



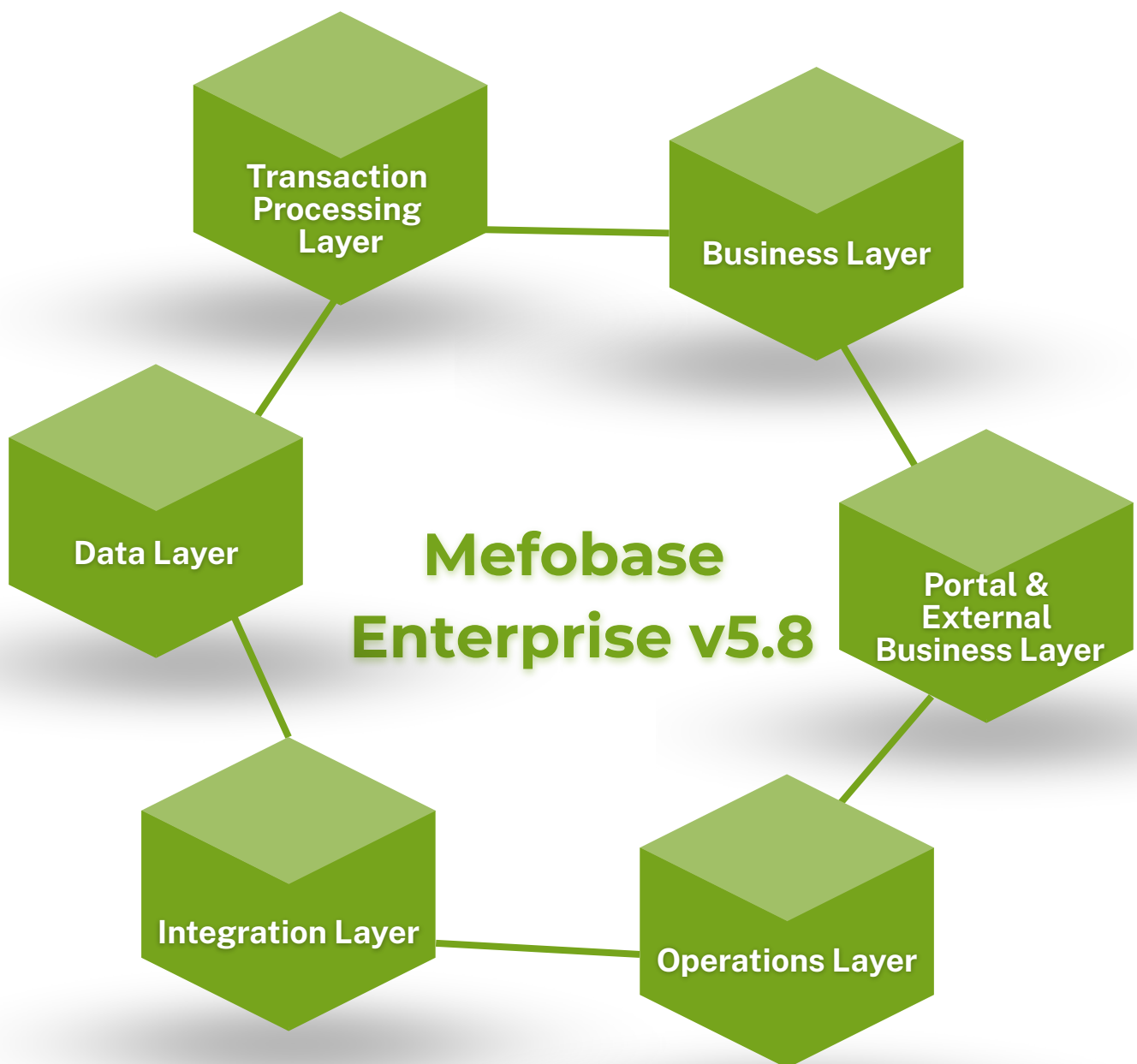
MEFO DATA

Mefobase Enterprise v5.8

Mefobase Enterprise v5.8 solution is a **federation/national-scale clearing and supervision backbone for road-tolling** that ingests lane/back-office events in real time and in batches; performs integrity checks, pricing/rating, settlement and revenue/cost allocation; provides exception handling & post-audit; exposes portals to operators and government; and integrates broadly (RFID/ALPR, national registries, payment rails, SMS/email). The architecture is layered and modular to support international deployment with policy-driven security, auditable data flows, and standards-based interoperability.

