CREATECH

SOFTWARE · AUTOMATION · ARTIFICIAL INTELLIGENCE

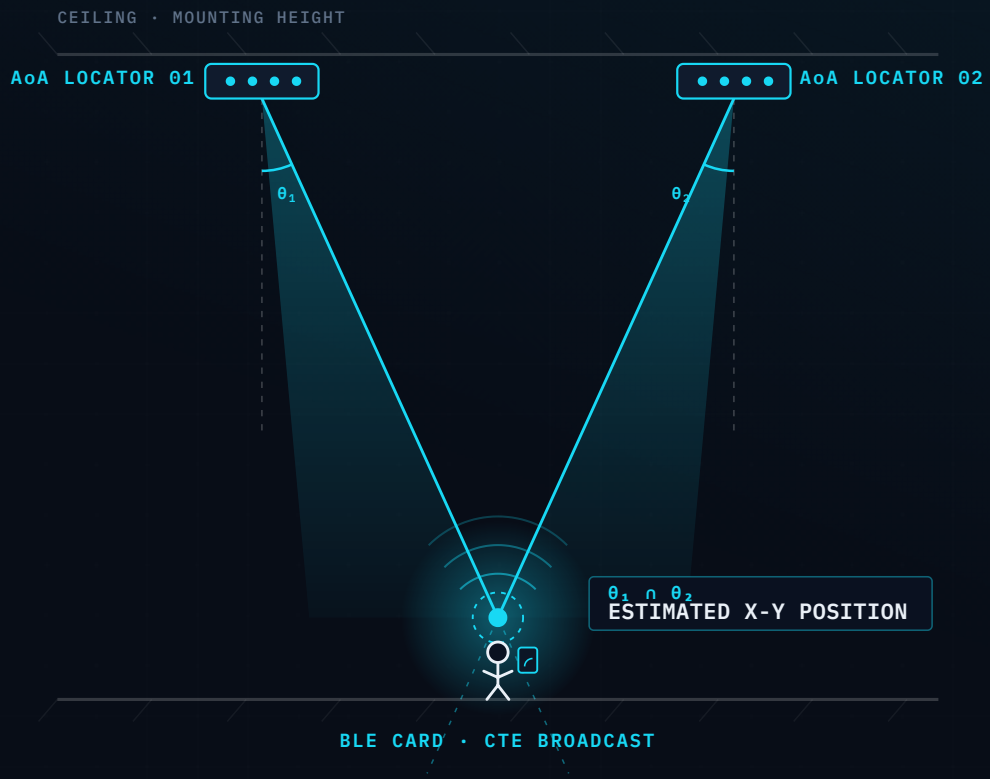
CORPORATE INTRODUCTION · SEPTEMBER 2026

BLE RTLS & AoA

Precise indoor positioning from the angle of arrival — with delivery management, telemetry and vision analysis on the same infrastructure.

This document presents the Createch BLE Location Platform in three layers: **AoA-based precise positioning** inside the plant, then **logistics and delivery management** beyond the loading dock, and on top of both, **telemetry with AI-powered vision analysis**.

PART A	PART B	PART C
Plant & AoA	Logistics & Delivery	Safety & AI



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DOCUMENT MAP

The chain starts in the plant, changes hands at the dock, and continues on the vehicle and the platform

This document follows that chain. The emphasis is on **AoA-based precise positioning** inside the plant; the delivery, telemetry and vision analysis layers are then added on the same data model.

ONE IDENTITY AND LOCATION DATA MODEL — CREALOG PLATFORM · CREAAI

01 · INSIDE THE PLANT
BLE RTLS · AoA precise position
Forklift safety · muster drill
Pallets, equipment, stock count
PAGES 03 — 14

→

02 · LOADING AND DOCUMENTS
RF-ID / barcode verification
Delivery on the tablet
Delivery note and invoice flow
PAGES 15 — 17

→

03 · ON THE VEHICLE
Telemetry · on-board unit
Cloud camera · blind spot radar
Route and dispatch optimization
PAGES 18 — 19

→

04 · SAFETY AND AI
CCTV + AI · card-less person
Driver behaviour analysis
Geofence · compliance
PAGES 20 — 23

ABOUT THE FIGURES IN THIS DOCUMENT

Accuracy ranges are **typical** values for each technology class; performance indicators are **target values**. An accuracy commitment follows a site survey, RF analysis and pilot installation.

IN ONE SENTENCE

Not a tracking system, but a **shared location and identity layer** that new assets and modules can be added to.

PART A · STARTING POINT

What a plant is missing is not data, but location itself

Production, maintenance and safety processes all rest on the same question: **who or what is where, right now?** When that question cannot be answered, reports rely on what people say, incident reviews rely on memory, and safety relies on discipline alone.

BLE RTLS closes that gap. The investment goes not into a single application but into a **location and identity layer** that further scenarios can be built on.

WHY DOES PRECISION MATTER?

"Which zone?" is answered economically with RSSI. But in areas such as forklift routes, production lines and loading bays, the decision turns on **sub-metre** differences. Angle of arrival (AoA) measurement is exactly what those areas call for.

KEY CHALLENGES

01 · VISIBILITY

Scattered, untraceable processes

When data from different equipment and vehicles cannot be gathered in one place, operational visibility is limited and every department works from its own spreadsheet.

02 · SAFETY

Proximity risk cannot be measured

Dangerous approaches between forklifts and people are discussed only after an accident; beforehand, no measurable indicator is produced at all.

03 · EVENT RECORD

Incidents are missed

Not being able to reach camera footage and position history in time at critical moments makes incidents hard to analyse and harder to prevent.

04 · COMPLIANCE

Site safety versus legal duty

Obligations such as a recording ban in restricted areas cannot be reconciled with the need for site safety by manual means.

05 · PRODUCTION

No visibility into machines

Being unable to pull data from robot and machine controllers makes bottlenecks in the production process impossible to identify.

06 · CONTINUITY

Monitoring stops at the gate

Data gathered inside the facility ends the moment goods or people leave the door; plant and field end up managed as two separate worlds.

WHAT THIS PART ANSWERS

A **hybrid BLE architecture** inside the plant: zone detection with RSSI across wide areas, and **precise X-Y positioning with AoA** in critical areas. The same card and the same platform then continue, without a break, into the logistics and safety layers.

01 · BLE PLATFORM

BLE RTLS: the plant's shared location layer

Broadcasts from BLE cards and tags are picked up by the Gateway and Locator devices in the field and turned into position data by the central RTLS engine. One infrastructure makes staff, forklifts, pallets and equipment visible on the same network.

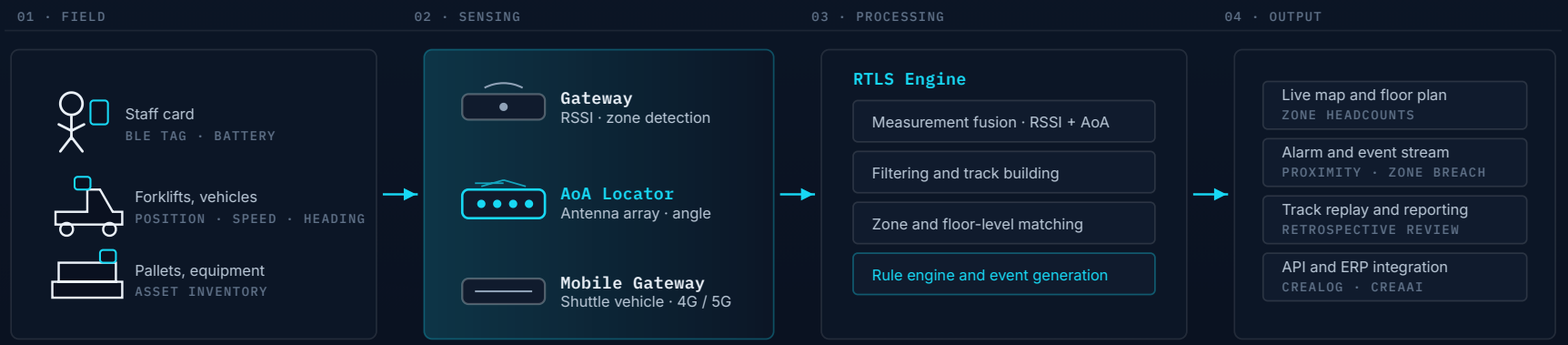


DIAGRAM · THE LOCATION CHAIN The same chain carries both RSSI and AoA measurements; which method is used in which area is decided during project design.

LOW POWER

Battery life is part of the design

Suited to battery-powered cards and tags. The broadcast interval and battery life are optimized together, and the position update rate is set to match the scenario.

FLEXIBLE COVERAGE

As much technology as each area needs

Zone detection and precise positioning can be used side by side in the same project. Coverage geometry is designed area by area rather than imposing one accuracy class on the whole site.

ONE IDENTITY

The identity layer stays whole

The same BLE card can be used in the plant, on the shuttle vehicle and in other processes, so a person's journey to the site and their movement inside it share one digital identity.

WHAT CAN BE ADDED TO THE SAME NETWORK LATER

New tag types and software modules join the same platform later.

AOA PRECISION AREA · NEW TAG TYPE · FORKLIFT SAFETY · PALLETS, EQUIPMENT · STOCK COUNTING · MUSTER DRILL · GEOFENCE · LONE WORKER · IN-VEHICLE GATEWAY · CCTV + AI

ARCHITECTURAL PRINCIPLE

The method suits the area; **the data model stays the same everywhere.** A zone's accuracy class can be raised later without touching the software.

