IOWN GLOBAL FORUM™

Recognized PoC Report – Significant Step Forward

CPS Industry Management Remote Controlled Robots Inspection RIM

AUGUST 2026

Contents

1. Introduction

This PoC report focuses on demonstrating the potential of IOWN Global Forum Technologies - particularly an Extra High Frequency (EHF) wireless network integrated with an All-Photonics Network (APN) - to improve safety and operational efficiency in inspection work at chemical manufacturing plants. The Proof-of-Concept (PoC) members in the Cyber Physical System (CPS) Industry Management (IM) team present this study from the perspective of plant operators who are responsible for running chemical plants and are continually required to improve productivity under constrained human resources.

1.1 Goal and Objective

Our goal is to provide an integrated system spanning from the physical layer to the cyber-physical layer using IOWN Global Forum Technologies, thereby enabling chemical plants to maintain stable operations with fewer operators. The IM team anticipates that the adoption of IOWN Global Forum Technologies will follow a trajectory like that of mass transportation systems: initial deployment focuses on foundational infrastructure such as hardware and physical networks, followed by the expansion to software layers that enhance efficiency, safety, and operational optimization. In a similar manner, next-generation high-speed communication is expected to begin with L1–L3 network infrastructure and subsequently extend to devices and application layers.

The objective of this article is to explore the realization of smarter plant inspection by replacing conventional human inspection tasks with sensor-equipped robotic systems. Through this article, the PoC members in the CPS IM team aim to provide insights into a possible future form of industrial inspection enabled by advanced optical and wireless network technologies.

1.2 Challenges and Countermeasures with IOWN Global Forum Technologies

The CPS IM team has identified 3 challenges facing Japan's chemical industry through two years of discussion.

#1 Countermeasures for the declining labor force

#2 Reduction of physical and mental burden on workers

#3 Cost optimization

#1 Countermeasures for the declining labor force

In Japan, due to the declining labor force, ensuring safety and productivity in chemical plants is becoming increasingly difficult. Considering the current recruitment situation and age structure in the chemical industry in Japan, the utilization of ICT is essential for the chemical industry to maintain productivity while addressing labor shortages. The IM team proposes replacing monitoring tasks with robots during nighttime, inclement weather, and intense sunlight. Human operators are dispatched only when anomalies are detected, which improves productivity and reduces the physical strain of human operators.

#2 Reduction of physical and mental burden on workers

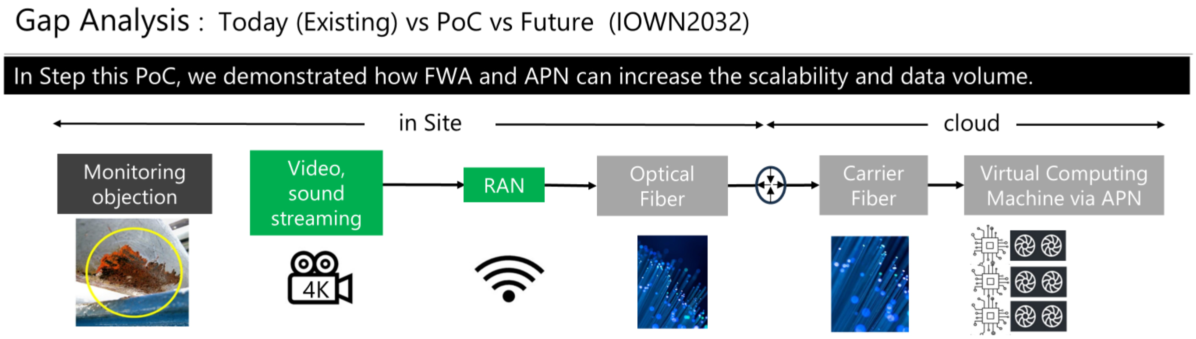
In the case of Mitsubishi Chemical Corporation, approximately half of the sensors within the plant are connected to the on-premises server and update data at a designated frequency, while the remaining half are not connected to the server, requiring personnel to manually inspect the sensors during patrols. Plant monitoring work requires operators to determine whether a meter is within the standard range or not within 5-10 seconds while walking several kilometers throughout a chemical plant. This imposes both mental and physical burdens on the operators.

By sharing data through 3D images, it is possible to reduce maintenance reporting work and prevent oversight through verification by third parties. The main sources of information acquired by operators include video, audio, tactile sensations (vibration, heat), and smells (gas concentration sensors), but we first confirmed whether it is possible to detect abnormalities using video and audio. Services that convert chemical plants into 3D images are general-purpose, but the IM team aims to demonstrate the differences between these existing data services and services using IOWN Global Forum Technologies.

#3 Cost optimization

In this PoC, "cost" refers to the configuration and transition costs associated with switching from conventional maintenance systems to various alternative solutions in chemical plant maintenance. The IM team recognizes that it is becoming increasingly difficult to continue using conventional systems due to the declining workforce. Manufacturers who have chemical plants need to check some costs to maintain production. The PoC members in the IM team aim to demonstrate that IOWN Global Forum Technologies can perform plant maintenance with fewer operators while maintaining high productivity and safety in this article.

To switch from conventional operating systems to a new system, it is necessary to improve the efficiency of plant maintenance operations by more than threefold. This work efficiency rate is expected to provide a strong incentive for transition, even if the introduction of the new system incurs costs. Improvement of 10% to 30% is not sufficient to drive change. The automated data collection by remotely operated robots is expected to generate a large volume of data. It is necessary to develop devices, including robots and application software, but also the expansion of data pipelines. This article focuses on the data pipeline from robots equipped with numerous sensors within a chemical plant and verifies whether wireless communication and APN connections are functioning properly.



Scenarios	Video(Live streaming)	RAN (Plant)	Optical fiber (in Plant)	Optical fiber (Out of plant)	Computing
Today 2026	3camerasx50Mbps =150Mbps	UL10Mbps @2.4GHz	Unused 200Mbps	2Gbps	Single Modal in the site
PoC	10camerasx50Mbps =500Mbps	UL900Mbps @60GHz+Wi-Fi6	2 Gbps	100Gbps (APN, private)	Single Modal on Cloud
Future IOWN2032	18camerasx50Mbps =900Mbps	UL900Mbps @60GHz	10-30Gbps	50-100Gbps (APN, public)	Multi Modal at DCIs

Figure 1-1: Gap Analysis

For your reference, we have attached a table in Figure 1-1. It shows the gap in data transmission among communication infrastructure deployments. We can see that the existing status of network data volume around a chemical plant is too small to use APN data volume; especially, RAN is expected to be improved if we use numerous sensors in a chemical plant.

1.3 Current Status in a Chemical Plant

The IM team recognizes that automated data collection even part of the plant inspection work will reduce the burden on human operators. If we suppose a chemical plant has 6,000–10,000 sensors in a plant, 50% are connected into a server on-premises, the plant status data flows into servers on the LAN. The other 50% of sensors need to be checked by human operators every 8 hours even on rainy days during cold winters or hot, humid Japanese summers. In existing plant maintenance, operators use their work experience to determine whether facility’s status is normal or abnormal and predict fatigue failure and determine replacement times. If similar situations occurred in the past, the risk could be reduced and relieve the pressure of operators making mistakes since maintenance records could be converted into explicit knowledge in a database.

When patrolling a chemical plant, there are many places where the robot must navigate around stairs and piping, so it is important to consider that the area in which the robot can move is limited. Considering existing wireless environments evaluated in this study, 4K video transmission was limited to 2 (two) devices per cell, but deploying 60GHz band network devices has increased the number of video cameras per cell.

The attached table below is a projected transition in sensor deployment and inspection practices from 2026 to 2032, assuming the introduction of IOWN-enabled Industry Management.

Table 1-1: Projected Changes in Sensor Deployment with IOWN Adoption (2026–2032)

		Existing 2026	IOWN IM 2032	Change (2026-2032)	Change % (2026-2033)
Connected sensors	Wired	4,000	4,000	0	0%
	Wireless	1000	1,000	0	0%
Disconnected sensors	Human operators	**5,000**	**4,000**	-1,000	-20%
	deployed on robots		**1,000**	1,000	20%
Deplyoed sensors	Total	**10,000**	10,000	0	

While the total number of deployed sensors remains unchanged, the composition of how sensor data is collected and handled shifts significantly.

In particular, the number of sensors requiring manual inspection by human operators is reduced by approximately 1,000, corresponding to a 20% decrease, as a portion of these disconnected sensors is replaced by sensors deployed on mobile robots. At the same time, the number of wireless-connected sensors increases, reflecting improvements in high-capacity and low-latency wireless communication enabled by IOWN Global Forum Technologies.

This transition indicates a clear direction of the use case: reducing the physical and cognitive workload of human operators engaged in routine patrol and inspection tasks, while maintaining the same level of plant-wide sensing coverage. By shifting inspection activities from human operators to robots and connected sensors, IOWN IM is expected to contribute to safer operations, improved efficiency, and more sustainable plant maintenance under conditions of labor shortage.

2. PoC Overview

2.1 PoC Overview

The IM team has been exploring solutions to address the three challenges in chemical plants. To meet the specific needs of the chemical industry, we have conducted PoC for the following two use cases. Both use cases require large-capacity and secure data paths to replace human inspection based on visual and audio information, which generate significantly larger data volumes than text or processed signal features (e.g., FFT-derived frequency characteristics).

The IM team proposes the following countermeasures to address the 3 challenges described above: declining labor force, reduction of physical and mental burdens on workers, and cost optimization.

UC1: **Disaggregated Computing–Based Crack Detection and 3D State Mapping**
Robotic equipment inspection uses external computing resources to replace human tasks and enable equipment status assessment and information sharing across multiple locations.
In this PoC, the video captured by 3 or more cameras at 4 K/30fps-60fps was transferred to the remote data center with less than 500 ms delay and with a frame-drop rate of less than 0.1%. Those results satisfied the criteria as specified [PoC Reference: Industry management Remote Controlled Robotics Inspection Use case].

Furthermore, these video streams and AI analysis results were integrated and visualized on a 3D map, enabling intuitive verification. This result indicates that operators can instantly identify where cracks have been detected even from remote locations.

In addition, a crack with a width of 0.1 mm was detected by AI analysis.
This result suggests the possibility that robots can perform maintenance work instead of humans. It is expected to enable real-time transmission of site video to a data center, where analysis results can be remotely monitored and validated with minimal human intervention.

UC2: **Anomalies Detection by Using Sound Data and Video Data from Deployed Robots**
We confirmed that anomaly detection and damage prediction can be achieved by assessing equipment conditions beyond human cognitive capabilities, such as measuring pipe vibration frequency and amplitude through video processing. Also, we confirmed that robots can autonomously travel long distances in chemical plants without operator assistance. In addition, we confirmed that functions for remote control can be used in the robot and functions for the remote operators can be used in remote PC. We evaluated whether abnormal vibrations occurred, which might be a factor in piping fatigue failure, can be detected using a smartphone instead of the conventional dedicated camera with a high-speed shutter. We could confirm the versatility and improved mobility.

Additionally, in building the communication environment, the PoC verified that a broadband wireless network could be deployed within a single day under the PoC conditions, achieving a main-line uplink capacity of approximately 1 Gbps.

Furthermore, regarding APN deployment, we will demonstrate that it can be deployed using existing infrastructure, thereby ensuring that the deployment of new wireless and wired technologies in the plant can be carried out without causing any plant production shutdown.

2.2 Key Features for this PoC in a Chemical Plant

We are focusing on monitoring operations in chemical plants with fewer operators by remote-controlled robots. To cover human operations, the IM team added the following 4 elements.

- **Inspection objectives:** We focus on cracks on the structural part and pipe anomaly vibration which leads to facility troubles if cameras mounted on a robot could detect them.
- **Connected robots**: They are equipped with multiple sensors to collect heterogeneous data and get outcomes of high inference accuracy by an external computing infrastructure.
- **Fixed Wireless Access (FWA) and APN**: Establishing a communication network that connects mobile robots and the Data Center via APN devices, enabling high-speed data transmission.
- **Data center**: To conserve battery power on robots, we propose using data center infrastructure to recognize plant conditions and predict appropriate replacement timing when anomalies occur and predict appropriate parts replacement time.

