5G-MOBIX German Trial Site Results and Lessons learnt on 5G for CAM

5G for CAM solutions

Adaptive QoS solution for Vehicular Media Communications
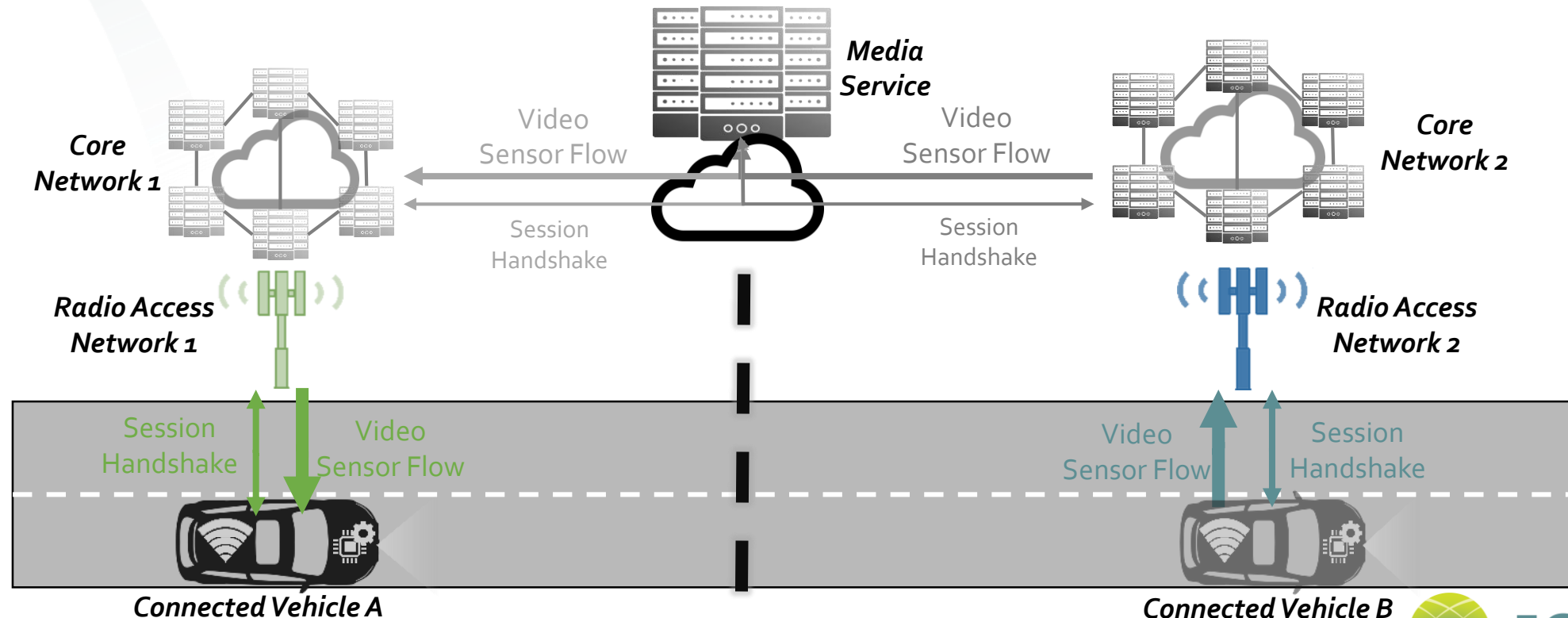
Dr. Angel Martin
San Sebastian, 22 June 2022

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Agenda

- Motivation
    - CCAM Scenario
    - Issues
- Solution
    - Standards
    - Implementation
- Results
    - Testbed Setup
    - Validation
- Conclusions
    - Existing limitations
    - Future Work

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Motivation: Scenario

- Vehicles has lots of sensors

- Vehicles gets connectivity

- Vehicles can act as external sensors for a wider understanding of the environment [2]
  - New CCAM services and applications
  - Supported by MEC infrastructures for quick handshake of local sessions [4]

[2] G. Velez, A. Martín, G. Pastor, and E. Mutafungwa, "5g beyond 3gpp release 15 for connected automated mobility in cross-border contexts," Sensors, vol. 20, no. 22, p. 6622, 2020
[4] G. Velez, J. Perez, and A. Martin, "5g mec-enabled vehicle discovery service for streaming-based cam applications," Multimedia Tools and Applications, Sep 2021. https://doi.org/10.1007/s11042-021-11421-x

Motivation: Issues

- Regulatory
  - Trust
    - MEC handshake and Negotiation
  - Privacy
    - Encryption

- Technical
  - RAN of Cellular Networks are tunned for content consumption
    - Download is faster than Upload
    - QoS is highly dynamic [8]
      - Concurrency
      - Geographical distance from Base Station
  - *Peer communications are limited*
    - NATs
    - Different domains for each peer
    - MEC accessible from different Networks
  - *Quick bootstrapping*
    - Session establishment & Handshake
    - Changes IP addresses (roaming)
    - Video encoding setup
      - Buffering & GOP size

Webinar 5G-MOBIX German Trial Site's results and lessons learnt on 5G for CAM

[8] L. Cominardi, L. M. Contreras, C. J. Bernardos, and I. Berberana, "Understanding qos applicability in 5g transport networks," in 2018 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), 2018, pp. 1–5

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Solution: Standards

- WebRTC Video Streaming for Peer Communications
  - Video/Audio + Data Channel – SRTP + SCTP
  - QoS Monitored – SRTCP https://www.w3.org/TR/webrtc-stats/
  - E2E Encrypted + Handshake – DTLS
  - NAT Transversal – STUN + ICE
  - Real-time – SRTP + UDP
  - Rooms for multicast / multi-party
  - Format Negotiation – ICE

