EON AI Ventures

Intrinsically safe solution in Hazardous Industrial Environments

A practical framework for offline Work Intelligence on appropriately certified hazardous-area field equipment

Field IQ Edge is designed to carry mission-scoped intelligence to the worker while preserving clear hardware, software and safety boundaries.

Table of Contents

Executive summary

Industrial work crosses boundaries that cloud software often ignores. A technician may move from full connectivity into a metal-dense plant, an offshore module, a remote utility corridor, an aircraft apron or an intentionally isolated network. In hazardous areas, the worker may face a second boundary: ordinary consumer electronics may not be approved for the location because electrical or thermal energy could become an ignition source.

Field IQ Edge is EON AI Ventures' framework for extending Work Intelligence across both boundaries. It is an offline-capable deployment profile of Field IQ, not a new product ecosystem. It carries a secure, signed and mission-specific package to an approved device so the worker can recognize known equipment, retrieve approved sources, follow deterministic workflows, capture evidence and synchronize the result when connectivity returns.

CENTRAL PROPOSITION

The objective is not to run the largest possible model on a field device. It is to deploy the smallest verified package that can safely support the assigned mission—and to make its limits visible.

This paper makes a critical distinction. Software is not intrinsically safe. The phrase describes a protection technique and an approved equipment configuration for a particular hazardous location. A valid deployment therefore requires two independent forms of assurance: the hardware configuration must be approved for the site classification, and the software mission must be bounded, validated and governed for the work being performed.

Five conclusions

1. Certified field computing is already a real device category. Modern smartphones, tablets and hands-free wearables are available with manufacturer-declared hazardous-area approvals for specific models and regions.
2. "Rugged," "industrial," "explosion-proof" and "intrinsically safe" are not interchangeable. Procurement must match the exact marking and certificate to the actual site classification and operating conditions.
3. Offline intelligence should be mission-scoped. Recognition, approved knowledge, workflow, safety logic, evidence and synchronization belong in one signed package with a defined validity period.
4. Generative models should assist, not authorize. Deterministic workflow, permission and stop logic remain the execution authority.

5. The right first step is a bounded pilot on one exact device configuration—not an enterprise-wide promise.

1. The double boundary in field work

The places where expertise matters most are often the places where cloud dependence is least reliable. Steel structures attenuate radio signals. Remote and underground sites may have sparse coverage. Regulated facilities segment networks. Cybersecurity teams may intentionally block public cloud access. Emergency conditions may remove infrastructure at the moment it is most needed.

Hazardous locations add a physical constraint. OSHA 29 CFR 1910.307 requires electrical equipment used in hazardous classified locations to be intrinsically safe, approved for the hazardous location or otherwise demonstrated safe for that location. Approval must consider the location class or zone, the relevant gas, vapor, dust or fiber, and applicable temperature marking. In the European Union, Directive 2014/34/EU governs equipment and protective systems intended for potentially explosive atmospheres, while Directive 1999/92/EC establishes minimum workplace protections for workers potentially exposed to explosive atmospheres. [1–4]

Boundary	What can fail	Design response
Connectivity	Cloud inference, enterprise search, remote expert calls and live synchronization become unavailable.	Keep the bounded mission executable locally; show the active intelligence source and queue evidence.
Hazardous location	A consumer device or accessory may be an ignition risk or may simply lack approval for the area.	Select the exact certified configuration for the site's zone/division, group and temperature requirements.
Operational authority	A model may generate plausible but unauthorized steps.	Place procedures, permissions, prerequisites and stop conditions in deterministic controls.

DESIGN IMPLICATION

The device certificate and the software safety case solve different problems. Both must be valid at the same time.

2. What "intrinsically safe" actually means

Intrinsic safety limits electrical and thermal energy so a circuit cannot ignite a specified explosive atmosphere under defined conditions. It is one recognized protection technique among several. Explosion-proof or flameproof equipment follows a different strategy: it

contains an internal ignition and prevents propagation to the surrounding atmosphere. A device can be rugged without being approved for a hazardous area, and it can be approved for one hazardous classification without being suitable for another.

