



Nokia Cognitive Operations

Maintaining control in complex
mission-critical operations

NOKIA

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Mission-critical organizations operate in environments that can change quickly. Teams must coordinate people, assets, communications and operational data, often across separate systems and locations. When information is fragmented, it takes longer to understand events and organize an effective response.

Operations are also becoming more distributed and automated. Sites increasingly depend on connected machinery and remote or autonomous equipment, while much of the supporting connectivity was originally designed for voice and radio traffic. A degraded connection can interrupt production, isolate a crew or stop a haul cycle.

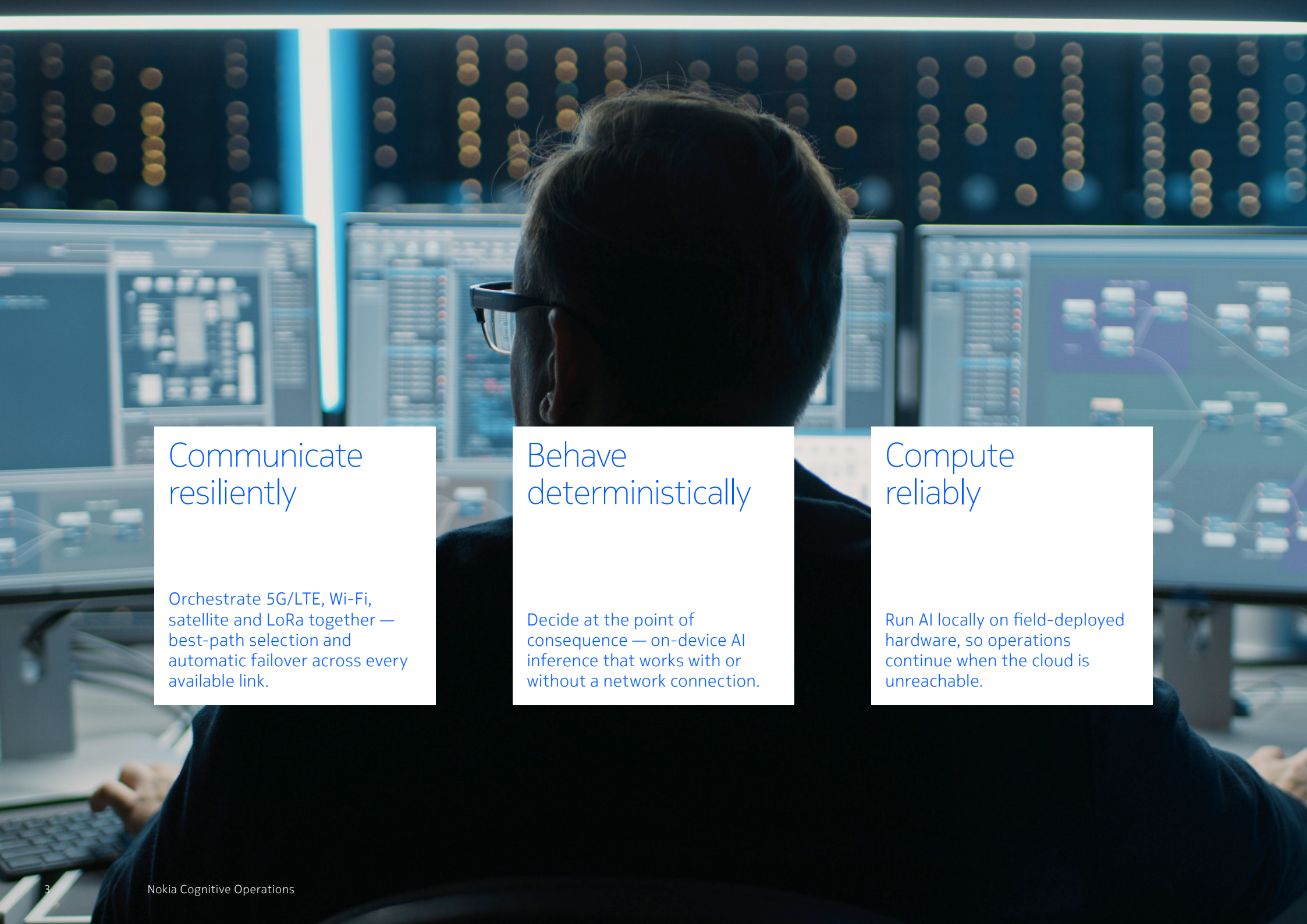
Some decisions cannot wait for information to travel to a control room and back. Collision warnings, fatigue alerts and connectivity issues may require an immediate local response. Teams need a current operational view and the ability to act closer to where events occur.

