



FIRST EDITION

IAF SMART MOBILITY

Connected Mobility and Human Experience Requirements

City readiness and cooperative connectivity
Driver and passenger experience

DRAFT FOR TECHNICAL REVIEW

Technical validation and formal adoption are required before operational use.
Release conditions and pilot validation are set out in Annex E.

International Automotive Federation

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Publication identity

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Scope of this publication

This document specifies requirements for connected mobility, city compatibility, interoperable vehicle services and the experience of drivers, passengers and other road users. It brings product behaviour, infrastructure dependencies and human interaction into one evidence based assessment framework.

Foreword

IAF Smart Mobility is a proposed voluntary technical standard. Its requirements are written for implementation and assessment; this proposal does not establish that a product has been tested or that the edition has received formal approval. Publication as an adopted edition requires technical review, pilot validation of the proposed acceptance criteria and an authorized publication decision.

The central objective is to make mobility understandable, usable and dependable throughout the journey, including when connectivity, infrastructure, sensors or services are impaired. A feature shall be evaluated through the outcome experienced by people and the behaviour of the complete service chain, rather than through the presence of equipment alone.

Clauses 1 to 26 and Annexes A to E contain the proposed normative provisions. Annex F describes future development directions and is informative. The requirements in this document are self-contained. An implementation evidence package may identify the technical specifications used by a product, but those specifications do not replace the requirements stated here.

The numerical acceptance criteria in Annex B are proposed IAF assessment thresholds. They are not statements of universal physiological limits or proof of collision avoidance. Before adoption, they shall be validated across representative vehicles, populations and environments under Annex E.

Reading and navigation

Select a section in the contents or use the PDF bookmarks to navigate. Numbered clauses and annex identifiers remain the reference points for implementation and assessment.

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1 Scope and purpose

1.1 This standard specifies requirements for the design, integration, operation, testing and assessment of smart mobility systems. It covers the relationship between vehicles, users, connected services and the environments in which journeys take place.

1.2 The scope includes passenger cars, commercial vehicles, buses, powered two and three wheelers, shared fleets, automated passenger services, aftermarket mobility products, roadside equipment, mobility applications and service platforms. Requirements shall be applied to the declared assessment object and its interfaces. A subsystem result shall not be represented as whole vehicle conformity.

1.3 The standard addresses city readiness, V2X interoperability, human machine interaction, ergonomics, accessibility, driver and passenger experience, cooperative information, charging experience, service continuity, artificial intelligence, personal data control and experience preservation after software changes.

1.4 This standard does not by itself establish crashworthiness, electrical protection, structural integrity, comprehensive cybersecurity assurance, legal permission for automated driving or compliance with all applicable market requirements. The responsible organization shall manage these interfaces and provide the safety evidence necessary for functions assessed here.

1.5 A road user shall not need a compatible phone, account, wearable or connected vehicle to receive the baseline protection required by the assessed function. Connected capability may improve information, but absence of a signal shall not be interpreted as absence of a person, vehicle or hazard.

1.6 Conformity shall be specific to a product or service version, module set, operating conditions, market and deployment configuration. Neither geographic universality nor compatibility with untested systems shall be implied.

2 Conventions and application rules

2.1 “Shall” expresses a requirement; “should” expresses a recommendation; “may” expresses permission; and “can” describes capability or possibility. A note or example does not create an additional requirement unless explicitly stated.

2.2 A conditional requirement becomes mandatory when the corresponding function is supplied, enabled, advertised or reasonably relied upon within the declared scope. A function shall not be excluded merely because its implementation or test evidence is incomplete.

2.3 Each requirement shall have an assessment status of pass, fail, not applicable or not demonstrated. A not applicable decision shall identify the functional reason and shall be accepted by the assessor. Lack of evidence shall be recorded as not demonstrated, not as not applicable.

2.4 The responsible organization shall maintain a market requirements register. Where a binding obligation and this document cannot both be satisfied, the conflict shall be recorded and the affected conformity claim shall be restricted or withheld. This standard does not authorize departure from applicable law.

2.5 A claimed benefit shall have a defined baseline, measurement method, operating conditions and uncertainty statement. A demonstration, simulation, planned capability or design intention shall not be presented as verified field performance.

2.6 Where a requirement calls for a risk-derived limit, that limit shall be justified and accepted before assessment data are examined. Annex B minimum criteria shall not be weakened by choosing a more permissive product limit. A tighter limit shall apply when needed for safe operation.

3 Terms and definitions

3.1 Assessment object. The identified vehicle, component, installation, service or integrated deployment for which evidence and a conformity decision are produced.

3.2 Responsible organization. The entity accountable for the declared assessment object, its interfaces and the accuracy of its claims, including services obtained from suppliers.

3.3 Operating domain. The documented conditions in which a function is intended to operate, including geography, road form, speed, weather, light, traffic, users, connectivity and infrastructure.

3.4 City readiness. Demonstrated compatibility with specified urban conditions and infrastructure services within an identified deployment area. City readiness is not a statement that all cities provide those services.

3.5 V2X. Information exchange between a vehicle and other vehicles, infrastructure, people, networks or energy services. Communication paths may be direct, network mediated or combined.

3.6 Interoperability. The ability of independently implemented systems to exchange, interpret and use information consistently under a declared communication profile and version combination.

3.7 Service contract. A versioned technical agreement defining meaning, timing, validity, operating limits, responsibilities and failure behaviour at an interface. It need not be a commercial contract.

3.8 Essential control. A control whose prompt, reliable use is needed to maintain control, communicate immediate intent, restore visibility, summon urgent assistance or leave a vehicle safely.

3.9 Critical task. A task for which failure, delay, misunderstanding or unintended activation can expose a person to serious harm. Criticality shall be established by the hazard analysis, not by commercial importance.

3.10 Degraded state. A known reduction in capability accompanied by defined restrictions, user information and a safe continuation or termination strategy.

3.11 Safe fallback. A context-appropriate response that maintains or reaches a condition of lower risk when a function cannot continue. It does not necessarily mean stopping immediately or stopping in the current lane.

3.12 Data age. Elapsed time between the source observation represented by information and the instant it is used, including processing, queuing, transfer and clock uncertainty.

3.13 Successful journey. Completion of a defined journey objective without an unplanned loss of essential access, unsafe behaviour, undisclosed additional charge or unresolved service failure within the assessment boundary.

3.14 Experience regression. A deterioration in task success, comprehension, accessibility, attention demand, comfort or service continuity compared with the accepted product baseline.

3.15 Independent implementation. A separately developed implementation of the interface under test, with sufficiently distinct software lineage to challenge interoperability assumptions. A second brand using the same underlying stack alone does not establish independence.

3.16 Mobility capability record. A versioned summary of the assessed features, module scope, tested conditions, dependencies, limitations and evidence status.

4 Assessment objects and module selection

4.1 Every assessment shall include a common core covering scope, governance, dependencies, people affected, validation, change control, claims and service continuity. The depth of evidence shall correspond to the assessment object and risk; small organizational size shall not remove an applicable product requirement.

Module	Assessment focus	Mandatory application trigger
H Human experience	Controls, information, attention, ergonomics and accessibility	A human interface or passenger environment is in scope
X Cooperative connectivity	Message interpretation, timing, trust and cross implementation behaviour	A V2X or cooperative capability is supplied or claimed
C City integration	Roads, roadside data, geofences, curbs and urban dependencies	City readiness or infrastructure integration is claimed
J Journey services	Planning, booking, handovers and shared access	A connected journey or shared mobility service is supplied
E Energy interaction	Charging discovery, access, payment and session continuity	Charging or energy service interaction is supplied
A Automated interaction	Driving responsibility, remote assistance and passenger fallback	A function performs a driving task or uses remote assistance

4.2 Clauses are cumulative. Module A does not replace H; X does not replace C where city readiness is claimed. Clauses 17 to 20 apply wherever artificial intelligence, personal data, software changes or external services affect the assessment object.