The selection variables

- Area system and severity: Zone 0/1/2 for gas or Zone 20/21/22 for dust; alternatively the North American Class/Division system.
- Material group: the gas, vapor or dust group for which the equipment has been evaluated.
- Temperature class and ambient range: the device surface temperature and environmental limits must be compatible with the hazard.
- Protection method and level: for example Ex ia, Ex ib or Ex ic, together with the equipment protection level.
- Exact commercial configuration: device model, battery, scanner, headset, cable, case, docking station and every accessory that enters the classified area.
- Jurisdiction and site approval: ATEX, IECEx, NEC/CEC and national schemes are not automatically interchangeable.

Gas zone	Presence of explosive atmosphere	Typical ATEX equipment category
Zone 0	Present continuously, frequently or for long periods.	Category 1
Zone 1	Likely to occur occasionally during normal operation.	Category 1 or 2
Zone 2	Not likely in normal operation; if it occurs, it persists briefly.	Category 1, 2 or 3

Dust zones 20, 21 and 22 follow the same frequency logic for combustible dust clouds. Source: UK Health and Safety Executive guidance summarizing hazardous-area definitions and ATEX category mapping. [5]

3. The 2026 certified field-device landscape

The field-computing choice is no longer limited to basic radios or obsolete handhelds. Current manufacturer portfolios show credible compute, cameras, wireless connectivity and ruggedization across multiple form factors. The examples below are representative, not endorsements. Certification is configuration- and market-specific; the controlling certificate and safety instructions must be reviewed for the exact SKU.

Form factor	Representative device	Manufacturer-declared approval	Why it matters for Field IQ Edge
5G smartphone	i.safe MOBILE IS540.1	ATEX / IECEx Zone 1/21	Qualcomm QCM6490, 48 MP camera, Wi-Fi 6 and mobile AI capacity support recognition and local workflows. [7]
5G smartphone	BARTEC SP9EX1	ATEX / IECEx markings include Ex ia IIC T4 Ga; NEC Class I Div. 1 groups A–D	Modern compact handheld with 5G, 48 MP camera, IP68 and a high-performance chipset. [10]
10.1-inch tablet	i.safe MOBILE IS940.1	ATEX / IECEx Zone 1/21; NEC Class I Div. 1 and related dust approvals	Android 14, QCM6490, 8 GB RAM, 128 GB storage, cameras, glove use and replaceable battery. [8]
10-inch tablet	BARTEC ET60/65EX2	ATEX / IECEx Zone 2/22; NEC/CEC variants	Android 14, QCM6490, Wi-Fi 6E and 5G options; useful where a larger screen and scanning matter. [11]
Hands-free wearable	RealWear Navigator Z1	ATEX Zone 1, IECEx and CSA Class I Div. 1 declarations	Monocular display, voice operation, QCS6490, 8 GB RAM and 128 GB storage support guided work while hands remain available. [9]

Illustrative hands-free field experience. Deployment depends on the exact device certificate, approved accessories, task ergonomics and site authorization.

The practical hierarchy

1. Start with the certified handheld. A phone or tablet provides the most complete camera, touch and evidence baseline.
2. Add a hands-free display where the task and certification justify it. The wearable should share the same workflow state rather than create a separate product.
3. Add an approved site-edge service only when the mission requires more compute, local integration or multi-user support.
4. Treat every accessory as part of the configuration. Charging, docking, scanning, thermal imaging, audio and protective cases can change what is permitted.

4. Field IQ Edge: a Digital Twin beyond connectivity

Field IQ Edge extends Field IQ into connected, degraded and fully offline conditions. It does not copy the entire enterprise Digital Twin to every device. Instead, the Work Intelligence Distillery produces a Mission Intelligence Package for a defined customer, site, role, work order, asset set, device profile, connectivity condition and risk envelope.

