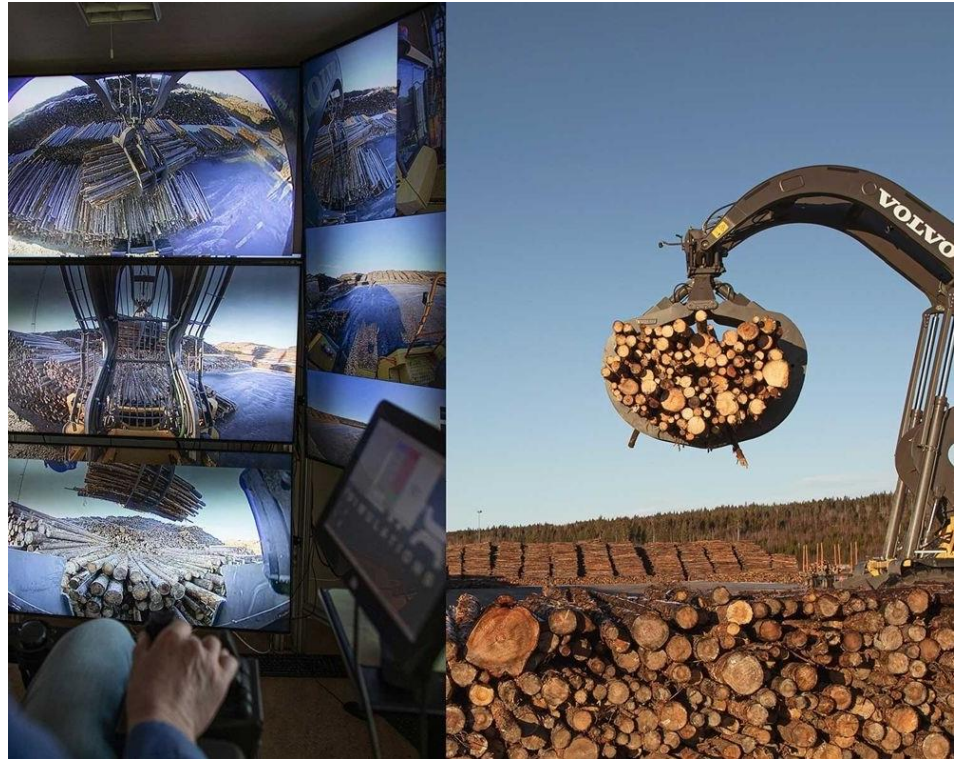# UX and QoE aspects of remote control operations using a laboratory platform (work in progress):

Shirin Rafiei, Kjell Brunnström, Chetna Singhal
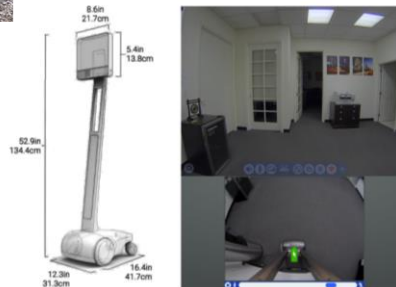RISE Research Institutes of Sweden AB

