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DESIGN STUDY

Digital product passport for a battery maker under the battery-passport regulation

Complete design on current platforms

CAPABILITY	INDUSTRY	SETTING
Supply Chain & Integration	Manufacturing	Battery cell manufacturer
DOCUMENT	**VERSION**	**DATE**
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Document control

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Sign-off	"An engagement under this design is signed by the practice lead before any build proceeds."		

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CONVENTIONS

Source tags. [S] figure read from the standard owner's or vendor's own current page on Sep 18, 2026 · [S*] figure from the owner's page summary where the page itself could not be opened · [A] design assumption · [T] design target (the record's outcome figure and anything derived from it). Every figure carries one tag. No figure comes from any prior engagement, file or asset. A row with more than one tag is counted once: as a published figure if any tag is [S] or [S*], otherwise as an assumption if any tag is [A], otherwise as a design target.

Table 1. Revision history

Date	Version	Change
Sep 18, 2026	1.0	First issue.
Sep 20, 2026	1.1	Public implementations added; figures reconciled with published sources.
Sep 27, 2026	1.2	Figures and platform details rechecked against published sources.
Oct 10, 2026	1.3	Approval line now reads: approved by the Founder, issued by Symbeeo. Avinash Dhinakaran remains the author.

1 · Scope

Who it is for. The head of quality or the head of IT of a battery cell manufacturer that must issue a battery passport for every battery it places on the EU market from February 18, 2027 and hand passport data to its OEM customers through a data-space connector rather than by file transfer.

Typical buyer [A]. A battery cell manufacturer supplying two OEMs. One production line, one manufacturing execution system (MES) holding batch and cell test data, one ERP holding part and customer master data. Both OEMs are Catena-X participants. Volume assumption: 1 passport per battery pack, 200,000 packs a year [A].

What is in. The passport data model and its mapping from MES and ERP; the unique product identifier and QR code on the label; the Digital Twin Registry entry per battery; the Dataspace Protocol connector that publishes passport data to each OEM; the audit trail of every exchange; the go-live plan against the regulatory date. **What is out.** Carbon-footprint calculation method (a separate workstream that feeds one passport attribute); the OEM's own connector; recycling-stage passport updates by third parties after handover.

Assumptions. The manufacturer is a Catena-X participant with a Business Partner Number [A]. The connector runs on the manufacturer's own infrastructure, on two hosts [A]. Passport attributes not yet fixed by delegated act are held as optional fields [A].

Related documents, read Sep 18, 2026. Regulation (EU) 2023/1542, consolidated text of July 31, 2025, Article 77 and Article 13 (https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:02023R1542-20250731) · Dataspace Protocol, release 2025-1 (https://eclipse-dataspace-protocol-base.github.io/DataspaceProtocol/2025-1/) · Dataspace Protocol 2024-1 catalog protocol, IDS specification repository, branch 2024-1, read Sep 27, 2026 (https://github.com/International-Data-Spaces-Association/ids-specification/blob/2024-1/catalog/catalog.protocol.md) · Catena-X Digital Product Passport use case (https://catena-x.net/use-case-cluster/digital-product-passport/) · CX-0143 Use Case Circular Economy Digital Product Passport Standard v1.4.0, CX-Titan release, read Sep 27, 2026 (https://catenax-ev.github.io/docs/standards/CX-0143-UseCaseCircularEconomyDigitalProductPassportStandard/introduction) · CX-0160 Battery Passport v1.1.0, CX-Neptune release 26.09, read Sep 27, 2026 (https://catenax-ev.github.io/docs/next/standards/CX-0160-BatteryPassport/Changelog) · CX-Titan and CX-Neptune release notes (https://catenax-ev.github.io/blog-releasenotes/cx-titan · https://catenax-ev.github.io/blog-releasenotes/cx-neptune) · Eclipse Tractus-X release

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changelog, release 26.09 of Sep 16, 2026 (https://eclipse-tractusx.github.io/blog-changelog/) · Eclipse Tractus-X Connector releases (https://github.com/eclipse-tractusx/tractusx-edc/releases) · Eclipse Tractus-X Digital Product Pass application, user release notes (https://github.com/eclipse-tractusx/digital-product-pass/blob/main/docs/RELEASE_USER.md) · Eclipse Tractus-X EcoPass KIT, Battery Pass application success story (https://eclipse-tractusx.github.io/docs-kits/kits/eco-pass-kit/success-stories/battery-pass-application-success-story/).