1. Reference Architecture

The solution is organized into layered building blocks that separate fast-path transaction handling from enterprise business operations, external portals, operations/observability, systems integration, and persistent data. The layers below summarize responsibilities and the principal subsystems.



1.1 Transaction Processing Layer

High-throughput services ingest and process toll events from toll back-end systems and lanes, validate and enrich them, and route them for rating, settlement, and post-audit:



- **Transaction Ingestion & Pre-check.** Maintains connections to toll back-end systems, receives toll transactions, and performs initial checks.



- **Abnormal Transaction Handling.** Detects and stores exception cases for later investigation (e.g., no RFID, invalid RFID, RFID mismatch with license plate).



- **Data Integrity Verification.** Verifies end-to-end integrity for exchanged data; supports compression, encryption, format validation, and integrity checks with searchable logs.



- **Automated Image Processing (ALPR).** Performs plate recognition when plate data is missing or inconsistent and feeds results into periodic or exception flows.



- **Connection & Job Monitoring.** Supervises inbound/outbound connections and internal processing pipelines, with alerting.



- **Periodic (Batch) Processing.** Collects and normalizes scheduled files (including during backhaul outages) via FTP; supports encryption/compression, binary/lot processing, and audit logs.



- **Real-time Online Processing.** Defines online channels, message formats (incl. binary), routing, queuing with backup on channel closure, real-time notifications (SMS/email), and live reporting.

1.2 Business (Operations) Layer

Enterprise applications support internal users who manage vehicles, accounts, RFID cards, pricing, payment instruments, revenues/costs, integration partners, and post-audit functions:

Vehicle Management

Pricing & Rating

Account Management

Payment Instrument Management

Account-Owner Management

Revenue & Cost Management

RFID Management

Integrated-Party Management

Monitoring & Post-Audit.

1.3 Portal & External Business Layer



Portals provide self-service and investigative capabilities to external stakeholders (operators, toll collection management units, and government agencies). Operators get instant access to transaction and revenue dashboards; government agencies receive deep cross-sectional supervision tools with multi-level reporting.

1.4 Operations Layer

Central admin and operations modules offer user and role administration, policy enforcement, and infrastructure/service monitoring with live visualizations and automated alerting.

1.5 Integration Layer

Standardized connectors integrate the platform with the ecosystem: toll back-ends (highways), Traffic Management Centers (TMCs), national citizen registry, vehicle registry (Vietnam Register), SMS gateways, ITS partners, and other road-payment service providers.

Capabilities include multi-protocol exchange (FTP, Web Service/API; import/export; online messages), scheduled pulls, data cleaning/deduplication, and secure transport with role-based access and audit trails.



1.6 Data Layer

A structured data estate includes shared reference catalogs (e.g., provinces, roads, financial institutions), operational databases (vehicles, accounts, owners, RFID, pricing, payment instruments, transactions, exception cases, uploaded files), and an aggregated store for reporting/statistics

2. Key Features by Module

Below are representative features across critical modules; these are not exhaustive but illustrate system depth and coverage.



2.1. Transaction Ingestion & Synchronization

- Define services and supported export/import formats; manage station/device catalogs and central users; accept data via FTP; send SMS confirmations; expose Web Services to partners.
- Provide access control and event logging with intrusion prevention.

2.2. Periodic Batch Processing

- Scheduled FTP collection; compression/encryption; binary/lot processing; input standardization; comprehensive processing logs; query tools; data services and access control.

2.3. Online Real-Time Processing

- Channel configuration; message format (incl. binary) and routing; queues with backup; violation checks; SMS/email notifications; metadata catalogs; real-time data exchange; live monitoring and audit trails; access control and reports.

2.4. Data Integrity & Verification

- Compression/decompression and encryption/decryption; binary handling; file-level schema checks; “missing file” resync over FTP; live integrity verification and reconciliations; searchable process logs and summaries.

2.5. Automated Image Processing (ALPR)

- Plate recognition for incomplete/mismatched events; feeds corrective results into periodic or exception flows for accurate downstream processing.

2.6. Exception (Abnormal) Transaction Handling

- Ingest and case-manage suspicious transactions and related images; cross-check against RFID account owner and vehicle registry; manual/assisted reconciliation; KPI tracking on exception processing; alerts and secure role-based workflows with full audit.

