

Vertical Services Leveraging Private 5G to Support Industrial DX

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Abstract

NEC provides vertical services that combine industrial applications and networks such as 5G to promote the realization of digital transformation (DX) by improving labor shortages, increasing the efficiency of on-site work in the industrial sector, and other solutions. This paper introduces cases of vertical services using private 5G (dedicated 5G networks in Japan hosted by entities outside the communication service sector is referred to as private 5G in this paper) to support industrial DX as well as NEC CONNECT as an approach to achieve co-creation with partner companies.

Keywords



private 5G, vertical service, open innovation, NEC CONNECT, 5G Lab, IOWN, Beyond 5G, Living Labs, green

1. Introduction

In Japanese industry, digital transformation (DX) using digital technologies such as 5G and AI is becoming more essential than ever before because of social challenges such as labor shortages, skills transfer, and the impact of the novel coronavirus infection (COVID-19). The labor savings, operation reforms, and creation of new values resulting from the use of digital technology are critical, and remote monitoring, remote control, and automation are key drivers in advancing digital transformation

Remote operation and automation as key drivers to reform operations for greater efficiency and labor savings

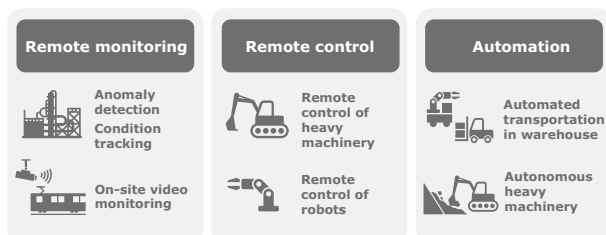


Fig. 1 Key drivers to achieve industrial DX.

in industry (Fig. 1). Private 5G and other networks are expected to play a role in the implementation of these remote control and automation technologies.

NEC offers NEC Smart Connectivity as a brand that supports the realization of industrial digital transformation (DX) that “wisely” connects everything customers need to create new value¹⁾. We have also developed industry-specific DX offerings through which we offer vertical services tailored to our customers’ objectives and environments, combining optimal networks and industry-specific DX

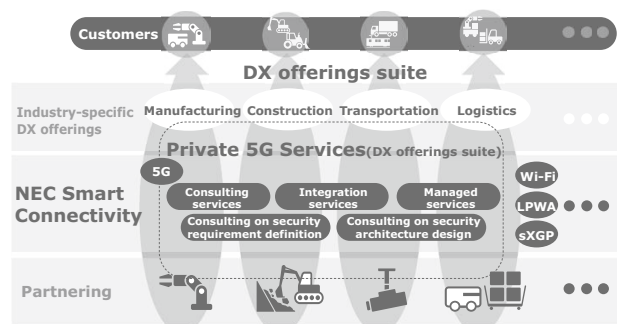


Fig. 2 Positioning of private 5G DX offerings.

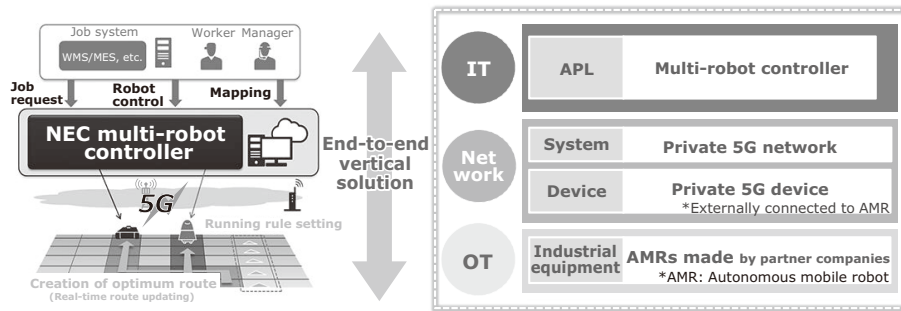


Fig. 3 AGV control solution using private 5G.

offerings with excellent technologies and products from partner companies (Fig. 2). This enables our customers to achieve reliable DX in a short period of time.

This paper introduces vertical services that use network technology to realize industrial DX as well as NEC CONNECT that can accelerate the development of such services.

2. Control Solution for Automated Guide Vehicles Using Private 5G

This section introduces the DX offerings suite, which combines a solution for control of automated guided vehicles (AGV) with a private 5G service as a manufacturing-oriented vertical service.