Nokia Cognitive Operations (NCO) brings communications, operational data, workflows and AI-supported decision capabilities into one shared environment. It gives teams a current view of mission activity so they can assess events, set priorities and coordinate the appropriate response.

NCO is a platform rather than a point solution. Once it is in place, adding fatigue detection, geofencing,

predictive maintenance or a new radio technology is a configuration and licensing decision, not another infrastructure project. Every new capability builds on what is already deployed.

NCO is designed for operations leaders, command centers, network teams and field teams that need a trusted real-time view of people, assets, connectivity and mission activity. The platform rests on three principles: communicate resiliently, behave deterministically and compute reliably.



Communicate resiliently

Orchestrate 5G/LTE, Wi-Fi, satellite and LoRa together — best-path selection and automatic failover across every available link.

Behave deterministically

Decide at the point of consequence — on-device AI inference that works with or without a network connection.

Compute reliably

Run AI locally on field-deployed hardware, so operations continue when the cloud is unreachable.

Connecting assets, systems and intelligence

NCO delivers a single operational environment that connects fixed, mobile and transportable assets, integrates critical systems and turns operational data into actionable intelligence. The result is enhanced situational awareness, faster decision-making and more effective operational coordination across the entire mission.

Designed for industries where operational continuity and rapid response are essential, NCO supports digital mining, emergency services and defense organizations seeking to improve safety, strengthen resilience and maximize mission success.

NCO integrates with existing field devices, sensors, cameras, communications systems and third-party platforms to build a common operational picture. The Cognitive Edge Node (CEN) extends NCO deeper into the field, adding connectivity, local intelligence and device integration at the asset itself.

NCO integrates at two levels. Through the CEN it interfaces directly with operational assets over CAN bus, IP, serial, digital I/O and ISO 15143-3, so equipment from any manufacturer can be brought into the same operational picture. At platform level it provides open APIs for third-party integration in both directions: other systems can consume NCO data, and NCO can consume theirs. Each source is integrated once and is then available to every application, so adding a system is a defined integration rather than a redesign.

NCO runs on-premises, on hardware the customer controls. That includes fully air-gapped sites, where working without a connection is a designed state rather than a degraded one. It is also available as a managed deployment through the Microsoft Azure Marketplace. Both options share the same applications and APIs. Customers can deploy either model across different sites and transition between them as operational requirements evolve. Sovereignty is built into the architecture: a hardware root of trust on every node, data encrypted in transit and at rest, zero-trust access, trusted sourcing and supply-chain practices, and data residency set per site. The architecture is compliance-ready for IEC 62443, ISO 27001 and NIST Cybersecurity Framework.



