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Inputs on “Consultation Paper on the Regulatory Framework for Vehicle-to- Everything (V2X) Communication” 27 May 2026

Dear Sir,

We are thankful to your organisation, for issuing the above draft paper on V2X communication dated 30th April 2026. It is being framed at the most opportune time, and it will be equally beneficial for the industry and all related parties.

In this context, please find enclosed our comments (Annexure -1) for the current public consultation on Consultation Paper on the Regulatory Framework for Vehicle-to-Everything (V2X) Communication.

We would **look forward towards incorporation of our suggestions in the final notification.**

Yours sincerely,

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Encl: Annexure - 1

Cc: Auto Component Manufacturer Association
Annexure-1



With regards to the Questions, we would like to comment as following:

Q1. V2I Communication Service Authorisation:

The V2I authorization framework could be based on ECC/DEC/(08)01^[1], particularly the following:

DECIDES

1. *that the purpose of this ECC Decision is to harmonize the use of **safety-related** Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band;*
2. *that, for the purpose of this ECC Decision, the following definitions apply:*
 - a) **safety-related Road ITS** are those applications **whose aim is to reduce the number of traffic fatalities or accidents using communications between ITS stations;**
3. *that CEPT administrations shall:*
 - a) **designate the frequency band 5875-5925 MHz on a non-exclusive basis for all safety-related ITS;**
 - c) **allow free circulation and use of ITS equipment subject to the provisions of this Decision;**
 - d) **exempt all vehicle-installed and mobile ITS equipment subject to the provisions of this Decision from individual licensing;**
 - e) **exempt Road ITS road-side equipment subject to the provisions of this Decision from individual licensing in 5875-5915 MHz;**

The nature of transmissions to/from RSU for V2I/I2V are broadcast in nature and not targeted unicast messages in the traditional communication network sense. The On-Board Units (OBUs) in the ITS/V2X system are not connected to an RSU in the same manner that a client may connect to the base-station in a telecom network. Hence, section 3(1)(a) of the Telecommunications Act 2023 that deals with "pro vide telecommu ica ions ser vice' is not a tech ically correct classification for direct communication (short range) of a V2X system. Section 3(3) that deals with providing exemption from authorization in public interest considering the safety-related nature of application may be better suited for this frequency range. Further, as per Section 4(6)(a) in public interest, the RSU may further be exempt from individual assignment and as per Section 4(6)(b) in public interest, for the specific usage of V2I/I2V, within the range of frequencies notified, only technical parameter compliance may be sought.

^[1] ECC/DEC/(08)01 of 14 March 2008 on the "Harmois ed use of Safety-Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band" latest amended on 7 March 2025 (ECC#66) <https://docdb.cept.org/document/412>

Q2. Alternative Mechanism for V2I Communication:

The regulatory framework may continue to mandate compliance with prescribed technical standards, emission characteristics, coexistence requirements, and interoperability guidelines for ITS/V2X deployments. If required, the governing authority may maintain a centralized database of RSU installations based on the category of road infrastructure (such as city roads, state highways, national highways, or private roads), along with associated technical and operational information for coordination, auditability, and spectrum management purposes. If needed, Periodic conformity assessments, interference reporting mechanisms, and deployment governance measures may additionally be considered to ensure safe, interoperable, and scalable nationwide ITS/V2X deployment.

Q3. Other Suggestions for V2I Authorisation:

Plan with Vehicle OEMs on introduction of **direct** V2X communications in all new vehicles: Regulate collection of selected safety relevant traffic information (SRTI). Work with New Car Assessment programs like Bharat-NCAP to reward fitment of V2X in new cars.

For instance, 5GAA recommends a phased and hybrid deployment strategy:

Combine V2N (network-based communication) for early scalability (including apps) for latency-tolerant informational use-cases and direct V2X (PC5) for local safety and low-latency use cases

Finalise publications:

- 5.9GHz spectrum regulation for direct V2X (PC5)
- V2X reference standards
- V2X deployment plan
- Digitalise road infrastructure:
- collect road traffic information at strategic traffic management centres
- create information interfaces (APIs) to disseminate road traffic information

Prioritise:

- fleet deployment (emergency vehicles, taxis, public transport)
- after-market devices to accelerate penetration
- deploy RSUs selectively at critical locations (e.g. intersections, high-risk areas)
- Plan with OEMs on introduction of V2X Direct in all new vehicles:
- Regulate collection of selected safety relevant traffic information (SRTI)

- Work with New Car Assessment programs like Bharat-NCAP to reward fitment of V2X in new cars
- Identify the need for allocating more bandwidth to support advanced driving with NR-V2X Direct.

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This approach allows early benefits while supporting gradual rollout of full V2X capabilities

Q4. C-V2X Technology Prescription:

As a Tier-1 supplier, Bosch is naturally delivering the technologies needed by our customers and therefore is technology neutral. Based on the decision in India to opt for a C-V2X approach, we would like to bring the following aspects to your attention:

India could prescribe a harmonized C-V2X technology framework for direct communication to ensure interoperability, ecosystem alignment, and efficient deployment of cooperative safety services.

