Spectrum for Intelligent Transport Systems

GSMA Public Policy Position

October 2017

Executive Summary

The automotive industry is going through a period of rapid technological evolution. This includes support for Intelligent Transport Systems (ITS) that will connect vehicles, roadside infrastructure, people and wide area networks to enable safer, more efficient road transport.

Mobile technology is set to play a vital role in ITS with the latest version of LTE – called LTE-V2X – which will gradually evolve to 5G. A significant portion of the automotive industry favours LTE-V2X over rival approaches due to its superior performance, clear upgrade path and its ability to leverage widespread existing cellular infrastructure.

However, the viability of cutting edge, cellular-based ITS is contingent on governments adopting a supportive regulatory framework - especially as it pertains to spectrum. This paper outlines the GSMA's positions relating to spectrum for ITS:

1. **Regulators should adopt a technology-neutral approach to spectrum that is set aside for safety-related ITS**
2. **Spectrum in the 3.4-3.8 GHz range should not be set aside for safety-based V2V communications**
3. **Regulators should adopt technology-neutral spectrum licences to support network-connected vehicles**
4. **Regulators should work with the mobile industry to support connected vehicles in future spectrum planning**

Background

The automotive world is about to undergo the single greatest revolution since its inception. Autonomous vehicles and Intelligent Transport Systems (ITS) are set to transform the efficiency, comfort, safety and environmental impact of road transport. The first fully autonomous-capable cars have been launched[1] and connected vehicles are expected to number 250 million by 2020[2]. In Europe, all new vehicles must be connected from April 2018 to automatically alert the emergency services (i.e. eCall) in the event of an accident[3].

Mobile networks and technologies are at the heart of many of these advances through Cellular Vehicle-to-Everything (C-V2X) connectivity, which supports four basic use cases:

1. **Vehicle-to-Network (V2N): Connects vehicles to the mobile network to support services like streaming media for entertainment and connectivity for dynamic route management, etc.**
2. **Vehicle-to-Vehicle (V2V): Directly connects vehicles for early warnings (e.g. an upcoming emergency) including beyond line of sight so augments shorter-range on-board sensors**
3. **Vehicle-to-Infrastructure (V2I): Directly connects vehicles to roadside infrastructure like traffic lights which in turn can be connected to the wider mobile network**
4. **Vehicle-to-Person (V2P): Directly connects vehicles to pedestrians equipped with compatible mobile devices to issue alerts about potential dangers nearby**

Currently, the only common type of V2X deployment is V2N connectivity, which relies on mobile networks using licensed mobile spectrum. A new variant of LTE – called LTE-V2X - was recently developed in 3GPP release 14 to support V2V, V2I and V2P connectivity and will provide direct connectivity between devices (whether in vehicles, roadside infrastructure or mobile devices) without needing network involvement.

The new LTE-V2X standard is a rival approach to a 10-year old variant of Wi-Fi called 802.11p that also directly connects vehicles and infrastructure. Several different V2X standards have been developed based on 802.11p, including DSRC/WAVE (the US standard) and ITS-G5 (the EU standard). These two regional variants of 802.11p are not compatible, so they will require different equipment – which affects the potential economies of scale – and have both so far failed to gain significant market traction[4]. Some researchers have concluded that 802.11p solutions 'may be inadequate for large-scale deployment'[5], while media reports[6] have likened regulatory proposals mandating 802.11p to demanding 'Henry Ford equip his model T with a telegraph machine' and dubbed the proposals 'a crushing blow to innovation and competition'.

The new LTE-V2X standard complements existing LTE-based V2N implementations and offers significant safety advantages over 802.11p. Tests have shown LTE-V2X supports around double the range of 802.11p so can provide early warnings to more vehicles - or more reliable performance over the same range[7].

Given it may take over a decade before a significant number of vehicles and roadside equipment is equipped with V2X capabilities, it is essential that there is a roadmap for technology evolution. There is already a clear roadmap for upgrades to LTE-V2X – with full backwards compatibility – leading to 5G. All vehicle manufacturers plan to support 5G-based V2X in future, however in the near-term, there had been considerable support for 802.11p. This has changed since the appearance of LTE-V2X, and the 5G Automotive Association (5GAA) – whose 60 members include the main vehicle manufacturers - now supports LTE-V2X.