3. Supported Use Cases

We will introduce details of two use cases on the application of smart maintenance in chemical plants.

3.1 Details of UC1 Disaggregated Computing–Based Crack Detection and 3D State Mapping Overview

As shown in Figure 3-1, remote inspection can be implemented to provide real-time understanding of on-site conditions, rather than relying on offline confirmation.
Video streams of the inspection targets are captured by multiple cameras mounted on robots located at the plant site.
The captured video is transmitted to the APN via a wireless network.
The video streams are then transferred through the APN to the remote operation site, where the images are analyzed to detect abnormalities.
Remote operators can use a presentation device to view the inspection targets and verify the anomaly detection results on a 3D map.
Furthermore, remote operators can control the robots remotely using a control interface device to closely inspect the targets.

Key requirements
To ensure smooth operation, a maintenance operator needs to transmit multiple 4K video streams with a latency of 500 ms or less, analyze them, and reflect the results in a 3D map.
In addition, image stability is required to inspect all areas without any video dropouts.

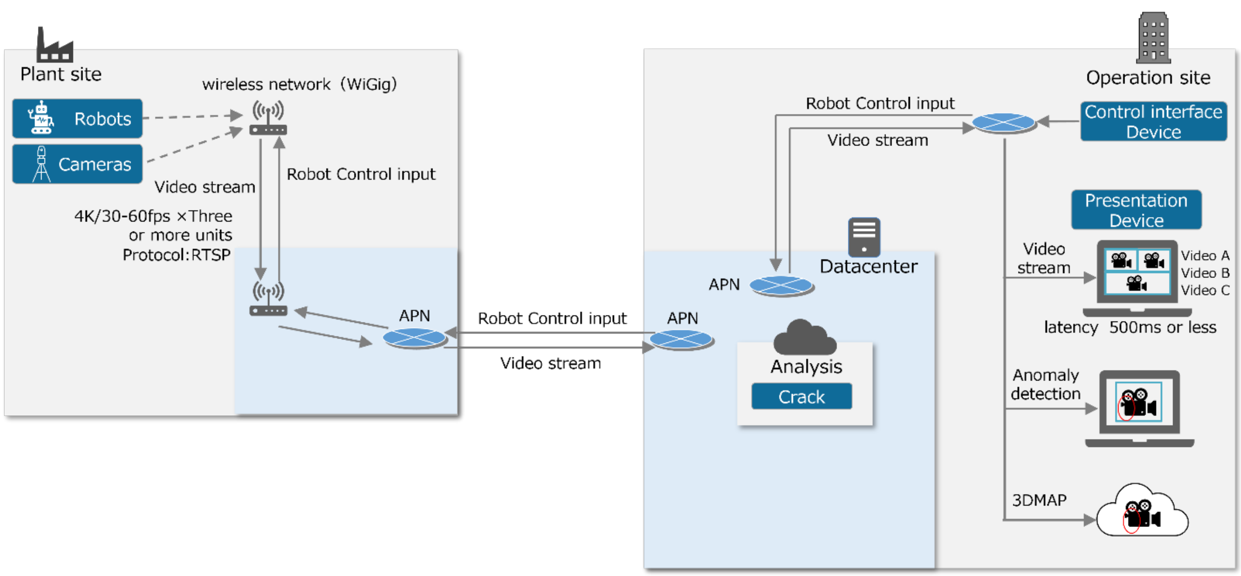


Figure 3-1: System Overview of Real-Time AI Anomaly Detection Using Remote Robotic Control

3.2 Details of UC2 Anomalies Detection by Using Sound Data and Video Data from Deployed Robots in a Chemical Plant

The PoC members aim to enable fully automated plant inspections using robots with NTT DATA technologies. To reduce the burden of equipment inspections on workers and increase productivity, robots and AI will detect abnormalities with high precision and automate inspection work. By integrating with core systems and exchanging data, we will create synergistic effects for core operations and inspection work.

Initial analysis, such as determining the presence of abnormalities, will be performed by robots. When a robot determines an abnormality, it will send the relevant data to the platform for detailed analysis and human confirmation. Functions common to various robots will be modularized and stored on the platform for retrieval by robots.

The team verified the accuracy of applications (image analysis) through IOWN and individual verification in PoC1 in 2024. We collect multiple sensor information from autonomous mobile robots and analyze the presence of abnormalities on the platform in a multi-modal manner in PoC2 in 2026.

The results of both PoC 1 and PoC 2 are reported in this PoC Report.

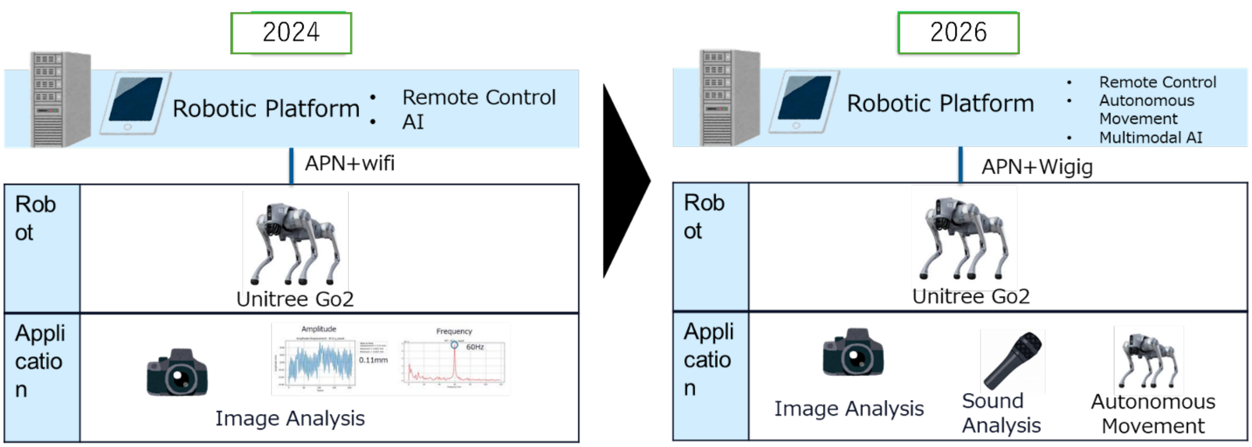


Figure 3-2: PoC Configuration Overview

Overview
Remote control of the robot is performed between Okayama and Tokyo over a network using an APN. The camera image of the robot is live-streamed to a human in Tokyo, and it is confirmed that the robot can be operated safely within the facility while viewing live video. In addition, verification related to autonomous movement and verification of applications such as reading measuring instruments are also carried out as independent verification.

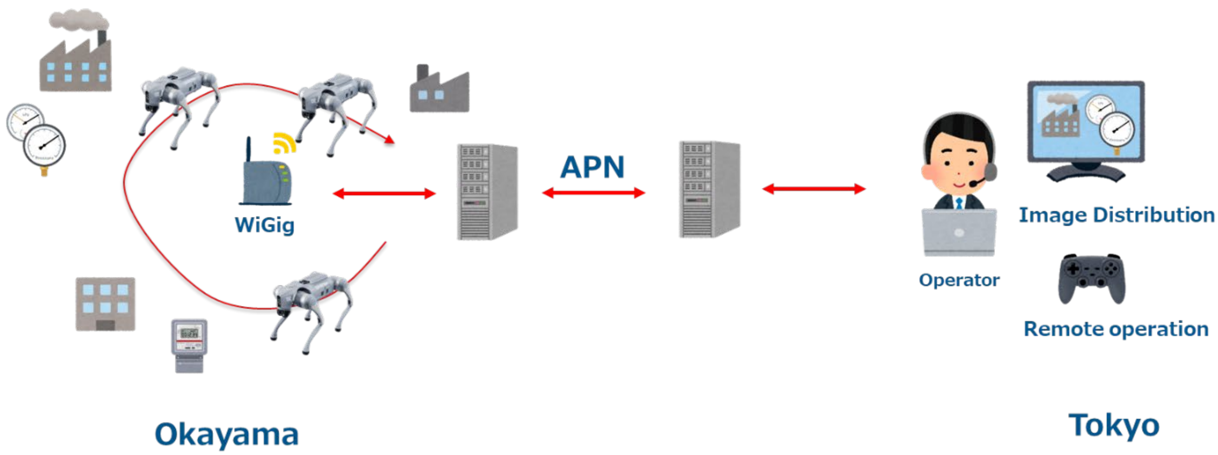


Figure 3-3: System Overview of Remote Control between Okayama and Tokyo

In the verification of the robot's autonomous driving function, we make sure that the preliminary preparation, the robot's autonomous driving (data collection), and the platform's analysis work together.

Preliminary preparation uses the robot's sensors to create a 2D map of the factory in advance. A human controls the robot and creates a 2D map of the factory from the robot's camera images and LiDAR. A human specifies the shooting points and the robot's posture (orientation) at the shooting points on the factory map. A human plans a route from the robot's current location so that the robot passes the predetermined shooting points.

In autonomous movement, the robot moves autonomously to inspect piping. The robot starts in the ON state. A human informs the robot of the start of inspection through the platform. The robot runs autonomously according to the planned route while correcting its own position and route with Simultaneous Localization and Mapping (SLAM). The robot records video at each inspection point. One marker is attached to each pipe. The position of the robot (the direction of the pipe) is determined at each shooting point. SLAM determines that the robot has arrived at the shooting point. The robot adjusts its position at the inspection point. The robot saves 5 seconds of video and audio and sends them to the platform. The robot collects sound using a microphone on the spot and sends it to the platform. The robot moves to the next shooting spot.

The platform analyzes information from the robot. The platform receives video and audio from the robot and saves them to the platform. The platform analyzes video and audio with AI and analyzes the amplitude and frequency of markers on pipes and the amplitude and frequency of sounds on pipes. The platform determines whether piping abnormalities are present based on the analysis results and the manual. The platform displays the analysis results and the presence or absence of abnormalities on the console for humans.

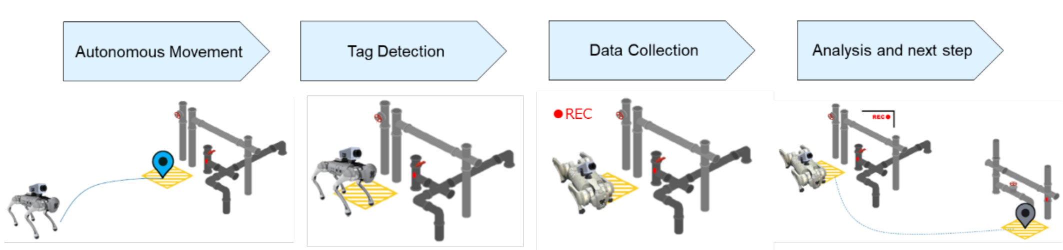


Figure 3-4: Flow Overview of Autonomous Movement.

Key requirements

To remotely control a robot, the delay time of a video of a certain quality using the robot's camera must be at least 500 ms or less.

To drive a robot autonomously, the robot must be able to recognize the surrounding environment and perform self-position estimation and navigation using SLAM without problems.

In the analysis by AI, it is necessary to analyze the amplitude and frequency of pipe vibration from the image as set, and to detect the occurrence of abnormal noise from the sound.

4. PoC System Configuration and Implementation

4.1 System Configuration and Implementation of UC1 Disaggregated Computing–Based Crack Detection and 3D State Mapping

4.1.1 System configuration of UC1

In Use Case 1, as illustrated in Figure 4-1, the image taken by the camera which is mounted on the robot is transmitted by the RTSP server.
The RTSP server transmits the image by 60Ghz millimeter wave to the APN equipment and then sends it to the remote location by APN.
The AI server in the data center analyzes the images and detects crack abnormalities.
The results are sent to the operator site, where maintenance personnel review them using the Presentation Device.
The remote control of the robot sends the command signal from the Control Interface Device in the operator base, and the robot at the plant site receives it and operates.

