Nokia RXRM, Space & Defense

Space Business Forum at BF HQ

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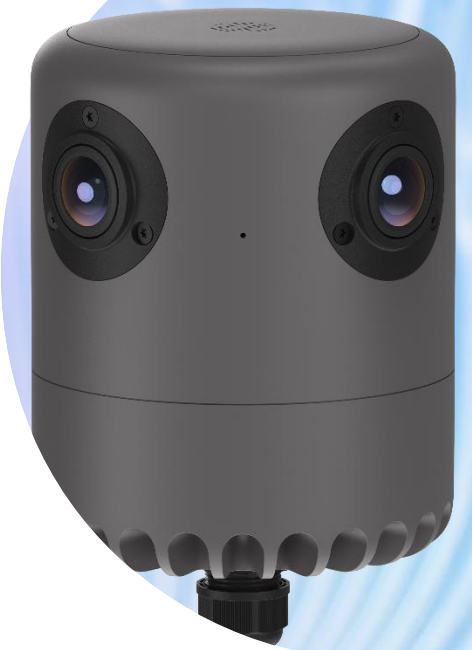


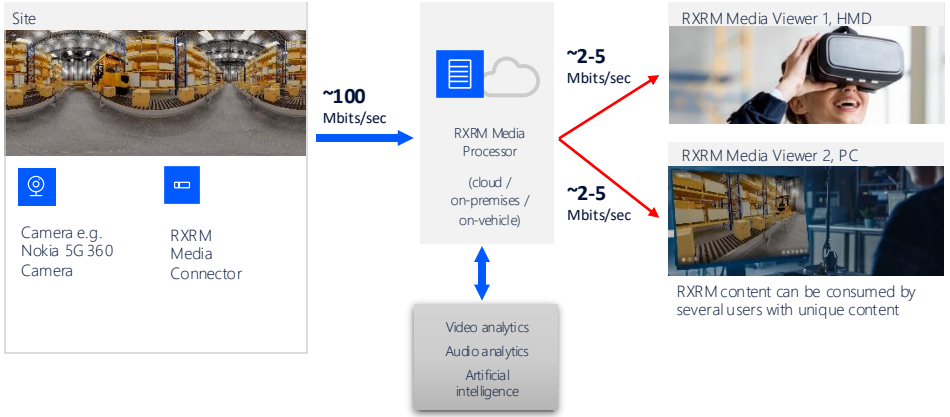
Real-time eXtended Reality Multimedia RXRM

Increase the accuracy and speed of what you see - and hear - to a fraction of a second

RXRM is a software solution that opens up the possibilities of 360° video and audio capture to industrial and commercial applications. With RXRM, enterprise can drive further efficiencies, improve productivity and employee safety, and harness new revenue streams.

Technical superiority of video
and audio quality:

- Truly wireless and mobile experience
- Real-time 360° view
- Very low latency
- Resolution up to 8K
- Frame rate up to 60 fps
- Bandwidth optimization of 360°-video (reduced up to 90% or more)
- OZO spatial audio for industrial sensing



Industrial use cases: Situational awareness, remote technical support, safety and security, industrial automation and teleoperations

Entertainment use cases: Immersive media experience at event venues, media broadcasting to remote participants

Allows both fully local deployment and cloud based, multitenant services

Open API

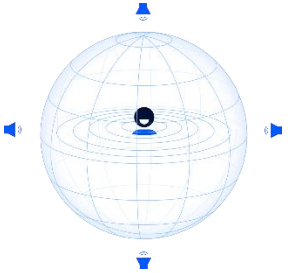
Integrating multimedia streams in a complex world

RXRM is open to third-party APIs, enabling different software systems and applications to communicate and integrate with RXRM. These systems include, for example, video and audio analytics, IoT data collection systems, AI and digital-twin solutions.

RXRM provides multimedia streams that can be consumed by third-party solutions. Information from these systems can then be utilized and visualized for the end user as overlays on top of a multimedia stream.

Spatial audio

Hear progress in every process



Spatial audio allows a remote operator or expert to distinguish the direction from which different sound sources originate. This allows, for example, teleoperation of equipment or accurate technical remote assistance.

High-quality audio also enables accurate remote condition monitoring of equipment or remote quality inspection, based on sound in addition to video.

Audio from RXRM can be used for audio analytics that contribute to automated industrial processes, such as predictive maintenance.

World’s first 5G 360° camera

Nokia 5G 360 Camera

Ability to both record and stream 360° video and authentic spatial sound

Durable and mobile device designed for harsh environments (IP67 rated) and simple deployment

Secure and reliable long-term performance with full privacy protection

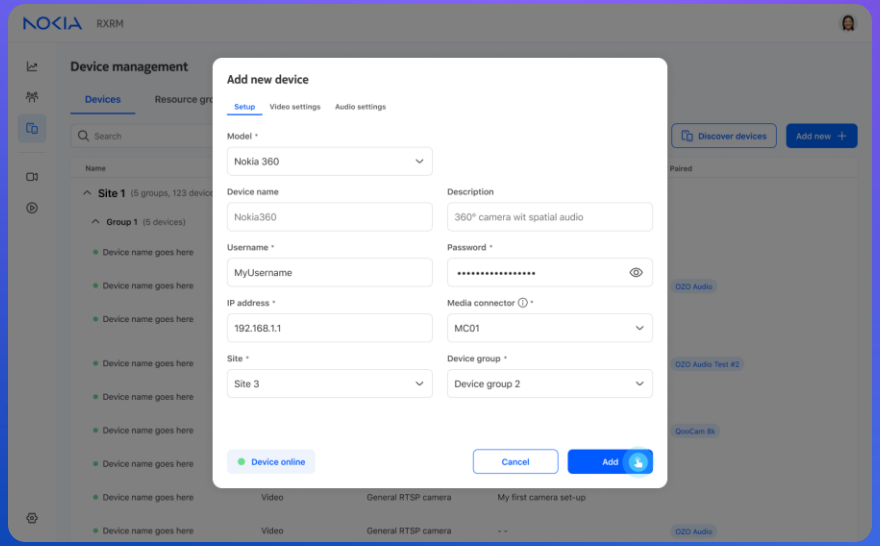
RXRM optimizes bandwidth usage by up to 90% for ultra high-quality video without congesting your network

