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Agenda Item 9.1.1

On unlicensed positioning and applicable use cases

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Summary

- This document aims to provide specific views on positioning in unlicensed spectrum and its relation to sidelink positioning, particularly V2X
- Rel-16 NR-U supports CA/DC modes in combination with licensed spectrum and SA mode for independent deployments
 - Support for NR-U positioning can **enable positioning for the SA** NR-U operation as well as **utilize higher BW availability** in the unlicensed spectrum with CA/DC modes
- For V2X, a new type of navigation solution needs to be supported
 - Problem statement for V2X: Determine the absolute location of an entity that can transmit/receive signals from **only one other entity** and other sensors **by leveraging mobility**
 - Consider **two distinct cases**:
 - (1) V2I: Device to be located is a moving vehicle, the other entity is a **single RSU** with known location
 - (2) V2P: Device to be located is a UE of a pedestrian, the other entity is a **single moving car** with known locations
 - Note that in “traditional” cellular positioning, three or more reference points have been assumed, different from V2X
 - V2X positioning requires **coordination signaling** in licensed spectrum (**primarily ITS spectrum**) and greatly benefits from transmission & reception of **sidelink ranging signals** for measurements in unlicensed spectrum
 - Those measurements can then be fused with other data from wheel sensors, etc.
 - Those transmissions need to allow for greater accuracy; hence they require **wideband signals** to be measured, hence they benefit from usage of unlicensed spectrum