4.3 A component assessment shall identify integration assumptions and unverified vehicle level outcomes. For example, a communication unit can demonstrate correct message processing without demonstrating that a vehicle warning is understandable or timely for a driver.

4.4 Module omission shall appear in the capability record. A vehicle without cooperative connectivity may obtain a scoped human experience assessment, but shall not claim V2X interoperability or comprehensive IAF Smart Mobility coverage.

4.5 The assessment boundary shall include all external dependencies that can affect a claimed outcome. Ownership by another supplier shall not justify ignoring an interface failure. The evidence may combine supplier tests and integration tests where their applicability is demonstrated.

5 Governance and accountability

5.1 The responsible organization shall appoint accountable owners for system behaviour, human factors, accessibility, cooperative interfaces, service operations and evidence management. One person may hold multiple roles if competence and independent review are maintained.

5.2 An integrated risk register shall address harm from confusing interaction, stale data, loss of access, accessibility failure, automation misunderstanding, connectivity loss, privacy misuse and conflicts between service providers. Each risk shall have a control owner and verification evidence.

5.3 Product decisions shall prioritize safe operation and essential user access over engagement, advertisement, subscription conversion, data collection or completion of a commercial transaction. Revenue objectives shall not justify overriding a critical control.

5.4 Suppliers shall provide the interface specifications, version information, change notices and evidence needed to assess integration. Commercial confidentiality may limit public disclosure, but shall not prevent an authorized assessor from examining necessary evidence under suitable confidentiality arrangements.

5.5 The organization shall maintain a user feedback and complaint process that accepts reports of confusing behaviour, inaccessible functions and service failures. Reports shall be linked to product configuration where practicable without unnecessary identification of the reporting person.

5.6 The team making the conformity decision shall be independent of the team responsible for achieving the measured product result. Conflicts of interest, competence and decision authority shall be documented.

6 Operating conditions and dependency contracts

6.1 Each assessed function shall have an operating domain covering road geometry, speed range, traffic mix, climatic conditions, light, visibility, positioning quality, network conditions, languages and intended user groups. Unsupported conditions shall be identifiable before reliance on the function becomes unsafe.

6.2 The organization shall classify every external dependency as essential, performance enhancing or convenience only. The classification shall be supported by analysis of what happens when the dependency is absent, incorrect, delayed or maliciously manipulated.

6.3 A service contract shall define data meaning, units, coordinate system, reference time, uncertainty, source authority, version, validity period, error responses, load limits and degraded operation. Shared assumptions shall be tested at both sides of the interface.

6.4 For a time critical use case, the organization shall allocate a complete timing budget from observation to required action. Sensing, processing, communication, user response where applicable, actuation and a justified safety margin shall fit within the available action time. Clock uncertainty and data age shall be included.

6.5 Different use cases shall not inherit a single universal latency target without justification. A traffic advisory, imminent hazard warning and cooperative motion function have different failure consequences and shall have separately justified limits and fallback behaviour.

6.6 Limits shall cover tail behaviour and loss bursts as well as average performance. Recovery from invalid time, location or identity information shall require verified restoration, not simply the receipt of another message.

6.7 At runtime, essential assumptions shall be monitored where technically feasible. If an essential assumption cannot be monitored, the organization shall provide evidence that the residual dependency risk is acceptably controlled and shall restrict the claim accordingly.

7 Human needs and inclusive design

7.1 User research shall include first time and experienced users, older adults, a representative range of body sizes, relevant languages and people with sensory, motor or cognitive access needs. Passenger services shall include people who do not drive and those who do not possess a smartphone or payment card.

7.2 The organization shall maintain a task inventory from planning and vehicle entry to driving or riding, energy replenishment, emergency response and journey completion. Each task shall identify the user, context, required abilities, foreseeable errors and recovery path.

7.3 Essential information shall not depend on colour, sound, speech, touch precision or memory alone where an equivalent accessible channel is feasible. The alternative shall convey the same necessary meaning within the available response time.

7.4 A reasonable accommodation shall not silently remove a safety relevant warning. Where an adaptation changes safety behaviour, the change shall be explained and validated with the intended users and vehicle configuration.

7.5 Accessibility claims shall identify the supported needs and the conditions tested. An overall usability average shall not conceal a failure that prevents a declared user group from completing an essential task.

7.6 Personalization shall provide a stable default, a comprehensible reset and protection against unsafe transfer of another person's settings. Rental, fleet and shared vehicles shall support an understandable first use experience without assuming previous brand knowledge.

7.7 Participants shall give informed consent for human studies. Hazardous scenarios shall use simulation or controlled facilities with safeguards. Participation involving children or vulnerable people shall follow an independently reviewed protection plan appropriate to the study.

8 Driving interaction and essential controls

8.1 The organization shall define essential controls for each vehicle category. Where fitted, direction indicators, horn, hazard warning, windscreen clearing, urgent assistance and emergency exit controls shall be assessed. Steering, braking, acceleration and direction selection shall be included wherever their interaction design is within scope.

8.2 A driver shall be able to locate and operate an essential control without navigating a changing menu, dismissing an advertisement, completing account authentication or using a network service. Its function and location shall remain predictable across normal operating states.

8.3 Essential controls used during driving shall provide a persistent and discriminable means of activation, with tactile identification or another independently validated means that does not require prolonged visual search. A temporary touchscreen element alone shall not satisfy this requirement.

8.4 Loss or restart of the main entertainment display shall not remove the ability to maintain vehicle control, restore essential visibility, signal an immediate hazard or perform the validated emergency exit procedure. A common electrical failure shall be addressed in the system safety evidence.

8.5 Manual text composition, non-driving video and other tasks that fail the moving vehicle attention criteria shall be unavailable to the driver while movement is possible. Passenger access shall be allowed only when driver distraction and mistaken user assignment are controlled.

8.6 Allowed secondary tasks shall be interruptible without penalty, loss of essential context or forced restart of a long sequence. On resumption, the interface shall show the current state without falsely implying that an unfinished action succeeded.

8.7 Critical actions shall have proportionate protection against unintended activation. A confirmation shall not delay a time critical emergency action. Repeated taps, gloves, vibration, moisture, steering angle and adjacent controls shall be considered in the validation.

8.8 Voice and gesture interfaces shall not be presumed distraction free. Their cognitive demand, ambiguity, correction effort and effect on driving shall be measured. A failed voice interaction shall offer a safe recovery path without forcing the driver into a complex manual task.

9 Displays and multimodal communication

9.1 Information shall communicate current state, required action and relevant limitation using language and symbols understood by the intended users. The interface shall distinguish available, active, restricted, failed and completed states where confusing them could affect behaviour.

9.2 Safety relevant information shall take precedence over navigation convenience, entertainment, promotion and nonurgent messages. The system shall manage simultaneous warnings so that a lower priority message does not obscure, delay or contradict a critical instruction.

9.3 Text, symbols and controls shall remain legible at the intended viewing distances and angles under the declared light conditions. Tests shall include darkness, glare, changing ambient light and commonly used corrective or tinted eyewear where relevant. Size and contrast declarations alone shall not replace user performance evidence.

9.4 The organization shall specify visual, acoustic and haptic signal limits, including intensity, pattern, duration and escalation. Signals shall be distinguishable without creating startle, pain, masking of environmental warnings or avoidable sensory overload.

