI, IoT, and robots that work harmoniously with humans at logistics sites are deployed to facilitate automation, labor saving, and improved operational efficiency, while ensuring safe and reliable logistics.

2.3 Mobility: Mobility services that support safe and reliable transport of people and goods

Vehicles used for transportation of people and goods are now undergoing DX with implementation of connected and autonomous driving. NEC's cutting-edge networking and AI technologies are facilitating advances in the technological sophistication of these vehicles. We are also accelerating our efforts to offer mobility services across a broad range of industries in collaboration with other stakeholders involved in the mobility field with a view to helping achieve a world in which transportation is consistently safe, reliable, and pleasant.

3. Main Operations, Core Solutions, and Service Platforms

NEC offers the following three solutions to facilitate the movement of people and goods: solutions supporting transport services, logistics solutions supporting the supply chain, and solutions to innovate mobility in both transport and logistics.

3.1 Solutions supporting transport services

In Japan, public transport smart cards have taken root as part of the social infrastructure and are now closely associated with people's lifestyles. From its inception, NEC has been supporting the development of JR East's Suica smart card and we are now deploying our know-how and expertise overseas. We also strive to introduce a system to easily utilize mobile devices and biometrics to seamlessly connect all means of public transport such as airplanes, railways, and buses. In our Fast Travel project, we are developing systems to enable people across the globe to move smoothly through airports, declare electronically, and have their identity verified automatically, then continue to their destinations safely, reliably, and comfortably, and, when they arrive, to be able to check into hotels and go shopping without having to carry a bag or wallet with them.

On the other hand, the existing transportation infrastructure is aging year by year, and it is becoming difficult to secure human resources. At the core of transportation services are the railway commanders and railway equipment maintenance workers who make optimal decisions based on their past experience. NEC uses AI and IoT to model the knowledge in the minds of these experts. By enabling the sharing of information, transfer of skills, and efficient response according to the situation, we are playing a part in resolving the issues facing transportation services.

3.2 Logistics solutions supporting supply chains

The functionality now required for logistics is a way to capture fluctuations of supply and demand and changes in markets and promptly apply that insight to production and sales. At the same time, it is essential to build an accurate logistics system that can ensure delivery of the right products to the right place, at the right time, and in the right quantity.

At NEC, we have years of experience and success in delivering solutions for warehouse management, transportation and delivery management, and import and export management to a variety of fields. Using our AI, IoT, and image recognition technologies, we can build systems to visualize the flow of goods in virtual space. At the same time, while helping innovate logistics sites, we help our customers develop logistics networks that integrate production, sales, and logistics into a well-oiled system where each part works smoothly with the others. In addition, we are well-equipped to manage the anticipated restructuring of supply chains in response to COVID-19. Using our technology, we will help create dynamic supply chains that will achieve optimal supply-demand balance while creating synergy through B2B
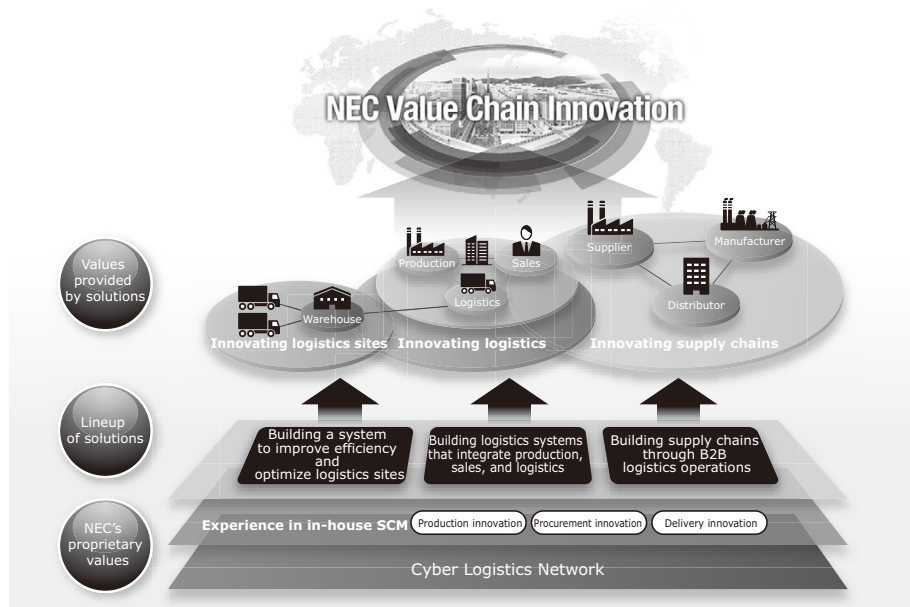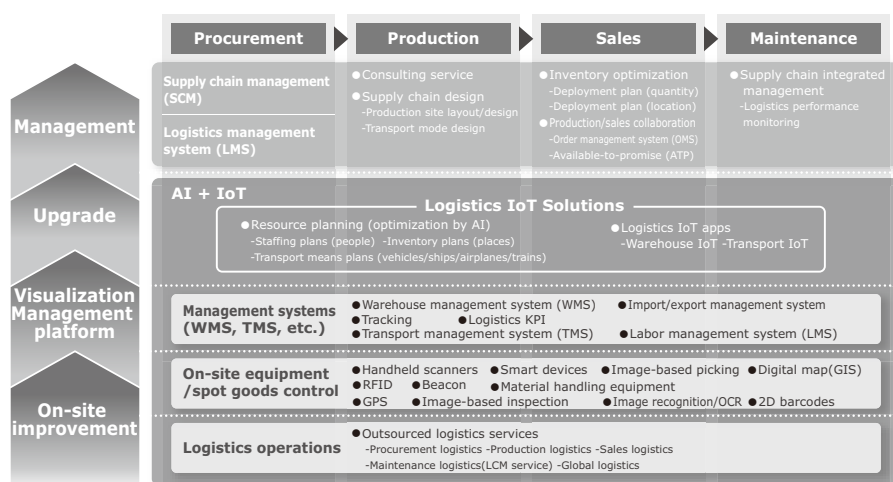