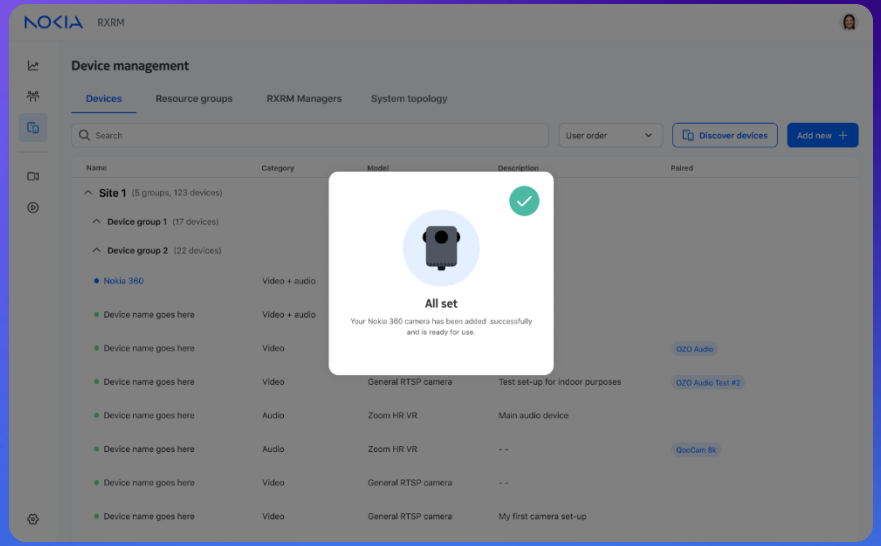
Fast enough video streaming for real-time teleoperation

An integrated robust 5G connectivity solution for truly wireless operation

Why Nokia 5G 360 Camera instead of a camera with limited Field of View (FOV)?

Together with RXRM solution and UX





- 360° output available for AI analysis and storage
- Customized design with branding available on demand (color, logo, possibly material options)
- Additional accessories available (e.g. mounting solutions, protective casings)

RXRM and Artificial Intelligence

Development opportunities

Immersive Multimedia Platform

RXRM delivers 360° video and spatial audio with ultra-low latency for immersive experiences.

AI-Enhanced Analytics

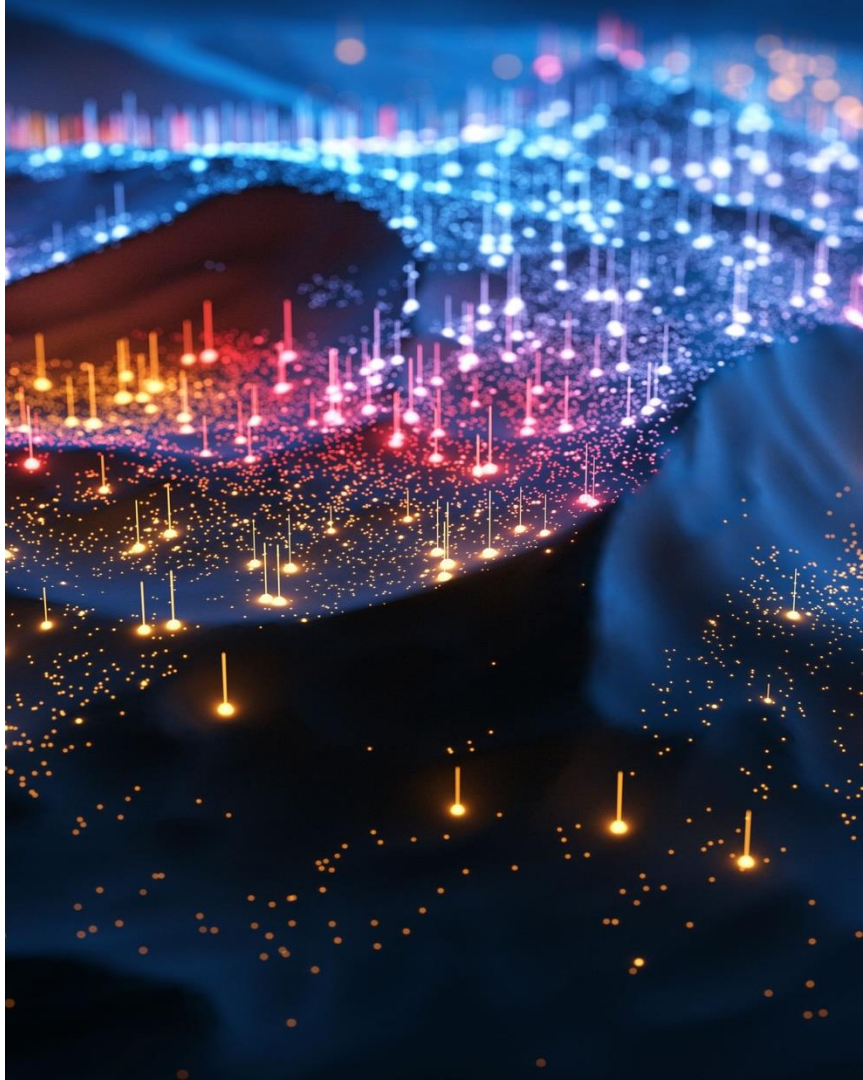
AI integration enables real-time video and audio analytics for smarter decision-making.