RISE

Introduction

- Telepresence / Remote operating

- Augmented Telepresence

- Needs
  - Improve personal safety
  - Improve working environment

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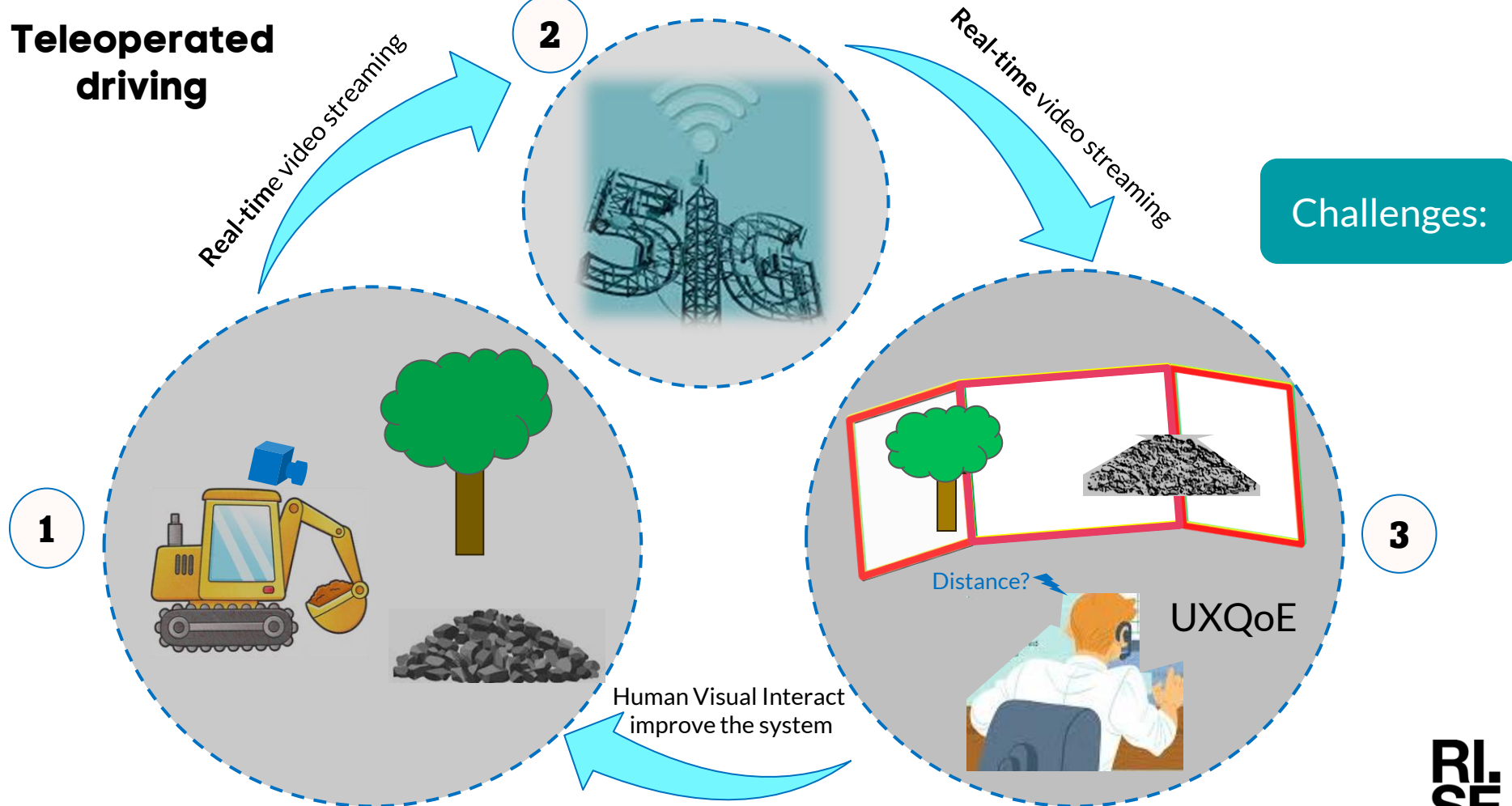
Enabled Teleoperated driving in industries

- Mine
- Robotics
- Constructions equipment
- Logging industries
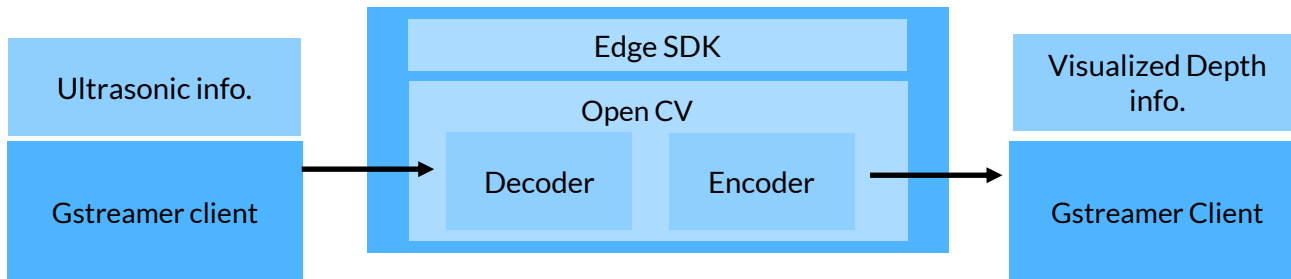- Cargo ships
- Remote airports

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Teleoperated driving

Real-time video streaming

②

Real-time video streaming

Challenges:

①

③

Distance?