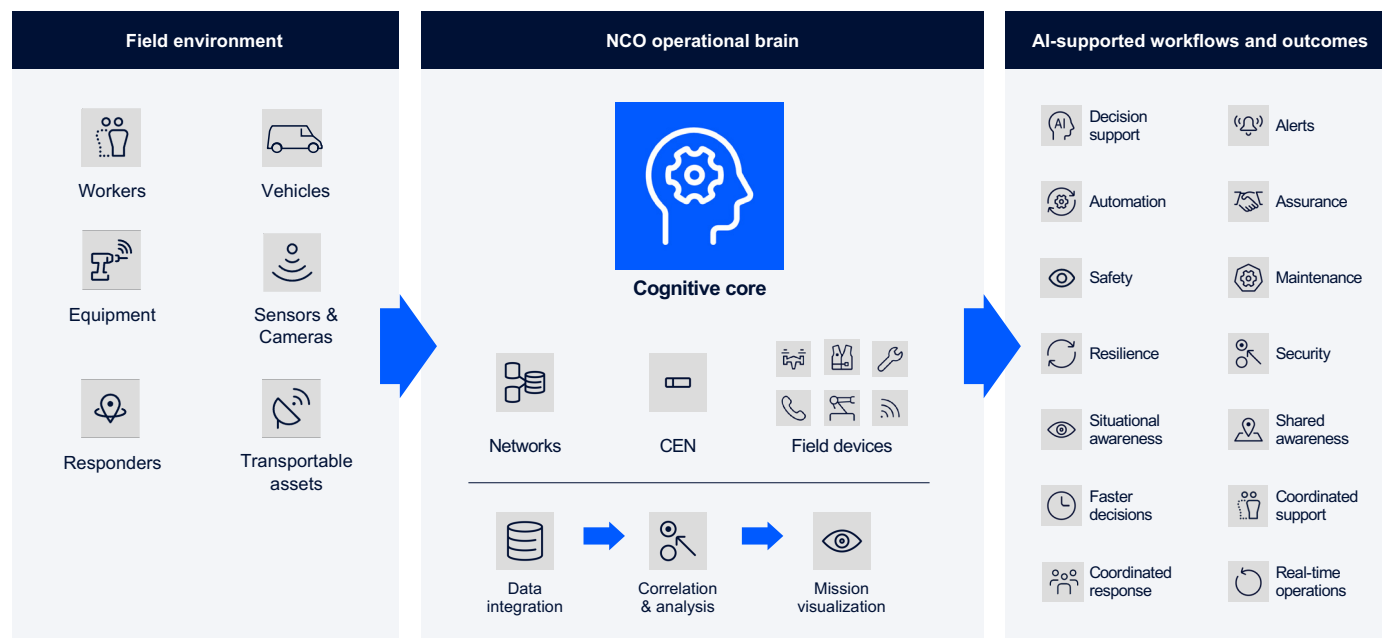
Building on a common operational foundation

Mission-critical organizations often add separate tools for asset tracking, worker safety, RF visibility, device monitoring and incident coordination. Each tool addresses a specific requirement, but the combined environment can create additional silos and operational complexity.

In a multivendor environment, each system may introduce another management interface, integration requirement and support process. As operations expand, every new capability can become another procurement and integration exercise rather than a straightforward configuration change.

NCO takes a platform approach by providing a common operational layer across people, assets, communications systems, CEN deployments and other field technologies. Teams build one trusted operational picture and expand it over time with new workflows, devices and AI-supported agents, without rebuilding the foundation for every new use case.

NCO common operational picture: from field data to coordinated action



Creating a trusted common operational picture

By connecting people, assets and operational information in one shared view, NCO helps teams make faster decisions, coordinate resources more effectively and maintain control as conditions change.

NCO combines operational data, network intelligence and device management in one environment, giving teams the context they need to coordinate people, assets and responses. Digital twin, RF intelligence and SLA-driven device management work together to provide the visibility and context teams need to coordinate people, assets and responses across the mission.

AI-powered decision support helps operators detect anomalies, identify emerging risks, prioritize incidents and surface recommended actions in live operational context, drawing on asset location, device status, network performance, environmental conditions and operational events.