In many countries around the world regulators have set aside a portion of spectrum for ITS, typically in the 5.9 GHz band. This generally includes a dedicated portion for safety-related communications between vehicles, infrastructure and people (i.e. V2V, V2I and V2P) which is where LTE-V2X and the variants of 802.11p compete. The GSMA's positions for the regulatory community regarding spectrum considerations for Intelligent Transport Systems are as follows:

1. Tesla claims it's Model 3 is the first mass market car with the hardware to support fully autonomous driving
2. Gartner research (2015)
3. The European Union agreed to mandate ecall from April 2018 – https://ec.europa.eu/digital-single-market/en/news/ecall-all-new-cars-april-2018
4. Although Volkswagen has announced plans to start equipping vehicles with the technology from 2019 – http://www.traffictechnologytoday.com/news.php?NewsID=86255. However Volkswagen is also reportedly planning to deploy C-V2X with 5G
5. 'An Overview of the DSRC/WAVE Technology' by NICTA, the Australian national ICT body
6. Wired article from May 2017, 'Senseless government rules could cripple the robo-car revolution'
7. These tests were by Qualcomm – which supports both 802.11p and LTE-V2X technology – and were based on using the same amount of spectrum (i.e. a 10 MHz channel) in the same band (i.e. 5.9 GHz) – https://www.qualcomm.com/documents/path-5g-cellular-vehicle-everything-c-v2x

Positions

1. **Regulators should adopt a technology-neutral approach to spectrum that is set aside for safety-related ITS**
   Automotive technology, including connectivity solutions for Intelligent Transport Solutions, is evolving rapidly. Governments and regulators should maintain a level playing field by following a technology neutral approach in spectrum set aside for ITS (e.g. the 5.9 GHz band) - and not take steps to pre-empt market forces by mandating or preferring one approach. Currently, a significant portion of the automotive industry favours LTE-V2X over 802.11p due to its superior performance, clear upgrade path – including to 5G – and its ability to leverage widespread existing cellular infrastructure for network communications in a common chipset. Governments and regulators should consider all options to maintain technology neutrality. For example, the 5G Automotive Association (5GAA) has outlined potential options that can be explored to ensure both LTE-V2X and 802.11p can co-exist in the band[8].

2. **Spectrum in the 3.4-3.8 GHz range should not be set aside for safety-based V2V communications**
   There have been proposals to use spectrum in the 3.4-3.8 GHz frequency range for safety-based vehicle-to-vehicle communications using LTE-V2X technology. However, this spectrum is critical for future commercial 5G services in many countries around the world. It is essential that future 5G services are not jeopardised when a harmonised portion of the 5.9 GHz band has already been widely set-aside for safety-related V2V communications. Furthermore, in many countries the 3.4-3.8 GHz range has yet to be assigned to mobile services, so reliance on this band for LTE-V2V and V2I would delay ITS deployments - and thus also the ability to save lives on the road. However, it should be noted that 5G services operating in licensed 3.4-3.8 GHz spectrum could be important for V2N communications to support rising media traffic like streaming video.

3. **Regulators should adopt technology-neutral spectrum licences to support network-connected vehicles**
   It is essential that governments provide a regulatory framework for licensed spectrum that facilitates the development and growth of connected vehicles and does not impose service or technological restrictions that hold back innovation. Regulators should not prevent operators from deploying any mobile technology in their spectrum to support connected vehicles. Spectrum licences that are technology specific (e.g. 2G) limit operators' ability to provide high capacity information and entertainment services or intelligent route management for connected cars. This will also allow existing mobile bands to be refarmed for 5G to enable lower latency connectivity, and thus improved response times in emergencies, as well as higher capacity in-vehicle entertainment services.

4. **Regulators should work with the mobile industry to support connected vehicles in future spectrum planning**
   As the numbers of autonomous and other connected vehicles grows, it is likely that the consumption of high bandwidth media content, such as streaming video, and other V2N applications, will increase significantly. It will be essential to ensure sufficient spectrum – both for 4G and in future 5G - is available in appropriate frequency bands to support this rising V2N data traffic. This spectrum is likely to be required below 6 GHz given vehicles consuming media will be widespread and not concentrated in dense hotspots that would suit millimeter wave 5G frequency bands (i.e. 24 GHz and above). Lower frequencies (below 6 GHz) travel further and are thus better suited to the wide area connectivity required by connected cars.

8. 'Coexistence of C-V2X and 802.11P at 5.9 GHz', 5GAA paper published in June 2017

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