Industrial and Commercial Applications

RXRM and AI support enhanced situational awareness, remote operations, and automation.

Open API Integration

RXRM's open API allows seamless integration with AI systems for versatile applications.



RXRM and AI benefit examples

Enhanced insights

Bandwidth Optimization

RXRM's viewport-dependent delivery reduces data transmission by up to 90% or more, improving streaming quality and reducing network congestion.

Spherical image dewarping

RXRM's viewport creation from spherical (360) inputs will eliminate the image distortion effects to AI, improving the reliability of AI (and even enable the analytics)

AI-Powered Insights

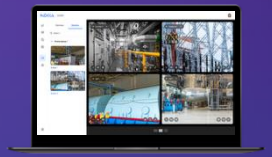
AI provides real-time video and audio analytics that enable predictive maintenance, anomaly detection, and better decision-making.

Complete solution by Nokia

Nokia 5G 360 camera

- IP67 rated industrial 360 camera with spatial audio capture
- Integrated wireless connectivity for mobility and easy re-deployment
- Minimized capture-stitch-encode-transmit latency (camera-only latency)
- Integrated OZO spatial audio recording functionality

Nokia RXRM



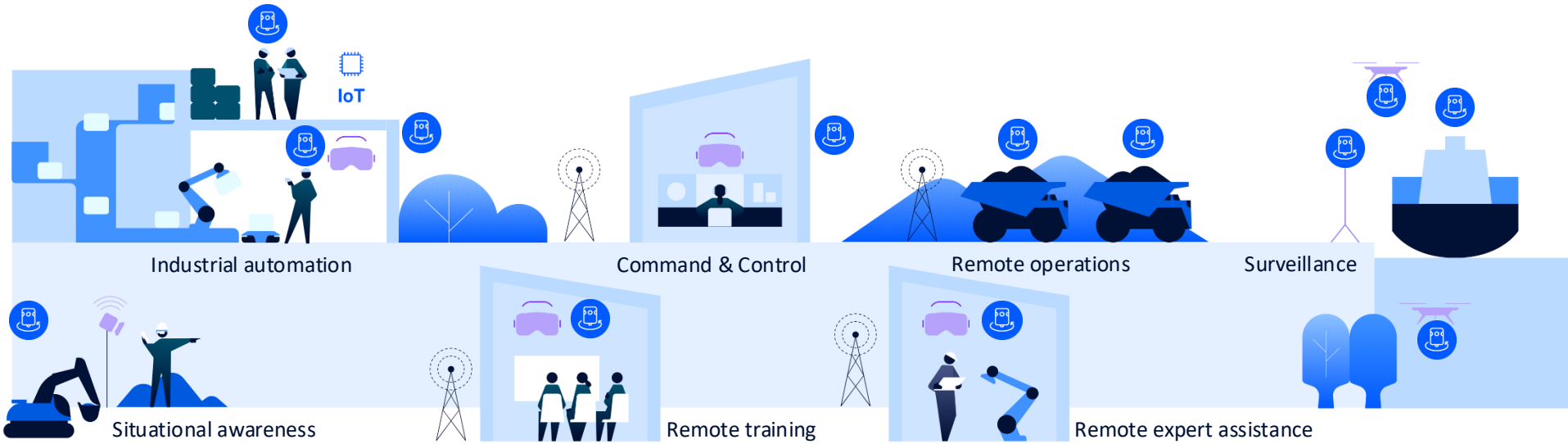
- Low latency high resolution immersive video streaming solution*
- Saves network capacity by reducing data rate up to 90% or more

Nokia industrial devices

- Nokia Mission Critical Industrial Edge (MXIE)
- Nokia 5G routers
- Nokia 5G Fixed Wireless Access devices

RXRM and Nokia 5G 360 Camera for various use cases

Any environment that can benefit from 360° multimedia streaming and spatial computing for operational efficiency, situational awareness and remote presence.



Nokia RXRM for Defense – use cases

Mission-critical use cases are unpredictable in both scope and scale.

RXRM provides a flexible and scalable setup, granting essential insight and a comprehensive view of real-time events – whether you're monitoring on the ground, in the air, or from thousands of miles away.

RXRM can be used e.g., for situational awareness, training, remote support, drone use cases and in equipment manufacturing.