1c · Public implementations this design follows

Each row is labeled. **Public deployment**: a named operator's real deployment, published and dated by the operator, its vendor or a partner, used where one exists. **Our own design**: the dated vendor or standards documentation this design was built from, where no public deployment of the design exists. Labels and dates checked Sep 27, 2026.

Table 2. Public implementations this design follows

Implementation	Who published it · date	What it settles for this design	URL
Our own design, built from published documentation. Tractus-X release 26.09 and Tractus-X Connector releases	Eclipse Tractus-X · changelog Sep 16, 2026; Tractus-X Connector 0.13.0 released Aug 27, 2026	The reference connector and registry both OEMs run: Tractus-X Connector 0.13.0 and Digital Twin Registry 0.13.0; the connector added Dataspace Protocol 2025-1 in 0.11.0 and removed 2024/1 in 0.12.0, so R9's protocol choice is the only one the reference implementation still speaks	https://eclipse-tractusx.github.io/blog-changelog/ · https://github.com/eclipse-tractusx/tractusx-edc/releases
Our own design, built from published documentation. CX-0143 v1.4.0 (CX-Titan, current) and CX-0160 Battery Passport v1.1.0 (CX-Neptune, 26.09)	Catena-X · Titan release notes Mar 18, 2026; Neptune release notes Sep 18, 2026, with the Neptune standards going live on Nov 24, 2026	R11 as published: CX-0143 v1.4.0 keeps AAS twins per CX-0002 and BPN per CX-0010 and moves the battery passport out of CX-0143 into CX-0160, whose models are the IDTA battery-pass submodels; this design is pinned on Sep 27, 2026 to CX-0160 v1.1.0 inside the CX-0143 v1.4.0 frame. The Tractus-X Digital Product Pass viewer (last release 4.0.1, Jul 25, 2024) is archived and reads only the older battery_pass 6.0.0 model, so it is no longer the OEMs' reference viewer	https://catenax-ev.github.io/docs/standards/CX-0143-UseCaseCircularEconomyDigitalProductPassportStandard/introduction · https://catenax-ev.github.io/docs/next/standards/CX-0160-BatteryPassport/Changelog · https://github.com/eclipse-tractusx/digital-product-pass · https://github.com/eclipse-tractusx/digital-product-pass/blob/main/docs/RELEASE_USER.md
Our own design, built from published documentation. Battery Pass application success story, EcoPass KIT	Eclipse Tractus-X · shown at Hannover Messe 2023 (page itself undated; docs version 26.09, released Sep 16, 2026)	The public flow is QR scan or product ID, Digital Twin Registry lookup, connector transfer, one viewer; the §3 diagram follows it	https://eclipse-tractusx.github.io/docs-kits/kits/eco-pass-kit/success-stories/battery-pass-application-success-story/

The passport standard is CX-0160 v1.1.0 within CX-0143 v1.4.0 (CX-0143 v1.0.0 belongs to the archived Jupiter release); the internal deadline (R3, §4.7), Dec 1, 2026, follows the Neptune go-live, and the connector row in §3 names the reference implementation version. No named battery maker's production passport on Catena-X was found on Sep 27, 2026; every row is documentation used to build our own design, and the success story shows the public flow, not a customer.