- H.264 AVC encoder config for prompt processing
  - Bitrate
  - Framerate & GOP
    - B-frames means reorder
    - Big GOP size means discrete jump in
  - Industry universal HW acceleration and support

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Solution: QoS Adaptive Implementation

- 3 Levels
  - Start from worst fidelity
    - Boost Start time
  - Step-by-step
    - Avoid quality leaps
  - Computer Vision
    - Favour Resolution
    - Damage Framerate
    - Keep quick access for GOP
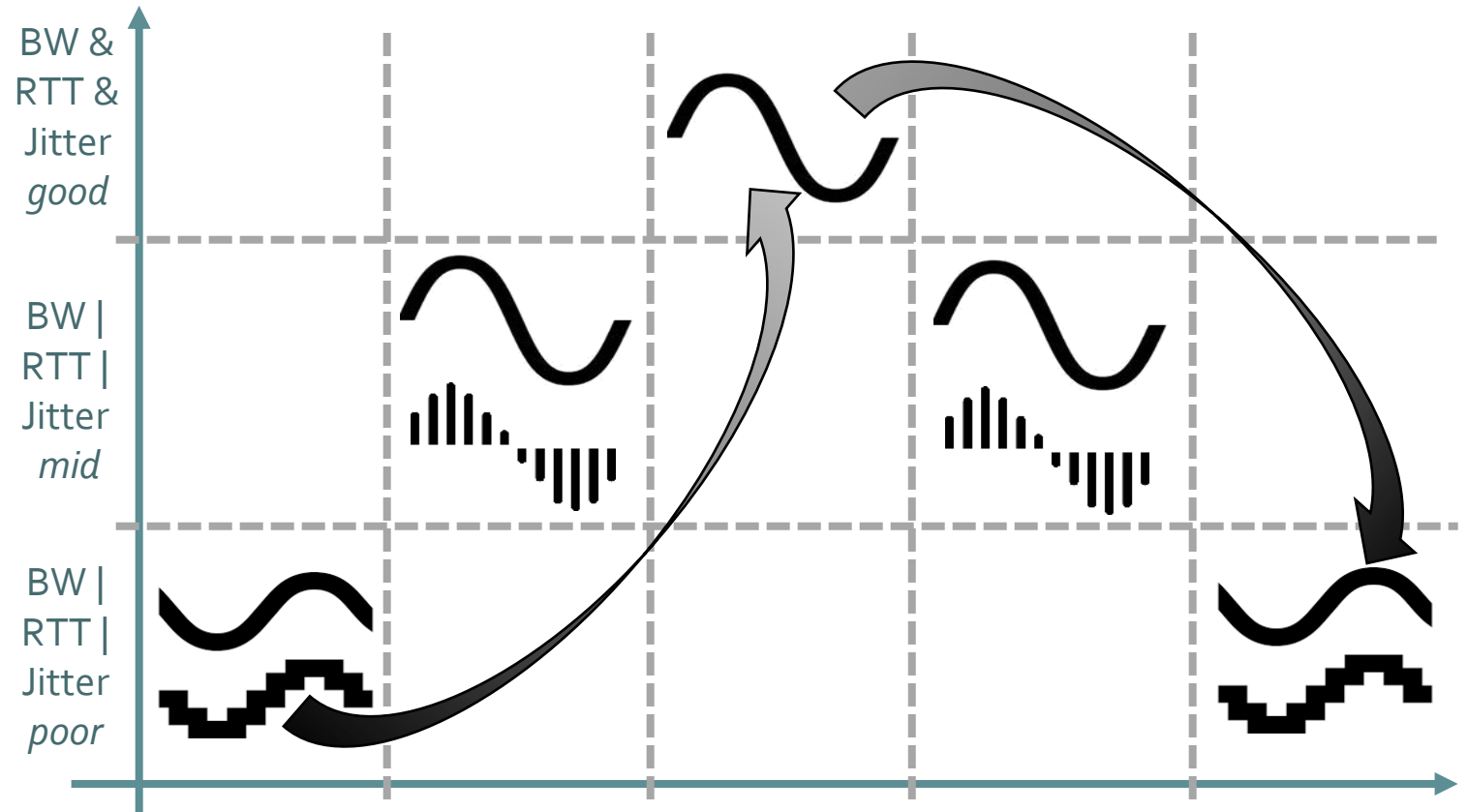- Parameters
  - Reporting Period
  - Resolution
  - Framerate & GOP size
- Upgrade & Downgrade
  - Mid divider coefficient
  - Poor divider coefficient

Webinar 5G-MOBIX German Trial Site's results and lessons learnt on 5G for CAM

[4] A.Martin, G.Velez, Z.Fernandez, J.Perez, M.Garcia, "Adaptive QoS of WebRTC for Vehicular Media Communications," in 2022 IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB), June 2022, pp. 1–5

Results: Scenarios

Server for handshake
Gateway for Traffic

Server for handshake
No Gateway – Direct communication

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Results: Validation

- RTCP Report Period
  - The more frequent the faster reaction (500ms – 1s)

- QoS levels (3)
  - Favour quick reaction
  - Avoid ping-pong effects

- Setup comparison
  - Gateways are not transparent adding reaction latencies

- Encoding and Streaming Pipelines do not react immediately
  - ~2s to sense issues from RTCP metrics
  - ~0,7s Receiver Reaction time

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Results: Conclusions

- Cellular Networks are not tuned for Vehicular communications of video sensor flows

- Applications need to deal with changeable conditions of wireless networks

- Visibility on networking issues is myopic as far as gateways or network functions come into play

- Canonical MEC brings limitations for multi-carrier sessions

- QoS techniques are crucial for boosting an enforcing live communications

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Thank you

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