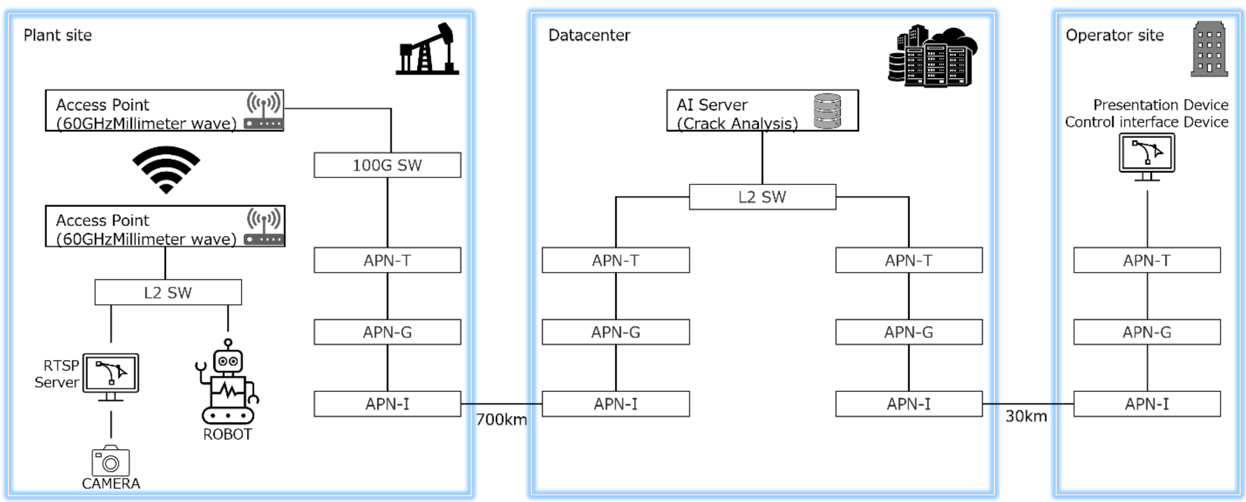


Figure 4-1: Basic Configuration

4.1.2 PoC implementation of UC1

In Use Case 1, the following products and communication standards are used to implement the configuration shown in Figure 4-1.
NTT Laboratories has developed a terminal-driven dynamic site diversity control technology. This technology is utilized to realize stable communications for mobile terminals.
In terminal-driven dynamic site diversity control technology, multiple wireless antennas are mounted on the robot on the terminal side, and the system connects antennas to different access points whenever possible. Furthermore, the communication quality of each wireless antenna is monitored, and the communication path is instantly switched to use the wireless antenna with the best quality. This helps avoid communication interruptions and improves communication stability even in environments where the terminal is moving.

NTT Laboratories' technology can solve the following problems. We selected WiGig as a 60Ghz millimeter wave wireless technology.
・Conventionally, since WiGig is not designed for mobile communications, access-point switching does not occur immediately, resulting in transmission speed degradation and communication interruption. Furthermore, smooth remote operation of robots deployed within a chemical plant from a remote site, as well as the transmission of camera images acquired by those robots, is required.
To achieve this, APN technology providing a high-capacity, low-latency communication environment is indispensable.

In this PoC, these requirements were realized through services provided by NTT DOCOMO Business.

Table 4-1: Hardware and Software List for PoC (UC1)

Components	Products / Standards
Robot	HSR Outdoor
AI Analysis	Deeptector®
Access Point	WiGig (Seamless Handover with Site Diversity Technique)
Messaging System	Mosquitto
Generator Presentation Device / Control interface Device	4DVIZ
APN-T	1Finity Ultra Optical System T300, T250
APN-I/G	1Finity Ultra Optical System L100, L110
APN	docomo Business APN Plus powered by IOWN®

4.2 System Configuration and Implementation of UC2 Anomalies Detection by Using Sound Data and Video Data from Deployed Robots in a Chemical Plant

4.2.1 System configuration of UC2

The outline of the network is the same as that of UC1. Only the differences from UC1 are described here.

Table 4-2: Overview of Key Technologies for Robotics and Video Streaming

ROS2 (Robot Operating System 2)	ROS2 is a middleware framework for building robot systems. It helps different software components (nodes) communicate with each other.
RTSP (Real Time Streaming Protocol)	RTSP is a protocol used to stream video and audio over a network. It is commonly used for IP cameras and live video feeds.
OpenCV	OpenCV is a library for computer vision and image processing. It allows you to analyze images and videos, such as detecting objects or faces.
GStreamer	GStreamer is a framework for building multimedia pipelines. It is used to process, encode, decode, and stream audio and video.
MediaMTX (formerly rtsp-simple-server)	MediaMTX is a lightweight media server for streaming video and audio. It can receive and distribute streams using protocols like RTSP, RTMP, and WebRTC.
WebRTC (Web Real-Time Communication)	WebRTC is technology for real-time communication in browsers. It enables low-latency video, audio, and data streaming without plugins.
Foxglove	Foxglove Studio is a visualization tool for robotics data. It allows you to view, debug, and analyze data from robot systems such as ROS/ROS2 in real time.

4.2.1.1 Sending and receiving messages

Raw video data from a ROS2 node is converted to RTSP by OpenCV and Gstreamer using Jetson's hardware encoder, and the video is delivered to a browser on a PC through MediaMTX using WebRTC.

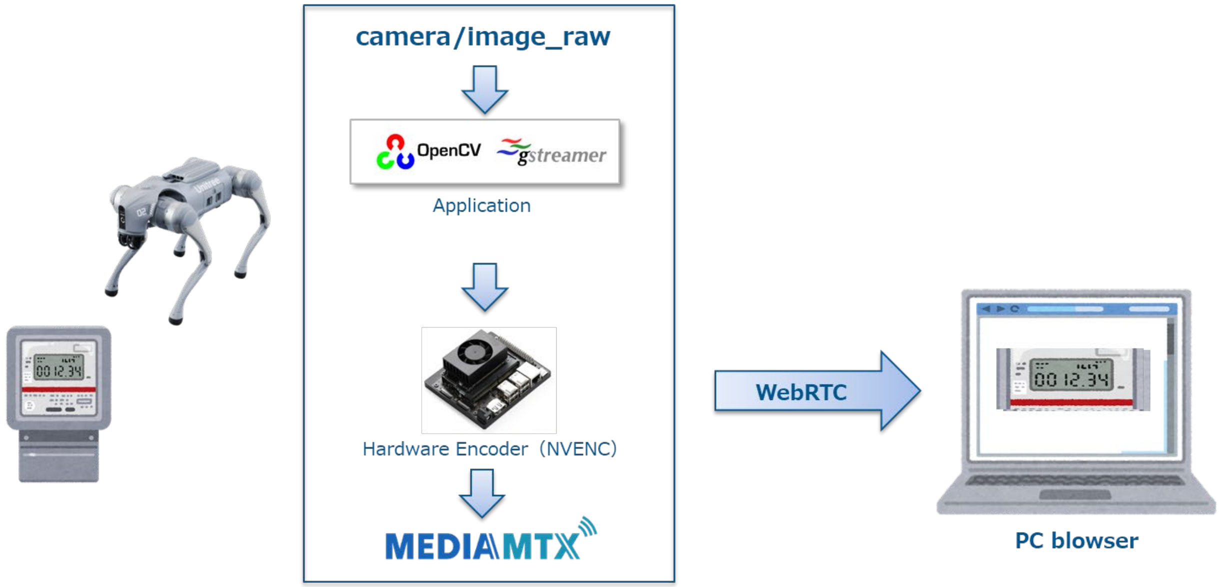


Figure 4-2: Sending and Receiving Messages

4.2.1.2 Remote operation

The game controller is configured for the Teleoperation tab in Foxglove Studio and remotely controls the Unitree Go2 by sending the/cmd_vel topic via WebSocket from the PC.

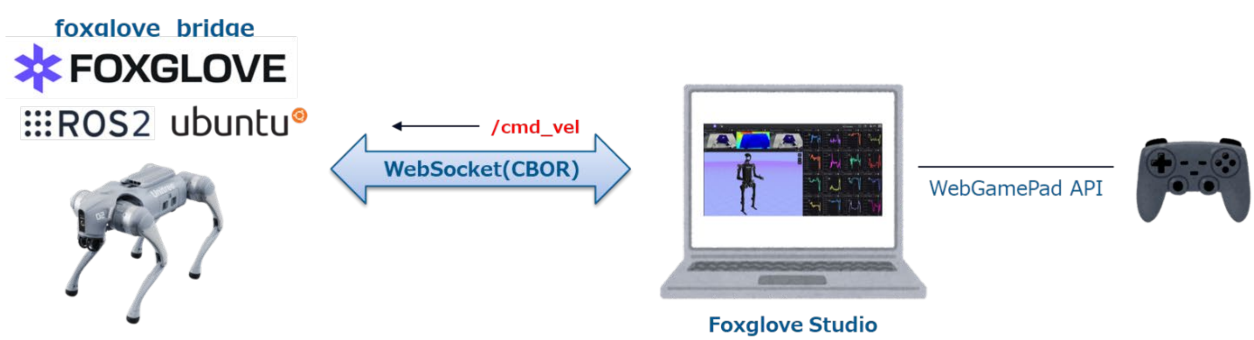


Figure 4-3: Remote Operation

4.2.1.3 Collection of images and sound data

To execute a specific program on the Unitree Go2 from a remote-control PC, send a std_srvs/srv/Trigger request to Foxglove Studio's Call service, and execute a specific script (Start of missions, start of video and audio collection, etc.) depending on the content of the received request in UnitreeGo2.

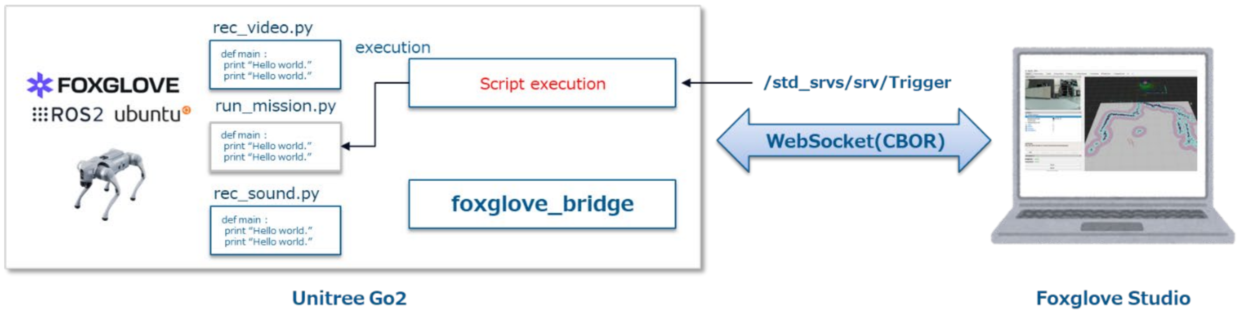


Figure 4-4: Data Collection

4.2.1.4 Autonomous movement

The /goal_pose topic sent by Foxglove (normally used for navigation commands to Nav2) is recorded by the Waypoint recorder, saved as waypoints.yaml, and loaded into the navigation executor to implement WaypointsNavigation. The navigation executor uses nav2_simple_commander to move to a specified location, confirm completion of the movement and execute follow-on tasks.

