IIT Delhi / Bharti School Response - Counter Comments

TRAI Consultation Paper No. 08/2026: Regulatory Framework for Vehicle-to-Everything (V2X) Communication

Note: This is an academic and technical response. It intentionally answers only the questions where IIT Delhi/Bharti School can add distinctive value: authorisation principles, technology selection, certification, higher-layer interoperability, security, spectrum assignment, and the need for India-specific pilots and research validation.

1. Preface:

IIT Delhi/Bharti School welcomes TRAI's consultation on a regulatory framework for Vehicle-to-Everything (V2X) communication. India should therefore adopt a framework that is safety-first, interoperable, technology-open and empirically validated.

The recommendations of the Task Force on ITS provide a valuable baseline, particularly with respect to the higher-layer ITS stack, message-set standardisation, security architecture, and 5.9 GHz harmonisation. These elements are broadly aligned with internationally accepted ITS frameworks, including ETSI-based approaches. However, the access-technology layer requires further India-specific technical validation before being locked into a single national prescription.

Globally, V2X deployment pathways remain diverse. Several jurisdictions have moved away from earlier DSRC-only approaches; some are adopting cellular V2X; others retain technology-neutral or class-authorisation models. There is no single global approach that India can adapt without testing. India's mixed traffic, high two-wheeler density, road geometry, urban congestion, highway work zones, and variable cellular coverage create a unique deployment environment.

Accordingly, IIT Delhi/Bharti School recommends that India should not prematurely mandate a single V2X access technology or a specific 3GPP release for nationwide deployment. The term C-V2X should be used in its complete technical sense, covering LTE-V2X, NR-V2X, PC5 direct communication, and Uu/V2N network-assisted communication. It should not be treated as synonymous only with 5G NR-V2X.

Before finalising large-scale regulatory prescriptions, India should conduct independent, multi-stakeholder pilot studies comparing ITS-G5/DSRC, LTE-V2X PC5, NR-V2X PC5, and V2N/Uu-based approaches across representative Day-0 and Day-1 safety use cases. The framework should be based on measured performance, interoperability, spectrum efficiency, deployment cost, security, and scalability rather than on vendor-specific technology preferences.

2. IIT Delhi Recommendation

IIT Delhi/Bharti School recommends a National V2X Technology Evaluation and Validation Programme before India finalises any binding access-technology mandate. The regulatory framework may recommend common higher-layer standards, security, certification, and interoperability requirements, but should keep the access layer open during pilots and early deployment.

3. Responses to Selected TRAI Questions

Q1. Need for V2I authorisation

IIT Delhi/Bharti School supports a regulatory mechanism for V2I/RSU deployment. Roadside Units (RSUs) are an important component of the V2X ecosystem because they can transmit safety-critical V2X messages and, unlike purely vehicle-to-vehicle communication, can also provide a broader infrastructure-assisted view of the road environment. RSUs can support applications such as signal-phase and timing information, intersection safety, roadworks warning, hazardous-location notification, emergency vehicle prioritisation, and traffic management.

IIT Delhi/Bharti School recommends that OBUs should remain licence-exempt, subject to equipment compliance, certification, and security requirements. RSUs should be enabled through a light-touch authorisation, registration, or class-licence framework linked to a national RSU registry, notified technical parameters, cybersecurity obligations, and interoperability requirements. Eligibility should be broad and should include government agencies, road authorities, highway concessionaires, smart-city SPVs, telecom operators, OEMs, V2X technology providers, startups, and academic/research testbeds. Such an inclusive framework will support both public-interest deployment and India-specific technical validation.

Q4. Whether a specific V2X access technology should be prescribed

IIT Delhi/Bharti School recommends that TRAI should not recommend a single V2X access technology or a specific 3GPP release at this stage. India's V2X framework should remain access-technology-open until sufficient independent field evidence is generated under Indian traffic, road, and spectrum conditions.

While C-V2X is an important technology, the term should be used in its complete technical sense. C-V2X includes LTE-V2X, NR-V2X, direct PC5 sidelink communication, and network-assisted Uu/V2N communication. It should not be narrowly interpreted as only 5G NR-V2X. Further, significant work has been carried out within 3GPP and the research community on sidelink communication, including mechanisms that allow vehicles and other V2X nodes to communicate directly and manage radio resources without necessarily depending on base-station scheduling. These distinctions should be clearly reflected in the regulatory framework so that terminology does not create premature technology lock-in.

India has not yet conducted sufficient independent pilot studies comparing ITS-G5/DSRC, LTE-V2X PC5, NR-V2X PC5, and V2N/Uu-based approaches for representative Indian scenarios. Indian roads have distinct deployment challenges, including dense mixed traffic, two-wheelers, pedestrians, buses, trucks, e-rickshaws, non-lane-disciplined movement, heterogeneous vehicle penetration, urban intersections, flyovers, highways, and adverse weather conditions. A regulatory mandate made without India-specific comparative evidence may create interoperability risks, avoidable costs, vendor dependency, or delayed deployment.

TRAI/DoT should therefore support structured comparative trials before finalizing a national access-technology. These trials should cover Day-0 and Day-1 use cases and the evaluation should measure latency, packet delivery ratio, reliability, communication range, scalability under dense mixed traffic, congestion behaviour, spectrum efficiency, device cost, RSU density, OBU penetration, security overhead, and multi-vendor interoperability.

