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5G VIIMA

Joint Positioning and Tracking in Industrial Facility
– A Bayesian-driven Approach via V2X

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5G TNF Results Webinar

9 September 2021

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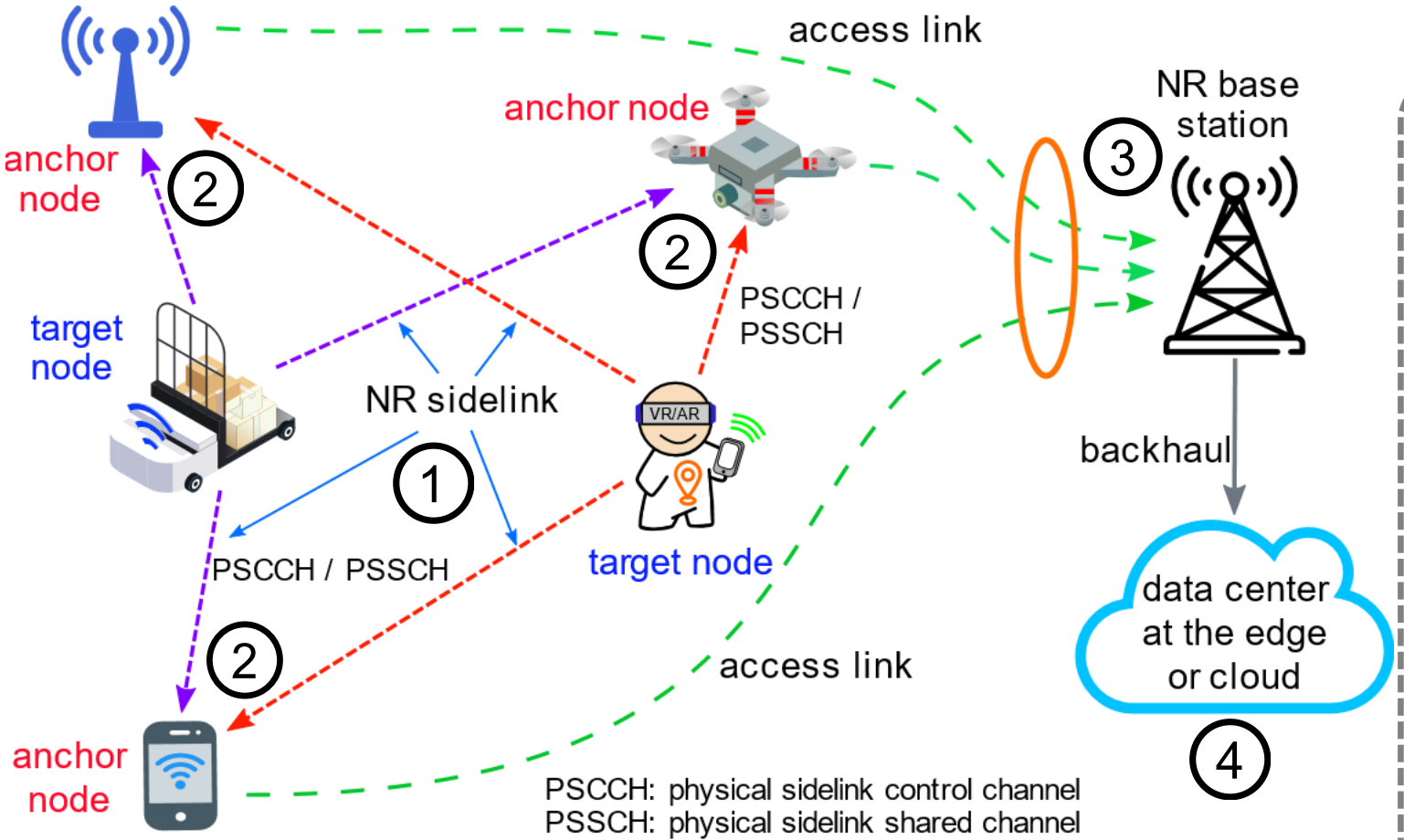
Joint positioning and tracking scheme via V2X – a conceptual level illustration



Overall process of the proposed joint positioning & tracking

1. Periodical transmission of NR sidelink reference signals from target nodes
2. Through beam sweeping, anchor nodes receive and measure the location-related measurements which are then forwarded to NR base station
3. Aggregation of available measurements, such as AoA / ToA / RSS
4. With the location-related measurements, joint positioning and tracking of both targets and anchors is carried out

A radio-SLAM approach applying the Bayesian framework

- A joint probability distribution is computed at the ith time instant

$$\mathbb{P}(\mathbf{s}_{\mathrm{T}}[i], \mathbf{s}_{\mathrm{A}}[i] \mid \mathbf{y}[1{:}\,i],\ \mathbf{s}[0])$$

to describe posterior density of the targets' state, $\mathbf{s}_{\mathrm{T}}[i]$ and anchors' state, $\mathbf{s}_{\mathrm{A}}[i]$ given the observations, $\mathbf{y}[1{:}\,i]$ from 1st to the current time instant, as well as the initial state, $\mathbf{s}[0]$ that includes the initial state of both targets and anchors.