This DX offerings suite integrates and manages on-site automated guided vehicles (AGVs) and autonomous mobile robots (AMRs) to automate transport tasks, thereby achieving labor and personnel reduction for efficient operations. AGV control solution is already provided as an industry-specific DX offering, and it can also be offered as a DX offerings suite that combines AGV control solution with private 5G services. The AGV control solution using private 5G consists of a multi-robot controller (AGV control software), autonomous mobile robots (AMR) from a partner company, a private 5G network, and a private 5G device (Fig. 3), all provided as a one-stop solution. The multi-robot controller is characterized by its ability to manage AMRs of different vendor types in a single system. Because of the use of private 5G, communications are stabilized with little interference and the communications range is expanded thanks to a handover mechanism. This enables simultaneous control of multiple units and multiple types of AMRs over a wider range in a more stable network than with the use of Wi-Fi, etc. (Fig. 4). Note, however, that the network is not limited to private 5G; compatibility is provided for various other networks including Wi-Fi and sXGP (shared Xtended Global Platform).

The application of AGV control solutions using private

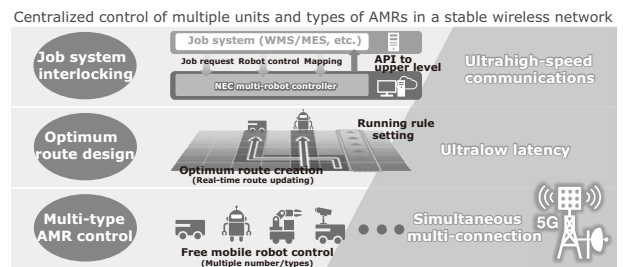


Fig. 4 Features of AGV control solution using private 5G.

5G is being advanced, and a demonstration experiment was performed at the Kofu Plant of NEC Platforms, Ltd. (Kofu, Yamanashi in Japan). We confirmed that AMRs made by different partner companies can be centrally controlled by a multi-robot controller and allowing for the automation of their transport tasks. The knowledge and expertise acquired from this experiment will be used in the future to sequentially expand the system to other domestic factories within the company.

3. Heavy Machinery Remote Control and Autonomous Work Services

This section introduces construction-oriented vertical services including the heavy machinery remote control and autonomous work.

3.1 Heavy machinery remote control service

The heavy machinery remote control service enables operators located remotely to operate heavy machinery in real-time while viewing camera footage installed at the site²⁾. One of the key features is the ability to achieve stable remote operation over an extended period, even in a wireless environment.

This service consists of the heavy machinery itself, actuators installed on the machinery for remote control,

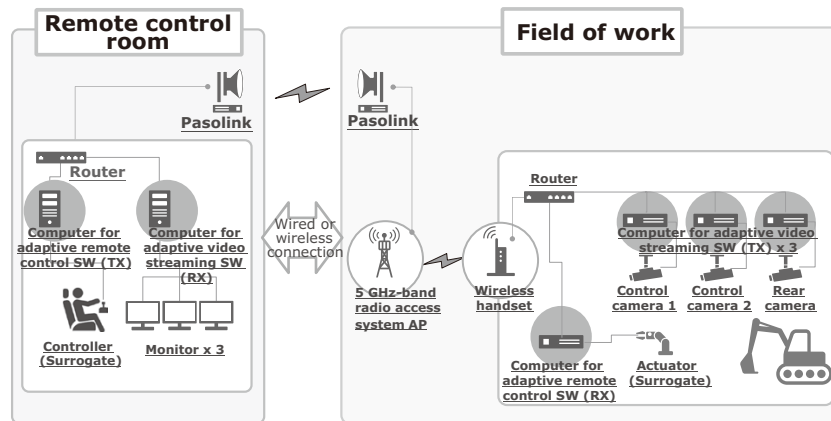


Fig. 5 Example of heavy machinery remote control service configuration.

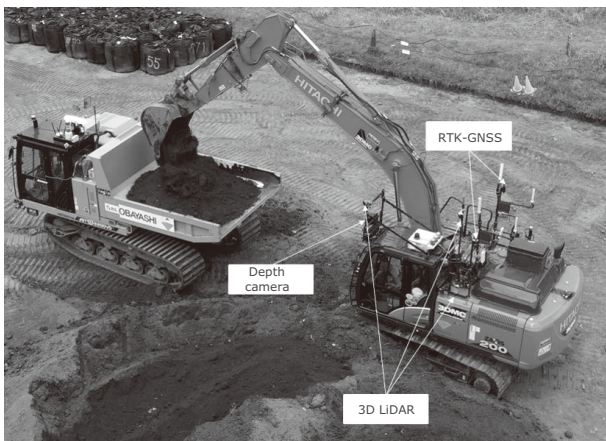


Photo Demonstration in Iitate-mura, Fukushima Prefecture.

a remote control device, a monitor displaying the construction status, and computers for remote control and video streaming (**Fig. 5**). In this case, Pasolink³⁾ is used as the connection between the construction site where the heavy machinery is located and the remote control room, and construction site uses a 5 GHz wireless access system to establish the network. Note, however, that the network within the construction site is not limited to the 5 GHz wireless access system and can be adapted to various networks such as private 5G, LTE, and carrier 5G based on the customer's environment and requirements.

