

# SUPPORTING VEHICLE-TO-EVERYTHING SERVICES BY 5G NEW RADIO RELEASE-16 SYSTEMS

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## Abstract:

Release-16 of the 5G New Radio (NR), developed by the 3rd Generation Partnership Project (3GPP), includes technology enablers for advanced vehicle-to-everything (V2X) communication services that go far beyond those offered by Long Term Evolution (LTE) systems. In particular, the Release-16 NR cellular interface and the NR side link interface are designed to enable platooning, advanced driving such as collision avoidance and cooperative lane change, extended sensors, and remote driving use cases. Compared to the LTE side link, the NR side link is equipped with a host of new capabilities including physical layer unicast and group cast, reliable communication using feedback-based retransmissions, operation in millimeter-wave frequencies, advanced resource allocation, and quality of service management. In this article, we summarize the outcome of the related work carried out in 3GPP and discuss how the Release-16 NR capabilities can be used to provide advanced V2X services. We conclude by discussing next steps of the V2X service evolution and the NR side link capabilities.

**Keywords:** LTE side link, V2X communication, 16 NR.

## 1. INTRODUCTION

Due to recent advances in communication, real-time control, and sensing technologies, the automotive and transport industries are evolving toward the intelligent transport system (ITS) that offers many benefits including improved safety as well as reduced traffic congestion, fuel consumption, and environmental impacts. A key enabler of emerging ITS applications is vehicle-to-everything (V2X) communication, which allows vehicles to communicate with other vehicles, pedestrians, road infrastructure, and the Internet. By utilizing V2X communication, real-time data related to the overall traffic situation can be collected and exchanged among users, enabling them to make safer, more coordinated, and smarter use of transportation networks. In parallel to the evolution of LTE, 3GPP Rel-15 marks the birth of a new radio interface for 5G systems, known as New Radio (NR). Although mobile broadband services continue to be the main driver, the NR technology also supports critical machine-type communications including V2X services [7]. NR makes use of new technology components, including flexible transmission durations, advanced multiple antenna techniques, and minimum control signaling overhead, without the constraint of being compatible with the former LTE releases. This high degree of design freedom and the increasing market demand for advanced ITS services motivated the introduction of entirely new capabilities for V2X in the 3GPP systems.

## 2. EXISTING SYSTEM

The most notable enhancements to existing features in release 16 are in the areas of multiple-input, multiple-output (MIMO) and beam forming enhancements, dynamic spectrum sharing (DSS), dual connectivity (DC) and carrier aggregation (CA), and user equipment (UE) power saving. Multiple-input, multiple-output and beam forming enhancements Release 16 introduces enhanced beam handling and channel-state information (CSI) feedback, as well as support for transmission to a single UE from multiple transmission points (multi-TRP) and full-power transmission from multiple UE antennas in the uplink (UL). These enhancements increase throughput, reduce overhead, and/or provide additional robustness. Additional mobility enhancements enable reduced handover delays, in particular when applied to beam-management mechanisms used for deployments in millimeter (mm) wave bands. Dynamic spectrum sharing DSS provides a cost-effective and efficient solution for enabling a smooth transition from 4G to 5G by allowing LTE and NR to share the same carrier. In release 16, the number of rate-matching patterns available in NR has been increased to allow spectrum sharing when CA is used for LTE.

## 3. PROPOSED SYSTEM

Vehicle to Everything (V2X) communication is a technology that provides connectivity between vehicles, pedestrians, and road infrastructure. Dedicated Short-Range Communication (DSRC) is proposed by different standards such as ETSI, IEEE, and others since ten years ago to provide wireless connectivity in V2X. Recently, the LTE-V2X based cellular communication is standardized by the 3rd Generation Partner Project (3GPP) Release 14 as an alternative V2X technology to support autonomous driving. 5G-NewRadio (5G-NR) is being proposed by the 3GPP Release 16 as a new radio access technology to offer enhanced radio coverage and wide ultra-high reliability services. 3GPP Release 15 was published in 2018 to include Phase 1 5G-NR standard. 3GPP Release 16 is designed to provide the 5G phase 2 and scheduled for being delivered in June 2020.