A phased approach based on LTE-V2X for initial deployment and Day-0 / Day-1 use cases, should be accompanied by a defined evolution path toward NR-V2X for future advanced applications.

LTE-based C-V2X can be adopted as the baseline technology for initial direct communication deployments, considering its higher ecosystem maturity, broad deployment experience, and suitability for currently identified use cases.

NR-based C-V2X should be treated as a future evolution path for advanced cooperative and automated driving applications that may require lower latency, higher throughput, or more advanced cooperative behaviour. NR-V2X can be considered as ecosystem maturity, device availability, and deployment requirements evolve.

Where future coexistence between LTE-V2X and NR-V2X becomes necessary, interoperability can be managed through phased migration strategies and interoperability considerations. In addition, the full benefits of NR-V2X may require availability of additional spectrum resources for advanced cooperative applications.

If multiple direct communication technologies are allowed without harmonization, interoperability risks may arise between vehicles, RSUs, OEMs, and infrastructure vendors, potentially increasing deployment complexity and certification burden.

In early deployments, V2N-based services to support infrastructure communication (i.e. V2N2I/I2N2V) can be deployed immediately using existing



cellular infrastructure and can complement direct communication use cases during the early deployment phases. This complementary deployment approach is also reflected in multiple 5GAA reports and whitepapers at [5GAA White Paper: Road Traffic Operation in a Digital Age](#). However, direct and network-based communications are complementing and cannot replace each other completely.

Q5. MTCTE for OBUs/RSUs:

RSUs and OBUs could be brought under interoperability and conformance frameworks. 5GAA recommends ETA for wireless emission testing and voluntary-based industry certification for protocol conformance and interoperability.

These devices perform wireless transmission and reception of safety-related information between vehicles, infrastructure, and communication networks. Their malfunction, non-compliance, or compromise may adversely impact road safety, spectrum integrity, interoperability, and trust in the V2X ecosystem.

The ETA for wireless emission:

- RF performance and spectrum compliance
- EMI/EMC and electrical safety

For industry certification on voluntary basis:

- Communication protocol conformance
- Interoperability validation
- Cybersecurity and privacy requirements
- Compliance with regulatory requirements in India

India might establish or adopt a V2X-specific voluntary conformance and interoperability certification framework to ensure interoperability across OEMs, RSUs, OBUs, chipset vendors, and infrastructure providers.

International certification ecosystems such as OmniAir (<https://omniair.org/>) and GCF (<https://www.globalcertificationforum.org/services/automotive.html>) may be used as useful references for defining interoperability and conformance testing methodologies. Certification and interoperability validation could extend beyond the radio layer to message-level behaviour, including aspects such as congestion control, positioning quality, message prioritization, and interpretation of safety message semantics.

As V2N-based services operate on existing certified devices (e.g. telematics control units, cellular modems) no additional V2X-specific radio equipment certification should be required. Such services can therefore be deployed more quickly while continuing to comply with applicable telecom, cybersecurity, privacy, and vehicle-level requirements. This can help build early user confidence, ecosystem learning, and momentum for broader V2X deployment.

Q6. Standardizing ITS Stack and Security:

Yes, for Direct (short range) communication there is a need to standardise additional layers (beyond the access layer) in the ITS stack to ensure interoperability among different RSUs/OBUs from multiple vendors.

Interoperability cannot be guaranteed solely through harmonization of the radio access layer. Standardization is also required at higher layers to ensure consistent interpretation of messages, congestion management behaviour, positioning quality handling, prioritization mechanisms and security services across different implementations.

Guidelines can be provided for application layer behaviour to enable consistent user experience across implementations.

Considering the Task Force recommendations, global maturity, and ecosystem alignment, ETSI TC ITS standards may be adopted as the baseline higher layer ITS framework for India.

At the same time, India may define an India-specific deployment profile for Day-0 and Day-1 deployments to ensure:

- reduced implementation complexity,
- practical certification requirements,
- lower deployment cost,
- and alignment with India-specific traffic and infrastructure conditions.

The ETSI stack provides a mature and feature-rich framework, including geo-networking capabilities, facilities-layer services, congestion control, and integrated security mechanisms. However, deployment and certification complexity for early-stage use cases should be carefully managed through phased implementation and profiling.

A common higher-layer standard adopted across the direct V2X ecosystem would accelerate ITS rollout and avoid fragmentation. The ecosystem should not be fragmented by having multiple V2V application layer standards. In this respect, the C2C-CC is maintaining a basic-system profile (BSP) for awareness-driving use cases which can already been used to ensure interoperability of independent implementation.

For security on direct communication, the adopted stack should rely on globally recognized V2X security mechanisms, including IEEE 1609.2-based certificate and message security frameworks as profiled by ETSI.