02 · AOA · ANGLE OF ARRIVAL

Angle of Arrival: the layer that measures the angle and computes the position

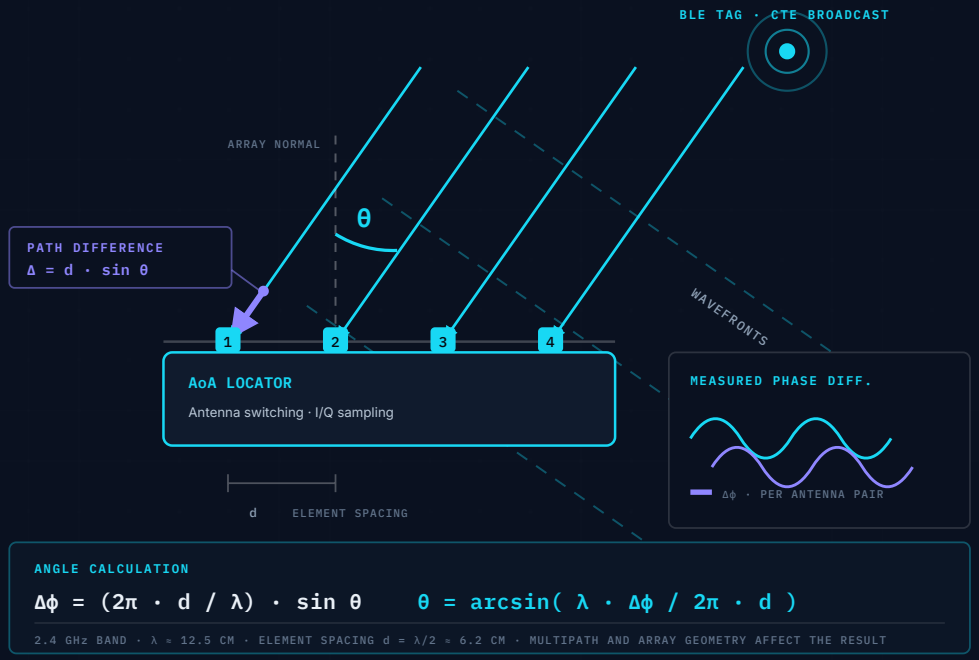


DIAGRAM · PHASE DIFFERENCE GEOMETRY The same wavefront reaches the antennas at slightly different times. The resulting path difference is measured as a phase difference, and the angle of arrival is calculated from it. Choosing half a wavelength as the element spacing avoids angular ambiguity.

The antenna array on an AoA Locator analyses the **phase differences** a BLE Direction Finding signal produces across its antennas. Using raw I/Q samples, the antenna geometry and positioning algorithms, it calculates **azimuth** — and with suitable hardware and installation, **elevation** as well.

01
BLE CTE
The tag broadcasts a Constant Tone Extension.

02
Antenna array
Antennas are switched in turn; phase differences appear.

03
I/Q samples
Samples are processed with the array geometry.

04
Angle calculation
Azimuth — and elevation where supported — is produced.

CTE TIMELINE · ANTENNA SWITCHING

A guard period, a reference period on a single antenna, then the switch and sample slots. The reference period sets the carrier phase for the measurement.

WHY ALONGSIDE RSSI?

RSSI answers “which section or zone?” economically. AoA enables precise X-Y positioning in critical areas. Rather than fitting out the whole plant with AoA, a **hybrid architecture** is built.

ENGINEERING NOTE

A linear array yields **azimuth** only; elevation needs a planar array. Spacing wider than half a wavelength introduces angular ambiguity (grating lobes).

03 · ACCURACY CLASSES

Which question does each measurement answer?

Position accuracy is not a product feature but a **design decision**. Because several methods can be combined on the same BLE infrastructure, accuracy is chosen according to the business value of each area.

TYPICAL ACCURACY RANGES · BY TECHNOLOGY CLASS

These are typical ranges for each technology class; the real accuracy of an installation depends on the RF environment, Locator geometry, mounting and calibration.

TECHNOLOGY	MEASURES	TYPICAL ACCURACY	TYPICAL USE
BLE Presence	Coverage	Room / zone	"Is this person in this zone?" · lowest-cost setup
BLE RSSI	Signal strength	2 – 5 m	Zone / section detection · wide-area coverage
BLE AoA	Angle of arrival	0.5 – 1 m	Precise X-Y positioning · critical areas
Channel Sounding	Distance	Class: sub-metre	Next-generation precise ranging · on the roadmap
UWB	Time / distance	10 – 30 cm	Point applications needing very high precision

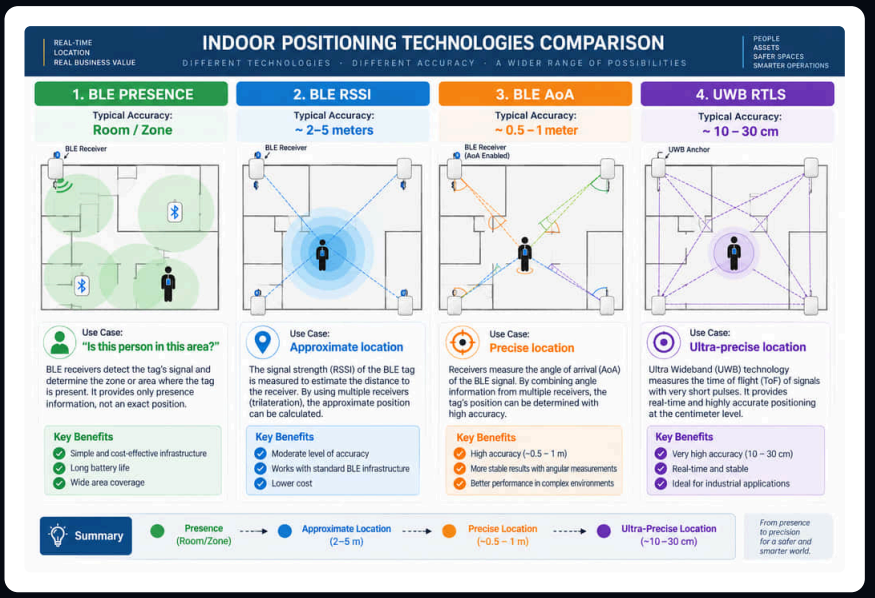


DIAGRAM · POSITIONING TECHNOLOGIES COMPARED Four methods on the same room plan: zone detection by coverage area, trilateration from signal strength, intersecting angles of arrival, and ultra-wideband time-of-flight measurement.

RETURN ON INVESTMENT

There is no need to fit the whole site with the most precise technology. When the accuracy class is chosen zone by zone, **the same budget buys wider coverage** and more scenarios — while no compromise is made where precision creates business value.

04 · ESTIMATION AND GEOMETRY

An angle alone is not a position: intersection and geometry

A single Locator gives only a **bearing**. Position is estimated by intersecting the angles measured by several Locators. That is why real accuracy is determined not by the hardware alone but by **how the Locators are laid out across the site**.

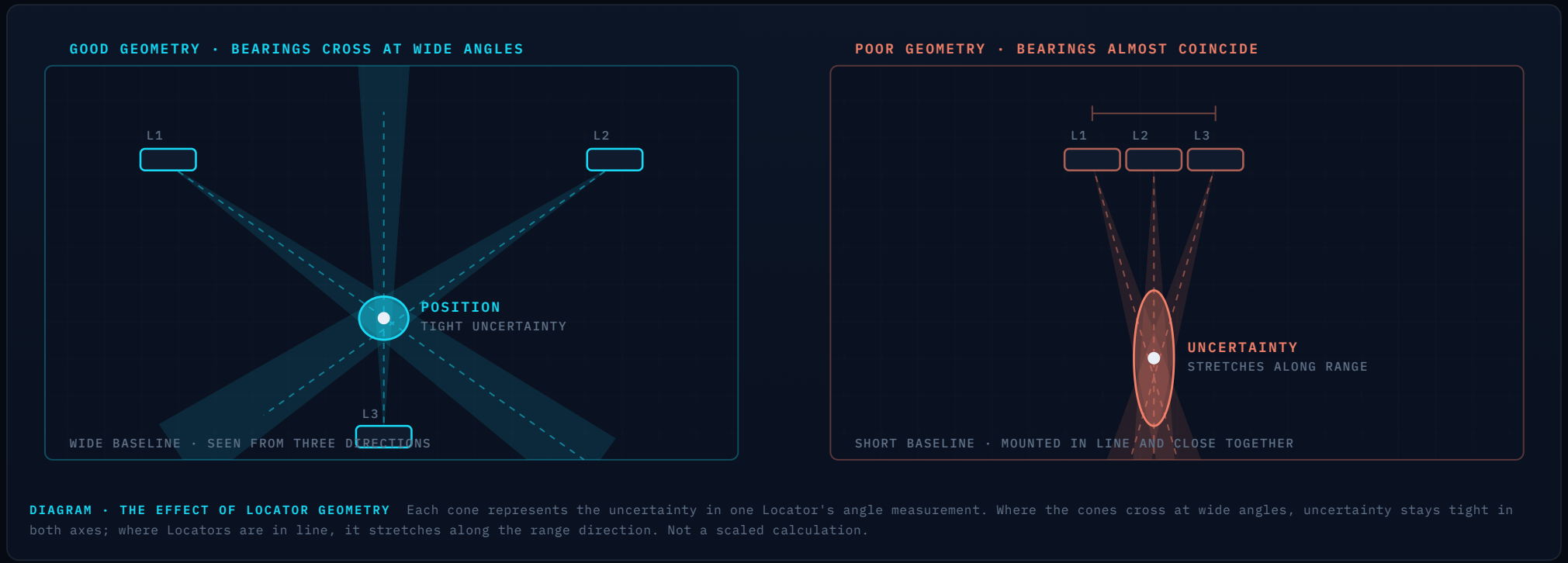


DIAGRAM · THE EFFECT OF LOCATOR GEOMETRY Each cone represents the uncertainty in one Locator's angle measurement. Where the cones cross at wide angles, uncertainty stays tight in both axes; where Locators are in line, it stretches along the range direction. Not a scaled calculation.

01 · LINES OF SIGHT

How many Locators see it?

In precision areas the tag should be seen by **several Locators**. A single line of sight yields only a bearing.

02 · BASELINE

The distance between them

As the distance shrinks, bearings converge and the intersection weakens. Layout is planned for **baseline length** as well as coverage.

03 · ORIENTATION

Antenna direction and height

Antenna orientation and mounting height directly affect coverage. Where floor levels differ, **elevation** is assessed separately.