9.5 Navigation and augmented displays shall distinguish a proposed route from a legal permission or guaranteed safe path. Misregistration, stale overlays and obstructed visibility shall be detected or mitigated. A projected line shall not imply that a pedestrian or oncoming vehicle has yielded.

9.6 A message about an external service shall distinguish confirmed information from prediction and unavailable information. "No hazard detected" shall not be used to imply that all hazards have been excluded. An unknown state shall not be displayed as a favourable state.

9.7 Unit changes, market localization and language changes shall not alter safety meaning. Mixed language fallback and truncated translations shall be tested. A critical control shall remain discoverable during a language mismatch.

10 Driver state and transitions of responsibility

10.1 The interface shall make clear who is responsible for controlling the vehicle and supervising the environment in each operating mode. Marketing names, animation and hands-free presentation shall not imply a capability beyond the validated function.

10.2 Mode activation, restriction, transition and termination shall have distinct feedback. A user shall not need to infer responsibility solely from a subtle colour change or a message displayed on an obscured screen.

10.3 Where driver monitoring is used, its operating limits shall cover head position, eyewear, illumination, relevant variation in appearance and sensor obstruction. A monitoring failure shall be distinguishable from a confirmed attentive state.

10.4 A request to resume driving shall allow a time and interaction sequence justified by the scenario, user state and available risk margin. The organization shall not use one generic takeover time for all situations. If timely user response is not credible, a validated system fallback shall control the risk.

10.5 Driver monitoring performance shall be evaluated for both missed detections and nuisance interventions. Repeated false alerts, workarounds induced by poor usability and foreseeable misuse shall be considered in the risk assessment.

10.6 A no-response strategy shall be defined for every transition requiring human action. A statement that the driver remains responsible shall not replace the engineering analysis of predictable nonresponse.

10.7 In services without a driver expected to take control, passengers shall receive clear information on stopping, assistance, route changes and evacuation. Remote assistance and remote driving shall be identified as different functions with different authority and timing requirements.

10.8 Remote personnel shall have authenticated authority, adequate situational information and a defined workload limit. Loss of the remote link shall invoke a validated vehicle response. Passengers shall not be assigned an unexpected driving task as a fallback.

11 Passenger experience and physical ergonomics

11.1 The organization shall define the anthropometric population and the seating, reach, visibility, ingress and egress conditions covered by the design. Vehicle adaptations and special use configurations shall be assessed separately where they change these conditions.

11.2 Controls, displays and storage used during movement shall not require unstable posture, interference with restraints or foreseeable contact with hazardous surfaces. Adjustment ranges shall be usable with the intended clothing, footwear and assistive devices.

11.3 Passenger comfort evaluation shall include relevant vibration, acceleration, jerk, thermal conditions, airflow, noise, seating pressure and motion sickness symptoms. The route, exposure duration, load, speed and environmental conditions shall be recorded with subjective responses.

11.4 Comfort claims shall identify their comparison baseline and limitations. A single comfort score shall not conceal a harmful exposure or an accessibility failure. Reducing discomfort shall not justify delayed hazard avoidance or reduced control authority.

11.5 Passenger interfaces shall support seat and cabin identification, journey confirmation, stop requests and emergency assistance as applicable. Critical passenger requests shall receive feedback even when the main entertainment interface or personal device is unavailable.

11.6 Automated motion shall be communicated with sufficient context for passengers to understand an unusual stop, reroute or service interruption. The communication shall avoid unjustified assurances that the environment is safe.

11.7 Where occupancy or child presence functions are supplied, the organization shall define detection scope, notification path, failure handling and protection against lock-in. Emergency exit capability shall not depend solely on a smartphone, a remote server or a subscription.

12 V2X interoperability

12.1 The organization shall maintain a versioned interoperability profile for every claimed service. It shall define message syntax, semantics, mandatory and optional fields, units, coordinate frames, time references, identifiers, trust processing and behaviour for unknown fields or versions.

12.2 Compatibility shall be demonstrated at message, application and outcome levels. Successful radio reception or decoding alone shall not demonstrate that another vehicle or infrastructure service interprets the information correctly.

12.3 Testing shall include at least two independent counterpart implementations for each claimed interface profile, with independence documented. Where this is not achievable, the result shall be described as single counterpart integration testing and shall not support an unrestricted interoperability claim.

12.4 The test matrix shall cover supported version combinations, direct and network mediated paths as claimed, gateway translation, dense traffic, handover, interference, loss bursts, congestion and recovery. Unsupported bearer combinations shall be explicitly excluded.

12.5 Receivers shall handle duplicates, reordering, expiry, contradictory information and missing mandatory data without unsafe action. Unrecognized information shall not be silently converted to an apparently valid default.

12.6 Time, position, direction and lane association errors shall be injected at the interface. Tests shall demonstrate correct handling of opposite road directions, stacked roads, tunnels, adjacent intersections and transitions between coordinate or map versions.

12.7 Authentication of a sender shall not be treated as proof that its observation is correct. Plausibility, relevance, freshness and confidence shall be checked according to the intended use. A compromised but credentialed source shall be included in testing.

12.8 Identity changes intended to reduce tracking shall not break essential safety behaviour. Long term identity correlation shall be minimized, and duplicate object handling shall not create phantom road users during a permitted identity transition.

12.9 Congestion management shall preserve the highest priority service according to its validated operating contract. The organization shall measure the effect of traffic load on complete application outcomes rather than on packet delivery alone.

13 Cooperative functions and trustworthy information

13.1 Cooperative information shall be assigned a permitted role: advisory information, warning support or motion influence. Promotion from one role to another shall require additional safety and integration evidence, not simply a configuration change.

13.2 Cooperative perception shall preserve object provenance, observation time, uncertainty and relevant dependencies between reports. Multiple reports derived from the same original observation shall not be treated as independent confirmation.

13.3 Object fusion shall address disagreement, false objects, missed objects, occlusion and uncertainty growth. Lack of external observations shall not justify reducing baseline protection for unconnected road users.

13.4 Cooperative manoeuvre proposals shall have explicit participants, states, validity times, acceptance conditions and an abort rule. Silence shall not count as consent. A communication acknowledgement shall not establish that another vehicle has executed the manoeuvre.

13.5 A participant shall remain within its validated motion authority. An external message shall not directly command steering, braking or acceleration without the checks and constraints defined in the safety architecture.

13.6 Traffic signal information shall be associated with the correct approach, lane and movement. Conflicting, expired or implausible signal data shall trigger the defined restriction. Signal timing advice shall not encourage acceleration that defeats a safe stopping opportunity.

13.7 Emergency vehicle priority, roadwork warnings and access permissions shall use appropriately authorized sources. A priority request shall not be presented as proof that the road is clear or that other users have yielded.

13.8 External vehicle displays intended for pedestrians shall avoid ambiguous promises of safety. Comprehension shall be tested with people outside the vehicle, including unconnected users and those unfamiliar with the display.

14 City and infrastructure compatibility

14.1 A city integration claim shall identify the actual deployment area, road classes, supported services, responsible infrastructure parties and configuration dates. A capability demonstrated at one junction shall not establish readiness for an entire city.

14.2 The city profile shall address traffic signals, variable restrictions, roadworks, tunnels, bridges, parking, loading areas, emergency routes, pedestrian areas and relevant public transport interactions. Rural and mixed traffic transitions shall be included where journeys cross the city boundary.

14.3 Digital road rules, map information and physical conditions shall be reconciled through a documented conflict strategy. The system shall not blindly follow a map instruction when current signs, a physical obstruction or another reliable observation make that instruction unsafe or invalid.