2.7. Business Applications

- **Pricing & Rating.** Define road/route catalogs, payment modes, tariffs, discounts, VAT, RFID issuance fees; compute charges, apply exemptions/adjustments, and maintain change history with reporting.
- **Revenue & Cost Management.** Model revenue distribution and scenarios, support percentage/periodic settlement, trial simulations, and discrepancy detection with rich reporting.
- **RFID Card Management.** Full lifecycle: issuance, activation, linkage to accounts/vehicles, status changes (locked, damaged, recovered), and historical traceability.
- **Account & Customer Management.** Account lifecycle (create/lock/delete), identity & contact updates, duplicates detection, payment-method linkage, external queries, detailed retrieval, and service KPIs — secured by login and action logs
- **Payment Instrument Management.** Catalog and search of bank accounts, cards (domestic/international), and e-wallets.
- **Integrated-Party Management.** Administer technical connections and datasets for all partner agencies/providers, with error alerts and detailed system/audit logs.
- **Monitoring & Post-Audit.** Investigate lane/plate/vehicle cases, manage explanations, reconcile end-to-end, and produce supervisory reports (e.g., claw-back transactions, unresolved explanations, daily/monthly/yearly fees).

2.8. Portals

- **Operator & Toll-management Portal.** Real-time transaction/revenue views, multi-dimensional reports, user/role management, document updates, and in-portal exception workflows.
- **Government Portal.** Centralized supervision with layered searches (e.g., priority/forbidden vehicles, violations, lane images), vertical/horizontal reporting by time/region/vehicle type, plus user/audit administration.

2.9. Data-Center & Service Monitoring

- End-to-end IT infrastructure monitoring (servers, switches/routers, services/processes), real-time dashboards, network maps, thresholds and runbooks, automatic ticketing, and KPI reporting.

3. Core Workflows

The core operational workflows are explicitly defined, including (a) transaction synchronization on entry and exit lanes, (b) post-audit supervision of toll data, (c) new account issuance, (d) account-information synchronization, and (e) periodic and real-time integrations with toll back-ends and front-end stations.



4. Security, Privacy, and Data Integrity

Security is enforced consistently across modules:

- **Authentication & Access Control.** Role-based access across all modules and portals, with IP/time policies where applicable.
- **Audit & Traceability.** Comprehensive login/action logs across ingestion, integrity verification, portals, and post-audit modules; full trace across data life cycle.
- **Integrity Controls.** File-format validation, binary handling, compression, encryption, and online integrity checks; automated FTP resynchronization for missing files.
- **Transport Security.** Encrypted channels and strict partner authentication in external integrations, with alerting and detailed system logs.



5. Interoperability & Compatibility

The integration layer and dedicated partner modules ensure interoperability with:

- **Toll Back-ends TMCs.** Bi-directional exchange of toll transactions and reference data; online and periodic modes.
- **National Citizen Database & Vehicle Registry.** Identity and vehicle verifications within exception handling and investigative workflows.
- **Front-End Stations (TMS).** Continuous station connectivity, blacklist/whitelist and transaction sync, device supervision, and secure, encrypted channels with live ops support.
- **Other Road-payment Service Providers.** Partner onboarding, role/IP gated access, and multi-channel exchange (FTP/SMS/Web Service/import/export) with comprehensive reporting and traceability.
- **ITS Partners.** Real-time queries and vehicle status synchronization via Web Services with full RBAC and auditing.
- **Protocol support.** Across modules the system supports FTP, Web Services/APIs, binary message payloads, and live/real-time data exchange.



6. Data & Reporting

The **Aggregated Reporting** Store consolidates operational data for analytics, KPI dashboards, and statutory reporting. The **Statistics/Reporting subsystem** provides comprehensive station operations, post-audit, and revenue reports—supporting anomaly detection and supervisory oversight across operators and regulators.