Summary

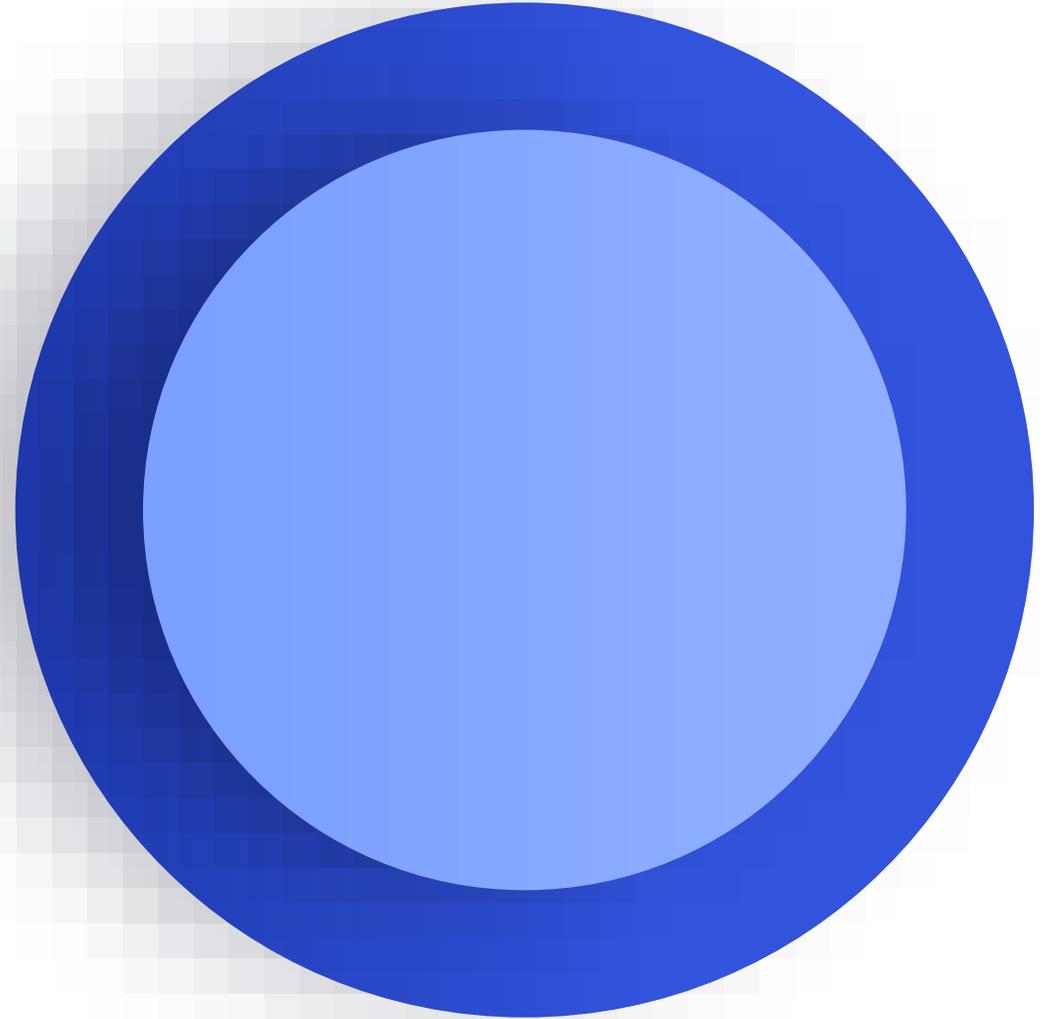
- **Observations:**

- NR-U positioning can greatly increase the value in some scenarios for NR-U SA operation and can further benefit positioning for CA/DC NR-U operation
- Sidelink based V2X positioning is required to address key V2I and V2P use cases
 - This is very different from traditional cellular positioning and will require coordination sidelink signaling in the ITS spectrum and sidelink ranging signals in the unlicensed spectrum

- **Proposal:**

- Address positioning in unlicensed spectrum in Rel-17 RAN positioning activities
- Address V2I & V2P use cases in using sidelink signaling in ITS spectrum and sidelink ranging in unlicensed spectrum in Rel-17 RAN positioning activities

Unlicensed Positioning



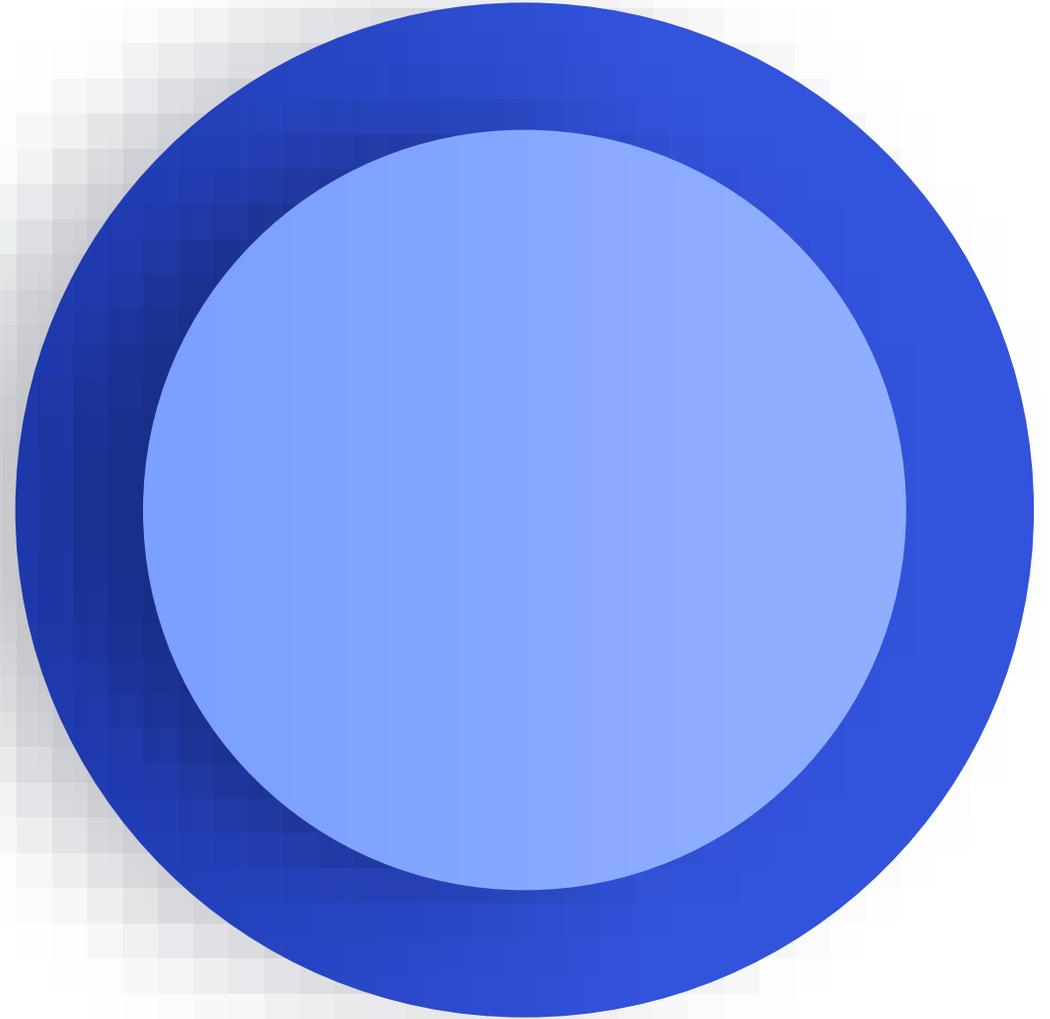
Advantages of using unlicensed spectrum for positioning