RXRM solution for defense use cases

- Highly secure made in Finland cyber-secure system. Compliant with Nokia's high security standards, DefSEC policies and processes
- Combine mobile equipment with legacy and/or fixed camera setups for a holistic view
- Low bandwidth needs make the solution operable on any network
  - Movable tactical networks
  - Satellite networks
  - Private wireless networks
  - Public networks incl. Public network slice
- Opportunity to communicate with specialist experts remotely can save lives
- Remote accessibility saves on manpower and travel time

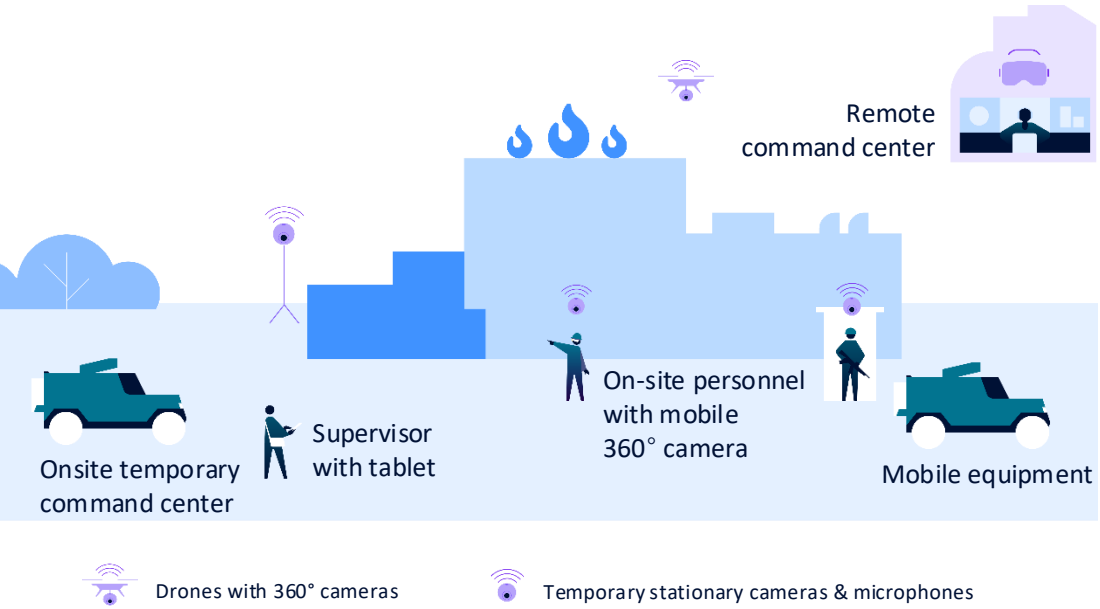
Nokia RXRM and Nokia 5G 360 Camera for mission critical applications

Increasing situational awareness of critical events and infrastructure

360° video and 3D audio in a comprehensive and fully scalable solution that can be applied to command and control in situational awareness, requiring a quick and effective response.

Drones, mobile cameras, temporary stationary cameras, and ground supervisors with mobile cameras transmit audio and video footage directly to command centers. This helps a central team to assess and manage the situation – ultimately saving lives.

Increasing situational awareness



Multimedia capture

360° video and spatial audio from mobile and stationary setups to capture multimedia streams for situational awareness.

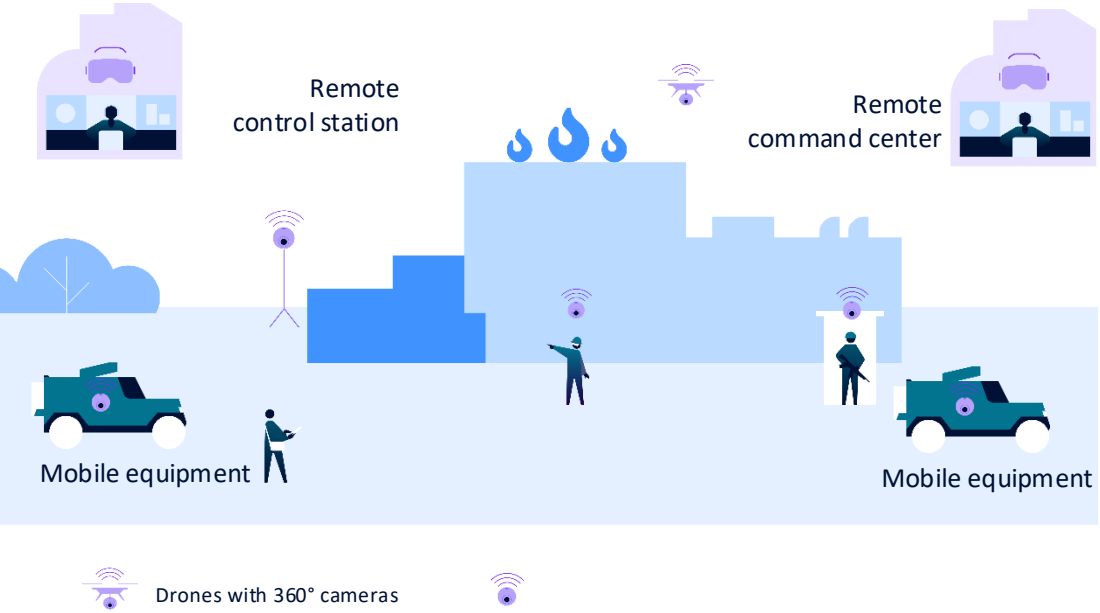
- Drones with 360° cameras
- Temporary stationary cameras & microphones
- Mobile cameras attached to on-site response personnel

Multimedia consumption

RXRM stream provides immersive multimedia for decision-making professionals (both onsite and offsite).

- Tablets used by onsite supervisors
- Decision-making personnel in temporary local command center
- Offsite command centers
- Media streams are saved for post-incident analysis

RXRM as multimedia platform



Multimedia capture

360° video and spatial audio from mobile equipment to capture the multimedia streams for situational awareness either in the equipment or remote operations and command centers

- Mobile equipment, drones with 360° cameras

Multimedia consumption

RXRM stream provides immersive multimedia for decision-making professionals (both onsite and offsite).