04 · CONSEQUENCE

Accuracy is born on site

The same hardware gives different results in different layouts, so precision is **measured in a pilot area** and turned into an acceptance criterion.

05 · HYBRID ARCHITECTURE

The right measurement in the right area: one network, three accuracy classes

The site is divided into zones according to the accuracy each one needs. Zone detection is enough in offices and the general warehouse; AoA comes into play along forklift routes, production lines and loading bays; shuttle vehicles carry coverage beyond the site. All of it runs on **the same platform and the same card**.

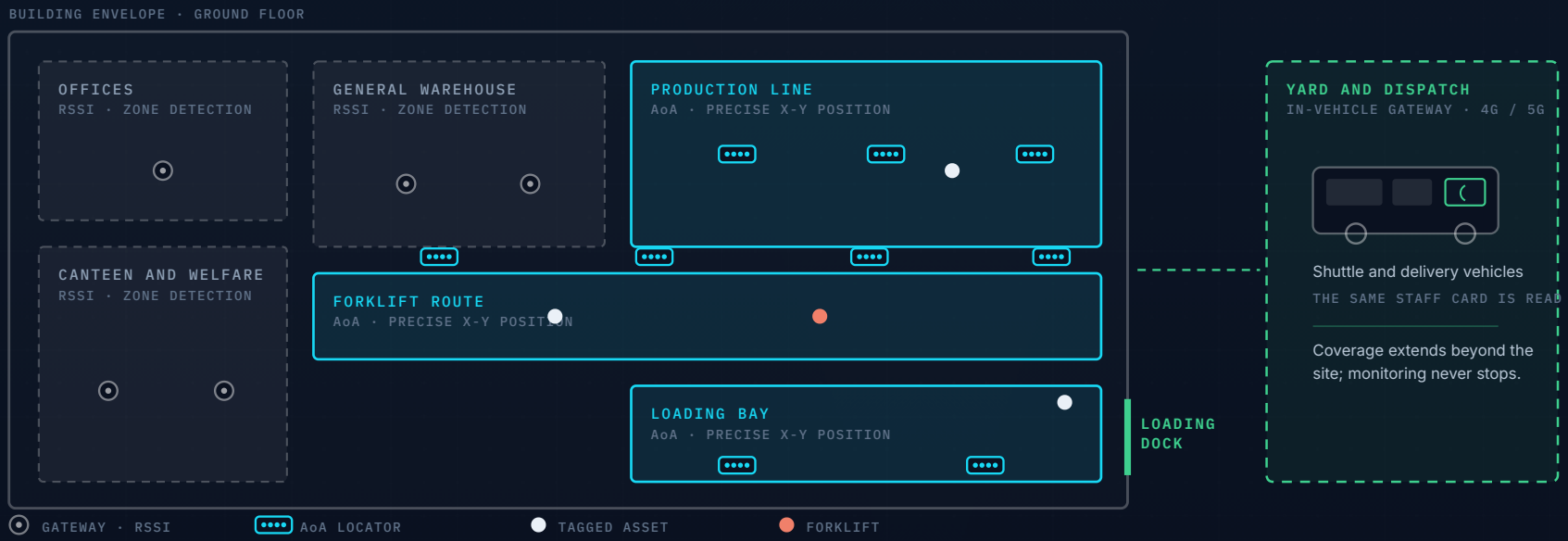


DIAGRAM · HYBRID LAYOUT The layout and zone names are illustrative; in a real installation the zone boundaries, Locator count and mounting heights are engineered from a site survey.

STANDARD AREAS

Zone detection is enough

Offices, canteen and general warehouse: “which zone?” is answered economically with RSSI, covering a wide area with few devices.

CRITICAL AREAS

Precise position with AoA

Forklift routes, production lines and loading bays: because the decision turns on sub-metre differences, angle-of-arrival measurement comes into play.

MOBILE AREAS

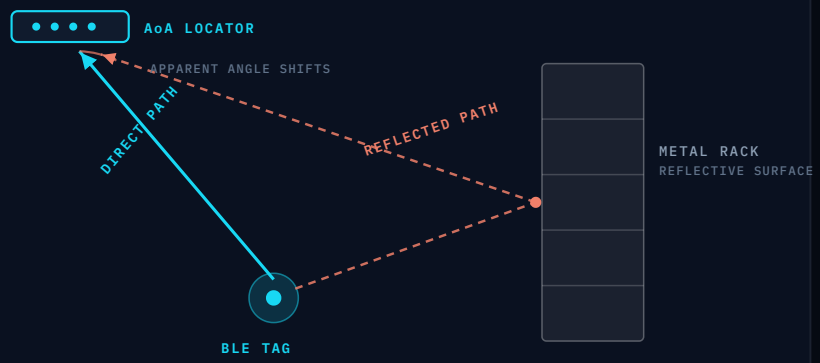
Coverage extends beyond the site

The BLE gateway in shuttle and delivery vehicles reads the same card; data flows to the platform over 4G/5G and the identity layer stays whole.

06 · FIELD ENGINEERING

Accuracy depends on the site, not the datasheet

MULTIPATH · DIRECT AND REFLECTED PATH



A reflection can shift the angle the array sees away from the true bearing. This is why, in precision areas, the aim is for the tag to be seen by several Locators from different directions.

HOW IS AN ACCURACY COMMITMENT GIVEN?

A theoretical accuracy figure is never written into a contract. Precision is defined after a **site survey, RF analysis and pilot installation**, as a measurable acceptance criterion based on points measured in the plant's real conditions.

01 · MULTIPATH

RF reflections

Reflections from metal racking, machine bodies and flat surfaces affect the measurement. Layout is planned with the position of reflective surfaces in mind.

02 · GEOMETRY

Locator layout

In precision areas the aim is for the tag to be seen by several Locators from suitable angles; baseline length and lines of sight are designed together.

03 · MOUNTING

Antenna direction and height

Antenna orientation and mounting height directly affect coverage geometry. The same device at the wrong height covers a narrower area than expected.

04 · CALIBRATION

Pilot-area measurement

Site calibration is carried out using reference measurement points across a pilot area, and the acceptance test is run against those same points.

05 · BROADCAST INTERVAL

Update rate and battery

Position update rate and battery life are optimized together: fast broadcast for safety scenarios, long battery life for inventory.

06 · HYBRID INSTALL

Where does AoA go?

AoA is used only in areas where the precision creates business value; the remaining areas are covered economically by zone detection.

PROJECT FLOW · THE COMMITMENT IS FORMED ON SITE

01
Site survey
Layout, floor levels, reflective surfaces and zone requirements are documented.

02
RF analysis
Coverage and interference analysis; device count and positions are determined.

03
Pilot install
Real measurement, site calibration and validation in a limited area.

04
Acceptance criterion
Measured values become the acceptance test and the contractual commitment.

05
Roll-out
The validated design is scaled across the whole site.

07 · IN-PLANT USE CASES

Eight scenarios running on one shared infrastructure

Once the location layer is in place, each additional scenario means **a new rule set and a new screen** rather than a new hardware investment.

01 · STAFF

Zone and position visibility

In-plant zone and position, entry/exit flow and time on task. Zone density and transition records are reported per shift.

02 · FORKLIFTS

Position, route and utilization

Vehicle position, the route taken, zone density and idle time. Utilization analysis becomes an input to fleet-size decisions.

03 · SAFETY

Dangerous proximity

Distance, direction of travel and speed between people and vehicles are weighed together to run risk rules. See the next page for detail.

04 · PALLETS AND EQUIPMENT

Last seen position

Where and when an asset was last seen is on record. “Where is this equipment?” is answered by a query rather than a search.

05 · STOCK COUNTING

Automatic zone-based control

Automatic zone-based control of BLE-tagged assets shortens counting time and exposes the gap between physical stock and the record.

06 · MUSTER DRILL

Assembled and still inside

When an emergency or drill starts, the number of people who have reached the assembly point and those still inside is tracked with elapsed time.

07 · GEOFENCE

Unauthorized zone entry

Unauthorized entry into areas such as a transformer room, chemical store or maintenance bay raises an immediate alarm and creates an event record.

08 · LONE WORKER

Working alone detection

A person left alone in a hazardous zone, a lack of movement, or an unusually long stay in one zone are all monitored by the rule engine.

THE SCENARIOS FEED ONE ANOTHER

The same track data produces the safety alarm, the forklift utilization report and the post-incident review. That is why infrastructure built for one scenario **needs no further hardware investment** when the others are commissioned.

INPUTS TO THE RULE ENGINE

- POSITION (X-Y)
- ZONE
- FLOOR LEVEL
- SPEED
- HEADING
- DWELL TIME
- IDENTITY AND RIGHTS
- BATTERY STATE
- SHIFT
- CAMERA ZONE

08 · FORKLIFT SAFETY

Not proximity, but the approach vector

The system weighs more than the distance between forklift and pedestrian: it takes the forklift's **direction of travel and speed**, the person's position and the **approach vector** together. The same distance therefore produces different risk in different directions.

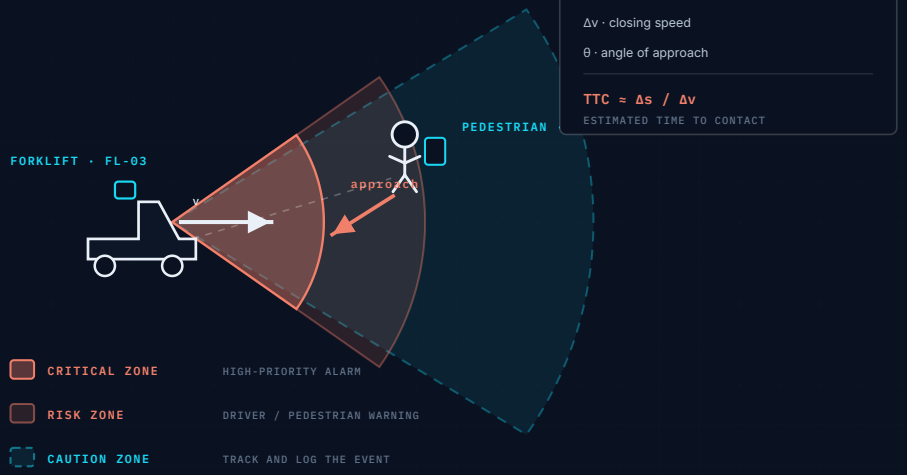


DIAGRAM · DIRECTIONAL RISK ZONES The zones extend along the forklift's direction of travel, so the same distance behind the vehicle produces lower risk. The radii and angles shown were chosen to illustrate the principle; project parameters are set on site.