PRODUCT PROMISE

Carry the right intelligence into the work, preserve the approved operating boundary, and bring governed evidence back.

What the worker can do locally

- Recognize a trained asset class and visible components.
- Confirm the specific asset using OCR, QR or NFC, location, work-order context and Digital Twin relationships.
- Open the approved procedure, drawing, checklist, animation or troubleshooting branch.
- Ask bounded natural-language questions against approved local sources.
- Receive concise visual, spoken or AR guidance controlled by deterministic workflow state.
- Capture readings, photos, video, voice notes, exceptions and completion evidence.
- Queue signed events for synchronization and later assessment.

What it is not

- Not an autonomous control system and not a default path to actuate industrial equipment.
- Not a general chatbot expected to solve every situation.
- Not a substitute for a qualified operator, responsible engineer or site procedure.
- Not a claim that EON software creates or extends a device certification.
- Not unrestricted access to all enterprise knowledge while offline.

5. The Mission Intelligence Package

The deployable artifact is an operational capability, not merely a small language model. Each component has a clear authority and update path.

Component	Purpose	Authority boundary
Perception	Vision models, OCR, QR/barcode, NFC and signal fusion recognize known assets and components.	Produces candidates and confidence; does not independently authorize critical work.
Approved local knowledge	Encrypted procedures, manuals, drawings, glossary and a local retrieval index.	Every procedural answer exposes source and revision.
Digital Twin subset	Assets, relationships, locations, dependencies and allowed states needed for the mission.	Bounds identity and context to the assigned work.
Workflow engine	Versioned sequence, prerequisites, conditional branches and interruption recovery.	Authorizes progression; the generative layer cannot bypass it.
Safety policy	Stop conditions, role permissions, evidence contracts, stale-content rules and escalation.	Overrides generative suggestions and normal progression.
Evidence ledger	Readings, media, confirmations, events, versions and hashes.	Creates a reconstructable record for Assess IQ and review.
Synchronization	Resumable upload, deduplication, conflict handling, revocation and package updates.	Returns evidence without silently overwriting approved truth.

Illustrative local recognition and step guidance on a rugged tablet. The user interface must distinguish model suggestions from approved instructions.

6. One experience across three connectivity states

Mode	Available intelligence	Worker experience
Connected	Full enterprise search, remote collaboration, large-model reasoning, live simulation and global analytics.	The same task experience may call approved cloud services when policy permits.
Degraded / site-local	Mission package plus optional on-premises models, sensor access and local expert services.	The task continues while bandwidth and service availability change.
Offline	Only the signed local package, cached sources, local models, deterministic controls and evidence queue.	The interface shows the offline state, package validity and unavailable capabilities.

Offline is not binary. Some capabilities are easy to bound and validate locally—content, checklists, trained recognition and tag reading. Others demand more context and compute—open-ended reasoning, enterprise-wide retrieval, remote expert collaboration and live simulation. Field IQ Edge should make this capability gradient visible rather than pretending every cloud function is local.

7. Generative assistance and deterministic authority

Generative assistance	Deterministic execution authority
Recognize and retrieve; summarize approved content; explain current state; ask clarifying questions; estimate confidence; recommend escalation.	Confirm asset identity; enforce procedure sequence and prerequisites; apply safety stops; check role and certification; require evidence; pin versions; record the audit trail.

SAFE BEHAVIOR

When identity is uncertain, signals conflict, the package is expired, required evidence is missing or the job moves outside the mission boundary, the system should clarify, stop or escalate—never guess.

8. Reference architecture

The recommended architecture is device-first, gateway-optional and cloud-enhanced. The core approved mission remains executable on the device. A site edge tier may add larger models, local sensor aggregation and multi-user services without public internet. The cloud retains the complete Digital Twin, enterprise governance, package manufacturing, large-scale simulation and continuous improvement.