14.4 Geofences shall have source authority, version, location uncertainty, validity and boundary behaviour. Entering or leaving a geofence shall not cause an abrupt unsafe vehicle action. Uncertain boundary position shall invoke the documented conservative behaviour.

14.5 Infrastructure condition shall be represented as verified available, degraded, unavailable or unknown. A missing update shall not preserve an old available state indefinitely. Restoration shall include verification of both communication and service meaning.

14.6 Curb and parking functions shall account for legal access, vehicle size, door opening, passenger transfer, assistive devices, cyclists and emergency access. A technically reachable stopping point shall not automatically qualify as a safe or accessible pickup point.

14.7 Shared city interfaces shall specify authorization, update responsibilities, auditability and dispute handling. The deployment shall prevent a single data source or operator failure from silently corrupting all dependent mobility services.

14.8 The organization shall perform a controlled or observational deployment validation in each materially distinct city profile claimed. Evidence shall include infrastructure outages and transitions between providers. Deliberate hazardous faults shall not be injected into uncontrolled public traffic.

15 Connected journeys and shared mobility

15.1 A journey service shall define its assessment boundary from the first supported planning or booking step to the last supported arrival or handover step. Interfaces outside the operator's control shall be identified with their failure and recovery arrangements.

15.2 Itineraries shall distinguish estimated, booked, confirmed and completed stages. Predictions shall include material uncertainty, and changes shall be communicated before the user loses a practical opportunity to choose an alternative where feasible.

15.3 Total disclosed price, material restrictions, cancellation conditions and accessibility limitations shall be available before commitment. A missed connection or charging failure shall not create an undisclosed automatic purchase.

15.4 Authentication, digital keys and boarding checks shall prevent access by an unauthorized person while providing a documented recovery path for a legitimate user with a dead battery, lost connection or failed recognition. The recovery path shall not rely on disclosing another user's personal data.

15.5 Shared vehicles shall reset personal information and unsafe inherited settings between users. Stored home locations, communications, payment credentials and accessibility preferences shall not be exposed to the next user.

15.6 Multimodal handovers shall consider walking distance, transfer time, language, baggage, assistive devices and physical accessibility. A nominal connection shall not be described as accessible where a required lift, crossing or boarding facility is unavailable or unverified.

15.7 Where the service carries passengers, a missed pickup, stranded user or failed journey shall trigger a defined assistance process. The organization shall identify who owns the issue across provider boundaries and shall measure time to acknowledgement and resolution.

16 Charging and energy service experience

16.1 Charging discovery shall identify connector compatibility, power assumptions, access restrictions, opening hours, price basis, accessibility information and the age of availability data. An estimated free connector shall not be displayed as a guaranteed reservation.

16.2 Route and range guidance shall account for relevant uncertainty in weather, elevation, load, consumption, battery condition and charger availability. Reserve assumptions shall be disclosed. A route shall not be presented as assured when completion depends on an unverified energy service.

16.3 Physical interaction shall be assessed for cable handling, reach, screen use, payment and unobstructed access by the claimed user population. A software accessibility claim shall not imply that the charging bay and route to the charger are physically accessible.

16.4 A session shall provide clear states for connected, authorized, charging, restricted, stopped and failed. The user shall be told whether energy transfer has actually started; a payment acknowledgement alone is insufficient.

16.5 Session initiation, recovery after interruption, duplicate requests, payment failure and receipt delivery shall be tested across the claimed vehicle, charger and service combinations. Repeated network requests shall not produce duplicate charges or contradictory session states.

16.6 Publicly offered energy services within scope shall disclose account requirements and provide an accessible assistance or alternative access path when the primary digital flow fails. The standard does not authorize bypassing payment or electrical protection.

16.7 Where bidirectional energy transfer is offered, the interface shall disclose direction, energy reserve, departure constraint, financial basis and stop conditions. A user's mobility reserve shall not be overridden by a service optimization request without valid authorization and clear feedback.

17 Artificial intelligence and adaptive interfaces

17.1 Each artificial intelligence function shall have a documented purpose, input sources, permitted outputs, authority limits, failure behaviour and validation scope. A model's fluent response shall not be treated as evidence of correct state estimation or authorized action.

17.2 A conversational assistant shall distinguish information, recommendation, requested action and completed action. It shall not state that a route is safe, a vehicle function is active, a payment is complete or assistance is dispatched without confirmation from the authoritative system.

17.3 Open ended generated output shall not directly control a safety critical actuator. Any permitted action request shall pass through a constrained, authenticated and independently validated control interface with explicit bounds and a safe rejection path.

17.4 Untrusted content in messages, maps, service descriptions, audio or other inputs shall not expand the assistant's authority or bypass user permissions. Testing shall include misleading instructions embedded in content, ambiguous speech, invented service information and conflicting requests.

17.5 Confidence handling shall be based on measured behaviour and use case risk. A low confidence or unsupported request shall produce a bounded response, a request for clarification when safe, or an appropriate refusal. Guessing shall not be used for a critical command.

17.6 Adaptive interfaces shall preserve the identity and location of essential controls. Personalization shall not silently change warning meaning, driving responsibility, privacy permissions or payment authority. Changes affecting these elements shall be separately validated and clearly communicated.

17.7 Continuous learning affecting an assessed function shall have a controlled release boundary. Unreviewed field learning shall not alter safety relevant behaviour. Data drift, population gaps, model replacement and rollback behaviour shall be monitored.

17.8 Emotion or wellness inference shall not be presented as a medical diagnosis. Users shall receive an accurate explanation of material sensing and inference, and optional personalization shall be separable from essential safety operation.

18 Service resilience and degraded operation

18.1 The organization shall define degraded states for loss of cloud service, communication, positioning, time synchronization, roadside support, identity services, primary display and relevant sensors. Each state shall specify remaining capability, user information and recovery conditions.

18.2 An essential local function shall not cease merely because an entertainment account, advertising service, optional analytics service or convenience subscription is unavailable. Dependencies needed for a particular automated or connected function shall be explicitly declared and safely managed.

18.3 A degraded state shall not be described as fully operational. The interface shall communicate the restriction at the time it matters, without an overwhelming sequence of repetitive alerts that obscures the action needed.

18.4 Recovery shall prevent oscillation between active and failed states. Hysteresis, confirmation intervals or another justified stability control shall be used where intermittent conditions could cause confusing or unsafe transitions.

18.5 Loss of connectivity during a time critical cooperative function shall invoke the validated fallback within its timing budget. Deferred remote processing shall not be treated as an acceptable substitute for a function that requires immediate local action.

18.6 Emergency assistance shall identify the available communication paths and their limitations. If remote assistance cannot be reached, the interface shall not display a false dispatch confirmation and shall provide the validated local guidance available for that configuration.

18.7 Stress testing shall cover peak processing load, resource exhaustion, power transitions, thermal constraints and simultaneous failures with a credible common cause. A fast response under an unloaded demonstration condition shall not establish service resilience.

19 Data use and personal control

19.1 A data inventory shall identify purpose, source, access, recipients, retention and deletion for location, vehicle state, cabin sensing, voice, biometric and journey data. Collection shall be limited to the declared purpose and necessary operational evidence.

19.2 Personal control shall be usable while stationary and shall separate essential operation from optional analytics, personalization and commercial sharing. Refusing optional processing shall not silently disable an unrelated essential function.

19.3 A user shall be able to understand whether processing is local or remote and which consequences follow from disabling an optional feature. The interface shall not use misleading defaults, repeated obstruction or unequal emphasis to frustrate an informed choice.