CAUTION ZONE

Tracked and logged

The approach is tracked and an event record can be created, gathering data before any intervention is needed. Reporting is built on these records.

RISK ZONE

A warning is raised

Warnings can be raised for both driver and pedestrian. The system steps in once the approach threshold is crossed and the event is flagged as priority.

CRITICAL ZONE

Alarm and integration

A high-priority alarm and integration scenario, designed to work alongside the existing safety systems on site.

DECISION CHAIN

01 **Position**
Forklift and pedestrian positions are read at the same time.

02 **Speed + heading**
The movement vector is derived from position history.

03 **Approach**
The approach vector and estimated time to contact are computed.

04 **Risk / alarm**
A record, a warning or an alarm is raised by risk level.

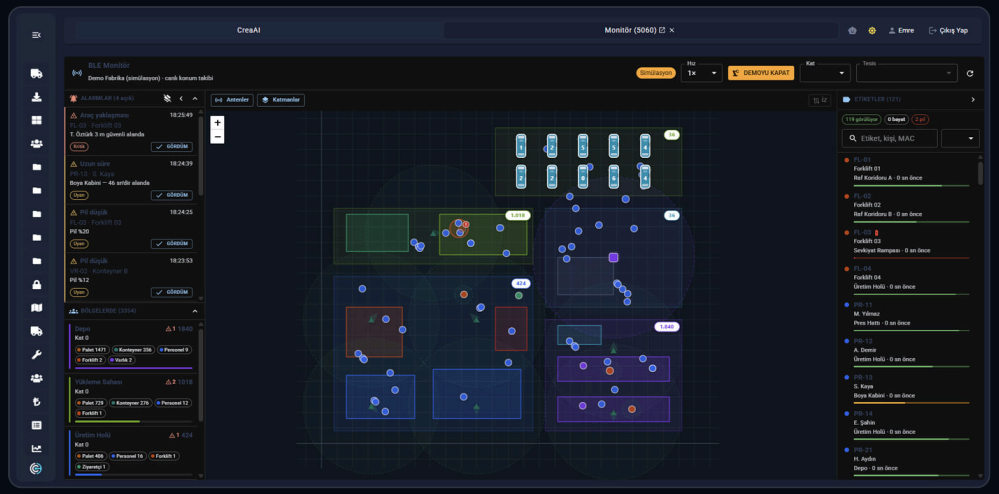
ENGINEERING NOTE · SAFETY-CRITICAL APPLICATIONS

In safety-critical applications, central RTLS **does not replace** the local sensors and warning systems on the vehicle; it is a complementary layer. Alarm thresholds are set together with the site's own safety procedures.

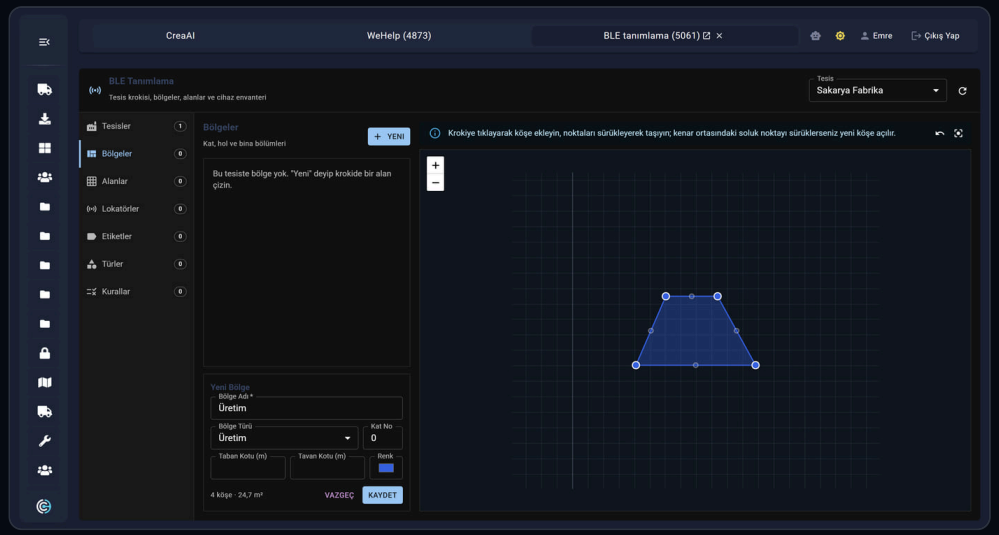
09 · PRODUCT SCREENS

Live position and site setup

The user-facing side of the location layer comes down to two screens: **BLE Monitor**, which watches the site live, and **BLE Setup**, which manages the site, zone, Locator and rule inventory.



01 · LIVE POSITION Every tag's current position and the Locator coverage areas on the site plan. The left panel holds open alarms and zone headcounts; the right panel lists the tags with their last-seen information. Screen labels are in Turkish.



02 · SETUP Zones are drawn onto the site sketch and floor, zone type and level data are entered. Locator, tag, asset-type and alarm-rule definitions are all managed from the same screen. Screen labels are in Turkish.

ALARM PANEL

Vehicle approach, zone breach, excessive dwell and low battery events are listed by priority; an acknowledgement is written to the operator log.

ZONE HEADCOUNTS

How many staff, forklifts, pallets and containers are in each zone is counted live, broken down by asset type.

TAG LIST

Search by tag, person or MAC address; visible, stale and low-battery states appear in a single strip.

ZONE DRAWING

Clicking the sketch adds a corner, and dragging a mid-edge point opens a new one; the area is calculated in m² instantly.

LEVEL AND FLOOR

Entering floor and ceiling levels separates zones vertically in multi-storey sites; zone type is marked by colour.

RULE SET

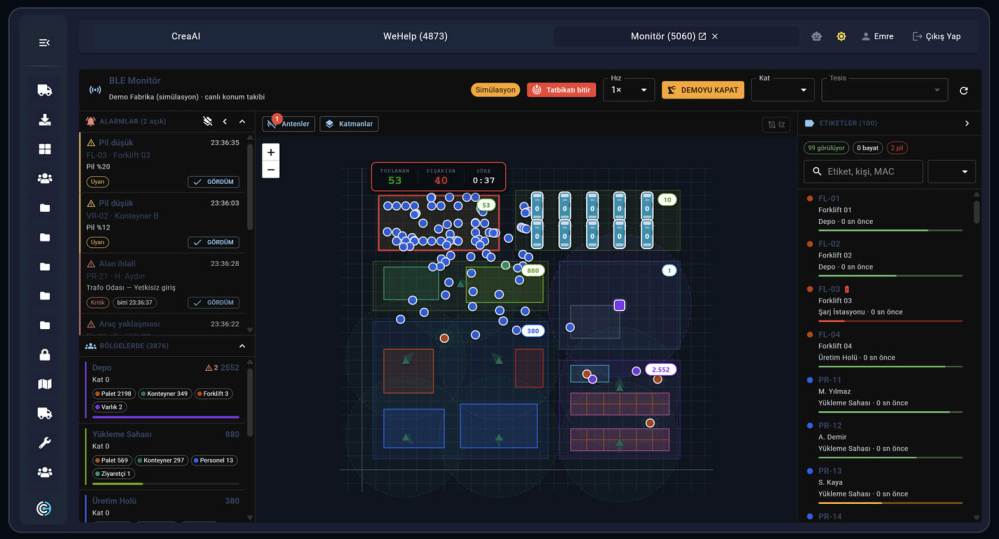
Alongside the Locator, tag and type inventory, alarm rules are defined in the same place.

The screenshots come from a simulation environment running on demo data; the plan, zone names and figures are illustrative.

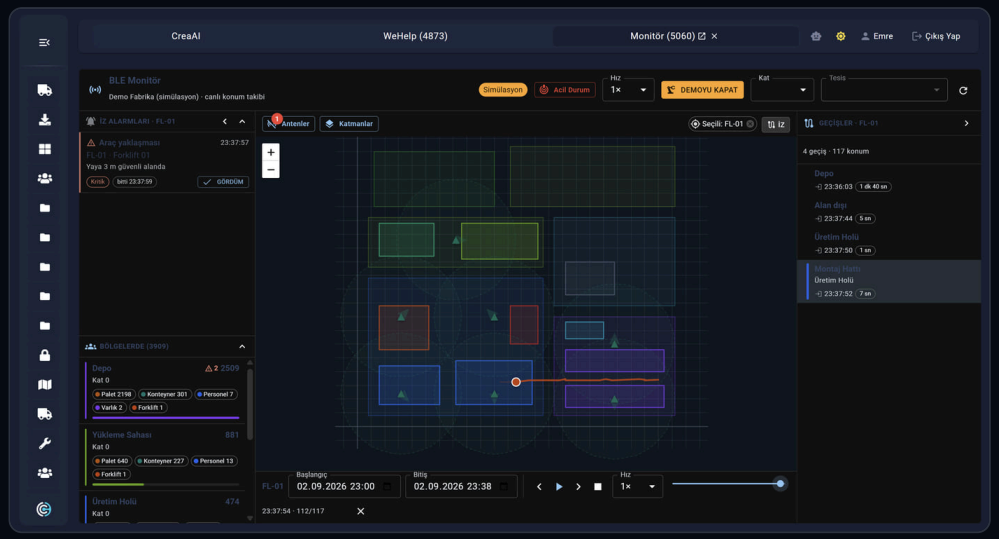
09 · PRODUCT SCREENS

Muster drill mode and retrospective track replay

Two different tenses of the same location data: in an emergency, **who is where now**; after an incident, **what happened then**.