Testing standards from ETSI and international interoperability and certification frameworks such as OmniAir may serve as useful references for certification methodology and interoperability validation.

Q7. Security Framework for ITS/C-V2X:

(a) **What should be the security framework for ITS/ C-V2X?** The security framework should align with globally adopted V2X security principles and standards associated with the selected ITS stack. The ETSI security framework and IEEE 1609.2-based mechanisms are both mature and well-established approaches and provide strong foundations for secure V2X communication.

(b) **Which agency [such as Controller of Certifying Authorities (CCA), Ministry of Electronics & Information Technology (MeitY)] should implement the Public Key Infrastructure (PKI) framework for ITS/ C-V2X in India?**

CCA/MeitY could play a central role in governance, policy management, and trust anchoring for the national ITS/C-V2X security ecosystem.

The operational V2X PKI / SCMS infrastructure may be implemented by designated national entities or licensed operators under approved certificate policies and governance frameworks. Existing global SCMS implementations and providers may be referenced or leveraged, subject to Indian policy, sovereignty, and governance requirements.

(c) **How to ensure coexistence of V2X PKI certificates with the legacy PKI mechanism in India i.e. based on X.509, operated by Root Certifying Authority of India (RCAI)?**

Conventional X.509 PKI mechanisms cannot directly replace V2X-specific credential management, since V2X communication requires additional privacy-preserving mechanisms such as pseudonym certificates and unlinkability. However, coexistence with the existing RCAI/X.509 framework can be achieved through trust anchoring, countersigning, or coexistence architectures, similar to those discussed in the Task Force recommendation. In this model, India's existing infrastructure can support national trust anchoring and governance, while V2X-specific certificate mechanisms continue to address pseudonymity, message signing, and privacy requirements.

India could adopt a coexistence framework that maintains compatibility with India's national trust infrastructure, preserves V2X-specific privacy requirements, supports interoperability with global V2X ecosystems, and minimize implementation complexity for OEMs and infrastructure providers.

The V2X ecosystem should operate as a controlled trust domain where only authenticated and authorized devices and infrastructure entities can participate while still supporting multi-vendor and multi-OEM interoperability.

Q8 to Q10 – No Comments from Bosch

Q11. Other Issues/Suggestions for V2X Regulatory Framework:

While existing ITS/V2X protocols and standards define the structure, syntax, and format of broadcast messages, additional regulatory or compliance mechanisms may be required to ensure correctness, consistency, and reliability of the data being transmitted by participating entities.

In safety-related V2X systems, merely ensuring packet-level protocol compliance may not be sufficient, as surrounding vehicles and infrastructure rely on the semantic accuracy of transmitted information for cooperative awareness and decision-making. Incorrect, inconsistent, stale, or improperly populated message fields — even within otherwise standards-compliant packets — may lead to unsafe behavior, interoperability issues, or degradation of trust within the V2X ecosystem.

Accordingly, a conformance and validation framework may be considered to verify not only adherence to protocol formats, but also the correctness and validity of critical broadcast message parameters such as position, speed, heading, timestamps, event information, object classification, and other safety-relevant data elements. Such validation mechanisms may include interoperability testing, behavioral conformance testing, scenario-based validation, and certification procedures for both vehicle-side and infrastructure-side implementations.

Further, standardized test profiles and certification requirements may help ensure that V2X implementations across different OEMs, infrastructure providers, and solution vendors behave consistently under real-world operating conditions. This would strengthen interoperability, improve reliability of safety applications, reduce risks arising from malformed or misleading transmissions, and enhance overall trust in the ITS/V2X ecosystem.

In addition, provisions relating to cybersecurity, message authenticity, traceability, and software update governance may also be considered as part of the broader compliance framework for safety-critical V2X deployments.

Q12. Spectrum Charges for V2I:

Given the safety-critical and public-interest nature of ITS/V2X deployments, particularly V2I communication through Road Side Units (RSUs), spectrum

charges may not be appropriate for such deployments, especially during the initial stages of ecosystem development.

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V2I systems are primarily intended to support road safety, collision avoidance, traffic efficiency, and reduction of traffic fatalities rather than provision of commercial telecommunication services. Global V2X deployment trends also indicate that several regions have adopted supportive regulatory approaches, including dedicated or protected spectrum access with limited or no spectrum usage charges for safety related ITS applications, in order to accelerate ecosystem adoption and infrastructure rollout.

Imposition of spectrum charges may create barriers for deployment by road authorities, municipalities, infrastructure operators, and OEMs, thereby slowing adoption of V2I infrastructure. Accordingly, a public-interest-oriented framework with no spectrum charges for safety-related V2I deployments may help accelerate ITS adoption while continuing to ensure compliance with prescribed technical, interoperability, coexistence, and cybersecurity requirements.

Q13 to Q26 – No Comments from Bosch