19.4 Cabin monitoring and identity functions shall minimize raw recording and unnecessary transfer. Where a derived event is sufficient, retention of continuous identifiable recording shall require a specific documented justification.

19.5 Transfer of ownership, vehicle rental return, account closure and service withdrawal shall include tested deletion or segregation of personal data and revocation of relevant access credentials. Deleting a visible profile name alone shall not count as removal of access.

19.6 Necessary safety or dispute records shall have a defined lawful retention basis, limited access and integrity controls. The organization shall avoid collecting identifiable bystander information when nonidentifying evidence can meet the verification objective.

19.7 Data portability, where supplied, shall preserve meaning and units and shall not export secrets or another person's information. Compatibility of transferred settings shall be checked before they affect the receiving vehicle.

20 Integration and software change

20.1 The integration baseline shall identify hardware, software, models, calibration, maps, service endpoints, interface profiles, languages and enabled features. Evidence from another configuration shall have a documented equivalence analysis.

20.2 Change impact analysis shall consider both technical compatibility and user behaviour. Relocating a control, changing a symbol, modifying a warning, replacing a model or changing a service provider can require reassessment even when the functional feature name is unchanged.

20.3 Updates affecting assessed outcomes shall repeat the impacted requirements, critical scenarios and regression measures. A larger number of convenience features shall not compensate for worse essential control access or loss of a supported accessibility path.

20.4 Installation shall be prohibited in an operating state where interruption could compromise control or essential access. Prerequisites, power availability, restoration, rollback or another safe recovery mechanism shall be verified before deployment.

20.5 A rollback shall not restore an unacceptable known vulnerability or create an unsupported data format without a compensating safe plan. The organization shall define how a failed update is handled when rollback itself is unsafe.

20.6 Users shall receive concise information on changes that affect driving responsibility, important controls, supported conditions, personal data or payment behaviour. Learning an unexpected new control sequence while driving shall not be the update strategy.

20.7 A material change shall trigger a conformity review before the existing statement is applied to the changed configuration. Claims shall identify the current assessed version and any configuration restrictions.

21 Validation and evidence quality

21.1 The validation plan shall link every applicable requirement to a method, test condition, acceptance rule and evidence record. It shall combine document review, interface tests, simulation, controlled vehicle tests, human studies and field evidence in proportion to the claim.

21.2 Simulation shall have a documented intended use, calibration basis, validation range and uncertainty. A scenario outside the validated model range shall not support a pass decision without additional evidence. Simulated human behaviour shall not replace all user testing for human experience claims.

21.3 The plan shall define the task unit, denominator, observation period, failure definition, independent experimental unit, sample size and confidence method before tests begin. Failed attempts, retries, unavailable service periods and aborted tasks shall be recorded rather than selectively removed.

21.4 Human studies shall use the participant and task provisions in Annex B. Aggregate and relevant subgroup results shall be reported. The assessor shall examine whether an average masks systematic exclusion or a hazardous misunderstanding.

21.5 Measuring equipment shall have traceable calibration and uncertainty suitable for the decision. Systems measuring latency or data age shall document synchronization accuracy. Eye tracking quality, manual coding rules and missing data handling shall be recorded.

21.6 The scenario catalogue in Annex A is a minimum set. The organization shall add scenarios identified by the operating domain, hazard analysis, complaints and field evidence. Passing the catalogue shall not be represented as exhaustive proof of safety.

21.7 The tested sample shall represent production hardware, enabled software and realistic load. Prototype evidence shall be labelled and reconciled with the production configuration before a production claim is made.

21.8 Reproducible evidence shall include setup, configuration, stimulus, logs, measurements, expected and observed results, limitations and reviewer approval. Necessary proprietary material may remain controlled, but its existence and review status shall be recorded.

22 Field monitoring and incident response

22.1 Field monitoring shall track critical interaction errors, unexplained mode changes, failed journeys, connectivity degradation, misleading information, accessibility failures and update regressions. The organization shall define exposure denominators appropriate to each measure.

22.2 A critical incident shall be triaged as soon as detected. Protective action shall be based on the potential harm and exposure, and may precede completion of the root cause investigation. A fixed administrative reporting period shall not justify continued unsafe operation.

22.3 Incident response shall assign ownership across vehicle, infrastructure and service providers. The user shall have an identifiable assistance route even when responsibility is still being investigated.

22.4 The organization shall define thresholds for investigation, restriction, rollback, feature withdrawal and reassessment. Recurrent nuisance warnings that induce users to disable protection shall be treated as a potentially safety relevant trend.

22.5 Field comparisons shall account for changes in software, user population, geography, season and service exposure. A fall in reported incidents caused by reduced usage or a broken reporting channel shall not be claimed as improved performance.

22.6 Lessons from incidents shall update risk controls, user information, training, test scenarios and supplier obligations as applicable. Closure shall include evidence that the corrective action works and has not created an unacceptable new failure.

23 Assessment and conformity decisions

23.1 Assessment shall proceed through scope acceptance, evidence review, risk based testing, finding resolution, independent decision and issue of a scoped statement. The assessor shall retain the rationale for sample selection and any evidence accepted from previous testing.

23.2 All applicable “shall” requirements shall pass before conformity is stated. Not demonstrated is not a pass. A high score on optional features, comfort or service convenience shall not compensate for a failed requirement.

23.3 A critical finding is a demonstrated or credibly exposed failure that can cause serious harm, defeat essential control or exit, misrepresent driving responsibility, or allow an unauthorized critical action. The affected conformity claim shall be withheld or suspended until correction and verification are complete.

23.4 A major finding is a systemic or material failure of an applicable requirement, including missing essential evidence or an unsupported interoperability claim. Other isolated requirement failures are minor findings. Major and minor findings shall also be closed before a pass decision; classification changes urgency, not the obligation to comply.

23.5 Each assessed module shall have a separate outcome. Partial module results may be reported as test results with precise scope, but shall not be described as conformity of the whole vehicle, journey or deployment.

23.6 This edition does not define a composite score, star rating or performance grade. Measures shall be reported individually with conditions and uncertainty. Any future graded scheme shall require separate published rules and validation before use.

23.7 An appeal shall be reviewed by competent persons who did not make the original decision. Commercial relationships or membership shall not change acceptance criteria or the treatment of findings.

24 Public claims and assessment records

24.1 An assessment statement shall identify the assessment object, responsible organization, document edition, modules, tested configuration, operating scope, methods, decision date, assessment body and restrictions. Annex D defines the minimum structure.

24.2 The public statement shall distinguish independently assessed conformity, supplier declaration, laboratory results, pilot results and planned capabilities. The use of a mark or endorsement shall require actual authorization under the applicable IAF scheme.

24.3 The mobility capability record shall disclose external dependencies, tested counterpart coverage, geographical scope, known limitations, support arrangements and the event or configuration change that would require reassessment.

24.4 There is no automatic fixed validity period established by this standard. The assessment remains tied to the evaluated configuration and conditions, subject to the assessment scheme's monitoring and change rules. A new material risk or change shall trigger review without waiting for a calendar expiry.

24.5 Claims such as “works in every city”, “fully interoperable”, “distraction free”, “zero risk” or “guaranteed accessible” shall not be used without evidence matching their entire meaning. A limited test set shall not support an unlimited claim.

24.6 Public summaries shall be understandable without disclosing security secrets, personal data or confidential engineering detail. Sufficient scope and limitation information shall remain visible for a purchaser or user to judge relevance.

25 Improvement and end of support

25.1 The organization shall periodically review experience, accessibility, interoperability and field reliability against the accepted baseline. Review frequency shall reflect risk, deployment change and observed failures and shall be defined in the operational plan.