3.2 Autonomous work service

NEC is also developing autonomous construction services to further streamline on-site work and reduce the need for personnel. NEC's autonomous construction ser-

vice features highly precise control of heavy machinery through adaptive predictive control technology and incorporates the concept of cloud robotics. Instead of relying solely on the judgment of individual heavy machinery units, the service utilizes wireless networks to collect on-site data. Based on this data, AI located in a remote control area can comprehensively assess the entire site and provide instructions to the heavy machinery.

As part of our co-creation activities with the construction company Obayashi Corporation, we have improved the autonomous excavator system jointly developed in 2019, expanding its application range to various construction sites, both indoors and outdoors⁴⁾. We applied this to demonstrate the automatic and autonomous operation of construction machinery at a site in Iitate Village, Fukushima Prefecture, and confirmed its practical usability for actual construction work (**Photo**).

3.3 Initiatives for smart factory implementation

As part of leveraging the heavy machinery remote control service, NEC is promoting efforts towards achieving a smart factory that aims at addressing the labor shortage and ensuring a safe and secure working environment of industries besides construction. NEC is also engaged in co-creation activities with Ishizaka Inc., which specializes in recycling industrial waste, with the aim of realizing a smart factory using networks such as private 5G and AI⁵⁾. NEC and Ishizaka are also accelerating co-creation activities for carbon emission reduction as two signatories to The Climate Pledge⁶⁾, which is an initiative launched by Amazon and Global Optimism with a commitment to achieve net-zero carbon emissions by 2040, a decade ahead of the goals set in the Paris Agreement.

4. NEC CONNECT – Open Innovation Initiatives

4.1 NEC CONNECT – Open collaborative space using networks

NEC is actively engaged in business activities with various partner companies, fostering a sense of shared understanding and empathy for the desired societal image outlined in NEC 2030VISION⁷⁾. To realize this vision of the future society, networks play an extremely important role as the foundation for all industries and social activities. Recognizing the essential need for collaborative spaces using networks, NEC established the concept of NEC CONNECT⁸⁾ in June 2022. NEC revolves around the keyword “connect” and focuses on three types of connections: connecting the present and the future, connecting people to people, and connecting ideation with implementation (Fig. 6).

With this collaborative space, NEC aims to create vertical businesses and solutions that contribute to the realization of a shared future by leveraging networks. To achieve this, NEC seeks stakeholders who resonate with the NEC 2030VISION and forms open partnerships. Together, these stakeholders generate business ideas through backcasting from the envisioned future and steadily implementing them in society by verifying technological feasibility and social acceptance. By repeating this cycle, NEC expands the circle of empathy and works towards realizing the desired future.



Fig. 6 NEC CONNECT.

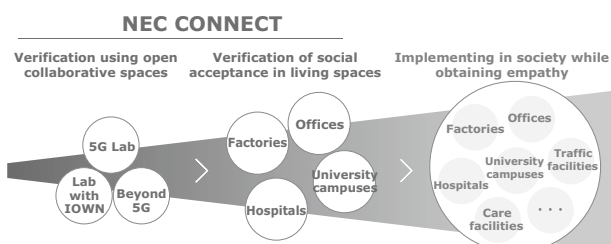


Fig. 7 Efforts toward social implementation.

4.2 Approach for social implementation

Based on the concept of NEC CONNECT, we are currently advancing the development and expansion of collaborative spaces using networks. In addition to the 5G Lab, which utilizes private 5G, we are steadily expanding the collaborative spaces by leveraging next-generation networks such as IOWN and Beyond 5G⁹⁾. Furthermore, we are conducting verifications using the living labs method in various internal locations such as offices, our own factories, and also in places like universities, where verifications are conducted as part of industry-academia co-creation. By advancing the verification of social acceptance in living spaces, we are broadening the opportunities for co-creation to involve external entities (Fig. 7).

5. Conclusion

This paper introduced vertical services using private 5G to support industrial DX, showcasing examples of their utilization. By combining NEC’s accumulated network technologies with industry-specific DX offerings and leveraging the excellent technologies and assets of partner companies, we will accelerate our efforts in creating social values through vertical services.

- * Wi-Fi is a registered trademark of Wi-Fi Alliance.
- * LTE is a registered trademark of European Telecommunications Standards Institute (ETSI).
- * IOWN is a trademark or registered trademark of NTT.
- * 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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