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Core operational intelligence capabilities

NCO addresses network monitoring first, and does so from both sides. It monitors the infrastructure — RAN towers, core and transport — and every connected device, vehicle and UE: signal quality, coverage, latency, throughput and availability, in one view. Tools that sit outside the network see it from the device outward or from the infrastructure inward, never both. That is why a degraded haul cycle and the cell that caused it are still two separate investigations. NCO closes that gap and replaces the standalone monitoring layer rather than operating alongside it. The capabilities that follow are what the platform adds on that foundation.

Network visibility and automated insights

End-to-end visibility from the RAN tower to the connected device: coverage, signal quality, latency, throughput, availability and link health across 4G, 5G, Wi-Fi, satellite and mesh. Alerts are configurable by site, asset and threshold, and delivered in the channels each team already uses.

NCO goes further than alerting: it correlates anomalies across asset behavior, network performance and application performance, and names the probable cause instead of leaving three dashboards to be reconciled by hand.

Digital twin of the operation

Create a live, 3D digital replica of the operational environment that continuously updates with KPI data, device and personnel locations, and operational events. Buildings, zones, personnel and equipment are linked to the data behind them, and every measurement is stored and searchable. Teams see where events are unfolding and correlate asset movement with performance, safety and connectivity conditions.

Operational and RF heatmaps

Visualize network and operational performance with interactive geographic heatmaps and radio analytics. Operations and network teams see coverage, find connectivity gaps and pinpoint where to act.

Historical maps replay past measurements, and Kriging interpolation fills the space between them to predict coverage across the whole site — exposing dead zones before anyone reports them. The same map plots any KPI the platform collects, not only radio metrics: vehicle speed, payload tonnage, fuel consumption and CAN bus telemetry. Production and connectivity can be read against the same geography. RF planning and drive testing run in the same application, so coverage is designed, validated and monitored in one place.

Asset tracking and geofencing

Track every vehicle, machine and worker in real time, with position, connectivity and device health on the same record. Geofenced zones are drawn on the site map and enforced automatically: entering or leaving a zone can switch network, raise an alert, log an event or trigger a custom action. Positioning uses multi-constellation GNSS, with centimeter accuracy where RTK is available.

Historical data and prediction

Every measurement is retained, indexed and replayable, so an incident can be reconstructed exactly as it happened rather than reasoned about afterwards. The same history feeds the models: trends are projected forward to anticipate degradation, congestion and equipment failure before they affect the operation. Retention depends on the storage provisioned and extends to a full year, so a site can hold a complete seasonal cycle rather than a rolling window.

SLA-driven networking and device management

Monitor device health, operator fatigue, location, connectivity and service-level performance from a single interface. Teams identify failing devices, degraded links and performance issues before they disrupt the mission. Traffic is bonded across every available link and steered by SLA, and tunnels are established make-before-break: the node brings the next path up before releasing the current one, so switching between

cellular, Wi-Fi and satellite occurs without packet loss. Voice, video and control sessions continue uninterrupted through the transition.

Camera and edge AI applications

Connected cameras and on-device inference turn video and sensor data into action at the asset. Typical workloads include fatigue and alertness detection for drivers and operators, collision avoidance and hazard warning, predictive maintenance from vibration and thermal signatures, and video and data compression that makes high-value footage transportable over a constrained link. The models run on the CEN itself. Detection and monitoring functions remain available even when connectivity is limited.

NCO-BOT operations assistant

Query KPIs across 4G, 5G and Wi-Fi in plain language, analyze trends across any time window, generate plots and heatmaps on demand, and isolate root causes automatically. Log analysis that used to take hours of

manual investigation returns an answer in seconds.

Predictive notification engine

Reports, test runs, drive-test results and issue records are generated automatically from live systems, and raised before a condition becomes a failure. Predicted degradations and emerging faults are routed to the team that owns them, in the online channels they already use. Teams receive a notification with the supporting evidence attached, ahead of the failure rather than after a threshold has been crossed or a user has reported it.

NCO supports resilient operations by keeping teams aligned around a shared mission view and enabling local decision-making closer to the field when paired with CEN.