Fig. 2 NEC's solution concept.

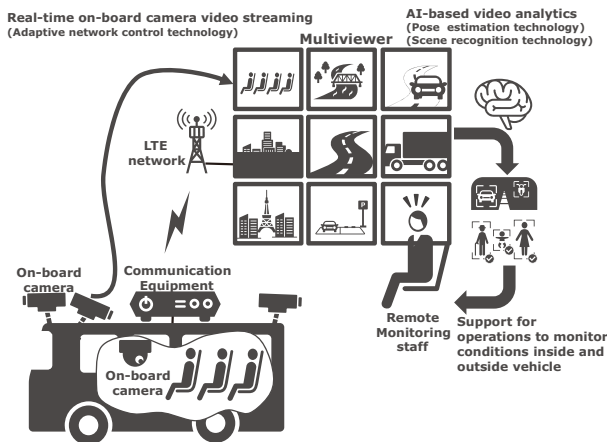Fig. 3 Selectable menus for different purposes and issues.

Fig. 4 Vehicle interior/exterior monitoring solution.

collaboration. In this way, we expect to achieve Value Chain Innovation (VCI) (**Figs. 2 & 3**).

3.3 Solutions to innovate mobility

Implementation of DX in public transport and logistics necessarily involves the connection of various modes of transportation into a seamless network that will ultimately include autonomous self-driving vehicles. The value of vehicles in particular has changed significantly in the past few years, and the structure of the industry itself is poised to undergo a major paradigm shift as evidenced by the development of new transport services by automakers.

In view of this trend, NEC is developing a vehicle interior/exterior monitoring solution (**Fig. 4**) in which AI-based video analytics technology is used to process various incoming data in real time. Through the utilization of AI for monitoring to reduce oversights caused by human error in operation and management tasks and injection of human input for decisions requiring a higher level of expertise, we will support the provision of safe and secure mobility for people and goods.

4. Case Studies

In this section, we review two case studies which exemplify NEC's approach to developing systems that respond to the demands of the new normal with sophisticated systems to visualize the real world.

4.1 Case study – NEC gets ahead of the new normal with trials at headquarters

In addition to seamless connectivity achieved using biometrics, we have begun conducting demonstration

tests at NEC's headquarters building in Tokyo focused on the future of our lives in the new normal (**Fig. 5**). These tests seek to determine both what the potential issues are when services are provided and how to solve them—for example, the application of thermographs and face recognition with masks worn. We also carry out tests to determine the optimum configuration of service platforms and find clues to social implementation of those technologies to transport and logistics services.

4.2 Case study – visualizing supply chains (India)

Now let's take a look at the system deployed to visualize logistics in the Delhi-Mumbai Industrial Corridor Development Project (**Fig. 6**).

Improving logistics infrastructure is a critical component of India's drive to modernize and attract foreign investment. NEC-supplied digital technology is playing a key role in this effort. By attaching RFID tags to the containers to collect location information as the containers

Fig. 5 NEC I:Delight demonstration tests at NEC headquarters.
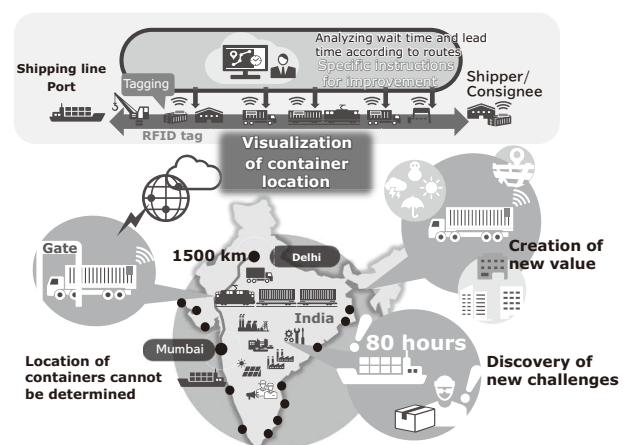