UXQoE

Human Visual Interact improve the system

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RI.SE
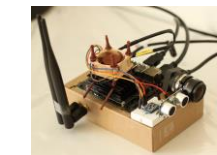
Test set up

HMD

2D conventional screen

Live Video Streaming

Ultra Latency≤200

gstreamer

Ultrasonic info.	Edge SDK	Visualized Depth info.
Gstreamer client	Open CV	Gstreamer Client
	Decoder Encoder	

RI.
SE

Test set up

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RI. SE

Latency measurement

Sender

Ultrasonic + camera

GPU

Truck controller

Access point

Receiver

2D conventional Display

140 msec

Method1:

Method2:

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RI.
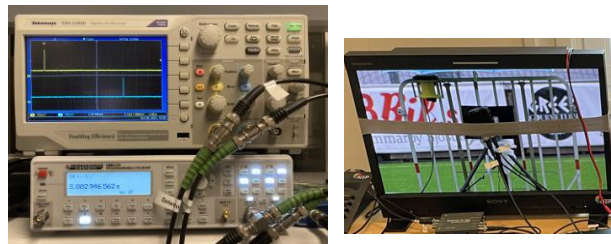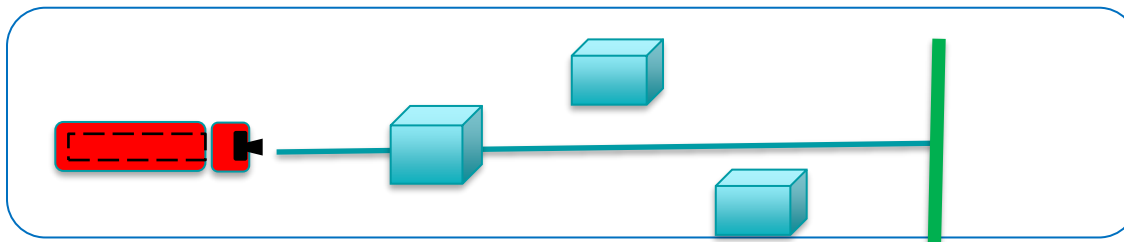SE
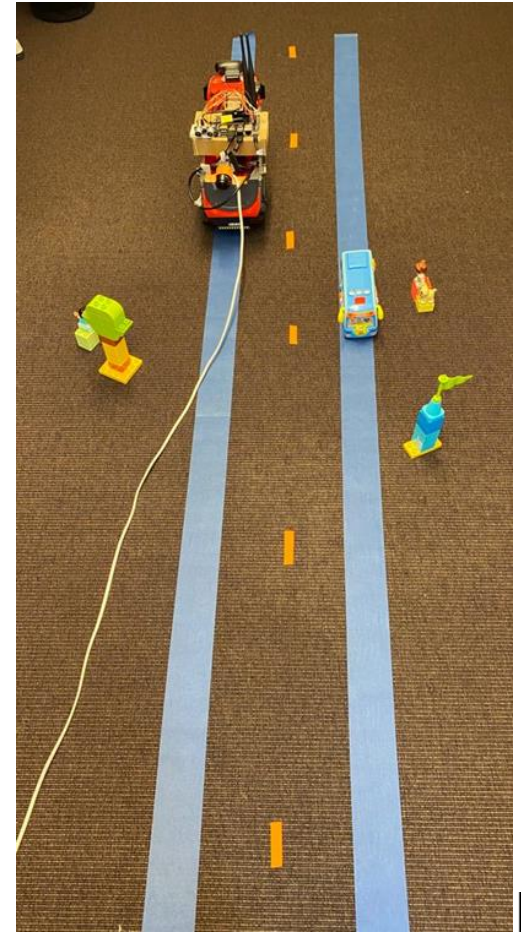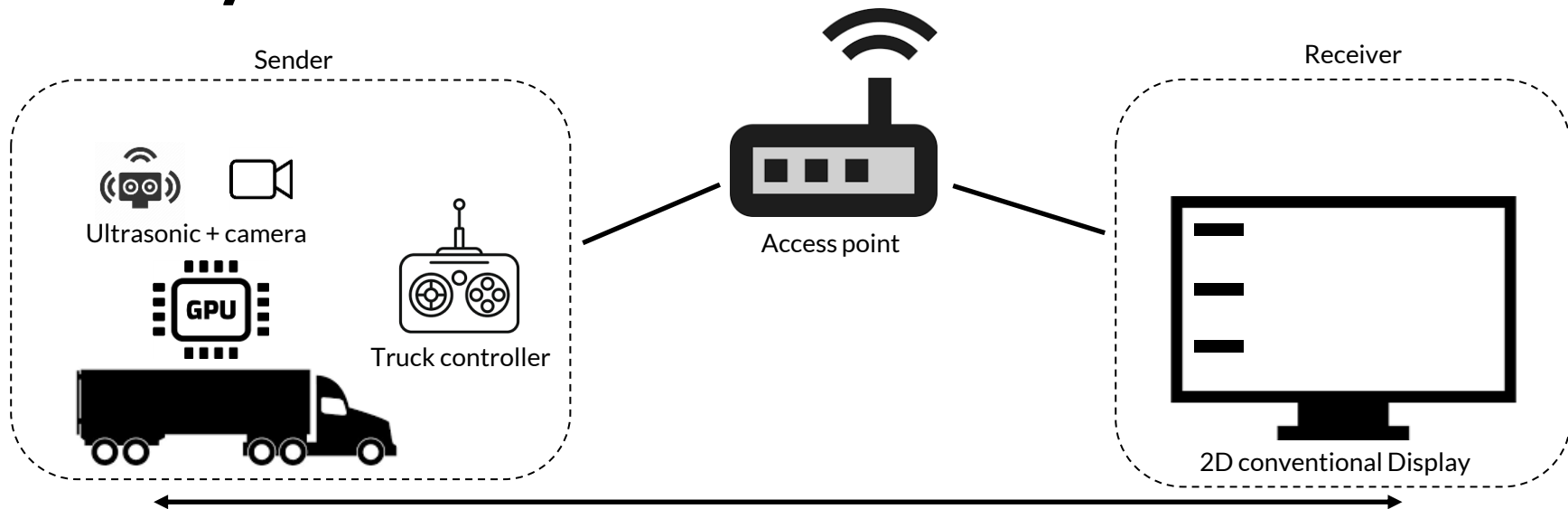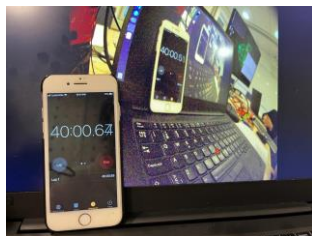
Pilot test. impairments and test environment:

Aim : Depth perception in Teleoperated driving

- Video Quality:
  - Resolutions: 720*640 – 640*480 – 480*320
  - Frame rate: 7fps – 30fps

- Field of view: 120 degree – 90 degree

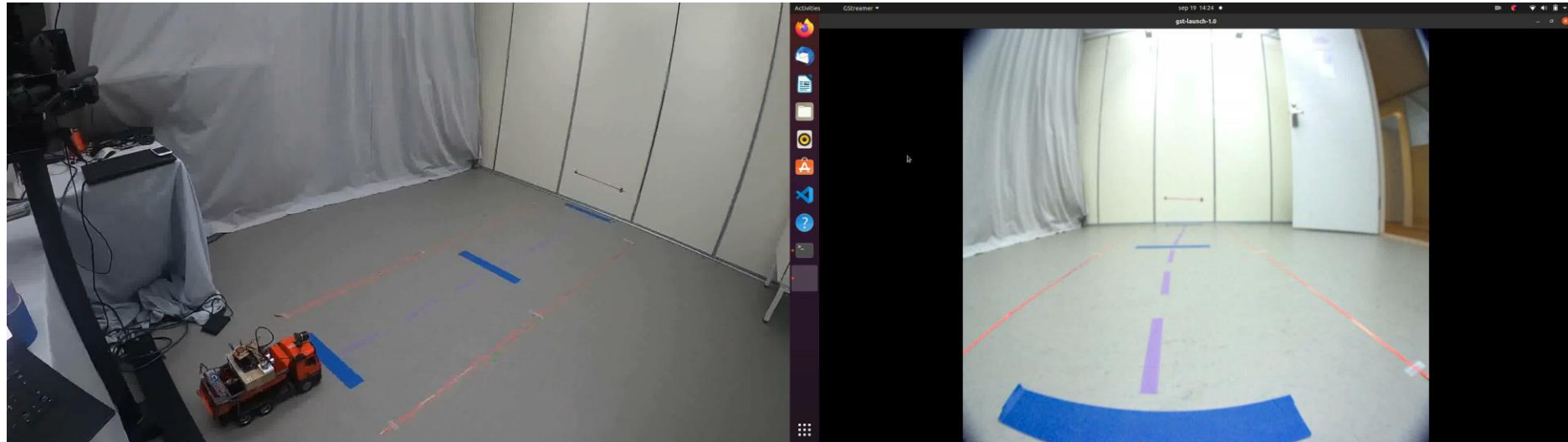- Latency: base latency (140 msec) + intermediate latency (300msec) + long latency (500msec)