- Positioning in unlicensed spectrum is the key enabler for industrial automation (planned deployment):
 - Some countries are allocating spectrum for industrial uses (ex. Germany, Japan)
 - However, licensed spectrum for industrial use cases may not be available in the near future in many countries
 - A planned unlicensed deployment is expected to allow industrial applications without dedicated spectrum
- High accuracy positioning (cm level) is one of the key requirements for industrial uses cases.
 - Positioning support may become a bottleneck for NR-U adoption in scenarios with no licensed spectrum available
 - Even with dedicated spectrum for industrial uses, wider bandwidth for positioning engaging unlicensed band is beneficial
- In licensed assisted mode, positioning function can be offloaded to unlicensed spectrum
 - PRS can be transmitted on unlicensed spectrum
 - Measurements can be reported on the available carrier

Advantages of using unlicensed spectrum for positioning (cont.)

- WiFi is expected to introduce its positioning protocol 802.11az very soon
 - Draft 2.0 of the specification is expected to be ready by Q1 2020.
 - http://www.ieee802.org/11/Reports/tgaz_update.htm
- Support for NR-U positioning can enable feature parity with 802.11 systems and improve the chances of NR-U adoption, especially for the standalone NR-U operation.

V2X Positioning



V2X sidelink positioning is different from cellular positioning

- Signaling from a **single entity** by leveraging mobility and information from other sensors can enable accurate positioning
 - By contrast cellular positioning relies on transmission/reception of signal from three or more nodes with known location
 - Single entity can be a vehicle or RSU
- V2X positioning requires **coordination signaling** in licensed spectrum (**primarily ITS spectrum**) and greatly benefits from transmission & reception of **sidelink ranging signals** for measurements in unlicensed spectrum
- Vehicle/RSU/Pedestrians are **unlikely to have large number of antennas** rendering difference made by angle-based methods less effective

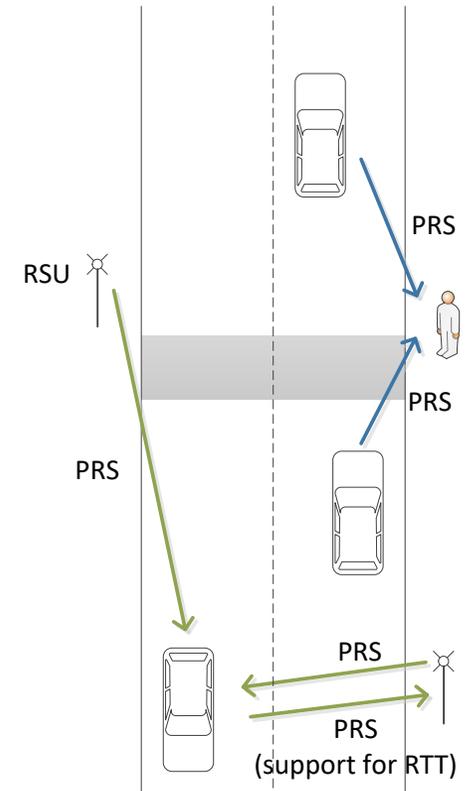
V2X Sidelink positioning use case details

- “Vehicle to Infrastructure”

- Vehicle positions itself on the basis of signals sent by an RSU
 - Autonomous vehicles require highly accurate positioning
 - Target is 0.1 meters relative lateral accuracy, 0.5 meters relative longitudinal accuracy for V2X (TS 22.186) in sidelink
 - Vehicles rely on GNSS and several other sensor based techniques to get positioning
 - Still it is not possible to get lane level accurate positioning in some scenarios, e.g., heavy urban
 - RSUs can help vehicles achieve accurate positioning by signaling over sidelink