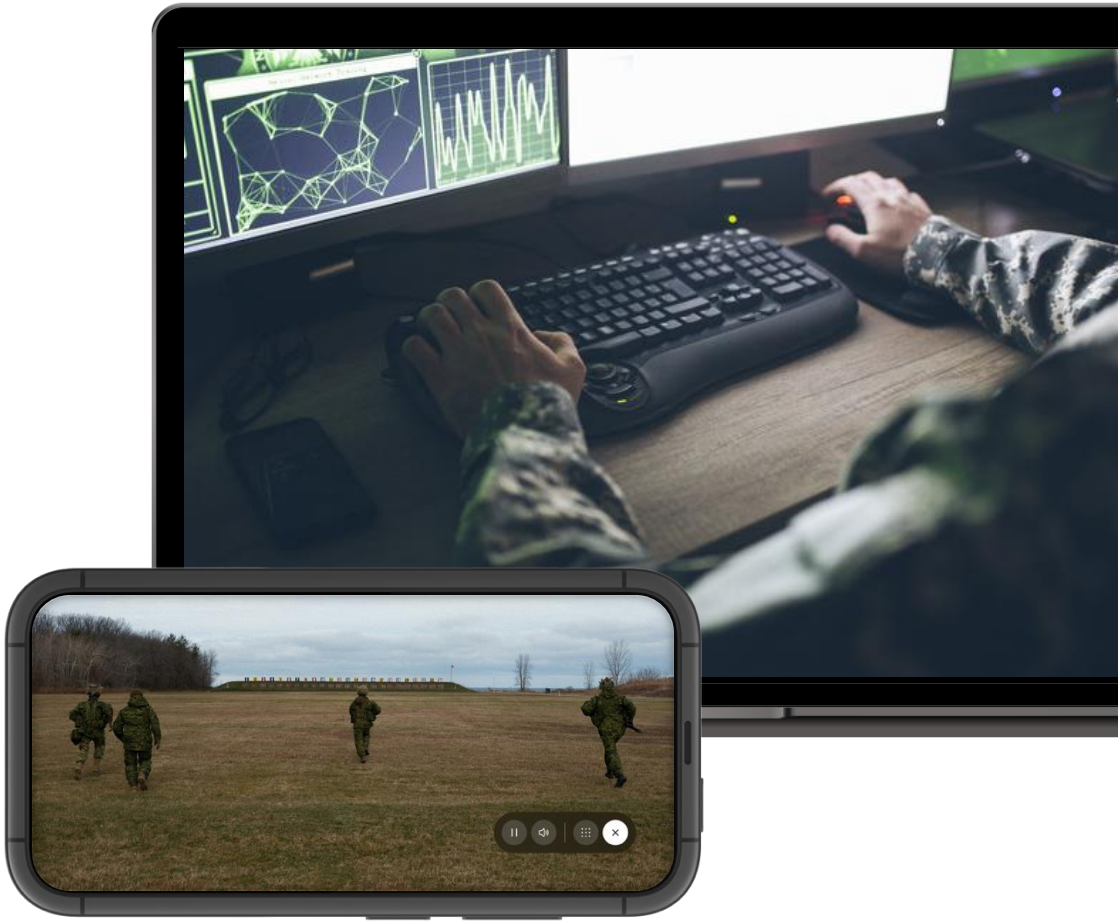
- On the equipment (for different purposes: for equipment operator, crew inside etc…)
- From equipment to equipment (if no connection to remote centers)
- Remote operations (teleoperation of equipment) and command centers
- Data fusion of additional information from for example visual analytics or other data sources
- Media streams can be saved for post-incident analysis

Training and education

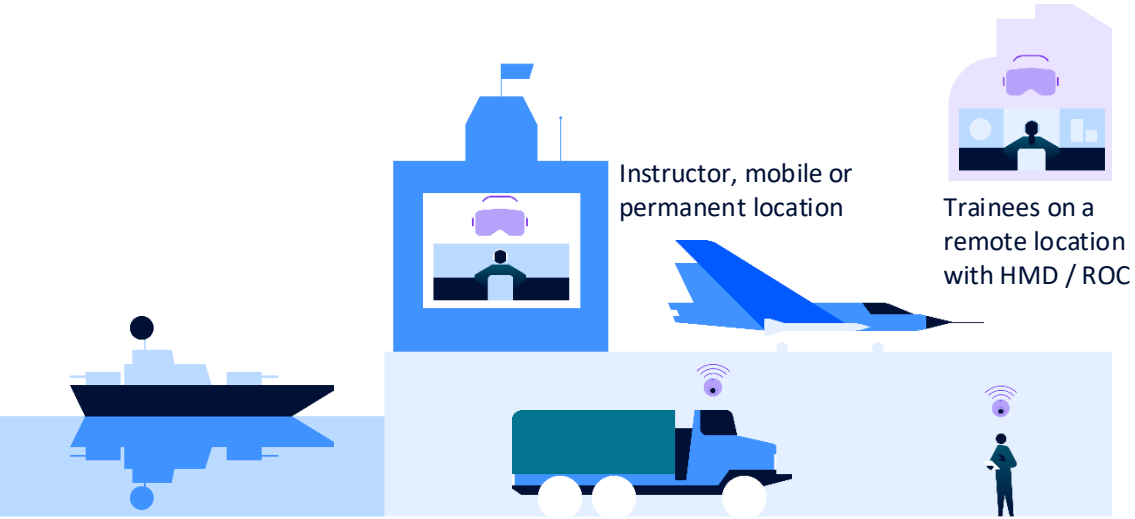
Training and education benefit from remote options in all situations. Utilizing 360° multimedia provides rich options for training and enables educating large amounts of people in short time frame.