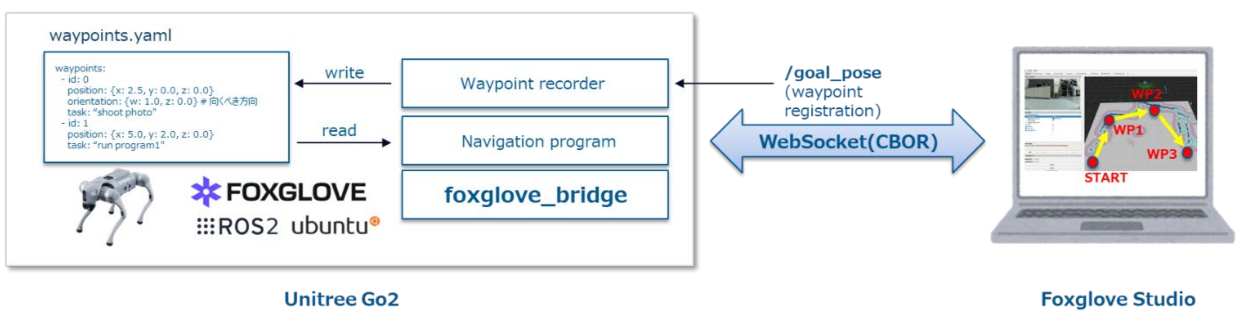


Figure 4-5: Autonomous Movement

Table 4-3: Hardware and Software List for PoC (UC1)

Components	Products / Standards
Robot	Unitree Go2
AI Analysis	NTTDATA's product
Access Point	Same as UC1
Messaging System	WebRTC
Generator Presentation Device / Control interface Device	Same as UC1
APN-T	Same as UC1
APN-I/G	Same as UC1
APN	Same as UC1

5. UC Technical Report

5.1 Technical Report of UC 1: Disaggregated Computing–Based Crack Detection and 3D State Mapping

5.1.1 Purpose of UC 1

This UC1 is related to STEP1 and STEP2 of the use case document [RCRI Use Case]. In other words, using video images from multiple cameras, it is possible to observe detailed conditions and possible equipment malfunctions in real time from a remote location. In this verification, we conducted tests in an actual plant to confirm whether robots can remotely patrol the plant and potentially replace operators' on-site work.

In this UC1, a wireless network is used for terminal connections for remote robot operation and camera image transmission. It is desirable to use appropriate wireless technology suitable for this UC1. In the verification, we measured using two types: Wi-Fi and WiGig. Based on the results, WiGig was used in the verification of the actual plant.

We examined the feasibility of the following key requirements (benchmark models) and functions described in the PoC document [RCRI Use Case RIM PoC Ref].

・It must be possible to transmit 3 or more images at 4 K, 30-60FPS.

・Latency of video streams must be 500 ms or less.

・Frame drop rate must be 0.1% or less.

In addition, the benchmark items include total system data rates and AI-based defect detection. However, the PoC reference does not define clear objectives, so we measured additional metrics to complement the existing benchmarks. We believe that this value will be the basic value for future PoC.

5.1.2 Scenario of UC 1

PoC participants will report on the results of their PoC using data from four tests to demonstrate the value of IOWN Global Forum Technologies in helping improve productivity and safety in chemical plants.

5.1.2.1 Scenario 1: September 2024, indoor test in Odaiba Wi-Fi/WiGig + APN

In Scenario 1, verification was conducted in an indoor lab. The APN distance was 60 km. The camera image was sent to the AI server 60 km away. The crack analysis result was then returned and displayed on the 3DMAP.
For remote robot operation, the command signal was sent once to Gotanda 60 km away, and the robot received the command back.

For wireless networks, Wi-Fi and WiGig were compared and verified.
The verification distance of the wireless network was several meters.

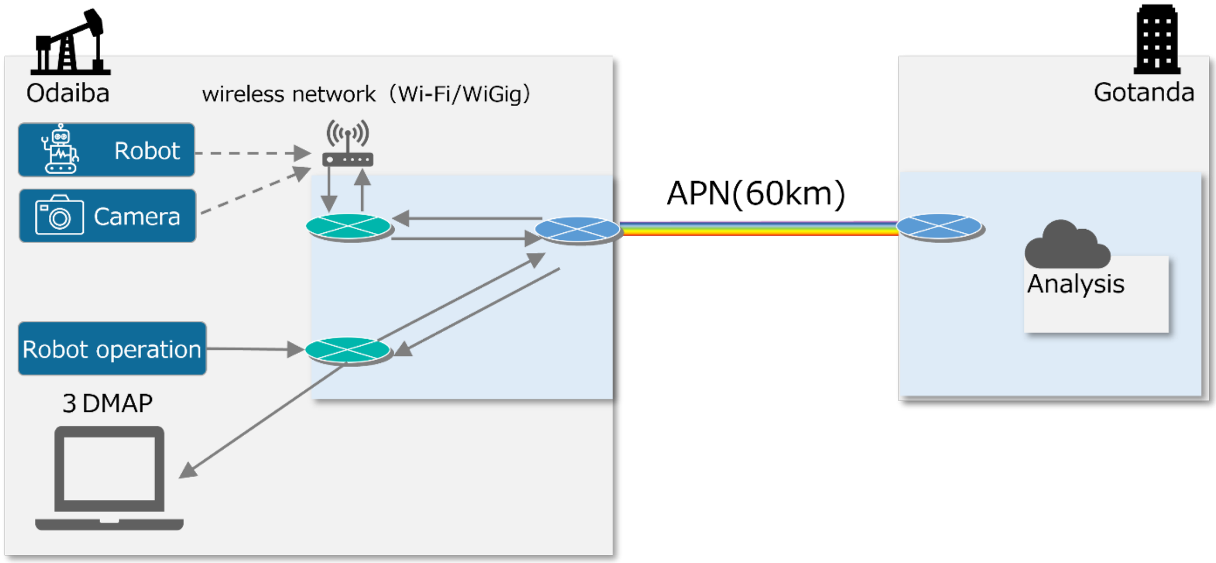


Figure 5-1: Structure of the Odaiba Verification

5.1.2.2 Scenario 2: April 2025, outdoor test in Sengawa Wi-Fi/WiGig + APN

In Scenario 2, verification was conducted outdoors. The APN was several meters long because it was configured locally.
Since the main purpose of this verification was to verify the wireless network, remote robot operation and AI analysis were not conducted.
As for the wireless network, Wi-Fi and WiGig were compared and verified.
Wireless network distances were measured at multiple points and verified at a maximum of 240 meters.

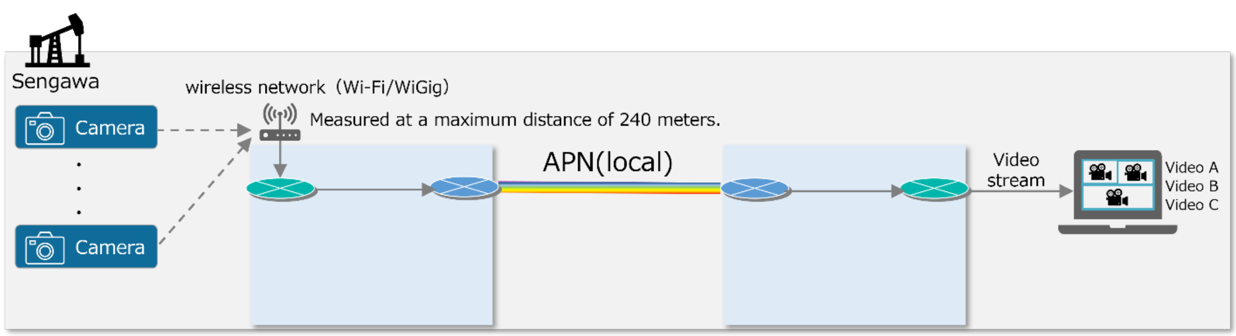


Figure 5-2: Structure of the Sengawa Verification 1

5.1.2.3 Scenario 3: July 2025, outdoor test in Sengawa WiGig + APN

Scenario three was tested with the same configuration as Scenario 2.
In Scenario 2, it was determined that WiGig was more suitable for UC1, so only WiGig was tested. The comparison results between Wi-Fi and WiGig are described in Section 5.1.4.2.
As an additional evaluation item compared to Scenario 2, NTT Laboratories' Seamless Handover with Site Diversity Technique was used to address WiGig issues, which were explained in 4.1.2.

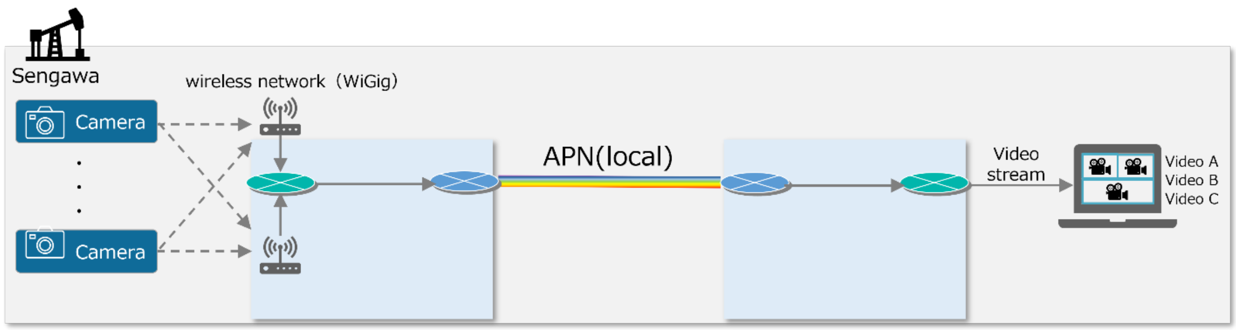


Figure 5-3: Structure of the Sengawa Verification 2

5.1.2.4 Scenario 4: February 2026, outdoor test in a chemical plant in Okayama WiGig + APN

In Scenario 4, verification was performed at an actual factory. The APN distance was 700 km. The camera image was sent to the AI server 700 km away, and the crack analysis result was displayed on 3DMAP.
Remote robot operation sent command signals from the Tokyo side to the robot in the factory.
The wireless network verification distance is 2 km.

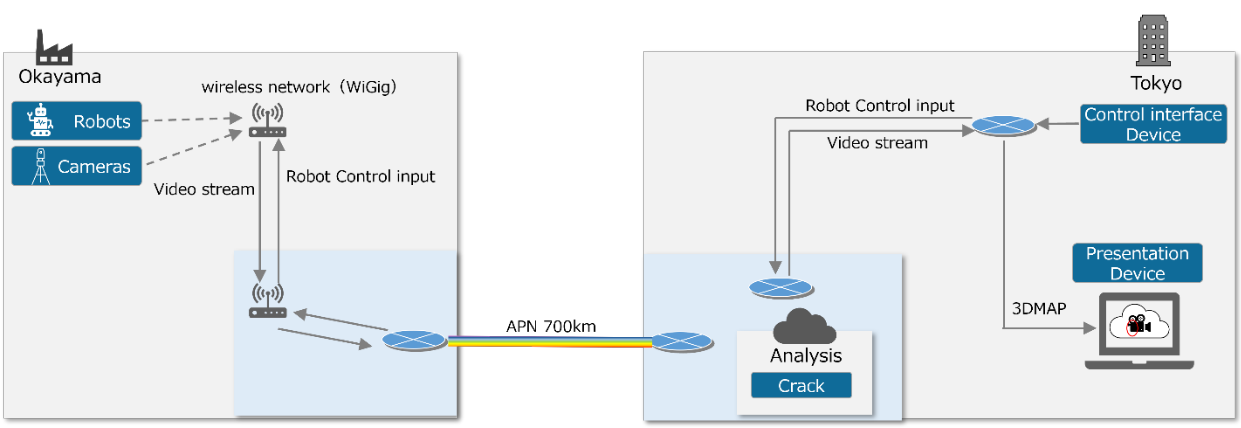


Figure 5-4: Structure of the Okayama Verification

5.1.3 Measurement method of UC 1

The measurement method was the same for all scenarios.

① Confirmation of network delay by ping

② Confirmation of network bandwidth by iperf

③ Confirmation of video delay by multiple video transmissions

④ Confirmation of crack analysis from video (Only Scenarios 1 and 4 were implemented.)

① and ③ confirmed the practicality of remote robot operation. ② confirmed whether a large amount of data could be transmitted. ④ confirmed whether abnormality detection could be performed at a level equal to or higher than that of humans.