The trials should also assess the complementary roles of direct PC5 communication and network-assisted V2N communication. Based on these results, India can define an evidence-based national V2X deployment profile that supports interoperability, safety, scalability, and future migration to advanced V2X technologies.

Q5. MTCTE / certification of OBUs and RSUs

IIT Delhi/Bharti School supports certification of OBUs and RSUs for RF compliance, EMI/EMC, cybersecurity, safety, and interoperability. However, certification should be phased and proportionate so that research pilots and early field trials are not delayed.

The certification framework should distinguish between: (i) research and pilot deployments, (ii) pre-commercial corridor deployments, and (iii) mass-market or nationwide deployments. For research and pilots, provisional approval with controlled operating conditions should be permitted. For mass deployment, stricter MTCTE/TEC conformity assessment should apply.

Certification should not only test radio conformance; it should also cover interoperability profiles, secure software updates, trusted identity, logging/auditability, and compliance with the national V2X security framework.

Q6. Higher-layer ITS stack and interoperability

IIT Delhi/Bharti School strongly supports standardisation of the higher-layer ITS stack. Interoperability cannot be ensured only at the access layer. Even if the radio works, vehicles and RSUs may fail to communicate meaningfully if they use different message formats, facilities-layer functions, security mechanisms, or application profiles.

The ETSI ITS stack and security framework recommended by the Task Force can be adopted as a baseline for Indian deployment, subject to Indian profiling and validation. India should define a national V2X interoperability profile covering message sets, facilities layer, networking/transport, security, certificate policies, and application behaviour for Day-0 and Day-1 services.

The framework should mandate multi-vendor plug-tests, conformance testing, and periodic interoperability events. An Indian V2X Interoperability Test Facility may be established with participation from TEC, C-DAC, ARAI, ICAT, GARC, NATRAX, IITs, industry vendors, OEMs, telecom operators, and road authorities.

Access-layer flexibility should not mean application-layer fragmentation. India can remain open to multiple candidate access technologies during evaluation while mandating common higher-layer service behaviour for safety-critical applications.

Q8-Q10. Spectrum assignment and related conditions

IIT Delhi/Bharti School recommends that the 5.9 GHz ITS spectrum should be treated as shared, non-exclusive, and safety-prioritised. Exclusive partitioning among multiple authorised entities may fragment the ecosystem, reduce spectrum efficiency, and create artificial barriers to interoperability.

The initial 30 MHz band should not be rigidly divided between safety and non-safety applications without technical evidence. Safety-of-life services should receive the highest priority, but the final channelisation and priority mechanism should be validated through Indian pilots.

TRAI/DoT should commission spectrum studies covering coexistence among multiple RSU operators, RSU density, adjacent-channel interference, power limits, out-of-band emissions, congestion control, hidden-node effects, urban/highway differences, and future use of the reserved 20 MHz band.

Q11. Other issues relevant to the V2X regulatory framework

IIT Delhi/Bharti School recommends the creation of a National V2X Technology Evaluation and Validation Programme before nationwide technology lock-in. This programme should be neutral, transparent, multi-stakeholder, and based on Indian road conditions.

The programme should include: (i) comparative access-technology trials, (ii) Day-0 and Day-1 use-case validation, (iii) 5.9 GHz channel measurements in Indian conditions, (iv) multi-vendor interoperability testing, (v) V2N plus PC5 integration studies, (vi) cybersecurity and misbehaviour-detection studies, (vii) low-cost OBU and aftermarket-device evaluation, and (viii) two-wheeler and vulnerable road-user safety studies.

IIT Delhi/Bharti School can contribute through research testbeds, simulation and field evaluation, Indian V2X datasets, spectrum measurements, AI/ML-based mobility intelligence, cooperative perception, cybersecurity, and collaboration with telecom operators, OEMs, V2X vendors, road authorities, and certification agencies.

5. Proposed National V2X Technology Evaluation Programme

Evaluation dimension	What should be tested	Why it matters for India
Access technologies	ITS-G5/DSRC, LTE-V2X PC5, NR-V2X PC5, V2N/Uu and hybrid models	Avoid premature technology lock-in; identify best fit for Indian use cases.
Use cases	Day-0 and Day-1 safety, emergency vehicles, roadworks, hazardous locations, intersections, VRUs	India needs evidence for mixed traffic and two-wheeler-heavy roads.
Radio performance	Latency, reliability, PDR, range, congestion, hidden-node effects, mobility	Safety applications require predictable performance.
Spectrum	30 MHz adequacy, channelisation, shared use, interference, reserved 20 MHz planning	Regulation should be based on measured spectrum behaviour.
Interoperability	Multi-vendor OBU/RSU plug-tests, message formats, certificates, application behaviour	Safety value depends on universal decodability across vendors.
Deployment cost	OBU/RSU cost, retrofit/aftermarket devices, RSU density, backhaul, maintenance	India needs scalable and affordable rollout models.
Security	PKI/SCMS, misbehaviour detection, rogue RSUs, spoofing, privacy, revocation	Trust is essential for safety-of-life messages.
V2N + PC5 integration	Cellular network assistance, cloud-based alerts, smartphone participation, backend intelligence	Early safety benefits may be possible even before high OBU penetration.