25.2 Support arrangements shall identify who maintains the product, interface compatibility, service dependencies and user assistance. A minimum support duration is not specified here; the declared duration and foreseeable end of support consequences shall be addressed before supply.

25.3 Withdrawal of a service shall have a transition plan covering user notice, remaining capability, stranded users, data removal and safe deactivation. Essential local access or control shall not be unexpectedly removed because a remote commercial service ends.

25.4 Replacement of infrastructure, communication technologies or trust services shall trigger compatibility assessment. Migration shall include mixed version operation, loss of older support and clear communication of affected features.

25.5 Efficiency claims shall report system boundaries and measured outcomes such as energy use per completed journey, occupancy or avoidable travel. Efficiency optimization shall not reduce safety, accessibility or essential user control.

25.6 The organization should provide a structured route for suppliers, cities, users and assessors to propose new scenarios and requirement improvements. Accepted changes shall preserve traceability to their evidence and decision rationale.

26 Adoption and maintenance of the standard

26.1 Before adoption of the First Edition, IAF shall complete the pilot validation programme in Annex E, resolve material ambiguities and approve the normative thresholds. An unresolved threshold shall not be presented as validated merely because it appears in this proposal.

26.2 The publication process shall include technical review across vehicle engineering, human factors, accessibility, infrastructure, services and conformity assessment. Conflicts of interest and substantive comments shall be recorded with their resolution.

26.3 Changes to normative requirements, assessment thresholds and module definitions shall be version controlled. Transition provisions shall state which configurations and assessment statements are affected.

26.4 New technology annexes shall define scope, hazards, measurable requirements and test methods before they become a basis for conformity. Informative predictions shall not create an implied claim of technical readiness.

Annex A Required test scenarios

This annex is normative. All applicable scenarios below shall be included in the validation plan. For each scenario, the plan shall specify initial state, input sequence, parameter ranges, fault duration, expected result, timing limits, measurements and acceptance rule. Tests shall use the criticality and sampling provisions of Annex B.

A01 First use and language mismatch. An unfamiliar user shall locate the required controls and interpret critical states using only the information supplied with the product. Test the primary languages, fallback language and at least one realistic mismatch. Record unaided success, misunderstanding and recovery.

A02 Driving task interruption. Interrupt each permitted secondary task during a representative driving demand. The task shall yield immediately to driving and resume without a false completion state or unnecessary repetition. Apply B02 and B03.

A03 Primary display failure. Freeze, blank and restart the main display during use. Essential controls and the declared fallback shall remain available under the fault scope, with no misleading display state. Distinguish display failure from common power failure.

A04 Simultaneous warnings. Present a critical warning together with navigation, incoming communication and service notifications. The critical meaning and action shall remain understandable. Record masking, delay and inappropriate dismissal.

A05 Human variation and access needs. Test the declared range of reach, vision, hearing, dexterity, language and relevant cognitive needs. Include cold or wet hands, gloves and vibration when credible. Validate alternatives with actual users of those alternatives.

A06 Driver monitoring obstruction. Challenge illumination, eyewear, head pose and sensor obstruction. Confirm that unavailable monitoring is not classified as attentive behaviour. Measure missed and false detections separately under B08.

A07 Responsibility transition and nonresponse. Exercise intended mode changes, unanticipated system restriction and failure to respond. Verify comprehension, response time and system fallback against the scenario-specific safety budget. Use protected simulation or closed facilities.

A08 Passenger only automated service. Test unexpected stop, route change, communication failure, assistance request and evacuation information without a driver available to intervene. Confirm that passengers are not given an untrained driving obligation.

A09 V2X independent counterparts. Exchange every mandatory message and claimed optional feature with the independently implemented counterparts. Verify semantics, timing, state transitions and outcomes, including supported version combinations.

A10 Invalid and contradictory messages. Inject malformed, duplicated, replayed, expired, out-of-order and mutually inconsistent data. Invalid information shall not be promoted to trusted current information. Verify the declared handling and fallback.

A11 Plausible but false trusted source. Supply incorrect yet syntactically valid and authenticated information. Include a phantom object and a wrongly located signal. Check that trust credentials alone do not authorize unsafe interpretation or motion.

A12 Network congestion and bursts. Apply declared maximum load, load beyond the domain, interference, handover and correlated loss bursts. Measure the complete service chain and tail latency. Verify controlled restriction when the service contract is exceeded.

A13 Time and position failure. Inject clock offset, drift, loss of synchronization, positioning outage and wrong lane association. Include opposite directions and stacked roads. Check validity decisions with measurement uncertainty included.

A14 Unconnected vulnerable road users. Include pedestrians, cyclists and small vehicles with no transmitter, no phone or a failed transmitter. The assessed function shall not interpret missing connectivity as an empty or safe path.

A15 Cooperative perception disagreement. Introduce correlated reports, double counted objects, stale observations and conflicting confidence. Verify provenance handling, uncertainty growth and the prevention of unjustified confidence inflation.

A16 Cooperative manoeuvre interruption. Lose or delay messages at proposal, acceptance, execution and cancellation stages. A participant shall not infer consent from silence or execution from acknowledgement. Check the abort path and local authority limits.

A17 City data conflict. Create disagreement between map data, a geofence, roadside information and a current physical condition. Test ambiguous boundaries and roadwork changes. Verify the documented conflict and uncertainty strategy.

A18 Infrastructure outage and restoration. Remove a signal feed, parking service, curb service or roadside unit. Confirm the transition to degraded, unavailable or unknown status and the evidence required to restore a verified state.

A19 Accessible pickup and transfer. Assess a pickup with a blocked curb, unavailable lift or inaccessible route. Confirm that the service does not label the handover accessible and offers its declared recovery process.

A20 Journey failure and shared access. Test a missed connection, failed booking, dead phone, revoked digital key and account outage. Prevent unauthorized access while executing the documented legitimate-user recovery and assistance process.

A21 Charging journey disruption. Test stale charger availability, incompatible equipment, authorization failure, duplicate requests, interrupted energy transfer and payment reconciliation. Verify actual charging state, price disclosure and route recovery.

A22 Artificial intelligence error and authority. Use ambiguous commands, invented destinations, malicious instructions embedded in service content and false claims of completed actions. The assistant shall stay within its permitted authority and use confirmed system state.

A23 Update and experience regression. Apply a representative interface, model or connectivity update, including an interrupted installation. Repeat impacted critical tasks and compatibility tests. Verify recovery and the absence of unacceptable regression.

A24 Privacy and ownership transfer. Change the driver or vehicle owner, revoke permissions, close an account and reset the product. Verify that personal information and access rights do not remain available to an unauthorized next user.

A25 End of service and compound failure. Withdraw a remote service while introducing a credible local fault or degraded network. Confirm retained essential access, accurate user information and the validated safe continuation or termination plan.

Annex B Measures and proposed acceptance criteria

This annex is normative within the proposal. Its numerical values are proposed IAF criteria subject to Annex E before adoption. They are assessment rules for a defined scope, not universal proof of safety. A risk-derived requirement shall be tighter whenever the default is insufficient.

B01 Test design and participants. A quantitative human experience assessment shall include at least 40 independent participants representative of the claimed users. At least 10 participants shall represent each declared access-needs subgroup materially affected by the assessed interface; groups may overlap. These are minimum recruitment floors, not proof of statistical adequacy. The organization shall additionally justify sample size against the endpoint, expected variability, margin and confidence objective. Critical accessibility paths shall be tested with users of those paths. Small subgroup findings shall be reported with uncertainty and shall not establish population equivalence.