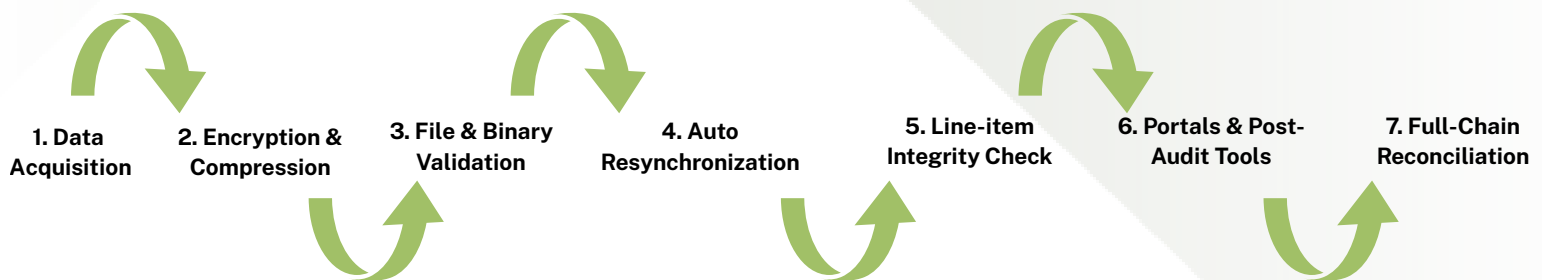
Operator and government portals expose these reports with multi-dimensional filters (periods, stations/regions, vehicle types) and drill-downs, supporting decision making, inspections, and policy development.

7. Operations, Observability, and Reliability

- **Service and Job Monitoring.** Centralized monitoring for all connections and background services with log capture, search, retention, and email/SMS alerting.
- **Data-center Monitoring.** Real-time infrastructure health and event-to-ticket workflows ensure continuous service; KPI reporting confirms availability and performance targets.
- **Access Policies & Least Privilege.** Granular role/group controls and policy inheritance, IP/time windows, and pre-authorization checks protect production operations.

8. End-to-End Integrity & Post-Audit

The platform emphasizes provable data integrity from acquisition to reconciliation through encryption/compression, file and binary validations, automated resynchronization, and line-item integrity checks. Coupled with portals and post-audit tools (searchable by lane, license plate, ticket classes, exemptions), it enables full-chain reconciliation — from lane events to final revenue confirmation — with auditable evidence.