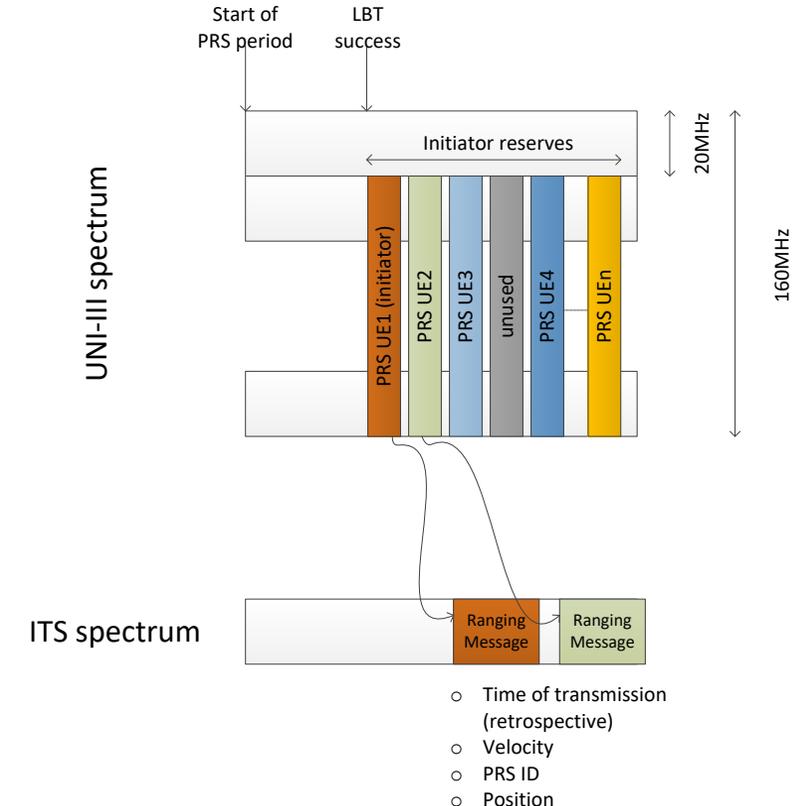
- “Vehicle to Pedestrian”

- V2P can significantly reduce the number and severity of accident between vehicles and pedestrians
- However the accuracy of V2P signaling is dependent on the accuracy of the distance between vehicle and pedestrian
 - Low accuracy can lead to false alarm rendering the feature ineffective
- V2P sidelink ranging between vehicle and pedestrian can significantly improve the relative distance accuracy leading to much lower false alarm



Unlicensed spectrum for V2X sidelink positioning

- Large number of antennas may not be available in I2V & V2P for angle-based high accuracy solution
- Wideband signal (>40MHz) transmission is required for desired accuracy for I2V & V2P use cases for timing-based methods
 - Targeted 0.1 meters relative lateral accuracy, 0.5 meters relative longitudinal accuracy for V2X is challenging with limited ITS spectrum.
 - Unlicensed spectrum (e.g. UNII-3) is a natural choice for practical deployment
- Potential area of study
 - Coupling of PRS on UNI-III and related assistance information for sidelink V2X positioning messages on ITS spectrum
 - Wideband but low duty cycle SL PRS signal transmission in unlicensed band
 - Low duty cycle signal can simplify LBT in unlicensed spectrum
 - All other assistance messages e.g. ID, location, TOA and other information exchange in ITS to reduce LBT issues in unlicensed.



Conclusion

- Stand-alone NR-U operation requires unlicensed positioning to enable feature parity with 802.11 systems
- Addressing positioning in unlicensed spectrum has additional advantages related to high-precision in IIOT
- Sidelink based V2X positioning is required to **address key V2I and V2P use cases**
 - This is very different from traditional cellular positioning and new specification is required
 - Define coordination sidelink signaling in the ITS spectrum and sidelink ranging signals in the unlicensed spectrum
 - Unlicensed spectrum is needed for effective performance
- **Proposal:**
 - **Address positioning in unlicensed spectrum in Rel-17 RAN positioning activities**
 - **Address V2I & V2P use cases in using sidelink signaling in ITS spectrum and sidelink ranging in unlicensed spectrum in Rel-17 RAN positioning activities**



Thank you

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