B02 Essential task success. For each critical task, every evaluable participant shall complete the required safe action without a hazardous error or prohibited assistance. Failure, abandonment or exceeding the scenario's safety time limit is a failure. The study shall test at least 40 independent participant-level outcomes per task unless the assessor accepts a larger risk-based design; fewer outcomes cannot support a pass under this criterion. Report success count, denominator and an exact one-sided 95% lower confidence bound. The all-success study rule is a screening gate and does not establish a zero population failure rate.

B03 Permitted secondary tasks while driving. Every permitted visual-manual secondary task shall be evaluated in a representative simulator or protected driving environment. For each participant and task, measure all glances away from the forward roadway toward task-relevant regions and the total duration of those glances from task start to completion or abandonment, including retries. Report eye-tracking definitions and exclude ordinary driving mirror checks from task glances only under a prespecified coding rule. For a participant-task record to pass the proposed gate, no individual task glance shall exceed 2.0 seconds and total task-glance time shall not exceed 10.0 seconds. At least 90% of participants shall pass both conditions for each task. Report each participant-task record and the exact one-sided 95% lower confidence bound on the participant pass rate; that bound shall be at least 80%. Do not hide poor users through pooling. An abandoned task fails. Passing this gate does not establish absence of cognitive distraction; B04 also applies.

B04 Driving performance during interaction. Compare interaction and baseline driving using a randomized or counterbalanced within-participant design. Prespecify scenario-specific limits for lane control, hazard response and missed events from the safety analysis. Every relevant endpoint shall meet its limit and a justified noninferiority margin. Report confidence intervals and effect sizes. A statistically nonsignificant difference alone shall not establish equivalence. Any task-associated hazardous event in the evaluated scenarios blocks acceptance pending investigation and corrective verification.

B05 Comprehension and ordinary usability. For every critical state or warning, all evaluated users shall identify the required action and responsibility correctly without a hazardous interpretation; use at least 40 independent participant outcomes per item. For each noncritical task, unaided completion shall be at least 90%, with the exact one-sided 95% lower confidence bound at least 80%. Success requires completion within the prespecified task limit and without prohibited assistance. Report first use and trained use separately. Critical rules shall not be relaxed to the noncritical threshold.

B06 Interface feedback. For a local noncritical input, visible, audible or haptic acknowledgement shall have a measured 95th percentile no greater than 250 milliseconds under the declared maximum operating load, with at least 100 valid operations per interface state. An action taking more than 1 second shall provide an accurate pending state and an available cancellation path where cancellation is safe. Feedback is not proof that the underlying action completed. Critical inputs shall satisfy their independently allocated safety budget even when it is shorter than these values.

B07 Accessible alternatives. Each claimed alternative interaction path shall complete the same essential outcome without an additional hazardous step, undisclosed dependence on another person or loss of necessary information. Apply B02 for critical tasks using a statistically justified population design; the subgroup minimum in B01 alone does not reduce B02's task sample requirement. For other tasks apply B05 and report outcomes per declared access group. Where a task has fewer required users available for study, evidence may be reported as exploratory but shall not satisfy the full criterion.

B08 Monitoring and transition performance. For driver state, occupancy and transition functions, report missed events, false events, detection delay and response delay by scenario and relevant subgroup. Acceptance limits shall come from the documented risk analysis and shall be fixed before testing. Normal and obstructed sensor conditions shall be separate strata. No aggregate accuracy percentage shall substitute for the required false-negative, false-positive and timing limits.

B09 Communication and freshness. Each use case shall state maximum acceptable data age, application latency, loss-burst duration, positioning error and time uncertainty, together with required service reliability and operating conditions. Test at least 1,000 application transactions per critical load condition as an initial characterization floor, expanding the sample to support the claimed reliability and tail quantile. Use application generation-to-use boundaries, not radio delay alone. A transaction missing its deadline is a failure even if it arrives later. Every use of information exceeding a hard safety validity limit shall be rejected or restricted as specified; a favourable average cannot override this gate.

B10 Interoperability and negative tests. Every mandatory test in the declared profile and every claimed optional feature shall pass with each required independent counterpart. Repeat each applicable critical negative scenario at least 30 times across the prespecified parameter variations as an initial coverage floor. There shall be no observed prohibited unsafe acceptance or critical action. These repetitions establish scenario coverage, not a rare-event rate claim. A justified reliability study is required if a numerical failure probability is claimed.

B11 Service and journey success. Define a service attempt from a user's request or scheduled start to confirmed completion, abandonment or timeout. Retries shall remain part of the original attempt. For each declared journey or energy workflow, test at least 100 attempts across claimed providers and conditions, with at least 20 per materially distinct combination. Observed successful completion shall be at least 95%, and the exact one-sided 95% lower confidence bound shall be at least 90%. Failure of a critical access or safety condition fails independently of the aggregate rate. This is a controlled-test gate; field availability claims need representative exposure data and separate uncertainty.

B12 Comfort. Measure relevant motion, noise, thermal and ergonomic variables using a declared exposure method and representative routes. Record participant discomfort before and after exposure, motion sickness, early termination and seat position. Every safety relevant exposure limit shall be justified and met. A claim of improved comfort shall demonstrate a prespecified meaningful improvement or noninferiority

objective, with uncertainty, against the declared baseline. This edition sets no universal comfort score or acceleration limit for all vehicle types.

B13 Resilience and recovery. In each applicable loss scenario, all essential functions within the declared fault tolerance scope shall remain available or reach their validated fallback within the allocated time. Restoration shall meet the prespecified stability condition. Repeat each critical recovery scenario at least 30 times across realistic load and fault timing. No false full-service state or prohibited unsafe action is permitted. Broader reliability claims require additional exposure evidence.

B14 Experience preservation after changes. Critical task, responsibility comprehension, accessibility and fallback gates shall pass again after an affected change. For continuous and noncritical measures, the release plan shall prespecify acceptable regression margins and confidence methods. The post-change result shall meet the absolute criterion and the justified comparison margin. An unproven regression shall not be dismissed merely because average satisfaction improved.

B15 Statistical treatment. Use the independent participant, session, vehicle or deployment block as appropriate; repeated observations from one source shall not be assumed independent. Define percentile estimates before testing. For the default nearest-rank estimate, sort n observations and select rank ceiling(p multiplied by n); report n , the estimated percentile and a justified confidence interval. When a percentile confidence bound overlaps the acceptance limit, record not demonstrated unless a more conservative decision rule was agreed before testing.

B16 Measurement and missing data. Instrument uncertainty shall be included in decisions against a hard limit. For an upper limit, the measured value plus the applicable expanded uncertainty shall remain within the limit under the agreed rule. Instrument loss shall be distinguished from product failure. Exclusion is permitted only for a documented test-system cause under the prespecified plan, with replacement testing and sensitivity analysis. Product-caused missing observations, timeouts and abandonment count as failures.

B17 Rare event claims. For zero observed failures in n independent Bernoulli trials, the exact one-sided 95% upper failure-probability bound is $1 - 0.05$ raised to the power of 1 divided by n . Thus approximately 2,995 genuinely independent zero-failure trials are required to support a failure probability below 0.001 at that confidence level. Packet counts in one correlated drive do not constitute that many independent trials. Dependence, multiple comparisons and untested operating conditions shall be addressed in the claimed inference.

B18 Decision discipline. Do not round a failing measurement into a pass. Borderline, underpowered or insufficiently representative evidence shall be recorded as not demonstrated. A failed critical gate shall not be offset by passing more scenarios. Protocol deviations shall be listed, assessed for bias and resolved before decision.