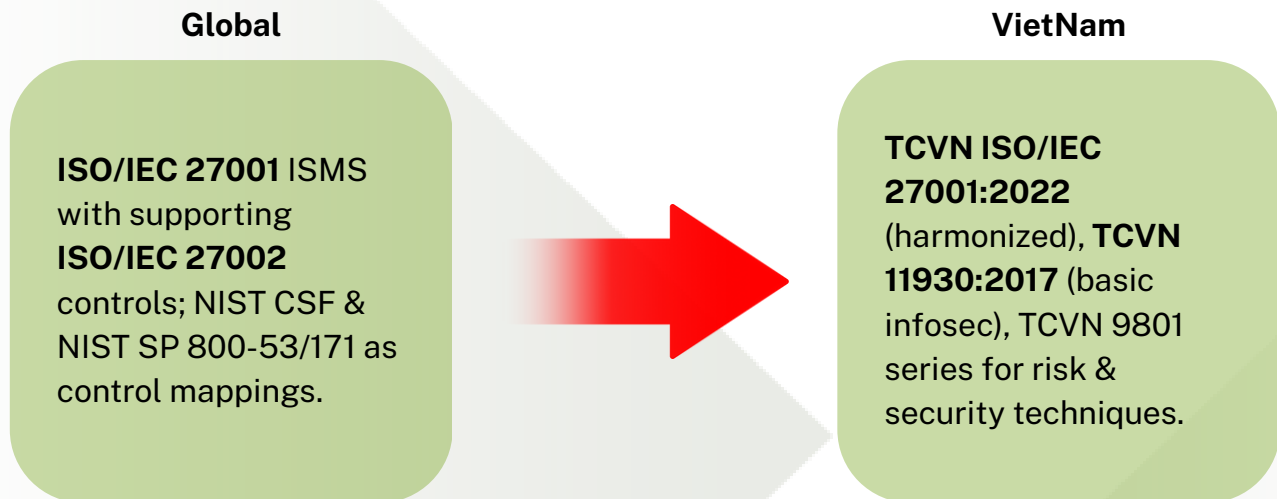


End-to-End Data Integrity & Reconciliation Flow

9. Global Compliance

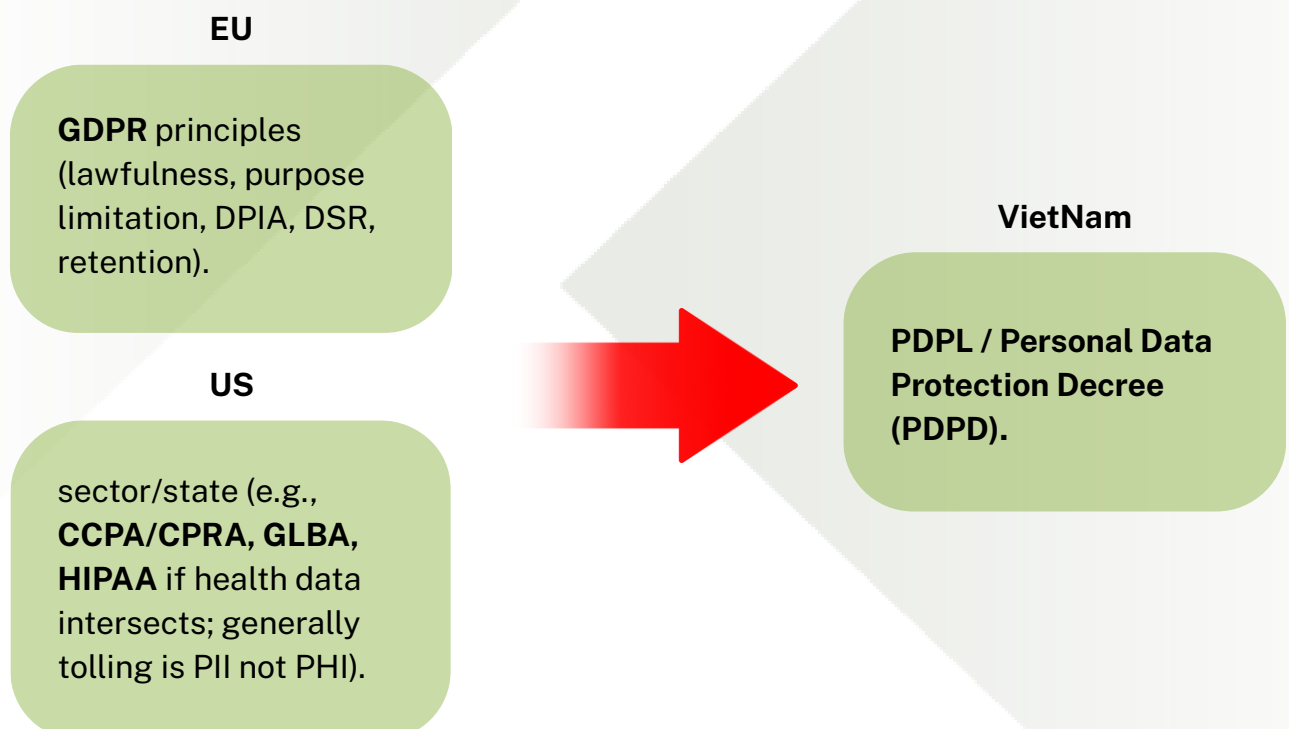
Principle: International/US/EU norms, localize to specific jurisdictions (like Vietnam) with minimal implementation deltas.

1/ Security Management Baseline:



Outcome: a single control library traceable to ISO/NIST, labeled for Vietnam (TCVN) compliance evidence.

2/ Privacy/Data Protection:



Outcome: configurable **privacy profiles** (legal bases, consent flags, retention timers, export/erase workflows) that satisfy GDPR-style rights and are profiled for PDPL requirements.

3/ Payments & Financial Data:

Global

PCI DSS for cardholder data (if directly handled), **SOC 2** for service controls (if audited).

EU

GDPR principles (lawfulness, purpose limitation, DPIA, DSR, retention).

VietNam

Decree 119/2024/NĐ-CP (payments/data protection considerations) + local banking/State Bank rules (integration by contract).

Outcome: a single control library traceable to ISO/NIST, labeled for Vietnam (TCVN) compliance evidence.

4/ Field Equipment, RFID & EMC/Safety

RFID

ISO/IEC 18000-63 (UHF Gen2v2); **EU EN 15509** tolling; US deployments (e.g., E-ZPass/6C) are compatible at protocol level.

VietNam

QCVN 18/96 (EMC for radio/short-range), **QCVN 47** (spectrum), **QCVN 01** (BCT) electrical safety, **QCVN 06** (BXD) fire safety.