03 · MUSTER DRILL MODE When an emergency or drill starts, the number of people who have reached the assembly point and those still inside is tracked with elapsed time. Low battery and unauthorized entry alarms appear on the same screen. Screen labels are in Turkish.



04 · TRACK REPLAY The selected tag's track over a chosen time range is drawn on the plan and played back and forth on a timeline. Zone crossings are listed with their dwell times, so post-incident review works from the record. Screen labels are in Turkish.

ASSEMBLED

The count of staff who have reached the assembly point rises live.

STILL INSIDE

How many people remain in the building, and in which zone.

ELAPSED

Evacuation time is measured and becomes a post-drill report.

TRACK

The selected tag's path is drawn onto the plan.

TRANSITION LOG

Zone entry times and dwell durations are listed.

PLAYBACK

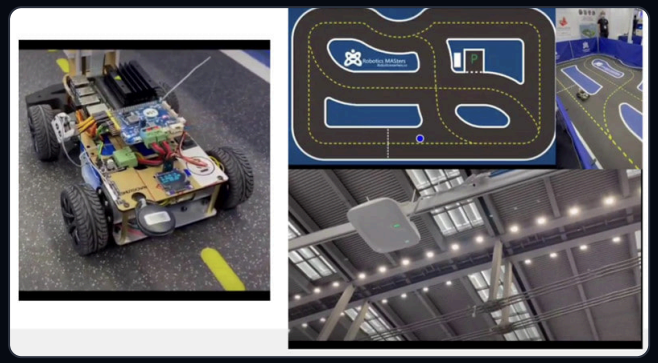
A time range is selected and the moment is replayed both ways.

The screenshots come from a simulation environment running on demo data; the plan, zone names and figures are illustrative.

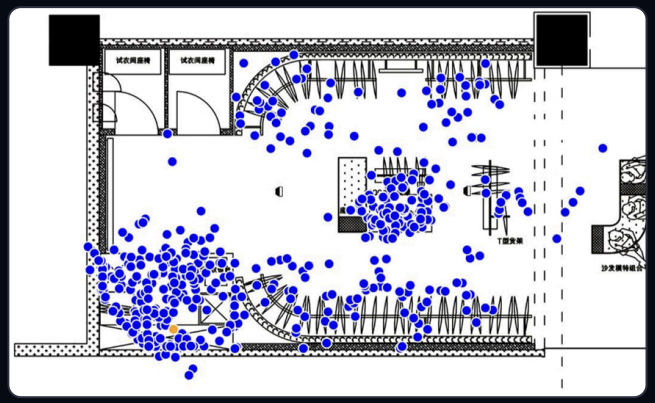
10 · FIELD VALIDATION

What the location layer looks like on site

An accuracy claim is measured on a moving asset, not in a laboratory. The images below come from reference installations and validation set-ups.



01 · VALIDATION SET-UP An autonomous vehicle moving along a reference track is detected by ceiling-mounted BLE devices and its position is marked on the digital plan in real time. Position accuracy and latency are measured on set-ups like this one.



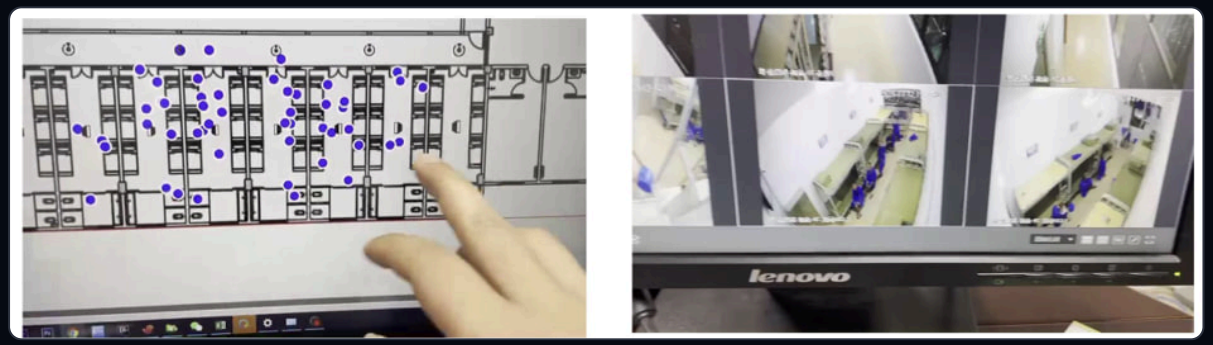
02 · DENSITY DISTRIBUTION A position cloud overlaid on the floor plan shows which zones people spend time in and for how long. The same data supports layout planning, shift planning and the measurement of space utilization.

WHAT VALIDATION MEASURES

- **Position error** at reference points
- **Latency** from broadcast to screen
- **Track continuity** while moving
- **Correct assignment** at zone borders

WHY A MOVING ASSET?

The position of a stationary tag is easy to measure. The real difficulty is holding the track of a moving asset without gaps or jumps, which is why acceptance testing is carried out on movement.



03 · PLAN AND CAMERA VIEW ON ONE SCREEN Staff, patient and equipment positions are marked both on the floor plan and on the live camera view.

A BRIDGE TO PART C

The operator does not have to switch between screens to verify an alarm: **the location and video layers merge in one interface**. That merge is also the basis of the CCTV + AI verification described in Part C — the person the camera sees and the card the RTLS sees become comparable on the same zone and the same timeline.

PART B · THE HANDOVER POINT

When goods leave the door, monitoring does not stop — only the measuring hardware changes

The two ends of the chain run in different environments but share one data model: the BLE location network inside the facility, and telemetry, cameras and the tablet on the vehicle. The handover point between them is the **loading dock**, where pallets are read by RF-ID or barcode and booked onto the vehicle.

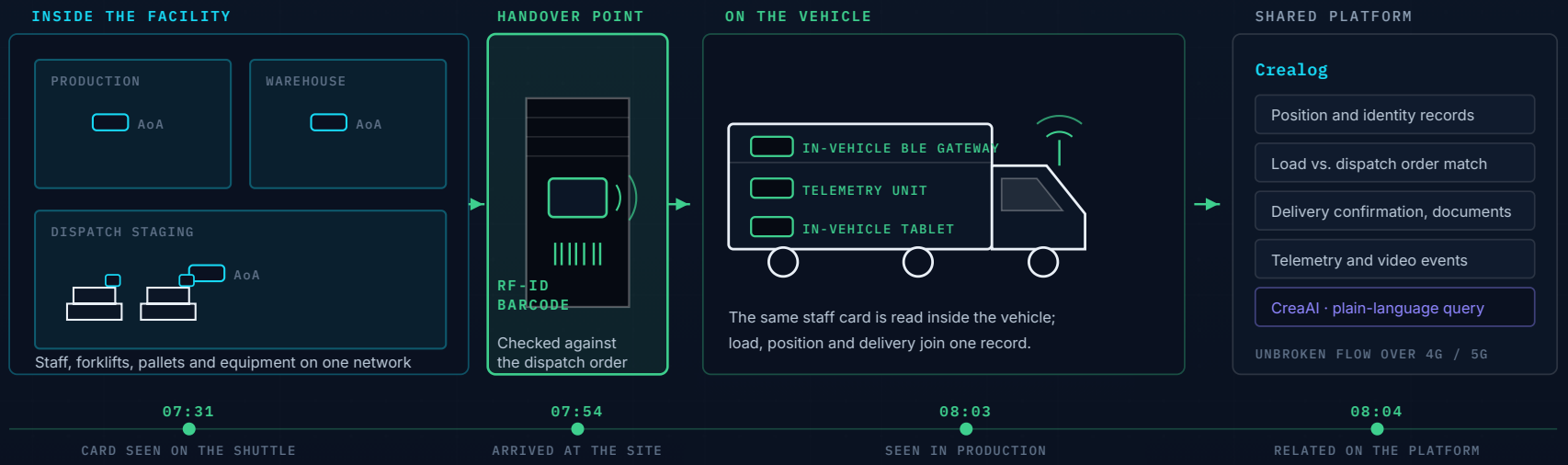


DIAGRAM · FACILITY TO VEHICLE, VEHICLE TO PLATFORM The layout, times and zone names are illustrative. The load read at the handover point is compared against the dispatch order, so an error becomes visible before the goods leave the door.

01 · LOAD VERIFICATION

RF-ID and barcode

Pallets, crates and cases are read at the dock and booked onto the vehicle, then compared against the dispatch order — errors are caught before departure.

02 · ONE BLE IDENTITY

The card keeps working at the gate

A BLE gateway on the shuttle reads the same staff card used in the plant. Occupancy, travel time and in-plant flow join under one identity.

03 · UNBROKEN DATA

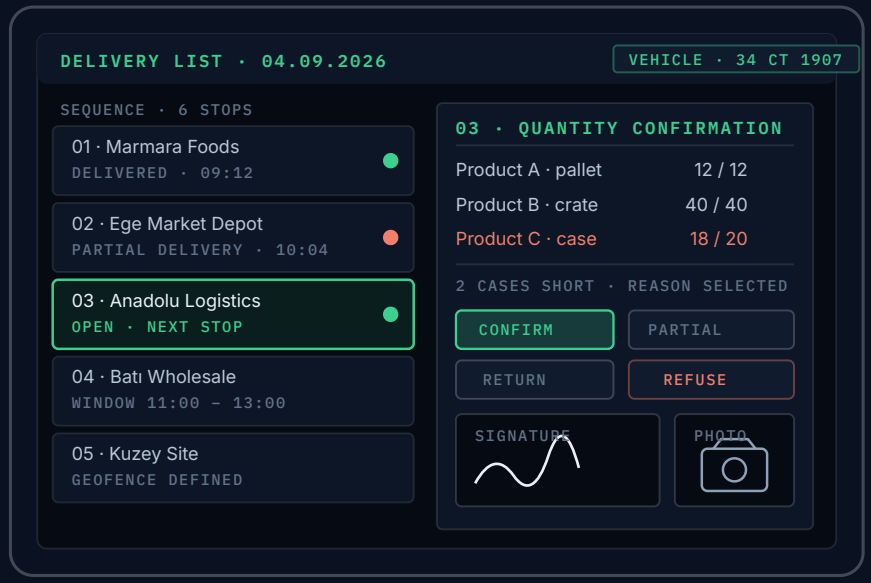
One data model

The gateway sends data over the vehicle telemetry unit or 4G/5G. In-plant and field data share one schema and are queried together.