Extending operational intelligence to the field

NCO extends its common operational picture across the field by connecting stationary, mobile and transportable assets through existing devices, communications systems and Nokia Cognitive Edge Node deployments. CEN extends connectivity across the operational environment and provides real-time visibility of asset location, status and performance where needed. NCO coordinates connectivity across available networks, selecting and managing paths according to operational and service requirements.

Latency is the determining factor. A fatigue-detection system that depends on a cloud round trip to warn a driver responds too late to prevent the incident, and a vehicle that waits for a remote decision before braking is not operating autonomously. Mission-critical decisions must therefore be made at the point of consequence, with or without a network.

This enables teams to maintain situational awareness, improve coordination and make faster, more informed decisions across dynamic or infrastructure-limited environments, while keeping NCO as the central operational intelligence layer.

NCO in action

NCO is delivered today in three industry solutions — NCO for mining, NCO for emergency services and NCO for defense — each building a common operational picture for its most demanding environments.

The platform is modular, so serving a new industry is an application decision rather than a new deployment. The same operational layer, the same nodes and the same agents extend to adjacent sectors — construction, energy, ports and maritime, rail and logistics — reusing what is already in place.

Solution area	Operational impact
NCO for mining	Connect workers, vehicles and fixed equipment in a live view of the mine. Local applications support fatigue detection, collision warnings and other time sensitive functions on the vehicle. Operational and connectivity data can be viewed together, helping teams understand how network conditions affect safety and production.
NCO for emergency services	Give incident command a current view of responders, vehicles, communications and incident data. Response vehicles can carry connectivity, computing and situational awareness capabilities directly to the incident area. Satellite and mesh connections help maintain essential functions when public network service is limited or unavailable.
NCO for defense	Maintain a shared operational view across fixed, mobile and transportable assets in denied, degraded, intermittent and limited environments. Multiple paths across 5G, mesh and satellite help keep command posts and field teams connected. Local processing allows selected applications to continue when external connectivity is unavailable.



Expanding intelligence with AI-supported agents

NCO is a platform that grows with operational requirements. Organizations extend the common operational picture with AI-supported agents for safety monitoring, predictive maintenance, logistics, security, environmental monitoring and operational intelligence. This helps teams add new use cases as mission needs evolve while continuing to work from the same trusted operational environment.

These agents form an expandable ecosystem of Nokia, partner and customer-developed capabilities.

- **Safety agents:** fatigue detection, worker safety and hazard monitoring
- **Maintenance agents:** equipment health, vibration analysis and thermal anomaly detection
- **Security agents:** perimeter monitoring, access control and threat classification
- **Environmental agents:** air quality, dust, noise and hazard monitoring
- **Operational intelligence agents:** production throughput, shift analytics and SLA tracking

Delivering better operational outcomes

- **Improve visibility:** bring people, assets, activities, network performance and operational events into a trusted real-time mission view.
- **Strengthen coordination:** enable teams and resources to work from the same source of operational context.
- **Accelerate decisions:** give operators, supervisors and decision makers the information they need to understand changing conditions and prioritize actions.
- **Increase resilience:** maintain control through real-time visibility, SLA-driven device management and shared situational awareness.
- **Turn data into intelligence:** convert fragmented operational data into insights that identify risks, optimize resources and improve mission outcomes.

Partnering with Nokia

Nokia combines mission critical communications, industrial edge technology and operational software in a scalable architecture. Customers can begin with a focused requirement, such as asset tracking, incident coordination or network visibility, and expand using the same platform as additional sites, devices and workflows are added.

The result is a more consistent view of operations, with the information and local intelligence teams need to coordinate an effective response.

Getting started

Start with a clearly defined operational requirement at one site. Identify the devices, data sources and teams involved, then establish the initial operational view and priority workflows. The deployment can later expand to additional assets, applications and locations. Contact your Nokia representative to discuss the appropriate starting point.

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