EMC/Spectrum/Electrical/Fire

EN 301 489 / EN 55032 / IEC 61000-4, EN 62368-1/IEC 62368-1; US FCC Part 15, NFPA 70/101.

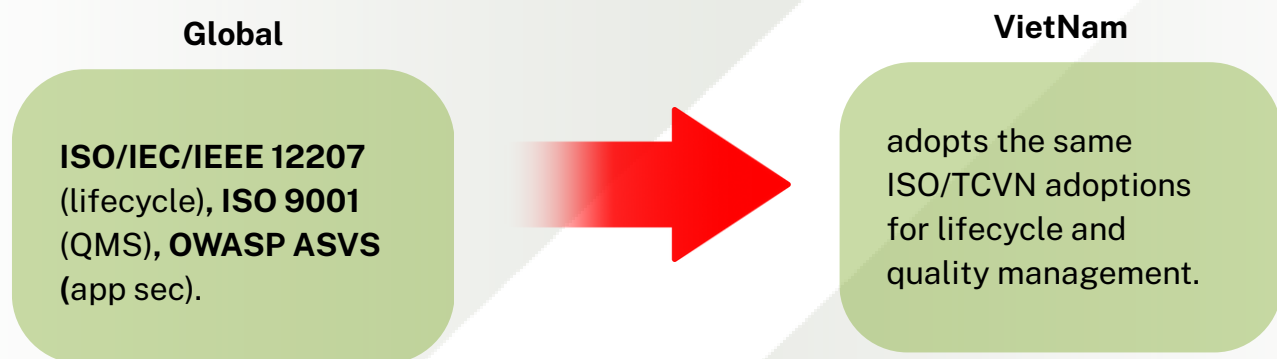
Outcome: configurable **privacy profiles** (legal bases, consent flags, retention timers, export/erase workflows) that satisfy GDPR-style rights and are profiled for PDPL requirements.

5/ Data Center & Continuity:



Outcome: target ratings (e.g., TIA Tier III equivalent), dual-site DR, and evidence binders aligned to TCVN.

6/Software Lifecycle & Quality:



Outcome: SDLC with change control, CI/CD gates, vulnerability management, secure coding, and audit trails.

10. Vietnam Crosswalk

Practical mappings

TCVN ISO/IEC 27001:2022 (ISMS)	→	US: NIST SP 800-53 / NIST CSF / ISO 27001 EU/Intl: EN ISO/IEC 27001 / ISO 27001	<i>Notes: Harmonized; use ISO 27001 as the master control catalog.</i>
TCVN 11930:2017 (Basic InfoSec)	→	US: NIST 800-53 / 800-171 EU: EN ISO/IEC 27002 Intl: ISO/IEC 27002	<i>Notes: Policy & control guidance; pair with 27001.</i>
TCVN 9801-1/2/3:2015 (IT security techniques)	→	US: NIST 800-30/37 EU/Intl: ISO/IEC 15408 (CC), 27005.	<i>Notes: Risk assessment and evaluation alignment.</i>
QCVN 18:2022/BTTTT (EMC for radio equipment)	→	EU: EN 301 489, EN 55032 Intl: IEC 61000-4 US: FCC Part 15 (Class A/B).	<i>Notes: EMC emissions/immunity equivalence.</i>
QCVN 132:2022/BTTTT & QCVN 22:2021/BTTTT (Electrical safety for IT/telecom)	→	EU: EN 62368-1/EN 60950 Intl: IEC 62368-1/IEC 60950-1 US: UL 62368-1.	<i>Notes: Harmonized product safety.</i>
QCVN 33:2019/BTTTT (Telecom network installation)	→	EU: EN 50174 (cabling), IEC 60364 (LV installations).	<i>Notes: Structured cabling practices.</i>
QCVN 47:2015/BTTTT (Radio spectrum)	→	EU: ETSI EN 300 440 family US: FCC 47 CFR Part 15/90.	<i>Notes: Spectrum etiquette and EIRP limits.</i>
QCVN 73:2013/BTTTT (Short-range radios)	→	EU: ETSI SRD standards US: FCC Part 15.	<i>Notes: Tag/reader low-power ops.</i>
QCVN 01:2020/BCT (Electrical safety)	→	US: NFPA 70 (NEC) EU/Intl: IEC 60364 / EN 60335 where applicable.	<i>Notes: Installations and protection.</i>
QCVN 4:2009/BKHCN (Electrical/electronic safety)	→	EU: EN 60335 family Intl: IEC 60335-1.	<i>Notes: Household/similar electrical – applies to certain devices.</i>
QCVN 12:2014/BXD (Electrical systems in buildings)	→	EU/Intl: IEC 60364; US: NEC.	<i>Notes: LV design inside buildings.</i>
QCVN 18:2021/BXD (Construction safety)	→	EU: EN safety regs US: OSHA equivalents.	<i>Notes: Site/occupational practices.</i>
QCVN 06:2022/BXD (Fire safety, buildings)	→	US: NFPA 101/72 EU: EN 54 / EN 13501.	<i>Notes: Evacuation, detection, materials classes.</i>
QCVN 9:2016/BTTTT (Grounding for telecom)	→	EU/Intl: IEC 60364 US: NEC Article 250.	<i>Notes: Earthing/bonding provisions.</i>