5.1.4 Evaluation of UC 1

5.1.4.1 Scenario 1: September 2024, indoor test in Odaiba Wi-Fi/WiGig + APN

Remote operators can detect anomalies while meeting the benchmark requirements defined in the PoC reference document.
Baseline values can be derived for cases where no specific requirements are defined.

Table 5-1: Results of Scenario1

	PoC implementation results
Total System data rates	・Data rates: 930Mbps out of a maximum of 1Gbps for wireless video transmission
Specifications of video	・Resolution, frame rate: 4K, 30~60 FPS ・Encoding: H264 ・Bit Rate: 30Mbps per video ・Number of streams: 3 cameras
Latency of video streams	・Delay: 440 ms (WiGig), 540 ms (Wi-Fi)
Stability of video transmission	・Frame drop rate: 0%
Defect detection AI	・Accuracy: The crack detection rate exceeds 90% ・Detection delay: 600 ms from image shooting to crack detection
Operational evaluation	・Reflection of crack-detection locations: Approximately 1 second from image shooting to digital twin reflection of the crack, and plotting detected crack locations (In this verification, the error was within 40 cm, which did not affect the operation). ・Distance between camera and object: 30 cm (camera lens with equal magnification) 65 cm (camera lens with 2 × magnification)

WiGig test: Comparison between WiGig and Wi-Fi
Measurements were taken at 10 locations, as shown in Figure 5-5.
・The measurement locations were 1~4 inside the same room, 5~8 outside the room, 9 and 10 in another room.

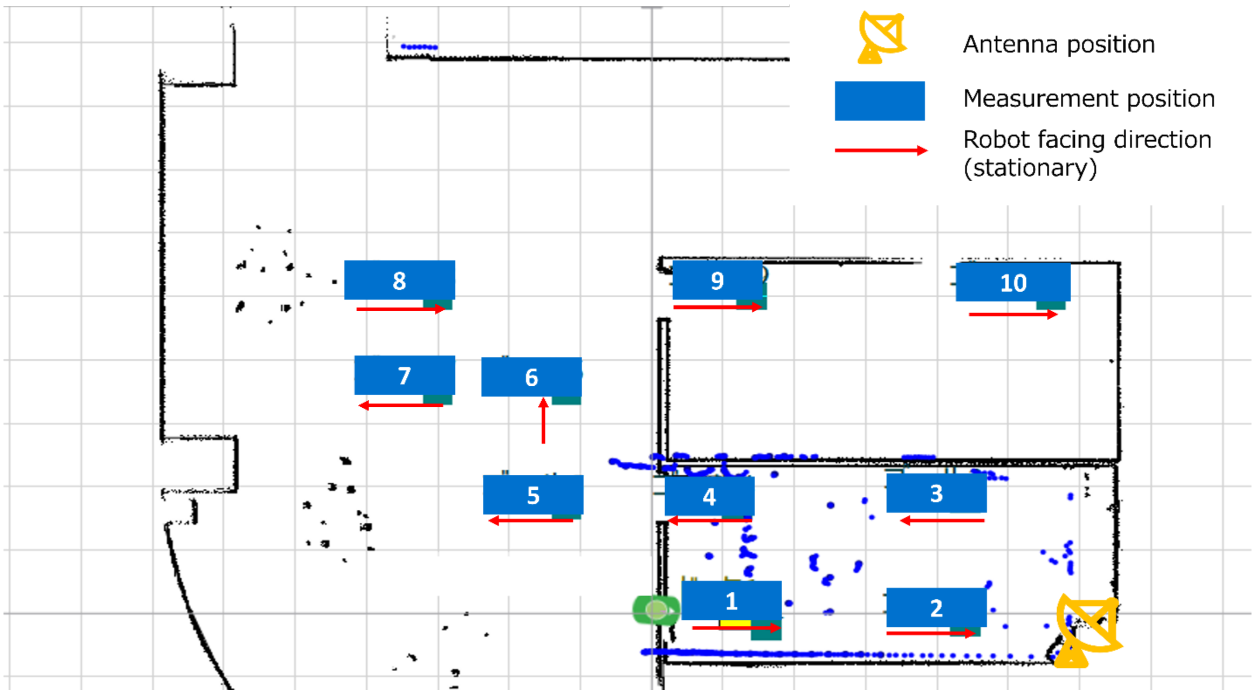


Figure 5-5: Measurement Position (Scenario 1)

The comparison results are shown in Figure 5-6.
In terms of throughput, WiGig outperformed Wi-Fi, and we were able to meet the benchmark requirements.
However, Obstacles caused performance to degrade substantially, so the antenna position and radio wave reflection must be considered.

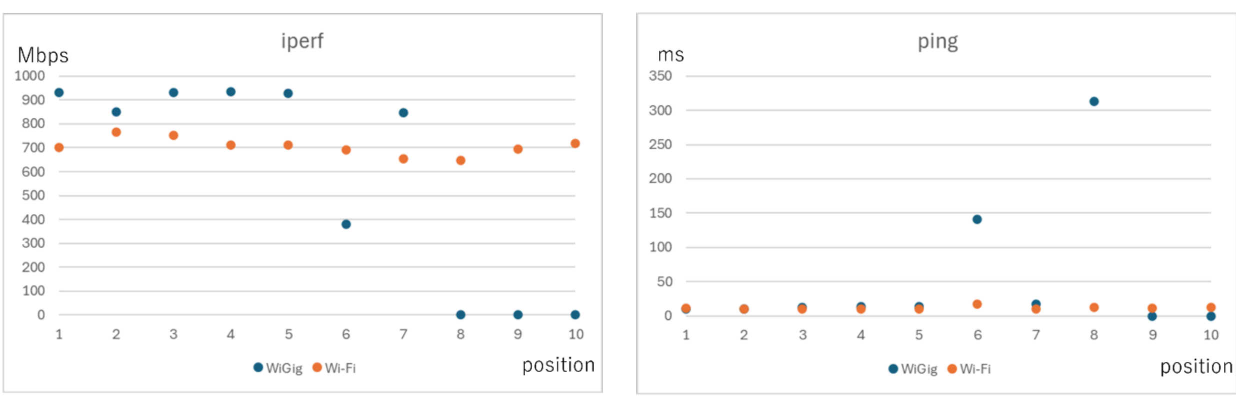


Figure 5-6: Results of Video Transmission

5.1.4.2 Scenario 2: April 2025, outdoor test in Sengawa Wi-Fi/WiGig + APN

Measurements were taken at eight locations, as shown in Figure 5-7.
・Measured at a maximum distance of 240 meters.
・Both straight-line and laterally offset positions were used as measurement sites.

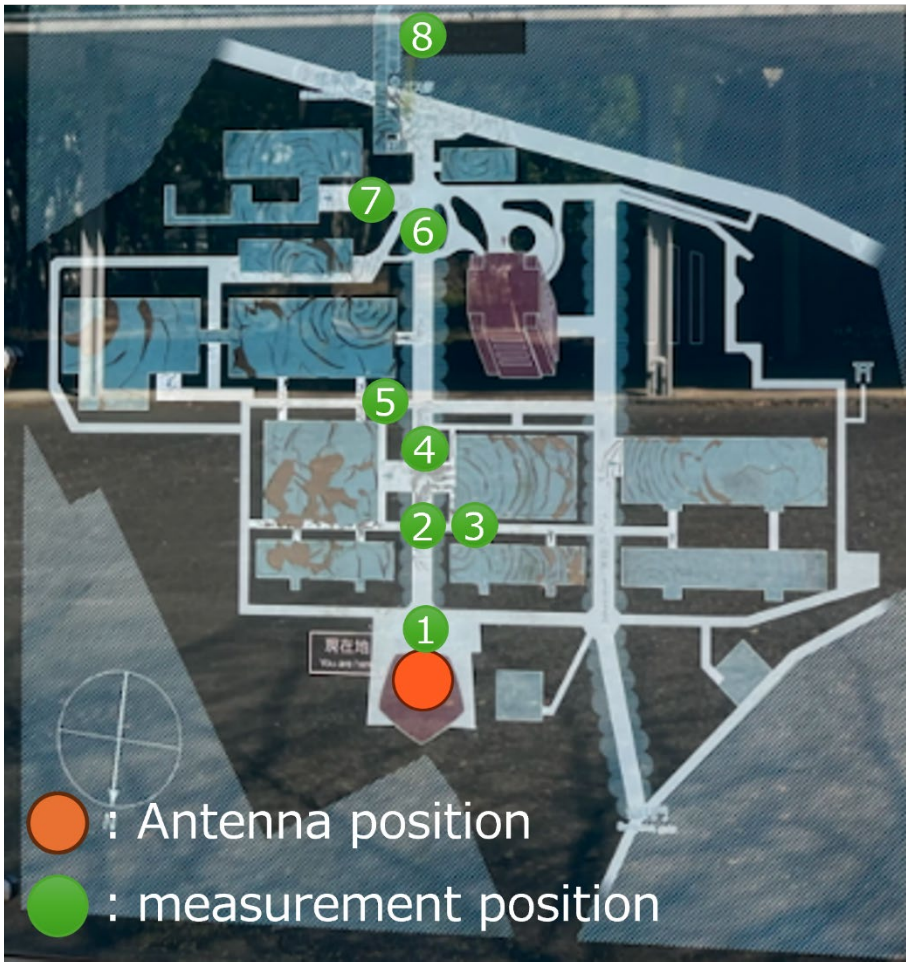


Figure 5-7: Measurement Position (Scenario 2)

Figure 5-8 shows the results for WiGig and Wi-Fi latency.
WiGig demonstrated fast response times and small standard deviations.
The Wi-Fi signal was only available up to position 5, and Measurements could not be performed beyond that point.
Based on the evaluation results, the evaluation indicated that WiGig was suitable for this PoC.

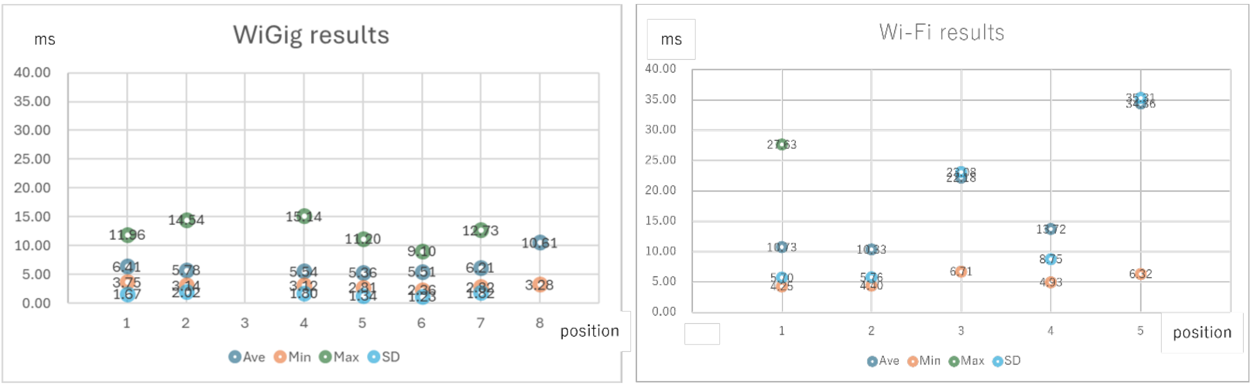


Figure 5-8: WiGig vs Wi-Fi

Table 5-2: Results of Scenario2

	Wi-Fi (2.4 GHz)	**WiGig**	**Comment**
Total System data rates	146.00 Mbits/sec	917.92 Mbits/sec ※	※Wired up to 1Gbps configuration
Number of available cameras	3 Units	4 Units ※ (18 Units ※^{2})	※Validated with up to four units ※^{2}logical value
video streaming delay	Difficult to streaming video	570ms	
Distance	50 m ※	240 m ※^{2}	※The ping was successful, but the video could not be received. ※^{2}Maximum distance in the validation environment
Others	Communication was possible at locations where WiGig communication was unavailable.	Antenna angle and presence of obstacles affect communication quality	

5.1.4.3 Scenario 3: July 2025, outdoor test in Sengawa WiGig + APN

In Scenario 3, NTT Laboratories' Seamless Handover with Site Diversity Technique was used to address WiGig's vulnerability to corners and obstructions.