Illustrative site-edge configuration. Hardware approval, enclosure, installation and interfaces require separate engineering review.

Tier	Primary responsibility	Failure posture
Certified device	Immediate perception, approved retrieval, workflow, safety rules, evidence and bounded assistance.	Complete or safely stop the mission without cloud dependence.
Optional site edge	Larger local models, sensor integration, multi-user coordination and site-wide services.	Device retains its local safety boundary if the gateway disappears.
Cloud / enterprise	Full Digital Twin, simulation, cross-site analytics, model training, package registry and Distillery.	Loss of cloud does not silently change the active local procedure.

9. The deployment decision starts with the site

1. Obtain the authoritative hazardous-area classification and permitted work practice from the site owner.
2. Identify the gas, vapor or dust group, temperature requirement, ambient range and jurisdiction.
3. Choose the exact device and every accessory; collect the certificate, marking, safety instructions and operating limitations.
4. Define the mission: role, asset set, approved procedure, abnormal conditions, stop rules, evidence and offline duration.
5. Benchmark perception, storage, latency, battery, thermal behavior, camera quality, speech and ergonomics on that exact hardware.
6. Compile and sign the Mission Intelligence Package; record provenance, versions, validity, rollback and revocation.
7. Validate in controlled conditions, then in the intended work area under the site's management-of-change and safety process.

Procurement questions that prevent expensive mistakes

- Does the certificate cover the exact model number and region being purchased?
- Does the marking match the site zone/division, group and temperature requirement?
- Are the battery, scanner, audio device, thermal camera, case, cable and charging workflow approved?
- Can the device run the required OS version, enterprise management, local AI runtime and storage footprint?
- Can it be used with gloves, in noise, under expected lighting, and for the full shift without unsafe charging or battery changes?
- Who owns certificate review, application validation, cybersecurity approval, site authorization and worker training?

10. A bounded 90-day pilot

Phase	Work	Evidence
Days 0–30: qualify	Select one classified area and exact device configuration; choose 20–50 known assets and one inspection plus one maintenance workflow; define stop conditions and test sets.	Certificate fit review, mission scope, benchmark baseline, approved sources and acceptance plan.
Days 31–60: build	Train recognition for known assets and components; compile workflows and safety policy; create the signed package; test in airplane mode, PPE, noise and difficult lighting.	Identity, source fidelity, latency, battery, workflow, refusal, recovery and tamper results.

Days 61–90: run	Technicians execute bounded jobs; evidence synchronizes to Assess IQ; validated deltas become governed improvement candidates.	Mission completion, safe fallback, evidence integrity, user trust, synchronization and one closed learning loop.

PILOT SUCCESS

Prove operational fit, not a theatrical demo: correct identity, correct source, usable local response, deterministic stops, durable evidence, safe failure and successful synchronization.

11. Business implications

When properly bounded, offline Work Intelligence converts connectivity resilience from a technical feature into an operating advantage. Workers can retain approved guidance in dead zones. Common recognition and retrieval can occur locally. Sensitive field evidence can remain device- or site-resident until policy permits synchronization. The enterprise gains a better record of what happened at the point of work.

- Continuity: core workflows remain available when public connectivity disappears.
- Safety alignment: approved instructions and stop conditions remain at the point of work.
- Faster resolution: asset-specific guidance reduces manual search and avoidable escalation.
- Data control: mission scoping limits what is carried and what leaves the site.
- Expertise preservation: validated operational knowledge travels across workers and shifts.
- Compounding value: governed field evidence can improve the next Digital Twin and package release.

12. Claims we deliberately do not make

- We do not claim that software, an application build or an AI model is intrinsically safe.
- We do not claim that one certificate makes a device suitable for every country, zone, gas, dust, temperature or accessory combination.
- We do not claim that generative AI should authorize safety-critical work.
- We do not claim that every mission can or should run fully offline.
- We do not claim that a representative manufacturer specification replaces certificate and site review.
- We do not claim availability or performance until the chosen package is tested on the exact device and mission.