QCVN 96:2015/BTTTT (EMC for SRD)	→	EU: ETSI EN 300 220/440 Intl: IEC 61000-4.	<i>Notes: SRD EMC specifics.</i>
TCVN 13420:2021 & TCVN 13421:2021 (ITS data)	→	EU/Intl: ISO/TC204 ITS data standards.	<i>Notes: Data formats & semantics for ITS.</i>
TCVN 10849:2015 (ETC interoperability/tech reqs)	→	EU: EN 15509 Intl: ISO tolling families.	<i>Notes: Ensures ETC functional interop.</i>
TCCS 44:2022 (TCĐBVN) Decision 2255/QĐ-BGTVT (RFID ETC)	→	US: ISO/IEC 18000-63 / 6C practice (e.g., E-ZPass) EU: EN 15509.	<i>Notes: UHF Gen2v2 for nationwide tag/reader interoperability.</i>
TCVN 9250:2021 (Data center)	→	US: TIA-942 EU: EN 50600 / ISO 22237	<i>Notes: Tiering/design operations.</i>
ISO/IEC/IEEE 12207:2017 (Software lifecycle)	→	US: NIST SP 800-64 (life-cycle security) EU: EN ISO/IEC/IEEE 12207.	<i>Notes: End-to-end SDLC governance.</i>
ISO 9001 / TCVN ISO 9001 (QMS)	→	Global: ISO 9001.	<i>Notes: Universal QMS standard.</i>
Decree 85/2016/NĐ-CP Circular 12/2022/TT-BTTTT (security by level)	→	US/EU: not direct; map via ISO 27001/NIST control depth + risk tiering.	<i>Notes: Classification & minimum measures for state systems.</i>
Decree 119/2024/NĐ-CP (payments & data protection context)	→	EU: PSD2 Intl: PCI DSS US: GLBA/CCPA depending on data.	<i>Notes: Regulatory posture; enforce secure payments & privacy.</i>

11. Conformance by Layer

11.1. Information Security (ISMS) & Privacy

- **ISMS:** One global ISO 27001 control set with trace tags to NIST SP 800-53 and Vietnam's TCVN identifiers. Policies include access control, cryptography, operations security, supplier security, and incident response.
- **Privacy profiles:** Feature flags to enable GDPR-style DSR (access/export/erasure), purpose-limited processing, DPIA templates, retention schedules, and logging for lawful basis evidence. Vietnam PDPL profile toggles consent language, cross-border safeguards, and Vietnam-specific DPIA triggers.
- **Data minimization:** At ingestion, only necessary fields are stored; sensitive fields are tokenized/encrypted at rest and in transit (TLS 1.2+; AES-256/KMS).

11.2. Transactions & Data Integrity

- **Online & Periodic:** SFTP/FTPS APIs with integrity checks (checksums, digital signatures where supported), binary frames for high-speed lanes, durable queues with back-pressure.
- **Evidence framework:** Immutable audit logs (WORM or equivalent retention policy), hash-chained log segments (optional), and reconciliation reports support post-audit and regulator scrutiny.

11.3. RFID/ALPR Interoperability

- **RFID:** Compliance targets ISO/IEC 18000-63 (UHF Gen2v2) readers/tags; configuration profiles exist for EN 15509. Vietnam localization includes TCCS 44:2022 parameter presets (frequency, power, anti-collision, security features).
- **ALPR:** Country/plate-aware recognition templates, Vietnam plate formats (old/new series), Vietnamese diacritics handling in metadata, evidence image encryption at rest.