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2 · Requirements register

Table 3. Requirements register

#	Requirement	Value	Source
R1	Batteries in scope	LMT batteries, industrial batteries above 2 kWh, electric vehicle batteries	[S] Reg. 2023/1542 Art. 77
R2	Regulatory date	passport required from February 18, 2027	[S] Reg. 2023/1542 Art. 77
R3	Internal deadline	passports issued for every pack from Dec 1, 2026, one week after the CX-Neptune standards go live and eleven weeks before the regulatory date	[T]
R4	Identifier	one unique identifier per battery that resolves to a web link to the passport	[S] Reg. 2023/1542 Art. 3(1)(66)
R5	Physical access	QR code on the battery giving access to the passport	[S] Reg. 2023/1542 Art. 13(6)
R6	Responsible party	the economic operator placing the battery on the market	[S] Reg. 2023/1542 Art. 77
R7	Access levels	differentiated access: public, authorized parties, regulators	[S] Reg. 2023/1542 Art. 78
R8	Volume	200,000 passports a year; 1 per pack; issued at end of line	[A]
R9	Exchange protocol	Dataspace Protocol 2025-1: catalog, contract negotiation, transfer process	[S] DSP 2025-1
R10	Message format	JSON-LD compact form; DCAT for catalog; ODRL for offers and policies	[S] DSP catalog protocol
R11	Passport standard	CX-0160 Battery Passport v1.1.0 (CX-Neptune 26.09, pinned Sep 27, 2026) within CX-0143 v1.4.0 (CX-Titan); digital twin per battery in the Digital Twin Registry; Asset Administration Shell submodels	[S] CX-0143, CX-0160
R12	Partner identity	Business Partner Number per participant	[S] CX-0143 referencing CX-0010
R13	Audit	every catalog request, negotiation and transfer logged with partner, policy, timestamp; retained for the battery's life	[T]
R14	Issue latency	passport reachable by its identifier within 60 s of end-of-line test pass	[A]

Fourteen rows; ten carry a standard's figure, two are design assumptions, two are design targets.

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3 · Architecture overview

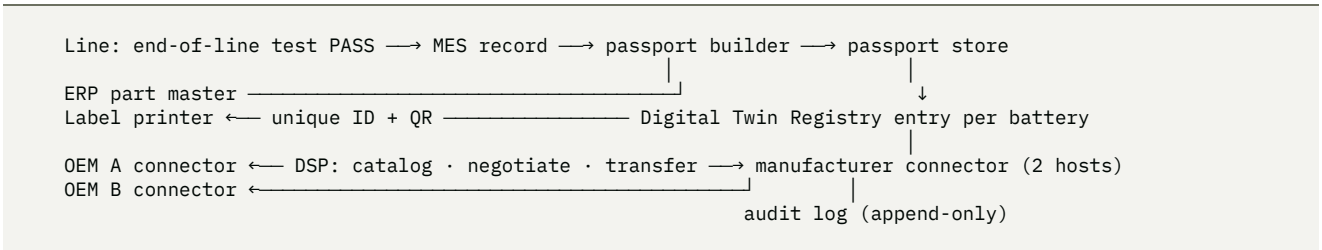


Figure 1. Battery passport issue and exchange

The passport is built from MES and ERP at end of line, registered as a digital twin, published through one Dataspace Protocol connector with one contract offer per OEM. The parts table lists Dataspace Protocol and Catena-X components rather than hardware.

Table 4. Architecture overview

Role	Component (exact name)	Qty	Capacity used	Why this unit
Exchange protocol	Dataspace Protocol 2025-1	1	3 protocol parts: catalog, contract negotiation, transfer process	current stable release; "further changes shall not affect conformity" [S]
Passport standard	CX-0160 Battery Passport v1.1.0, within CX-0143 v1.4.0	1	IDTA battery-pass submodels	the battery passport moved out of CX-0143 into CX-0160 [S]; pinned Sep 27, 2026
Twin standard	Asset Administration Shell per CX-0002 (Digital Twins in Catena-X)	1 per battery	200,000 twins a year [A]	required by CX-0143 v1.4.0 [S]
Discovery	Digital Twin Registry	1	200,000 entries a year, growing	CX-0143 mandatory component; "unique identification and discovery of digital twins across the Catena-X dataspace" [S]
Partner identity	Business Partner Number per CX-0010	3 (manufacturer, OEM A, OEM B)	—	CX-0143 identification scheme [S]
Connectivity	Dataspace connector per CX-0018 (Dataspace Connectivity)	1 logical, 2 hosts	2 contract offers, 2 counterparties	CX-0143 references CX-0018 [S]; reference implementation Tractus-X Connector 0.13.0 in release 26.09 [S] (`https://eclipse-tractusx.github.io/blog-changelog/`); host count [A]
Catalog and policy	DCAT catalog with ODRL offers, JSON-LD	1 catalog, 2 offers	1 offer per OEM	DSP catalog protocol [S]
Label	unique identifier string and QR code	1 per battery	—	Reg. Art. 3(1)(66), Art. 13(6) [S]