Multimedia enhances the learning experience, whether in a dedicated training situation or instructions on the go. Multimedia training works well in versatile environments and with complex objects (e.g. machinery).

It caters to various learning styles and offers new opportunities for soft-skills training and on-boarding of new employees.



Training and education



360° cameras & microphones

Multimedia capture

Ultra-low latency 360° footage from a fixed training location or from a mobile set-up in the field

- Mobile 360° cameras & microphones
- Can be accompanied with fixed 2D cameras & microphones

Multimedia consumption

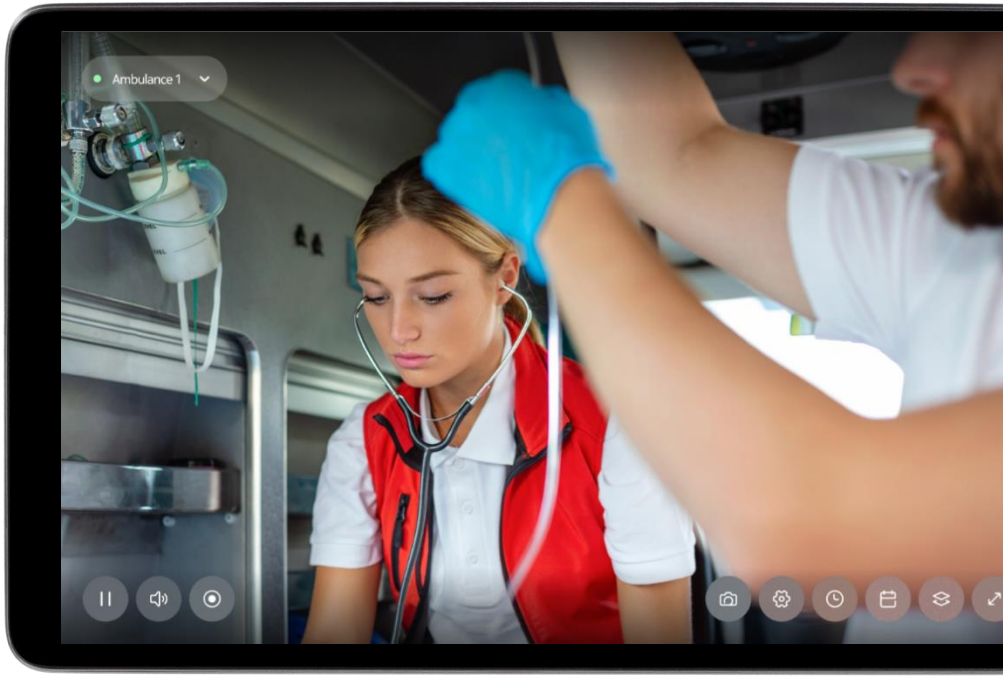
Trainees in various remote locations

- Viewing via HMD, ROC or laptop
- Media streams are saved for later viewing

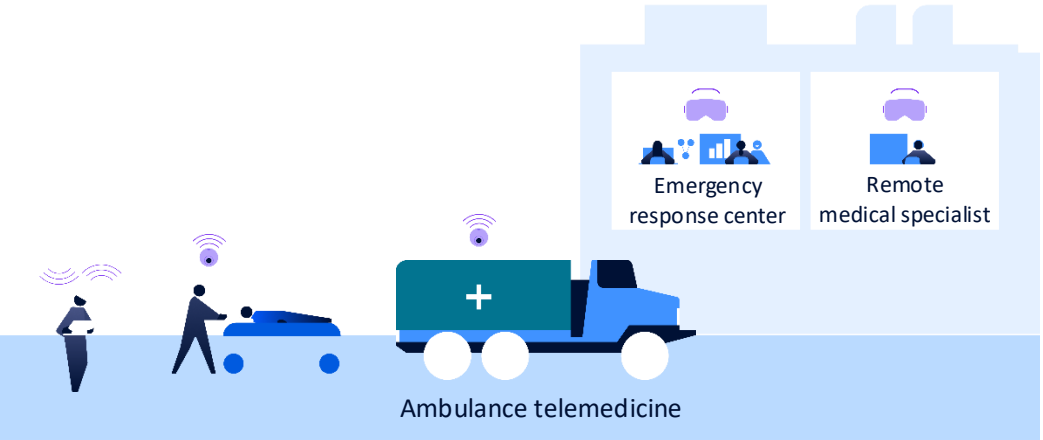
Remote support for telemedicine

RXRM's ultra-low latency and 360° streaming allow paramedic workers to communicate with specialist experts through a video link, offering victims an instantaneous and expert service that can be life-saving.

The remote specialist receives a comprehensive view of the situation for appropriate triage and maintains continuous communication with the on-site paramedics and the victim.



Remote support: telemedicine



Mobile 360° cameras & microphones

Multimedia capture

Paramedics utilize 360° camera and spatial audio to source medical expertise from an offsite specialist.