11.4. Business & Settlement

- **Tariffs & taxes:** Flexible rating engine supports VAT rules, exemptions/discounts, and policy-dated configurations (versioned tariffs).
- **Revenue/cost allocation:** Scenario models and periodic settlement with discrepancy detection; export formats aligned to local fiscal systems.
- **Payments:** If cards are processed, PCI DSS scope reduction (tokenization, SAQ-A where possible); for bank transfers, secure API channels and SCA-like flows modeled on PSD2 practices.

11.5. Portals & Gov Supervision

- **Role-based access (RBAC):** Least-privilege roles, time/IP scoping where required; admin segregation of duties; comprehensive audit of login/actions.
- **Reporting:** Multi-dimension reports (time/region/vehicle type/operator), anomaly queues, “explain & resolve” workflows for exceptions—all consistent with regulatory KPI dashboards.
- **Accessibility & language:** Full Vietnamese/English UI, date/time localization, Vietnamese address formats, and privacy notices consistent with PDPL.

11.6. Integration: National Registries, ITS, Operators

- **Registries:** Connectors for national citizen ID and vehicle registry queries; caching with TTL; **request logging** for audit.
- **ITS/TMC:** Standards-based data exchange (aligned to TCVN 13420/13421 / ISO TC204), secure REST with signed tokens, and throttling.
- **Operators/partners:** SFTP/API connectors, schema registries, **contractual SLAs**, error alerting to partners, **and machine-readable interface specs.**

11.7. Data Center, Safety & Operations

- **Facilities:** Target **TIA-942 / EN 50600** classes (mapped to TCVN 9250) for power, thermal, connectivity, and resilience; **dual-site DR** with RTO/RPO objectives.
- **Safety & EMC:** Procurement requires equipment with CE/UL/FCC marks or equivalent, **QCVN conformity** for Vietnam import/operation, and installation manuals mapping NEC/IEC to **QCVN/BXD** clauses (grounding, clearances, fire compartments).
- **Monitoring:** End-to-end telemetry, synthetic checks for lanes/interfaces, runbook automation, ticketing integration, and KPI reports (availability, latency, integrity checks passed).

12. Vietnam-Specific Localization

12.1. Legal/Regulatory Fit

- PDPL consent & cross-border data safeguards (on/off as deployment dictates); export contracts and SCC-like clauses for vendors.
- “Security by level” alignment: classify the system per Decree 85/Circular 12; apply **baseline controls** and **independent assessment** artifacts.

12.2. Operational & Content Localization

- **Vietnamese language** front-end and notifications (SMS/email); Unicode/diacritics preserved end-to-end.
- **Plate formats** (two-line/special series), police/priority vehicle flags, national/BOO operator codes, and province/road catalogs.

12.3. Inter-Agency Workflows

- Portal features tuned to **Department for Roads of Viet Nam** oversight (e.g., KPI bundles referencing ETC compliance metrics), with **drill-downs** to lanes, images, and explanations.
- Evidence packs (CSV/PDF exports) that match agency import templates.

12.4. IDeployment & Hosting

- Choice of **on-prem (state DC)** or **VN-region cloud**; data residency controls; **key management** with HSM or VN-approved KMS; **local SMS gateways** (anti-spam compliance).
- Hardening guides referencing QCVN electrical/grounding/fire rules for **site acceptance testing**.

13. Minimal Implementation Deltas (VN vs. global)

- **RFID parameters** (regional RF masks/power/EIRP) → ship VN preset aligned to QCVN/TCĐBVN.
- **Language & Interface** (Localization/UI): Ensure 100% Vietnamese localization of the user interface, reports, and SMS/email notifications, including date/time formats, currency (VND), and decimal formatting.
- **Integration Standards:** Confirmation of compliance with data and integration standards as stipulated by the Ministry of Construction.
- **Data Retention:** Apply transaction data retention periods in accordance with Circular No. 34/2024/TT-BGTVT
- **Privacy UI** (consent text, notices, DSR) → ship **PDPL text pack**; preserve GDPR config for multi-region reuse.
- **Reports & KPIs** → deliver VN KPI bundle with regulator-named fields and **Vietnamese headings**.
- **Facility commissioning** → add **QCVN checklist** to the global IEC/EN/UL acceptance script.
- **Contracts & DPAs** → include PDPL cross-border and data processing clauses; localize breach notification timelines.