02 · DELIVERY MANAGEMENT

The in-vehicle tablet: the field record and the office document from one source

The driver sees the day's delivery sequence, customer details and load contents on the tablet. **Quantity confirmation, partial delivery, returns and refusals** are captured on the tablet at the delivery point, with a signature and photo attached to the transaction.



MOCK-UP · THE TABLET DELIVERY FLOW This screen is drawn in HTML/SVG rather than captured; the customer names, plate and quantities are illustrative.

01 · TASK SEQUENCE

The day's delivery plan

Stops, customers, load contents and the delivery window are on the tablet; changes reach the driver at once.

02 · QUANTITY CONFIRMATION

The quantity actually received

The quantity delivered is confirmed line by line. Anything short, over or damaged is recorded with its reason.

03 · PARTIAL DELIVERY

A delivery left incomplete

When only part of a delivery is accepted, the remainder stays open; balance tracking and rescheduling run from the same record.

04 · RETURNS AND REFUSALS

Goods not accepted

Returns and refusals are captured with a reason code; goods loaded back stay visible in inventory.

05 · PROOF

Signature and photo

The recipient's signature and photo are attached, so disputes are answered from the record.

06 · OFFLINE

It works out of coverage too

Where there is no connection the record is held on the device and uploaded once coverage returns, so the driver never has to wait.

WHY ON THE SAME PLATFORM AS THE PLANT?

The RF-ID/barcode read at loading and the quantity confirmed on the tablet belong to one dispatch order, so “loaded” versus “delivered” is visible in **a single query**.

03 · DOCUMENT FLOW

The delivery note and the invoice are produced from the field record itself

The load list verified at loading becomes the source for the delivery note, and the quantity confirmed at delivery becomes the source for the invoice. Documents are created on the platform and pushed to the existing ERP or e-document infrastructure: **the field record and the accounting document come from the same data**.

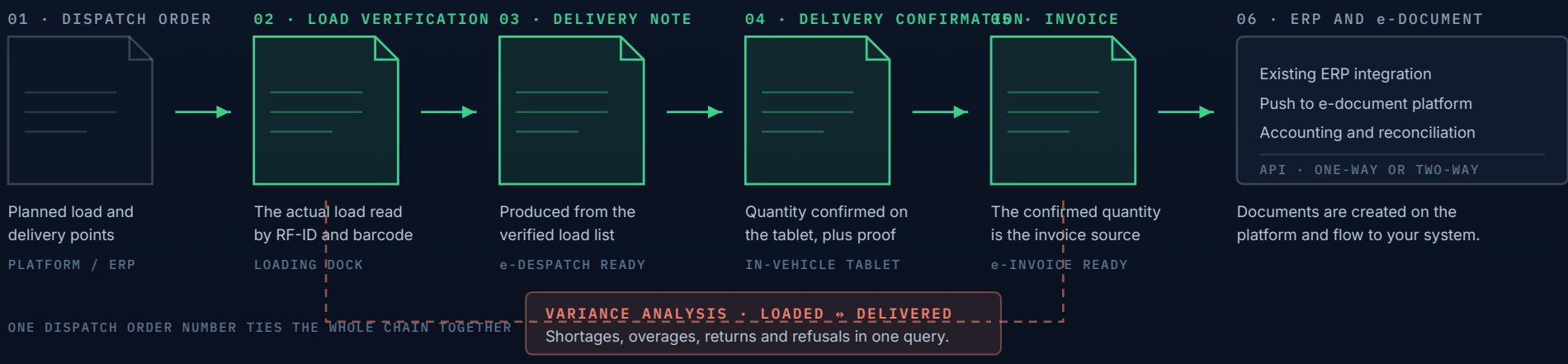


DIAGRAM · THE DOCUMENT CHAIN Every step draws on the record before it, so no manual data entry is left between the field and the document.

ONE SOURCE

No manual entry

Beyond the barcode read at loading and the quantity confirmed on the tablet, no separate data entry is needed, so transcription errors disappear.

TRACEABILITY

What is each line tied to?

A document line carries which pallet, which vehicle and which delivery confirmation it came from. In a dispute, the evidence is inside the record.

SPEED

Less billing delay

As soon as the delivery confirmation lands on the platform, an invoiceable record is ready; there is no wait for end-of-day paperwork.

COMPATIBILITY

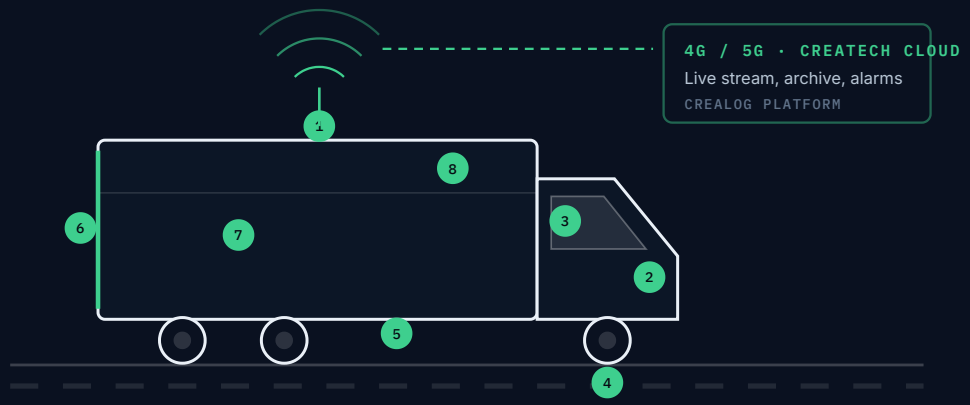
It works with what you have

Your ERP and e-document setup is left untouched. The platform produces the document and pushes it to the existing system over an API.

04 · TELEMETRY

The on-vehicle hardware layer: far more than position

Position, speed, fuel, door, drum and sensor data are collected by the on-board unit and sent to the control center. The driver sees the task sequence and any alerts on the in-vehicle tablet, and **when a deviation or anomaly is detected the system steps in immediately**.



1 GNSS antenna · position, route, speed
2 On-board telemetry unit
3 In-vehicle tablet · tasks, alerts
4 Speed, odometer, vehicle bus (CAN)
5 Fuel level and consumption
6 Door and lock sensor
7 Temperature and humidity · cold chain
8 Sector-specific sensor input

The diagram is drawn on a box-body vehicle; in tanker, mixer and bus configurations the sensor set changes with the vehicle.

01 · LIVE TELEMETRY

A continuous stream

Vehicle data flows continuously to the center over sensors and the vehicle bus; map, list and chart views feed from one stream.

02 · TABLET INTEGRATION

The driver's side

Drivers follow task and delivery information live on the in-vehicle tablet and talk to the center both ways.

03 · REAL-TIME ALERTS

Deviation and anomaly

A route deviation, movement outside a zone, a door opening or a threshold breach notifies the center.

EVENT TYPES PRODUCED FROM TELEMETRY

ROUTE DEVIATION · GEOFENCE BREACH · SPEEDING · EXCESSIVE IDLING · HARSH BRAKING · DOOR OPENING · FUEL DROP · TEMPERATURE BREACH · DRUM ROTATION · UNPLANNED STOP · SERVICE THRESHOLD

SECTOR EXAMPLE · CONCRETE

The mixer drum's direction and speed are read continuously; discharge is detected automatically and the mixing data is logged with a timestamp.

SECTOR EXAMPLE · COLD CHAIN

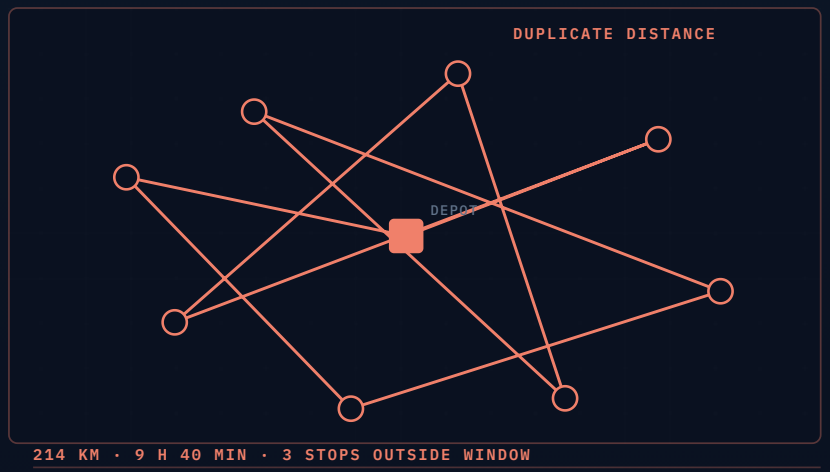
Compartment temperature monitoring continues through the in-vehicle sensors once the goods are loaded; a threshold breach raises an alarm.

05 · ROUTE AND DISPATCH OPTIMIZATION

The same delivery list over a shorter route and to a predictable schedule

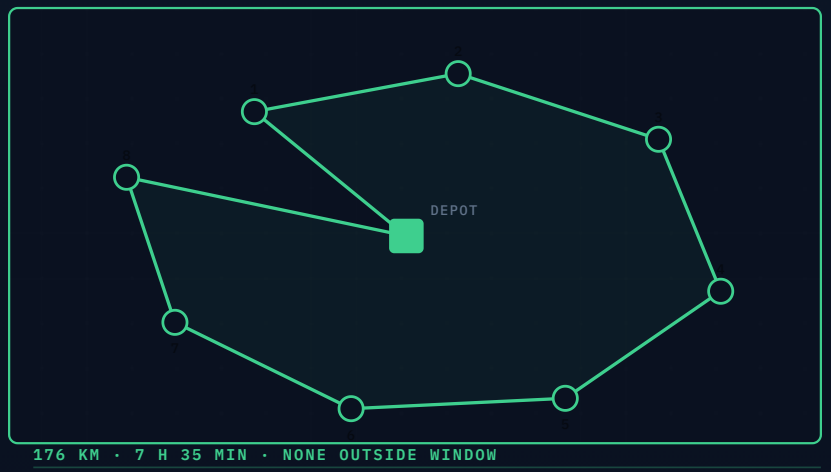
Vehicle positions, live traffic data and delivery priorities are analysed at the same time to determine the most efficient route. The three things optimization manages are linked: **cost, time and equipment**.