Fig. 6 Logistics visualization for the Delhi-Mumbai Industrial Corridor Development Corporation.
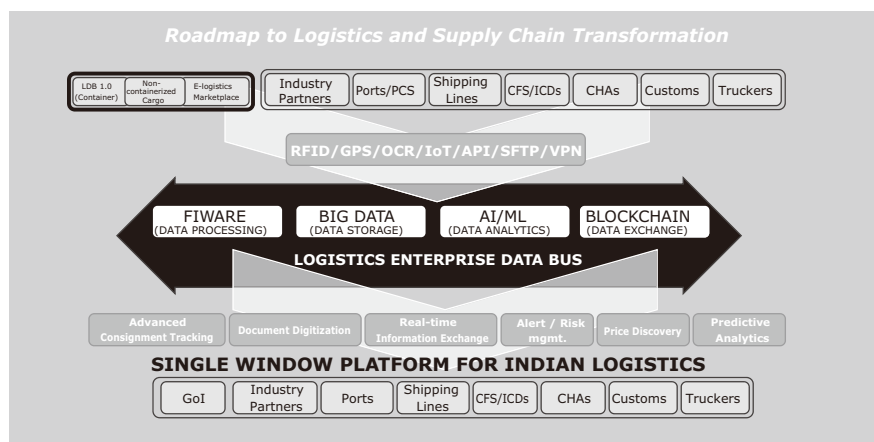
Fig. 7 LDB 2.0 Road Map: Logistics Enterprise Data Bus.

pass the gates, we helped make it possible to visualize container movement and location. As a result, data such as the length of time a container would be held at a port could be digitalized in real time, enabling any stakeholders involved to work towards a solution. This has helped to reduce logistics lead time and optimize inventory as well as to improve production plan accuracy.

Thanks to its initial success, the system is now being deployed throughout India. This was the first step in our efforts to visualize the real world in cyberspace. Since then, we have drawn out the LBD 2.0 Road Map towards the achievement of the Logistics and Supply Chain Transformation (**Fig. 7**). By working together with the people of India to apply these systems to support India's supply chains, we will contribute to the economic development of the country.

5. Core Technologies That Undergird Our Businesses and Solutions

It is not an exaggeration to say that the movement of people and goods is the very lifeblood of the world itself. By converting real world information into usable data that can be analyzed by AI and visualized in cyberspace, DX will make it possible to track and manage the flow of people and goods through the network. By integrating biometrics with AI and networking technology, NEC is playing a leading role in the realization of DX.

5.1 Biometrics – connecting people with services

In November 2019, we announced NEC I:Delight[1], a platform that uses biometrics technologies to streamline various services to ensure a comfortable and effortless experience. This platform allows people to move seam-

lessly through airports, train stations and cities. Our biometrics—which includes powerful face recognition technology ranked number one in the world[2]—not only authenticates individual identity, it does it instantly so there's no waiting and no stress. People can just keep on walking without interruption. Going forward, we are planning to sharpen the system's personal recognition capability by also incorporating iris recognition and more.

5.2 AI technology – converting tacit knowledge into explicit knowledge

NEC owns a wide array of AI technologies that can be adapted to a wide variety of sites. For example, our heterogeneous mixture learning technology can capture and convert the personal knowledge and intuition of experienced traffic control and maintenance personnel who support public transport services and on-site managers who work in logistics services into explicit knowledge that can be used to ensure secure, reliable operations. The system is also able to help understand current conditions in facilities and supply chains and even make predictions by analyzing past chronological data. Our AI technologies also include system invariant analysis technology that monitors those conditions and detects any deviations or anomalies.

This facilitates preventive maintenance and failure symptom detection in transportation infrastructure and can support the transition from periodical maintenance to condition-specific maintenance.

5.3 AI and network technology to achieve safe, reliable transportation

At NEC, we are focused on achieving a network that

uses AI to monitor and predict any changes in conditions, thereby optimizing the operations of the various modes of transportation incorporated in the network.

At a more granular level, video processing performed by AI video analytics technology will provide users with an accurate understanding of conditions both inside and outside of the vehicle. Vehicle operating status and condition can also be tracked in real time using data transmitted from the vehicle via the network, enabling failure symptom detection and facilitating preventive maintenance.

6. Conclusion

By integrating the real world with cyberspace and merging logistics with mobility, NEC aims to provide digital solutions to ensure the safe and secure movement of people and goods and thereby realize a society in which everyone and every industry has equal access to services and opportunities. Furthermore, NEC strives to offer solutions that combine the technologies we have developed over the years to ensure secure, worry-free transport in the age of the new normal, as well as to facilitate the creation of robust supply chains. Going forward, we will continue to participate in industry-academia-government partnerships, as well as work closely with other stakeholders to create new value and bring into being a new and more accessible world of logistics and mobility.

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* Suica is a trademark of East Japan Railway Company.
* LTE is a trademark of European Telecommunications Standards Institute (ETSI).
* All other company names and product names that appear in this paper are trademarks or registered trademarks of their respective companies.

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