- Paramedics with mobile 360° cameras & microphones
- Ambulance with mobile 360° camera

Multimedia consumption

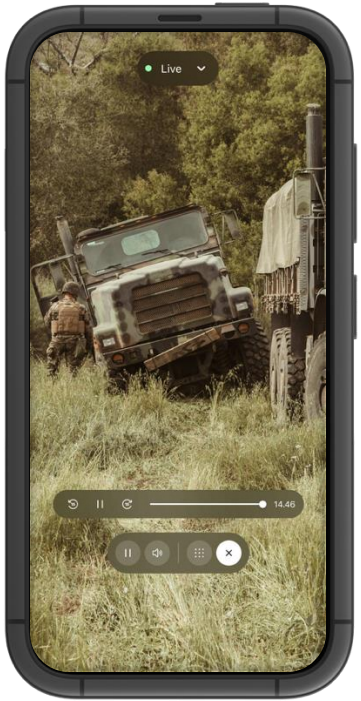
The offsite expert is able to triage the situation quickly and efficiently and assist in emergency care where necessary.

- Specialist medical expert in remote location
- Supervising personnel in emergency response center
- Onsite paramedic
- Media streams are saved for later analysis

Remote expert assistance

In the case of remote repair support, audio and visual information can be transmitted from the location to a remote expert to give prompt instructions on fast repair. Having the right person physically available isn't always possible across large operating environments, which is why RXRM can prove invaluable.

Near-zero latency ensures real-time responses, allowing expert advice to be implemented without unnecessary travel time or additional costs.



Remote expert assistance

Multimedia capture

An onsite technician can relay issues arising on the site.

- On-site technician with mobile 360° camera & microphone

Multimedia consumption

The remote specialist provides specialist technical assistance from a remote location.

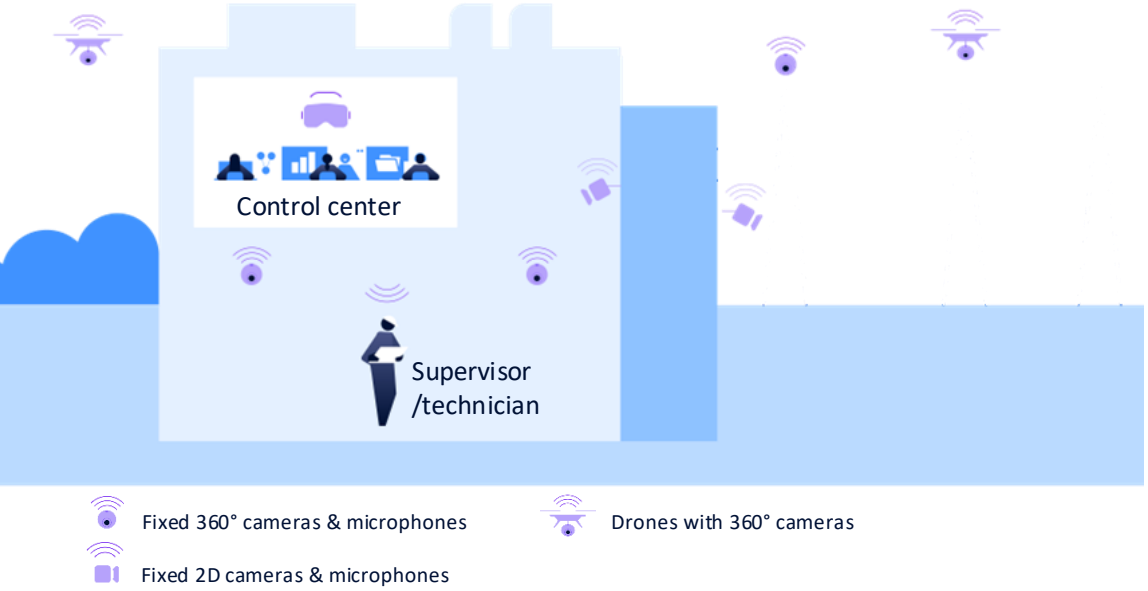
- Remote expert can assist in real time through a live discussion
- Recorded content can also be sent to a remote expert

360° view via drones and mobile cameras

Remote monitoring with drones eliminates the need for experts to visit sites to perform manual and potentially unnecessary labor. Personnel can be dispatched only when an issue arises that mandates an onsite visit.

Drones can be used to stream 360° video to remote experts, who can then provide guidance. Situational awareness can be managed from a central control center located on the premises or offsite. This approach reduces cross-site travel time and decreases the manpower needed for daily operations.

360° view via drones and mobile



Multimedia capture

Mobile and fixed cameras monitor plant and outdoor operations and relay 360° footage and 3D audio.

- Drones with 360° cameras
- Fixed 360 °cameras & microphones
- Fixed 2D cameras & microphones

Multimedia consumption

Onsite/remote staff receive immersive multisource audio-visual input for better situational awareness.