The verification details are the same as in Scenario 2.
The access points are in the same position as in Figure 5-7. However, two access points with different orientations were installed at each location.
◆Conditions for each verification
Test (1)-1: NW load by iperf
Test (1)-2: No load
Test (1)-3: Video transmissions by ten cameras (approximately 500 Mbits/sec)

Table 5-3: Results of Scenario3-1

Measurement points	①	②	③	④	⑤	⑥	⑦	⑧
Test (1)-1 **Bandwidth (Load)**	955 Mbits/sec	955 Mbits/sec	949 Mbits/sec	953 Mbits/sec	949 Mbits/sec	954 Mbits/sec	950 Mbits/sec	954 Mbits/sec
Test (1)-2 **NW Delay (Ave) (*)**	10.97 ms	14.55 ms	14.54 ms	11.74 ms	14.96 ms	11.65 ms	14.28 ms	18.74 ms
Test (1)-3 **Video delay**	330 ms	200 ms	640 ms ※	720 ms ※	620 ms ※	230 ms	240 ms	320 ms

※The test was conducted on an extremely hot day, and it is assumed that the delay likely increased because of heat-related effects on the devices.

As an additional verification, Because the robot moves during actual operation, network performance was evaluated while the robot was in motion from ① to ⑥ in Figure.5-7.
We tested a total of 4 patterns with 4 APs, 2 APs, 3 cameras, and network bandwidth load, as shown in Figure 5-9. The team evaluated whether PsPing introduced network delays or momentary video interruptions when an antenna passed (switched antennas).

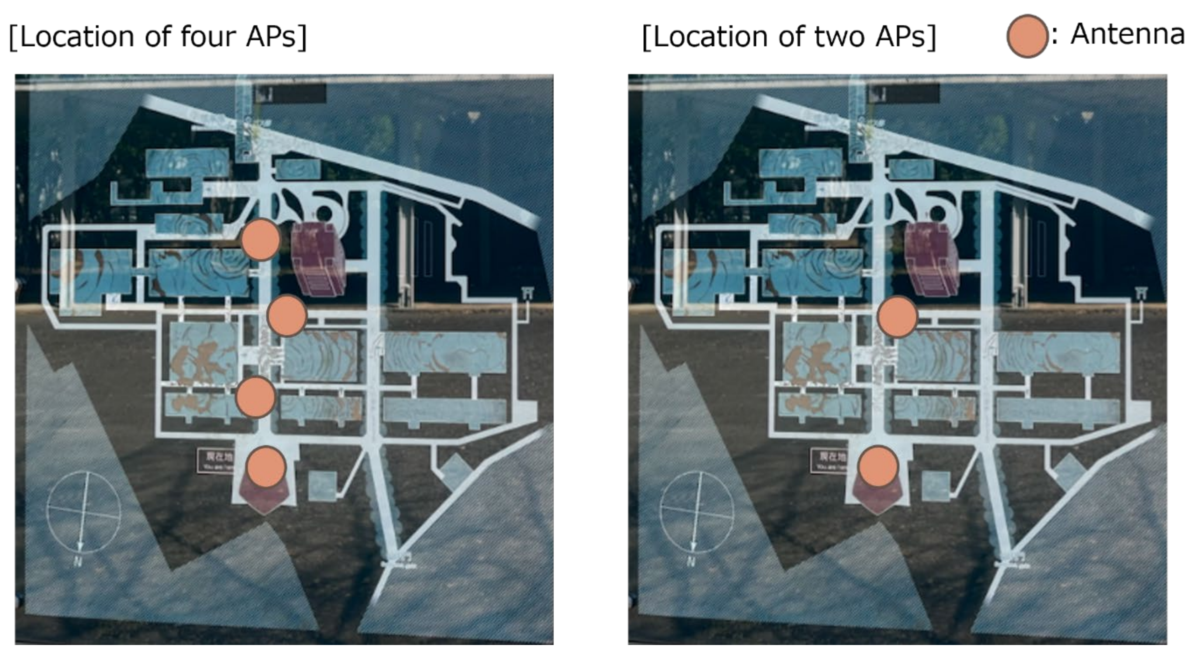


Figure 5-9: Antenna position

Measured values for each test pattern are as follows.
None of the test patterns caused interruptions in video transmission while the robot was moving.

Table 5-4: Results of Scenario3-2

	① AP: 4, 3 Cameras distributed	② AP: 4, NW load	③ AP: 2, 3 Cameras distributed	④ AP: 2, NW load
Bandwidth used	150 Mbits/sec (1 camera 50 Mbits/sec)	954 Mbits/sec	150 Mbits/sec (1 camera 50 Mbits/sec)	954 Mbits/sec
NW Delay (Ave)	13.00 ms	51.33 ms	14.84 ms	46.44 ms
Video Distribution Status	・The video was not interrupted or disturbed when the antenna was switched.			
Others	・NW delay increased when antenna switching occurred: Maximum 353 ms. ・However, as described before, video distribution was not affected.			

In Scenario 2, communication could not be established at Point ③ because of multiple obstructions.
In Scenario 3, the use of multiple antennas enabled communication even in areas with substantial obstructions.
In addition, seamless antenna switching by NTT Laboratory technology enabled uninterrupted video transmission while the robot was moving.

5.1.4.4 Scenario 4: February 2026, outdoor test in a Chemical Plant in Okayama WiGig + APN

In Scenario 4, the following two tests were performed.

AP1: The evaluation confirmed whether it was possible to build a wireless environment with a transmission rate of about 1Gbps in two days from the end of the APN to a berth at 2 km.
The evaluation measured a 2 km wireless-network section and a 1,400 km wireless-network-plus-APN path.

The WiGig equipment used in this test has a maximum P2P communication range of 500m.
Due to the frequency characteristics of WiGig, communication is difficult in areas without line of sight.
For these reasons, in order to achieve long-distance communication, a wireless path was designed that uses WiGig relay points placed at regular intervals every few hundred meters while avoiding obstacles. (Figure 5-10)
As a result, a communication throughput of over 900Mbps was maintained and a communication delay time of less than 30ms was recorded over a total communication section of 2km at both ends.
From the above, the results demonstrated that WiGig provides sufficient performance for building wireless networks in wide-area industrial environments.

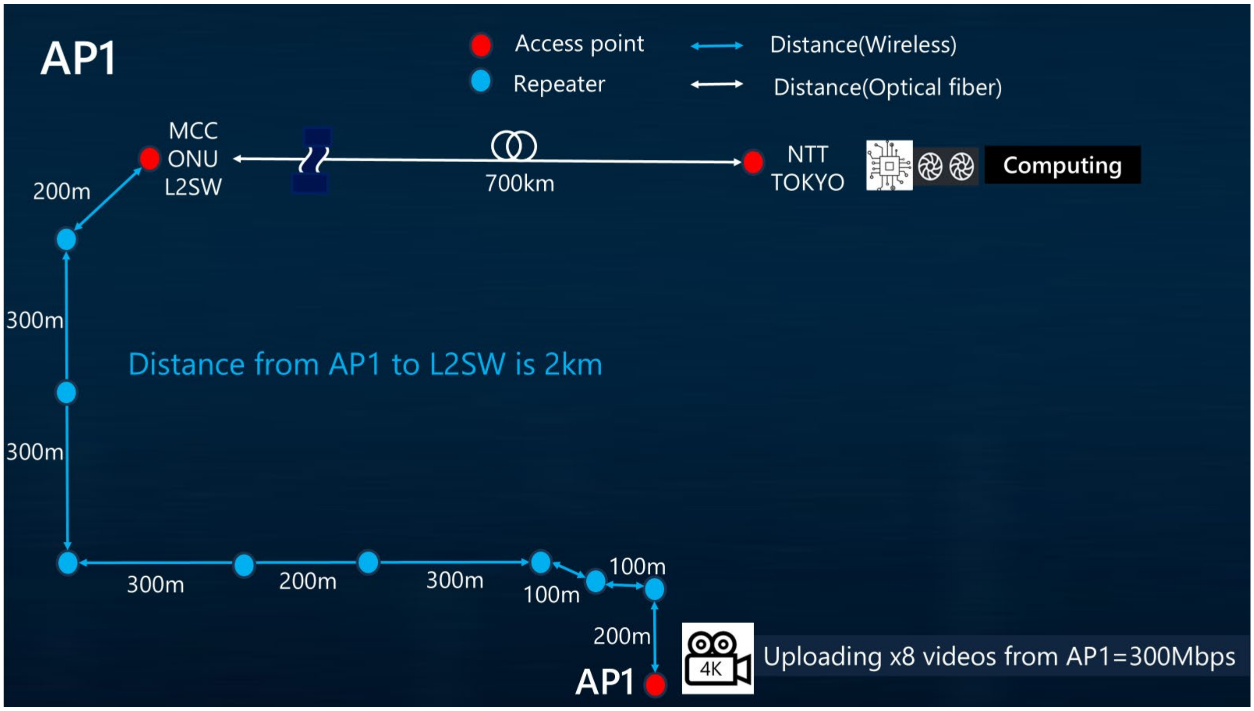


Figure 5-10: AP1 in Okayama to DC in Tokyo

Table 5-5: Results of Scenario4-1

	PoC implementation results
Total System data rates	928 Mbits/sec
Specifications of video	・Resolution, frame rate: 4K, 30~60 FPS ・Encoding: H264 ・Bit Rate: 50Mbps per video ・Number of streams: 8 cameras
Latency of video streams	Wireless NW only: 230 ms Wireless NW+APN: 370 ms
Others	・NW Delay Wireless NW: 21 msec/2 km with 9hops Wireless NW+APN: 42 msec/1400 km

AP2: The evaluation confirmed the feasibility of detecting abnormalities through crack-monitoring analysis using robots and video in a tank yard facility patrol using disaggregated computing in Tokyo. Confirmed the processing time to reflect the calculation result on a 3D map and the accuracy of the display of points of concern.

As an advanced evaluation, a mobility-access wireless network was designed using WiGig.
Due to its frequency characteristics, WiGig has strong directivity, and unlike Wi-Fi or LTE, it cannot expect much signal penetration. Therefore, currently, most deployments use fixed wireless equipment

communicating from fixed locations.
In AP2, we designed a wireless network for mobility control utilizing NTT's terminal-driven dynamic site diversity control technology.
As shown in Figure 5-11, the robot moves in a circular motion around the sides of a rectangle. WiGig access points were positioned to cover this movement range, designing an area that the robot can always access.
The radio used in the experiment had a directivity of 120° horizontally and 32° vertically, meaning that coverage might be limited in the immediate vicinity of the radio.

Therefore, the design ensured complete coverage by positioning radios in opposing directions from both directions at each side of each vertex. Furthermore, the terminal's wireless antenna was positioned front and back to cover different directions.

As a result, by selecting and moving a high-quality wireless antenna using the technology, communication could be maintained along straight routes as well as around corners where radio handovers would normally be necessary.

The mobile unit was able to travel around a rectangular area without communication interruption, demonstrating the feasibility of WiGig-based wireless network coverage.