UNPLANNED SEQUENCE · BY DRIVER EXPERIENCE



214 KM · 9 H 40 MIN · 3 STOPS OUTSIDE WINDOW

OPTIMIZED SEQUENCE · A SINGLE LOOP



176 KM · 7 H 35 MIN · NONE OUTSIDE WINDOW

DIAGRAM · UNPLANNED VERSUS OPTIMIZED SEQUENCE The same depot and eight delivery points in both panels; only the visit order changes. The distance, duration and window figures are illustrative examples, not measured results.

01 · COST

Distance and fuel

- Total trip distance and fuel consumption fall
- Empty returns and duplicate legs never enter the plan
- Trip cost is reported per vehicle and per driver

02 · TIME

Trip duration and window

- Arrival time is calculated before departure
- Stops outside the window raise a warning at planning
- Cancellations or new orders resequence the day

03 · EQUIPMENT

Vehicle and compartment capacity

- Load factor is measured for every trip
- Fewer trips leave half loaded
- Fleet size is planned to real demand

CONSTRAINTS CONSIDERED

TIME WINDOW · COMPARTMENT CAPACITY · PRODUCT TYPE · GEOFENCE · TRAFFIC AND ROADS · DRIVER HOURS · BREAKS · PRIORITY DELIVERIES

PART C · A SECOND SENSING LAYER

The layer that reveals a card not being carried: CCTV + AI

Thanks to the CCTV integration and AI models developed by our R&D team, if a person detected in camera footage is in a zone with no matching BLE staff card signal, the system can treat that as a **“card-less person” event**.

DIAGRAM · TWO DATA SOURCES, ONE DECISION Camera and RTLS are compared over the same zone and the same time window. Zone names, camera code and time are illustrative.

CCTV + AI

Detects human presence

The AI model detects human presence in the image together with the relevant camera and zone. Its output is **presence**, not identity.

BLE RTLS

Supplies identity and position

It provides the identity and position of the staff cards present in the zone. Where AoA is installed, that position is at **precise X-Y** level.

RULE ENGINE

Compares by time and zone

It compares AI human detection against BLE card presence by time and by zone, and raises the mismatch as an event.

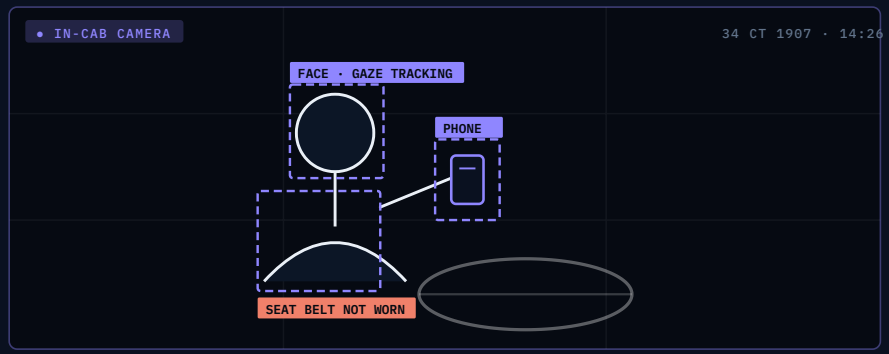
WHY IT MATTERS

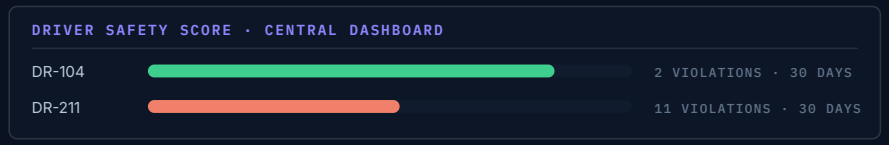
This capability is **not an alternative** to the BLE system; it is a second sensing layer that complements the RTLS infrastructure by confirming human presence with a camera. The reliability of the project no longer rests on card-wearing discipline alone.

02 · AI-POWERED VISION ANALYSIS

In-cab and surround footage is analysed on the vehicle

The system monitors in-cab driver behaviour in real time using AI-powered cameras. It detects safety violations automatically and warns **both the driver and the control center**; each driver's violation history and safety score is tracked on the central dashboard.





MOCK-UP · IN-CAB ANALYSIS AND SCORING The view, detection boxes and score values are SVG mock-ups; the plate, driver codes and numbers are illustrative.

01 · PHONE USE

Detected while driving

If the driver picks up a phone while driving, the system detects it at once, warns in the cab and reports the event to the center.

02 · SMOKING

Where fire is a risk

The in-cab camera detects smoking; the driver is warned at once, keeping fire and explosion risk to a minimum.

03 · SEAT BELT

Checked while moving

Whether the seat belt is fastened is checked and logged while the vehicle is moving; if not, an urgent warning is triggered.

04 · FATIGUE

Eye and gaze analysis

Signs of fatigue and distraction such as closing eyes, a dropping head or prolonged gaze deviation are analysed in real time.

05 · SCORING

Per-driver reporting

Each driver's violation history and safety score is tracked on the central dashboard, with detailed reports on demand.

06 · ON-VEHICLE PROCESSING

Analysed on board

Analysis runs on the vehicle, so the cab warning needs no connection; only events and their footage reach the center.

THE PURPOSE · PROTECTING HUMAN LIFE

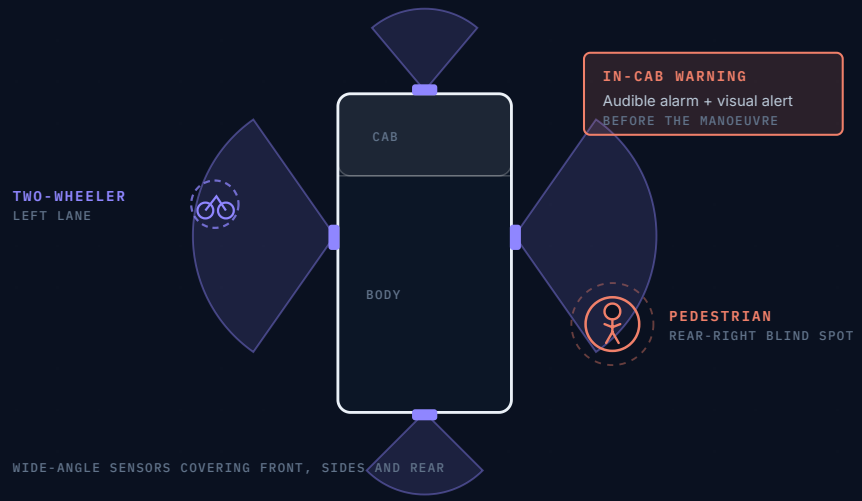
The purpose is not to penalise but to **prevent workplace accidents** and keep safety standards high in dangerous goods transport.

03 · CAMERA, RADAR AND EVENT RECORDING

Surround sensing and event-based management of footage

The video layer does three jobs at once: **access from anywhere** (cloud camera), **detecting the unseen** (blind spot radar) and **keeping the right moment** (event-based recording). All three write to the same event stream.

BLIND SPOT RADAR · PLAN VIEW



The coverage angles and distances shown were chosen to illustrate the principle; real coverage depends on the vehicle type and the sensor configuration.

CLOUD CAMERA · 01

Remote access

The cameras on every vehicle in the fleet can be reached live over the internet, at any time and from anywhere; recorded footage opens in the same interface.

CLOUD CAMERA · 02

Automatic backup

Critical footage is backed up to the cloud automatically, preventing data loss and preserving continuity of record in dangerous goods transport.

CLOUD CAMERA · 03

Real-time event alerts

When a safety or operational risk is detected, managers receive an immediate alert backed by footage.

CLOUD CAMERA · 04

Archive and reporting

Events are easy to filter and detailed safety reports are produced quickly; the footage archive can be searched by event type.

01 · INSTANT WARNING

Audible and visual

An object in a blind spot triggers an alarm in the cab, so the driver knows before manoeuvring.

02 · WIDE ANGLE

Side and rear coverage

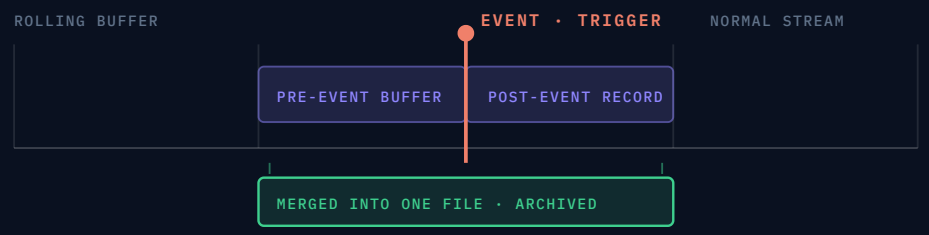
Sensors covering both sides and the rear cover lane changes and reversing.

03 · LOGGING

Input to risk analysis

Every event is logged with a timestamp; driver-level risk analysis follows.