- The measurement / observation model is

$$\mathbb{P}(\mathbf{y}[i] \mid \mathbf{s}_{\mathrm{T}}[i], \mathbf{s}_{\mathrm{A}}[i])$$

The estimation algorithm can be carried out using Kalman filter (EKF, UKF) or particle filters, Gauss-Newton method.

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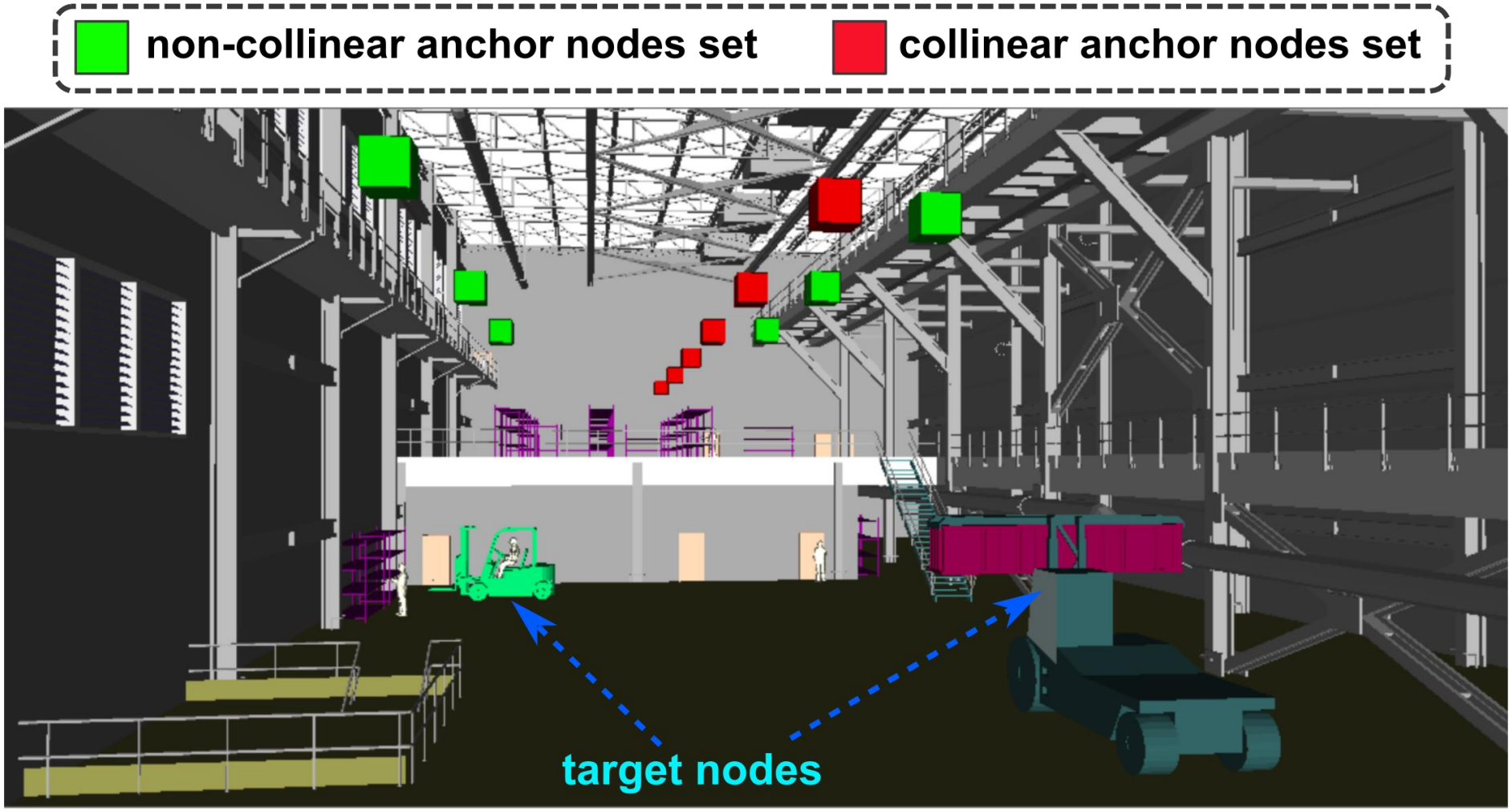
Utilized ray-tracing engine: Wireless InSite



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Demonstration of the Joint Positioning and Tracking

- Due to the potential size of the multimedia, the video is omitted. Please, follow the link for the video demonstration.

https://research.tuni.fi/wireless/research/positioning/cps-d2d/

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Thank you!

- Y. Lu, M. Koivisto, J. Talvitie, E. Rastorgueva-Foi, M. Valkama and E. Simona Lohan, "**Cooperative Positioning System for Industrial IoT via mmWave Device-to-Device Communications**," *2021 IEEE 93rd Vehicular Technology Conference (VTC2021-Spring)*, 2021, pp. 1-7, doi: 10.1109/VTC2021-Spring51267.2021.9448644.
- Y. Lu, M. Koivisto, J. Talvitie, E. Rastorgueva-Foi, T. Levanen, M. Valkama and E. Simona Lohan, ”**Joint Positioning and Tracking via NR Sidelink in 5G-Empowered Industrial IoT: Releasing the Potential of V2X Technology**”, IEEE Vehicular Technology Magazine, under review.

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