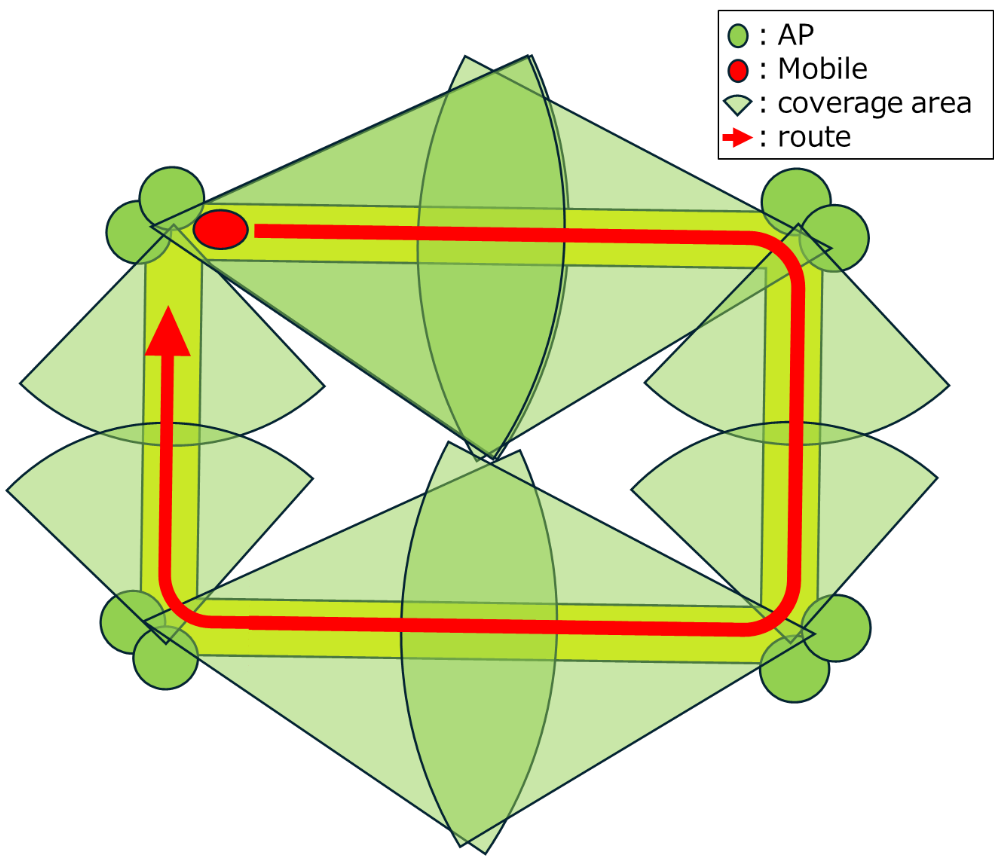


Figure 5-11: AP2 Coverage and route

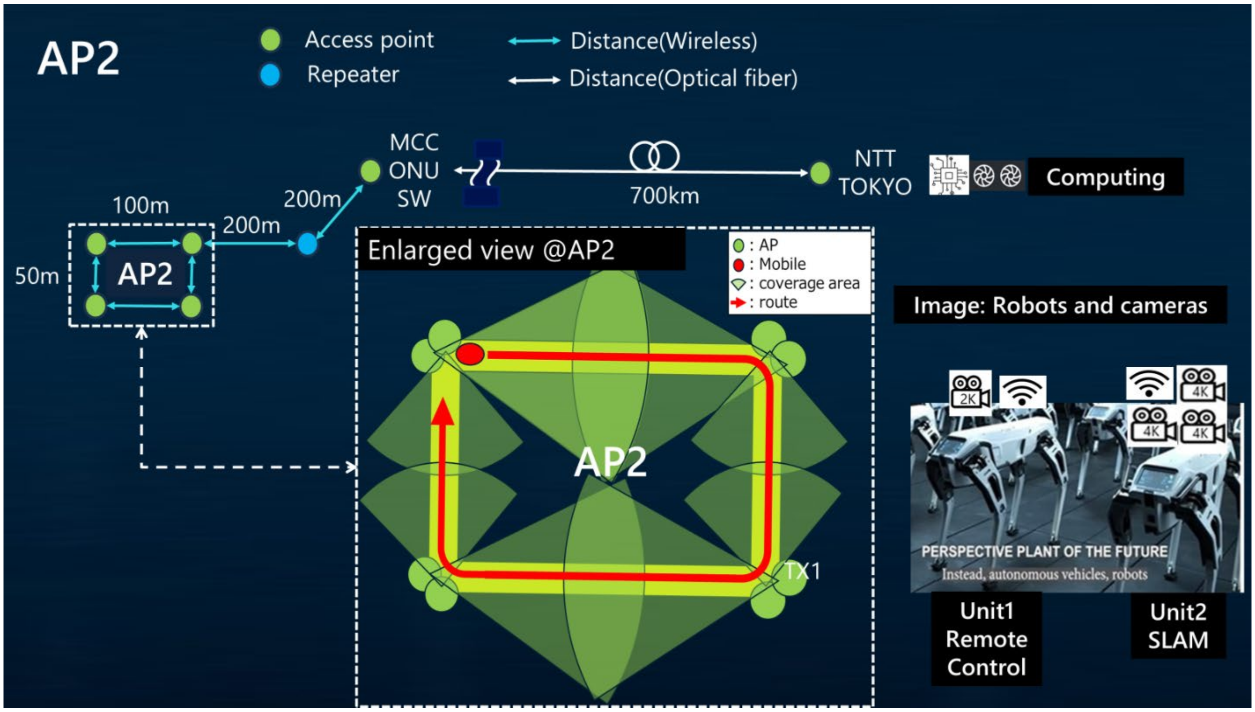


Figure 5-12: Robots in AP2, Okayama to DC in Tokyo

The results of crack monitoring using a robot and video are shown in the environment shown in Figure 5-12.

Table 5-6: Results of Scenario4-2

	PoC implementation results
Total System data rates	400 Mbits/sec (Upper limit is 900Mbps or higher, same as AP1)
Specifications of video	・Resolution, frame rate: 4K, 30~60 FPS ・Encoding: H264 ・Bit Rate: 130Mbps per video ・Number of streams: 3 cameras
Latency of video streams	Wireless NW+APN: 370 ms
Stability of video transmission	Less than 0.1%
Defect detection AI	The analysis generated six annotations, but there were two overlapping ones. Detection accuracy was high because cracks existed at the two actual locations. It is assumed that accuracy can be improved by having an image of accumulated cracks adjusted to the angle of view and scale. It is assumed that subtle cracks can be detected by adjusting the threshold.

Others	・End-to-end tracking of the mobile robot and reflection on the 3D map were completed within 0.5 seconds. ・Decision time for AI analysis: 130 ms

5.2 Technical Report of UC2 Anomalies Detection by Using Sound Data and Video Data from Deployed Robots in a Chemical Plant

In the remote control, we confirmed that it was possible to remotely control the robot from Tokyo to Okayama and move around a circuit of about 300 meters while watching real-time video from the robot. The team also confirmed that it was possible to read measuring instruments manually.

In autonomous movement, we confirmed that the SLAM mapping program can be started remotely, and SLAM maps can be created and saved by operating the robot with the game controller while viewing images from the robot's camera. It was also confirmed that the SLAM map could be generated in an area of about 300 meters and the SLAM map could be autonomously moved around by setting waypoints on the map. We verified that autonomous navigation (waypoint navigation) was possible via the waypoints. (The robot loaded the saved waypoints and followed configured waypoints in order and verified that it stopped after reaching the last waypoint. We set and save waypoints on a map created with SLAM. Obstacles like suitcase and human, which did not exist when the SLAM map was generated, were placed on the route, and the robot was able to move to the desired waypoint by avoiding obstacles during autonomous movement.)
In analysis, we were able to analyze the amplitude and frequency as set by the vibration tester. A microphone attached to the robot outside was used to collect the sound of a water hammer and successfully analyze the noise.

Table 5-7: Results of Scenario4 UC2

Parameter	**PoC Target**	**Result**
Video transmission delay time	Ideal 100ms At most 500ms	Achieved
video stability	Drop rate<0.1%	Cannot be confirmed (To investigate frame drops, we attempted to capture and save the video streamed from the robot in Okayama on a PC in Tokyo at NTT DATA. However, because the PC experienced processing delays, it was not possible to determine whether the frame drops were caused by the network or by the PC itself. Therefore, measurement and verification could not be performed.)

Accuracy	・Vibration of piping is detected ・Reading of measuring instruments of piping ・Noise of piping is detected ・Malfunction is checked using multimodal AI.	・0.3~1.0 mm, 5 Hz vibration was detected from the robot image, as set by the tester. ・From the robot image, the value of the measuring instrument was read as the same value as the visual observation. ・When the robot ran near a pipe with a water hammer sound, a lower frequency component was detected compared to the sound collected at a distance, and it was determined that some kind of abnormal noise was occurring. ・With a simulated abnormality in the pipe, the robot input the recorded image and recorded sound, and asked the multimodal AI about the condition, and determined that it was abnormal.
sending and receiving information	The video can be collected by the robot in Okayama be seamlessly transmitted to Tokyo for analysis. The robot can accept operation commands from Tokyo.	No problem
Remote operation	・The controller can control the robot in Okayama from Tokyo. →The robot must not run out of control when operated from Tokyo. → The robot stops when communication is interrupted. ・The robot can go around the AP2 (Figure 5-12) by remote control.	The remote control from Tokyo worked as intended (not out of control) and the robot shut down as expected when communication was lost.
Autonomous movement	・The robot's sensors can generate a map of the factory. ・The robot can generate a route according to a pre-registered destination. ・The robot can recognize people and objects (such as measuring instruments). ・The robot can avoid obstacles. ・The robot can move autonomously around the AP2 area.	・Maps can be generated ・It was able to drive without problems ・It was able to recognize people and objects ・It was able to avoid the obstacles ・It was able to go around a full circle

6. Contribution to IOWN Global Forum

The PoC team verified the feasibility of deploying IOWN products and services from **4 perspectives** specific to chemical plants.

1. **Connectivity between a chemical plant and a remote data center**
   This PoC represented the first attempt to connect robots deployed in a chemical plant with a data center located 700 km away. The team demonstrated the feasibility of replacing some inspection-related cognitive activities by connecting robots, sensor devices, and a data center through FWA and APN.
2. **Practical deployment value of FWA in plant environments**
   The PoC demonstrated that Fixed Wireless Access (FWA) can be a practical deployment option for chemical plants, where rapid installation and minimal on-site construction are important. In the testbed, a 2 km wireless section was established in approximately six hours, suggesting that FWA could be a practical alternative to underground optical-fiber installation in certain plant environments.
3. **End-to-end software functionality in an actual plant**
   The PoC confirmed that the software pipeline connecting plant robots to remote computing resources functioned as intended in an actual plant environment. One robot operated autonomously and another was remotely controlled from a location 700 km away, while video and audio data were transmitted continuously to remote computing resources and the detected anomalies were visualized on a 3D map.
4. **Practical end-to-end latency reference**
   The PoC provides a practical reference for industrial users by evaluating both network-segment latency and end-to-end processing time from sensing and user input to computing output. Under the PoC conditions, the upstream transmission load reached approximately 400 Mbps, video-stream latency over wireless NW + APN was 370 ms, and end-to-end processing remained within approximately 0.5 seconds, indicating its suitability for near-real-time industrial inspection indicating that the system is suitable for near-real-time industrial inspection.

7. Conclusion

The PoC team confirmed that the Remote-Controlled Robot Inspection (RCRI) use case met the expected indices defined in the PoC reference document under the tested conditions, based on the four test campaigns conducted to date. The wireless and wired communication equipment, including APN devices, functioned properly during the tests. Using NASA's Technology Readiness Level (TRL) definitions as a reference, system maturity was internally assessed at approximately TRL 5 for the PoC implementation and based on the assessment criteria of the U.S. Department of Energy Advanced Research Laboratory (ARL), the system was assessed at Level 4. Since the sensor equipment deployed at the chemical plant was temporary for the testbed, the provided applications were not fully tuned and had not yet reached their final form. The applications have not yet been fully optimized and have not reached their final form, so the IM team recognizes the need to further verify system mechanisms and functionality using mass-production models for actual deployments.

The IM team aims to demonstrate that IOWN Global Forum Technologies can replace certain human-operated inspection tasks. The team focuses on video and sound, as processing this type of data requires higher-capacity pipelines and significant computing power compared to text. These communication and data-center infrastructure are expected to reduce processing time and ensure smooth, reliable performance suitable for inspection tasks in not only chemical plants but also oil and gas plants, which are typically carried out by humans in real-world improvement processes. The team will proceed beyond the tested phase to further improve plant operational efficiency.