## 4. ANALYSIS

A power supply is a device that supplies electric power to an electrical load. The term is most commonly applied to electric power converters that convert one form of electrical energy to another, though it may also refer to devices that convert another form of energy to electrical energy. A regulated power supply is one that controls the output voltage or current to a specific value; the controlled value is held nearly constant despite variations in either load current or the voltage supplied by the power supply's energy source. Every power supply must obtain the energy it supplies to its load, as well as any energy it consumes while performing that task, from an energy source

An AC power supply typically takes the voltage from a wall outlet (mains supply) and lowers it to the desired voltage. Some filtering may take place as well. The voltage produced by an unregulated power supply will vary depending on the load and on variations in the AC supply voltage. For critical electronics applications, a linear regulator may be used to set the voltage to a precise value, stabilized against fluctuations in input voltage and load. The regulator also greatly reduces the ripple and noise in the output direct current. Linear regulators often provide current limiting, protecting the power supply and attached circuit from over current. Adjustable linear power supplies are common laboratory and service shop test equipment, allowing the output voltage to be adjusted over a range.



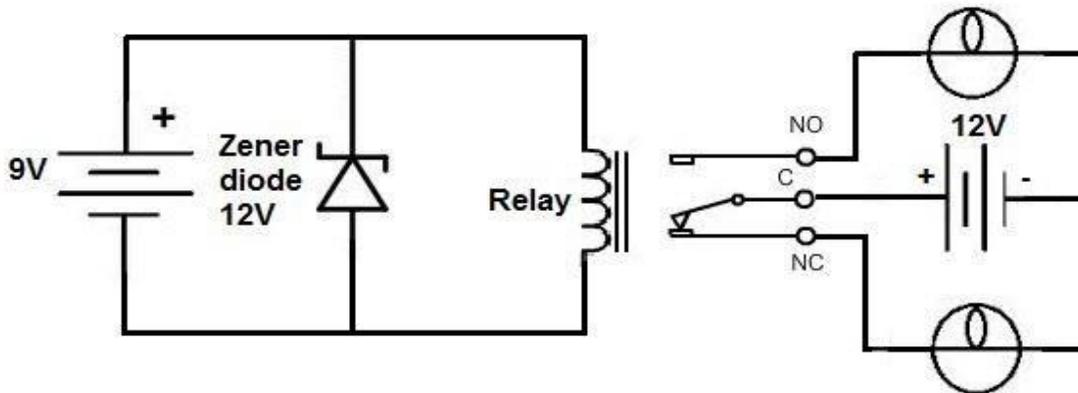


Fig. Driver Circuit

That means the operations of the two modules can be separated either in the time or frequency domain, respectively. Furthermore, different coexistence rules are defined for different combinations of transmission and reception in the two sidelinks. For example, the transmission in one sidelink can be prioritized over the transmission in the other sidelink by comparing the priority level of the respective packets.

## CONCLUSION

The recent developments in 3GPP allow using 5G NR as a communication technology for ITS. Although the cellular interface of NR can provide many V2X services, the sidelink interface complements it by enabling latency critical communication, even without network coverage. To this end, the sidelink communication in NR goes beyond the capabilities of LTE by supporting unicast and groupcast transmissions at the PHY layer in addition to traditional broadcast based transmissions. Together with these enhancements, an advanced QoS framework and resource allocation allow NR sidelink for better provisioning of advanced V2X use cases as compared to LTE sidelink. The constant evolution of NR technology in the coming years will result in further advancements in both the cellular and sidelink capabilities needed for ITS applications. While Rel-16 of the NR sidelink mainly targets vehicle-to-vehicle applications where device battery consumption is not a major constraint as the device is installed in the vehicle, solutions in future releases (e.g. Rel-17) are required to target vulnerable road users in V2X use cases. Therefore, in addition to latency and reliability enhancements, Rel-17 will also target procedures and resource allocation mechanisms focusing on power-efficient operation. Besides this, we expect that the NR sidelink will evolve to support other use cases beyond V2X as well, such as national security and public safety applications. Therefore, aspects related to coverage extension using relaying become relevant and will be studied in Rel-17.

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