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4 · Design by subsystem

4.1 Passport builder.

A service that subscribes to the MES end-of-line test event, joins the batch record with ERP part master data, and writes one passport document per pack in the CX-0160 v1.1.0 models [S]. Attributes whose delegated act is not yet final are optional fields that the builder leaves empty rather than filling with a placeholder [A]. Assumed: 60 s from test pass to reachable passport (R14) [A].

4.2 Identifier and label.

One unique identifier string per battery, generated by the builder, encoded in the QR code printed at the labeling station, resolving to the passport [S] Art. 3(1)(66), Art. 13(6). Rejected: batch-level identifier — Article 77 is per battery.

4.3 Digital Twin Registry.

One Asset Administration Shell per battery registered with the identifier as the lookup key, pointing to the passport submodel endpoint on the manufacturer's connector [S] CX-0143. Registry hosted by the manufacturer [A].

4.4 Connector and contracts.

One Dataspace Protocol 2025-1 connector on two hosts, active and standby [A]. The catalog publishes one dataset per passport class with one ODRL offer per OEM; the offer restricts use to the counterparty's Business Partner Number [S] DSP catalog protocol, CX-0010. Each OEM's connector runs catalog request, contract negotiation and transfer process against it [S] DSP 2025-1. Rejected: SFTP drop per OEM — no usage policy, no negotiation record, no per-exchange audit (R13).

4.5 Access levels.

Public attributes served from the QR link without authentication; authorized-party and regulator attributes served only through negotiated contracts or an authenticated regulator endpoint [S] Art. 78; the split of attributes by level follows the regulation's annex as finalized [A].

4.6 Audit.

Every catalog request, negotiation state change and transfer written to an append-only log with partner BPN, policy, dataset identifier and timestamp; retained for the service life of the battery [T]. Log store sized at 1 kB per event, 20 events per passport, 200,000 passports a year: 4 GB a year [A].

4.7 Timeline.

Passport issued for every pack from Dec 1, 2026, after the CX-Neptune go-live of Nov 24, 2026 [S] and eleven weeks before the regulatory date of Feb 18, 2027 [T]. The eleven weeks are the buffer for OEM connector interoperability tests [A].

5 · Failure behavior

Table 5. Failure behavior

Failure	Behavior	Source
MES event not received	pack held at labeling; no label without a passport identifier	[A]

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Failure	Behavior	Source
ERP master data missing for a part	passport built with the attribute flagged incomplete; pack held; alert to quality	[A]
Connector active host down	standby host serves catalog and transfers; in-flight negotiations restart from their last state	[A]
OEM connector rejects an offer	negotiation ends in the protocol's terminated state; event logged; passport still issued and reachable by QR	[S] DSP 2025-1; [A]
Digital Twin Registry unreachable	passports still built and stored; registrations queued and replayed	[A]
Audit log write fails	transfer refused until the log is writable; no unlogged exchange	[T]

6 · Limits

- Delegated acts on passport content can still change attribute lists; the builder holds optional fields but a new mandatory attribute means a model change.
- CX-0160 v1.1.0 is pinned on Sep 27, 2026 from the CX-Neptune release, which the standard library still labels preview until its go-live of Nov 24, 2026 [S]; any change at go-live is taken before R3's date. The OEMs' passport consumer is confirmed at the interoperability test, since the Tractus-X viewer is archived [S].
- The design covers passport issue and exchange, not the carbon-footprint calculation behind one attribute.
- Two OEMs, two offers; a third customer is a third offer and a third interoperability test, not a redesign.
- No figure here has been measured; every latency and volume is an assumption or a target.

7 · Lessons learned

None yet — this is a design study; populated after the first build against it.

8 · The author

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Signed off by Edwin Ozer, Founder.

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SYMBEEO

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Figures are as published by their sources on the dates given in this document; figures marked [A] are assumptions.

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