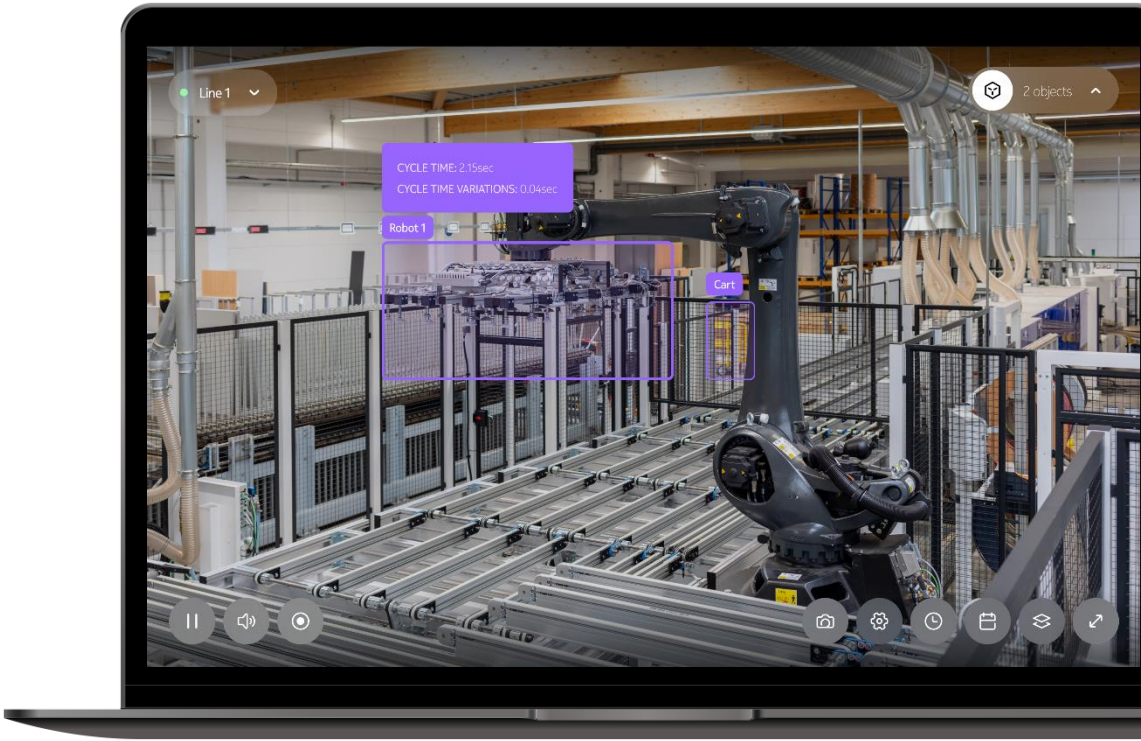
- Onsite supervisor/technician
- Remote control center
- Media streams also saved for later viewing

Industrial automation for defense manufacturing

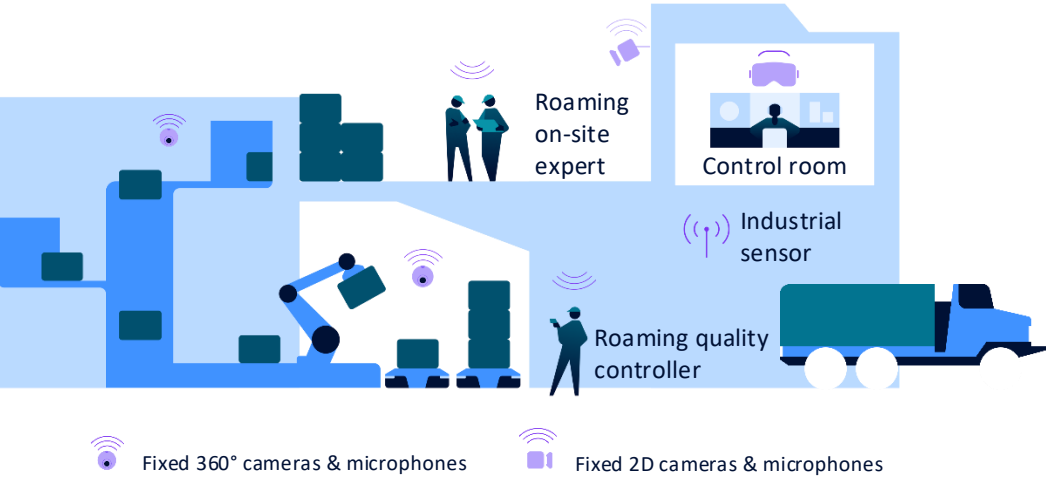
RXRM enables almost complete automation of industrial monitoring and quality control processes, utilizing video data analytics to check for issues or irregularities. Should an issue arise, a remote expert can be alerted.

With RXRM, you can also get access to third-party APIs. These can be used by video and audio analytics consultants and readily adapted to your needs.

Audio and visual information can be transmitted from a roaming quality controller to both the remote expert and control room. All three parties have ready access to the same data.



Industrial automation for defence manufacturing



Multimedia capture

A network of cameras and microphones provides superior situational awareness.

- Fixed 360° cameras & microphones
- Fixed 2D cameras & microphones
- Industrial sensors & microphones

Multimedia consumption

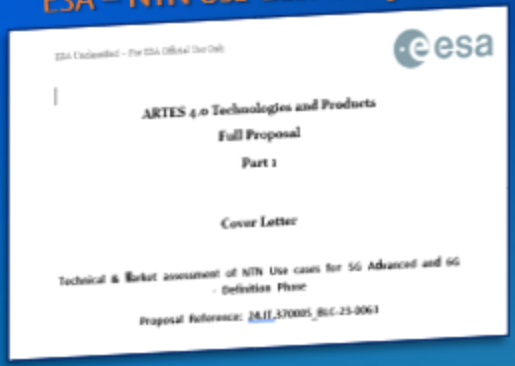
A team on the factory floor, in the onsite control center and in remote locations respectively are supported by video data analytics for semi-automated quality monitoring and control.

- 3rd party data analytics processor
- External IoT data
- Roaming quality controller
- Roaming on-site expert
- Control room
- Remote expert

Nokia Bell Labs references in space projects

ESA – NTN architecture study

ESA – NTN Use Case study



ESA – Satellite emergency POC

NATO – 5G sweet spot

IM-2 Mission

Component selection guidance (Bell Labs)
(environmental challenges heat, footprint, power)

Bell Labs Consulting


NOKIA

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