EVENT-BASED RECORDING · BEFORE AND AFTER IN ONE FILE

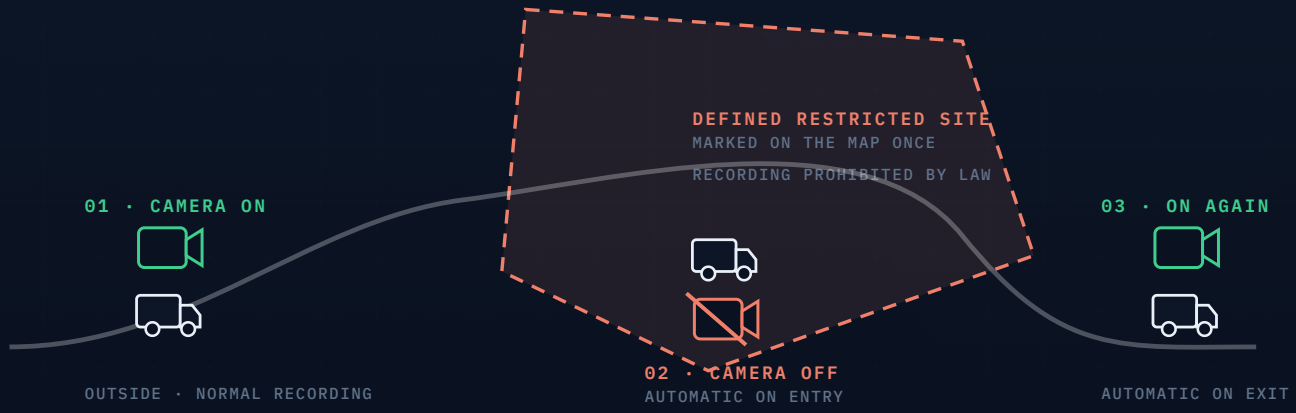


When a defined event occurs, recording is triggered at once; the footage from before and after the event is merged automatically into a single file, archived and sent to the people concerned. Remote analysis and fast decisions work from that file.

04 · GEOFENCE AND COMPLIANCE

Automatic camera shutdown in restricted areas: compliance becomes systematic

At some sites, camera recording is prohibited by law for operational reasons. With geofence-based camera management, these sites are marked on the digital map **once**; the camera system switches off the moment the vehicle crosses the boundary and comes back on when it leaves.



AUDIT LOG

10:14:22	Boundary entered
10:14:22	Camera switched off
10:14:23	Center notified
10:52:07	Boundary exited
10:52:07	Camera switched on

When and where the camera went off and on is logged; the compliance record is built from that log.

DIAGRAM · GEOFENCE-BASED CAMERA MANAGEMENT The boundary geometry, times and route are illustrative. The same geofence infrastructure also serves route-deviation, out-of-zone discharge and unplanned-stop scenarios.

01 · ZONE DEFINITION

Marked once

Restricted sites are marked on the map once; the system remembers those boundaries permanently and applies them to every vehicle.

02 · AUTOMATIC ACTIVATION

No driver action

Cameras switch off when the vehicle enters the boundary and on when it leaves. Because no manual step is needed, human error is eliminated.

03 · FULL AUDIT LOG

A compliance record

When and where the camera went off and on is logged, producing a compliance record that can be presented in an audit.

04 · CENTRAL MANAGEMENT

Updated from one place

Zone rules for the whole fleet are updated and monitored from one platform; adding a new site is a single operation on the map.

CLOSING · SHARED PLATFORM

The whole chain comes together in one data model

Location and temperature data from inside the facility, production records from line automation, the barcode and RF-ID reads captured at loading, the delivery confirmations taken on the tablet, and the telemetry, camera, radar and vision analysis output from the vehicle all come together **in one data model on the Crealog platform**.

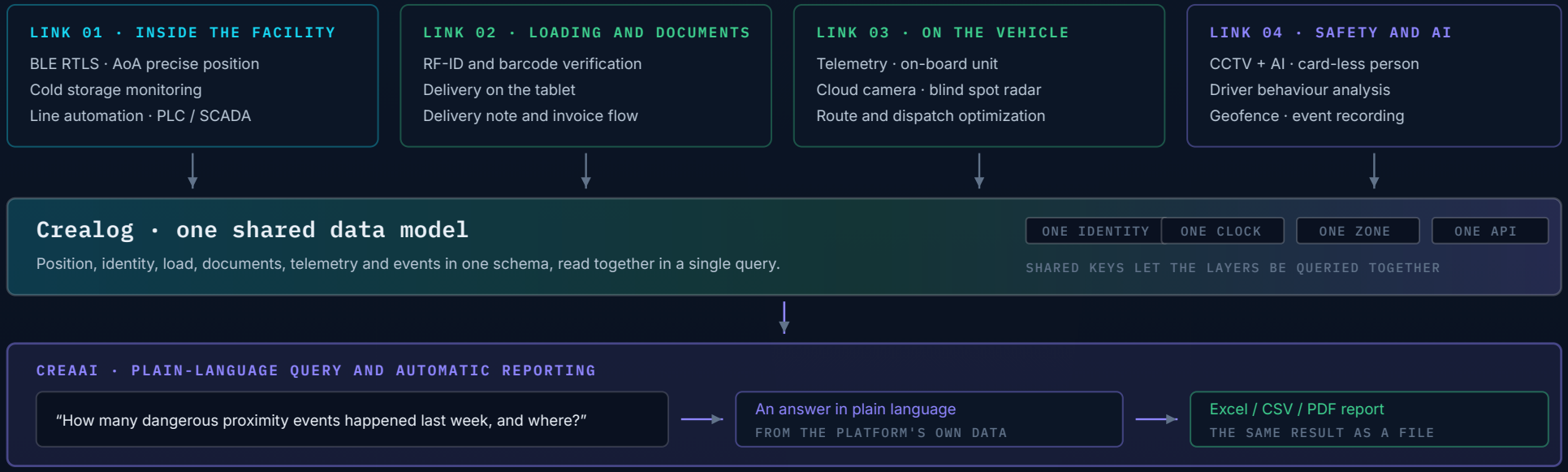


DIAGRAM · FOUR LINKS, ONE DATA MODEL The layers can be commissioned in sequence; whichever order they are installed in, they join over the same keys. The example question and output formats are illustrative.

DATA STAYS IN-HOUSE

The platform works from its own data

Queries run against the organization's own platform records, so the answer interprets what is in the system rather than information gathered from outside.

PERMISSION-AWARE ANSWERS

Who can ask what?

Answers stay within the user's own permissions; a user without the necessary rights cannot reach the underlying records indirectly either.

TRACEABLE RESULTS

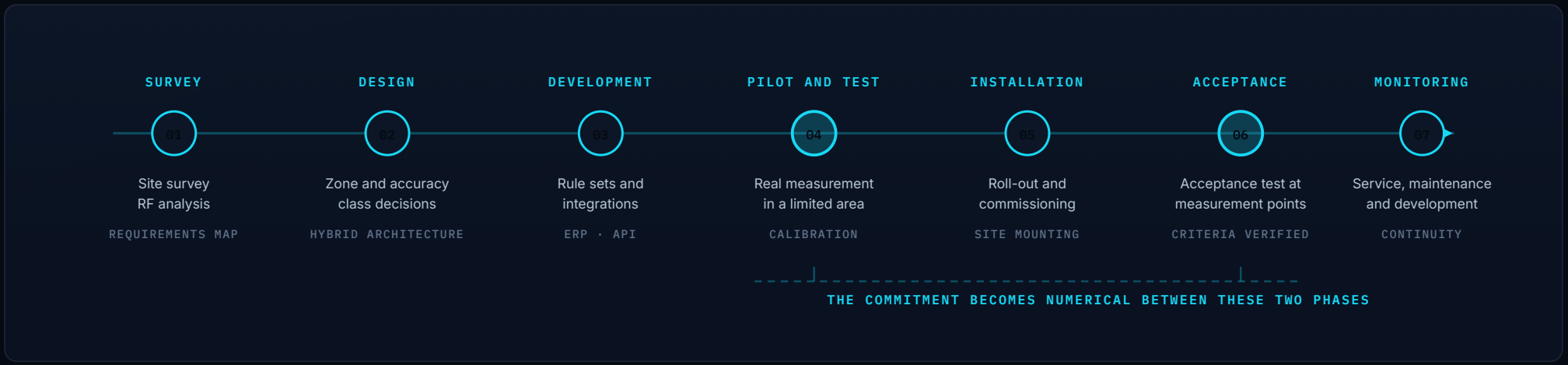
The records behind the answer

Answers and reports show the records they derive from, so a questioned figure can be traced to its source.

CLOSING · ROLL-OUT ROADMAP

An installation that starts with a pilot and is measured against acceptance criteria

The project runs in seven phases. Precision and performance targets become numerical acceptance criteria **after the pilot, not before installation**, and the roll-out is built on the validated design.



WHAT THE ACCEPTANCE TEST MEASURES

- **Position accuracy:** error at reference points, by zone class
- **Zone detection:** correct-assignment rate and border behaviour
- **Latency:** time from broadcast to screen and to alarm
- **Coverage:** dead-spot sweep and Locator lines of sight
- **Alarm accuracy:** false alarms and misses counted per scenario
- **Battery life:** expected service life at the chosen broadcast interval

WHY IS A PILOT ESSENTIAL?

The same hardware gives different results in different plants: metal density, racking layout, ceiling height and machine bodies all shape the RF environment. A pilot shows **whether the commitment holds on site**.

TARGET

100%

MACHINE VISIBILITY

Every robot and machine monitored from one platform.

TARGET

60%

FAULT DETECTION TIME ↓

Central data flow shortens response time.

TARGET

40%

DOWNTIME ↓

Predictive maintenance data reduces unplanned stops.

TARGET

95%

DATA AVAILABILITY

Different brands and protocols in one structure.

ABOUT THESE FIGURES

The percentages above are **target values**, not measured results from an installation. Project-specific targets are set by measuring the current baseline and reviewing the pilot results.

NEXT STEP

Not a tracking system, but a digital infrastructure

Infrastructure that starts with staff tracking can grow into forklift safety, pallet and equipment tracking, stock counting, shuttle vehicles, delivery management, telemetry and CCTV/AI verification. The investment is never tied to a single problem.

Solving today's need while running tomorrow's scenarios on the same infrastructure.

01

Site survey

The site's RF environment, zone requirements and accuracy classes are determined together.

02

Pilot area

Real measurement in a limited area; the commitment becomes numerical from that measurement.

03

Demo

A live walkthrough of the BLE Monitor, setup and reporting screens.

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