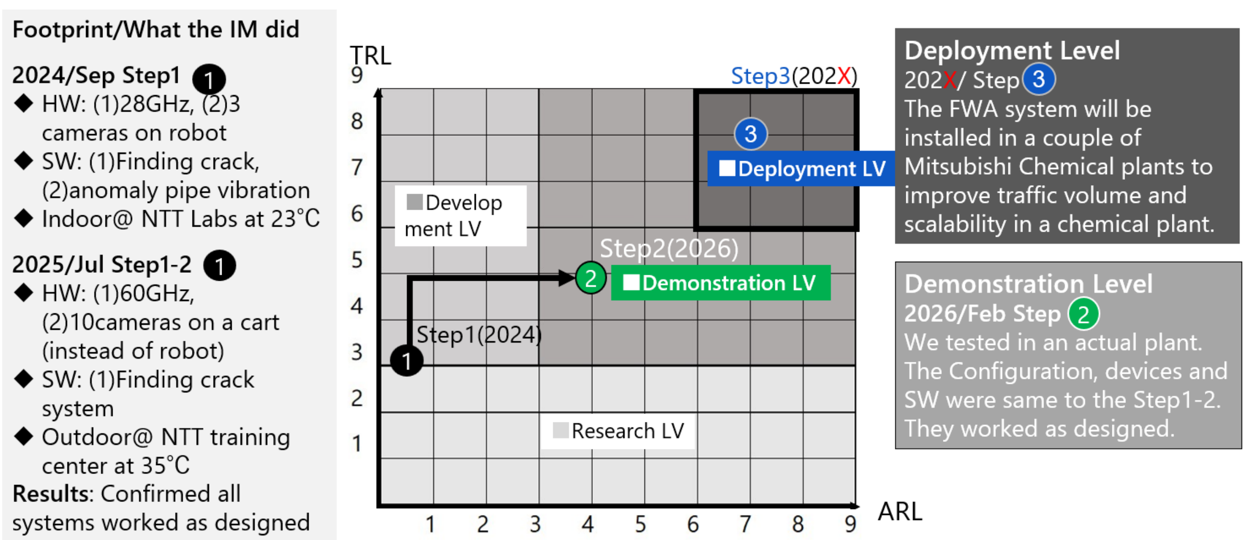


Figure 7-1: TRL x ARL of IOWN RCRI

7.1 Summary of Key Findings

The PoC team in the IM discussion group identified the following 7 findings based on 4 test campaigns.

(1) Validation against PoC benchmarks
From both the IOWN Global Forum Technology perspective and economic rationality, the proposed use case for the chemical industry was evaluated against the benchmarks defined in the PoC reference

document. The evaluation confirmed that the use case satisfied the expected performance and feasibility criteria.

(2) Rapid deployment of FWA infrastructure
NTT EAST successfully deployed Fixed Wireless Access (FWA) within approximately half a day, covering a distance of 2 km from the Optical Network Unit (ONU) to the designated access points inside the chemical plant. This demonstrated the practicality and speed of network deployment in an industrial environment.

(3) Wireless performance and throughput evaluation
Using iperf measurements, the PoC operation team confirmed the construction of a wireless area achieving peak throughput of up to 900 Mbps under the evaluated test conditions. This performance is approximately 40 times greater than conventional carrier-based wireless communication and approximately 900 times greater than the capacity of the existing plant LAN configuration used as a reference in this study. The maximum data transfer speed in this test was approximately 400 Mbps, due to test environment limitations. By utilizing APN, we were able to secure sufficient bandwidth of up to 100Gbps, allowing us to proceed this test without any issues.

(4) Network stability under robot mobility
The PoC team confirmed that the FWA connection remained stable even while industrial robots were in motion. Continuous data transmission at volumes significantly exceeding those of the conventional plant LAN was maintained without interruption.

(5) APN system stability and scalability challenges
The APN provided by NTT DOCOMO BUSINESS, together with 1Finity's APN devices, operated stably with no issues impacting the testbed environment.
However, to further assess APN stability, additional testing with increased data traffic and scalability is required. Addressing this requirement has been identified as a key challenge for the Industrial Management team.

(6) Anomaly detection system functionality
The anomaly detection systems developed by NTT DATA and NTT DOCOMO SOLUTIONS operated as designed. These systems successfully processed the video and audio data sent from the Mitsubishi Chemical Okayama site to the NTT Docomo data center, assuming a remote data center in Tokyo.

(7) End-to-End latency performance
Despite the physical distance of approximately 700 km between the plant and the data center, the end-to-end data processing latency remained below 500 milliseconds throughout the PoC trials. This figure includes approximately 200 milliseconds required for camera-side video encoding, indicating suitability for near-real-time industrial applications.

7.2 Recommendations and Suggestions for Future Research: Video Frame Loss Evaluation and Criteria Revision

The PoC team in the Industrial Management (IM) team respectfully proposes a revision to the video frame loss index specified in the expected benchmarks of the PoC Reference.
According to the video transmission measurements obtained from the Okayama chemical plant testbed, as reported by VLC monitoring tools, the observed video frame loss rate during the PoC was consistently

below 0.1%. This result confirms that the current benchmark value can be achieved under controlled test conditions.

However, the original frame-loss criterion was defined based on PoC assumptions for RDMA-oriented scenarios, in which video signals are transmitted via short-distance HDMI cables (typically less than 10 meters) in indoor environments. These assumptions differ significantly from the operational conditions of the Remote-Controlled Robotic Inspection (RCRI) use case, where video and audio data are transmitted wirelessly from mobile robots operating in outdoor industrial environments.

From the perspective of anomaly detection based on video and audio streams, the PoC operation team confirmed through experimental evaluation that the loss of up to one video frame per second at a frame rate of 30 fps does not degrade detection accuracy or operational effectiveness. Based on this observation, a frame loss rate exceeding 0.1% is not considered a critical issue for the RCRI use case in terms of detection accuracy and operational effectiveness.

Considering these findings, the IM Team recommends revising the frame loss criterion to better reflect the performance requirements of wireless video and audio streaming for mobile robotic inspection. The team intends to submit a detailed proposal for updated frame loss criteria tailored to video- and audio-based inspection applications following further discussion within the working group.

7.3 Next Phase of PoC

The goal of the IM in the IOWN Global Forum is to deploy the IOWN products and services to chemical plants and oil and gas sectors all over the world. The team has demonstrated the potential of connected robots to data center via wireless and APN to reduce human workload and improve operational efficiency in chemical plants in the testbed 2026. The team recognizes that it is necessary to demonstrate that robots connected through IOWN's products and services can enhance the productivity of chemical plants.

7.3.1 Overview of the next PoC phase

The team plans to demonstrate that it is possible to replace human inspection tasks with sensors on remote control robots by synchronizing heterogeneous data such as video, audio, vibration, and environmental sensors in real time. The demonstration is required to be the accuracy of anomaly detection, condition assessment, and failure prediction can be improved to a level equal to or exceeding that of skilled workers. The status of the IM team discussion is as follows.

Why: The purpose of the PoC activities is to accelerate IOWN Global Forum Technologies adoption and social implementation of the products and services through realizing future use cases. And the activities for the industrial use case will lead to safer chemical plants while keeping high productivity.

When & Where: The IM team plans that a testbed in laboratory should be the 1st to check if the configuration works or not. After verifying the laboratory test, the 2nd test will be done in a real chemical plant.

Who: The IM team always welcomes new participants who can bring innovative technologies and insights to the testbed. We know that the doors of the IOWN Global Forum are always open to challengers.

What: The next PoC phase is to demonstrate that it is possible to automate inspection tasks performed by humans through data processing using live streaming data.

How: This will be achieved through cloud computing resources connected to chemical plants via APN and high-speed wireless access to integrate and process multiple heterogeneous data streams to recognize precisely the state of the plant by minimizing human intervention.

7.3.2 About more detailed test contents

The team confirmed the effectiveness of transmitting and processing video and audio data through the experiment. The IM team is aware that there are issues to consider for the next test run.

Challenge-1: APN Robustness

The team confirmed the effectiveness of video and audio data transmission and processing in an actual chemical plant in the last four testbeds. The communication data volume was 400 Mbps out of the maximum of 900 Mbps in the wireless section because we did not secure enough scalability to check Radio Access Network and 100 Gbps in the APN section. Unfortunately, due to the small amount of data handled in the APN section, it was not possible to verify the robustness of the APN. In the next demonstration, it will be necessary to increase the number of connections per access point, add more access points, and if possible, upload data from multiple sites to check whether further advancement of a stable communication environment capable of controlling multiple devices simultaneously.

Challenge-2: Transmission of stop signals from any location to the robots

As of February 2026, operating robots or drones requires a supervisor for the operations even on private land in Japan. Since 1 person operates 1 robot, improvements in work efficiency are limited. To reduce the number of operators and operate multiple robots or drones, it is necessary to prove that the robots can safely stop through external intervention if they exhibit abnormal behavior other than programmed actions or control commands. Experiments that contribute to unmanned use of robots by establishing safety stop mechanisms lead to a reduction in management costs. Initially, we plan to examine and verify whether it is possible to prioritize the transmission of stop signals from low to high frequencies and move to a safe location. The team is considering the priority transmission of stop signals and the measurement of time until a safe stop in the event of in robot behavior. It is not only for signals for robot manipulation, but to prove that it is possible to safely stop them by giving priority to sending a stop command from a remote location, it requires sending priority signals together with a key among complex commands such as hacking countermeasures, so the range of applications is considered to be wide.

Challenge-3: Can chemical plant operators use a multi-modal data processing service?

To support plant inspections conducted by humans, the team provides a type of multimodal AI processing system. In fact, there are a very large number of single-modal processing services offered by system integrators around the world. From the user's perspective, these services are expected to be used on an integrated service platform because operators do not need to bring multiple devices into the plant to identify anomalies. The process involves aligning several types of data by time stamps to identify the locations of anomalies in a time series, using manufacturing data such as sound, video, temperature, and flow rate. Presumably, video data, which is large, will experience transmission delays, and synchronization errors are expected. If we can concretely define the practical error tolerance in terms of delay time and how much it affects anomaly verification predictions, it could serve as a benchmark for multimodal data processing.

Hardware-accelerated data processing pipelines with IOWN Global Forum Technologies are expected to feasibly achieve multi-modal data processing in an economic-rational manner.

7.4 Acknowledgements

This PoC document was prepared as an interim progress report on the adoption of IOWN Global Forum Technologies. Through the collaborative efforts of the PoC participants and the Industrial Management working group, the PoC team demonstrated the feasibility of replacing certain inspection activities with anomaly detection performed using external data-center computing resources by connecting robots deployed in an operational chemical plant with external computing infrastructure via FWA and APN.

The PoC team extends its sincere appreciation to the chemical plant operators and on-site personnel who provided valuable opportunities to conduct validation activities in real industrial environments. The team also acknowledges the dedicated PoC operations team, whose careful planning and execution enabled safe and reliable experimentation under strict operational constraints. Their contributions were indispensable to achieving the outcomes presented in this report.

While this result represents a meaningful advancement and should be regarded as one step in an ongoing process rather than an outcome. Building on the technical knowledge and practical insights gained through the PoC team intends to continue working closely with members of the IOWN Global Forum to further refine use cases, address remaining challenges, and expand the applicability of IOWN Global Forum Technologies across a broader range of industrial domains.

In this context, the team welcomes organizations interested in exploring innovative, high-value initiatives in the industrial use cases of IOWN Global Forum Technologies. The PoC team believes that through participation in open collaboration within the framework of the IOWN Global Forum, new participants will have the opportunity to provide their expertise, co-create practical solutions, and help accelerate the deployment of IOWN Global Forum technologies in real industrial environments. Let us all enjoy the IOWN PoC activities together.