NORTH STAR

The Digital Twin should not end at the screen, the control room or the network boundary. Field IQ Edge carries a governed portion into the work itself—and brings verified evidence back.

Conclusion

The opportunity is not to force cloud AI into every environment. It is to engineer a trustworthy bridge between enterprise intelligence and real work. Certified field devices provide the physical platform. The Mission Intelligence Package provides the bounded operational capability. Deterministic controls preserve authority. The Work Intelligence Distillery manufactures, validates and updates the package. Assess IQ and Compound IQ turn governed evidence into the next improvement cycle.

This is a disciplined path to field AI: qualify the location, select the exact hardware, scope the mission, verify the package, expose the limits, capture the evidence and improve only through governance.

Appendix A. Standards and terminology map

Term	Meaning in this paper
ATEX 2014/34/EU	EU equipment directive covering equipment and protective systems intended for potentially explosive atmospheres.
ATEX 1999/92/EC	EU workplace directive on minimum safety and health protection for workers potentially at risk from explosive atmospheres.
IECEx	International certification system based on IEC and ISO standards for Ex equipment and related services.
OSHA hazardous classified location	A U.S. regulatory framework in which equipment must be suitable and approved for the specific hazardous location.
Intrinsic safety	A protection technique limiting electrical and thermal energy under defined conditions.
Zone / Division	Alternative systems describing how likely an explosive atmosphere is to be present.
Equipment group / gas or dust group	Classification of the material hazard and the equipment's approved coverage.

Temperature class	Maximum equipment surface-temperature classification relevant to ignition risk.
Mission Intelligence Package	EON term for the signed, versioned bundle of local perception, knowledge, twin subset, workflow, safety, evidence and synchronization assets.

Appendix B. Sources

[1] U.S. Occupational Safety and Health Administration, 29 CFR 1910.307, "Hazardous (classified) locations." https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.307

[2] U.S. Occupational Safety and Health Administration, 29 CFR 1910.399, definitions of acceptable, labeled and listed equipment. https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.399

[3] European Union, Directive 2014/34/EU on equipment and protective systems intended for use in potentially explosive atmospheres. https://eur-lex.europa.eu/eli/dir/2014/34/oj/eng

[4] European Union, Directive 1999/92/EC on minimum requirements for workers potentially at risk from explosive atmospheres. https://eur-lex.europa.eu/eli/dir/1999/92/oj/eng

[5] UK Health and Safety Executive, hazardous-area definitions and ATEX equipment categories. https://www.hse.gov.uk/electricity/atex/definitions.htm

[6] IECEx, standards operated by the IECEx System, including the IEC 60079 family. https://www.iecex.com/resources-and-news/standards/

[7] i.safe MOBILE, IS540.1 manufacturer product information. https://www.isafe-mobile.com/en/company/news/detail/is5401-das-weltweit-erste-explosionsgeschuetzte-5g-smartphone

[8] i.safe MOBILE, IS940.1 manufacturer product and approval information. https://www.isafe-mobile.com/en/products/product-range/zone-1/21/is9401

[9] RealWear, Navigator Z1 specifications and certification statements. https://shop.realwear.com/products/realwear-navigator-z1

[10] BARTEC, SP9EX1 smartphone manufacturer product and marking information. https://bartec.com/products-solutions/product-finder/product-detail/bartec-sp9ex1-smartphone

[11] BARTEC, ET60/65EX2 Android tablet manufacturer product and marking information. https://bartec.com/products-solutions/product-finder/product-detail/bartec-et60-65ex2-android-tablet

[12] EON AI Ventures, Field IQ Edge White Paper Draft v1, Product Specification v0.1 and Work Intelligence architecture materials, July 2026.

PUBLICATION NOTE

Technical and certification information is current to July 18, 2026 based on the cited public sources. Always verify the latest certificate, exact SKU, approved accessories and local requirements before procurement or deployment.