Annex C Mandatory evidence register

This annex is normative. Each record shall identify owner, version, assessment object, evidence location and approval status. Records may be combined where traceability remains complete.

Record	Required evidence	Principal clauses
C01 Scope and capability	Product boundary, modules, market, operating conditions, exclusions	1 to 4 and 24
C02 Responsibility	Accountable roles, competence, independent review and supplier duties	5
C03 Risk and dependency	Hazards, service contracts, timing budgets, fallback and residual risk	5 and 6
C04 Human requirements	User populations, tasks, access needs and criticality	7 to 11
C05 Interaction validation	Controls, warnings, attention, comprehension and comfort evidence	8 to 11 and B
C06 Interoperability	Profiles, counterpart independence, version matrix and test outcomes	12 and 13
C07 Deployment	City profile, infrastructure ownership, site evidence and limitations	14
C08 Journey and energy	Service chain, price and access flows, failed-attempt records	15 and 16
C09 Artificial intelligence	Authority boundaries, evaluation data, failure tests and release control	17
C10 Continuity	Fault catalogue, degraded states, recovery and emergency access	18
C11 Personal data	Inventory, permissions, retention, reset and ownership transfer tests	19
C12 Configuration and changes	Version baseline, impact review, update and regression evidence	20
C13 Validation package	Approved plan, instruments, raw data, uncertainty and deviations	21 and A to B
C14 Operational evidence	Incidents, exposure, complaints, corrective actions and monitoring	22 and 25
C15 Decision and claims	Findings, closure, independent decision, statement and capability record	23 and 24

C16 Traceability record. Every applicable requirement shall map to one or more evidence records, and every test result shall map back to the configuration and requirement it addresses. The mapping shall show unresolved gaps and the reason for each not applicable decision.

C17 Retention and integrity. Evidence shall be retained for the period required by the assessment scheme and applicable obligations, with a documented rationale supporting the life of the claim. The organization shall protect evidence against unnoticed alteration and preserve access for authorized review without retaining unnecessary personal information.

Annex D Assessment statement and capability record

This annex is normative. It defines required record fields; it does not issue an assessment result, certificate or authorization to use a mark.

D01 Identification. Record the assessment object name, responsible organization, unique product or deployment identifier, hardware and software baseline, relevant model and map versions, and the edition of IAF Smart Mobility applied.

D02 Scope. Record selected modules, vehicle or service category, supported markets, languages, user populations, operating domain, city profiles and explicitly unassessed functions. Identify whether the result is for a component, integrated vehicle, service or deployment.

D03 Dependencies. List essential infrastructure, connectivity, service, account and counterpart dependencies. State which functions continue without each dependency and the restrictions that apply.

D04 Evidence. Identify the assessment plan, test dates, methods, counterpart coverage, participant coverage and evidence register version. Distinguish simulation, controlled tests, field observations and supplier evidence.

D05 Results. State the outcome for every module and applicable requirement, unresolved limitations, measured values with uncertainty, finding closure and the independent decision authority. A “not demonstrated” result shall remain visible and shall not be translated into a qualified pass.

D06 Continuing applicability. Identify the assessed configuration, support arrangements, monitoring responsibilities and reassessment triggers. Give the status of the statement as current, under review, suspended, withdrawn or superseded according to the actual decision.

D07 Public capability summary. The user-facing record shall answer: What was assessed? In which conditions? With which systems? What remains dependent on other services? What does the user need to know when a dependency fails? Where can the current assessment status be checked?

D08 Claim construction. A claim shall use the structure: assessment object; assessed modules; edition; tested configuration; operating scope; assessment status; evidence identifier. It shall not omit limitations that materially change how the result would be understood.

Annex E Pilot validation of the standard

This annex is normative for adoption of this proposed edition. It applies to IAF's standard development process, in addition to product assessments under the other clauses.

E01 Pilot diversity. Before adoption, pilot the requirements on at least three materially different vehicle or service categories, three distinct deployment environments and two independently operated assessment teams. These are minimum diversity floors; the technical review shall expand them where important use cases or populations remain unrepresented.

E02 Threshold calibration. Evaluate the proposed task success, attention, comprehension, feedback, interoperability and service thresholds using prespecified endpoints. Determine whether they detect meaningful failures, are practical to measure and create unintended exclusions. A threshold shall not be selected only because most pilot products can pass it.

E03 Repeatability and reproducibility. Repeat selected measurements within one team and between the independent teams using the same configurations. Assess measurement uncertainty and agreement on pass, fail and not applicable decisions. Material disagreement shall be resolved through clearer requirements or improved methods before adoption.

E04 Population validation. Include relevant age, language, experience, body-size and accessibility variation. Examine whether the protocol systematically misclassifies a declared group or rewards a design that creates a new barrier. Reducing inclusion solely to simplify recruitment shall not resolve a protocol deficiency.

E05 Safety review. Examine the proposed gates against known hazard mechanisms and plausible misuse. Confirm that statistical averages cannot conceal critical failure, that time budgets include all relevant stages and that fallback rules do not transfer an unrealistic obligation to a user.

E06 Disposition and publication. Maintain a change log showing pilot findings, stakeholder comments, revised text, reasons for numerical changes and the final approval decision. Until this process is complete, identify the edition as a technical proposal and do not claim that its thresholds have been validated.

Annex F Future mobility development directions

This annex is informative. It identifies technology directions for further development and does not assert their deployment dates, commercial success or technical readiness. Existing normative clauses continue to apply when a feature is supplied within the assessment scope.

F01 Cooperative world models. Future mobility systems may combine local perception, roadside sensing and information from nearby vehicles into continuously updated models. Useful extensions would measure uncertainty propagation, correlated evidence, conflicting participants and graceful operation when cooperation disappears.

F02 Negotiated use of road space. Vehicles and cities may negotiate curbs, crossings, merging areas and charging access dynamically. Future requirements should address fair access, authority, negotiation expiry, emergency priorities and protection of people who do not participate digitally.

F03 Distributed and nonterrestrial connectivity. Future services may use multiple terrestrial, aerial or satellite paths. Assessment should remain based on service outcomes, actual latency, uncertainty and fallback, rather than on a communication generation label.

F04 Personal mobility assistants. Assistants may organize journeys across vehicles, public transport, energy services and accessibility needs. Useful controls include portable but limited permissions, revocable action authority, confirmation of consequential transactions and truthful reporting of uncertainty.

F05 Spatial interfaces and predictive comfort. Augmented displays and anticipatory cabin or motion control may improve understanding and comfort. Future assessment should test attention capture, visual registration, motion sickness, individual variation and the interaction between comfort optimization and hazard response.

F06 Portable experience profiles. Users may carry preferences between vehicles and operators. A future profile should transfer accessible settings without assuming equivalent controls, exporting unnecessary identity information or changing safety behaviour without validation.

F07 Collaborative digital twins. Product, infrastructure and service twins may support scenario generation and update evaluation. A simulation claim should identify model validity, evidence provenance and the boundary beyond which physical or human testing remains necessary.

F08 Experience aware update assurance. Future monitoring may detect changes in task difficulty, accessibility and user understanding after an update. Development should focus on privacy preserving indicators, meaningful baselines, false alarms and action thresholds that are understandable to both engineers and users.

F09 Future trust migration. Long-lived vehicles may need changes to identity, cryptographic and communication mechanisms. Future provisions should address mixed-generation operation, resource limits, downgrade resistance and continuity of user access during migration.

F10 Shared human and automated environments. Urban roads are likely to contain a changing mix of human driven and automated vehicles, pedestrians and micromobility. The enduring objective is predictable behaviour and understandable interaction for every road user, including those with no connected device.