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# Remote control applications: Lab platform

- Lab platform developed for remote control
- Platform tech
  - Based on NVIDIA Jetson Nano
  - Gstreamer video streaming (latency about 100 ms)
  - Radio controlled miniature truck
- Experiment plan
  - Study parameters: Field of View, Video Quality, Latency and Display type
  - Pilot study almost ready to go (4-8 participants)
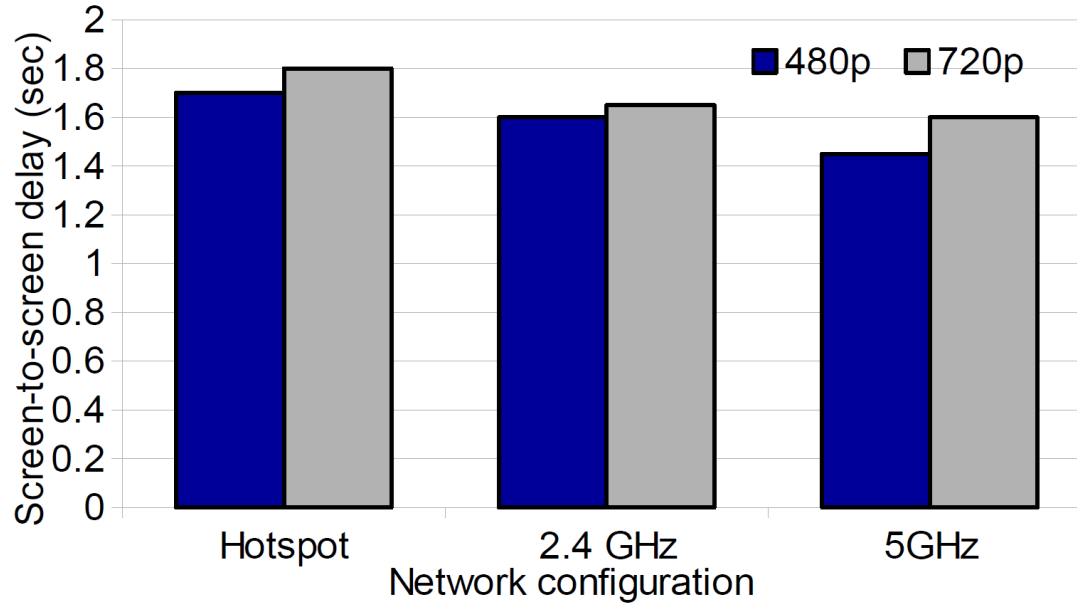 - Main study early 2023

RI.SE
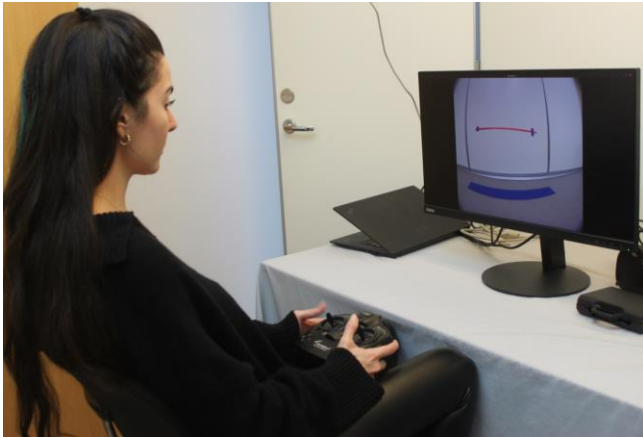
Remote control applications: Lab platform video example

Latency results:

Resolution: 640*480

Resolution: 480*320

Latency results:
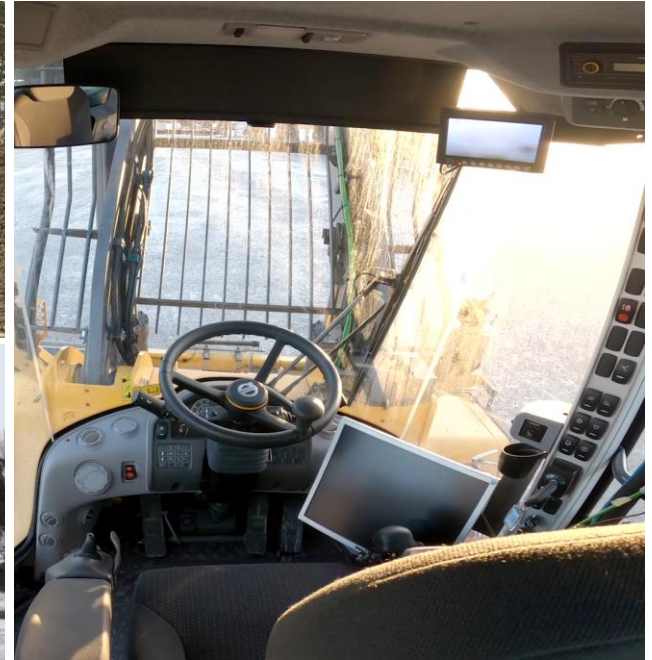
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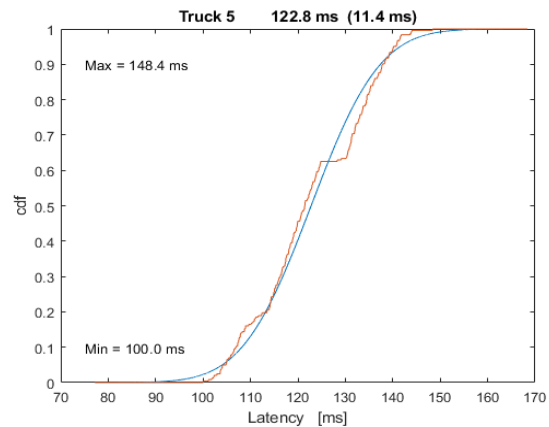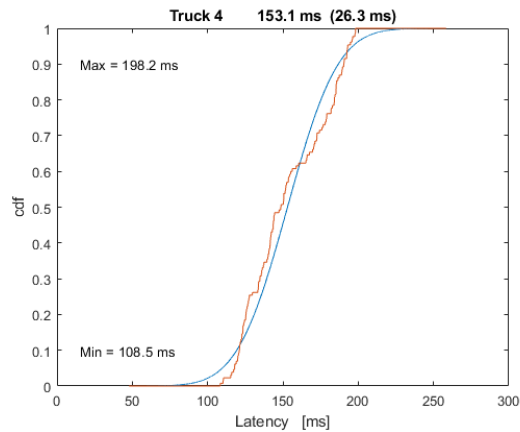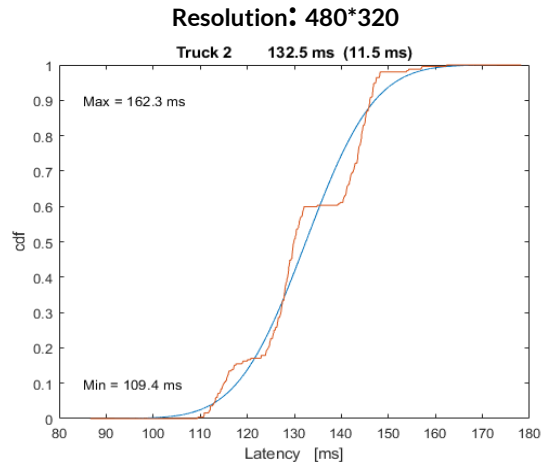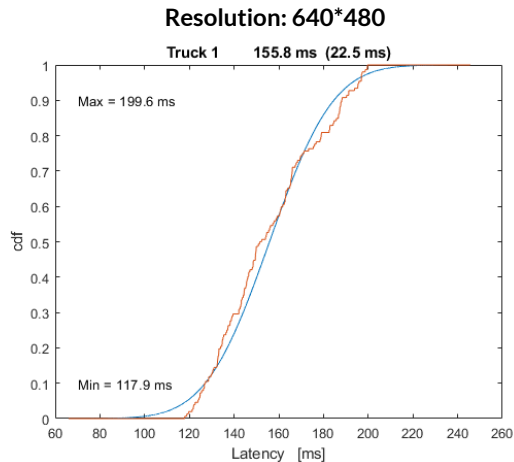
On-going work:
Collaboration with Volvo CE: Remote control of heavy machines

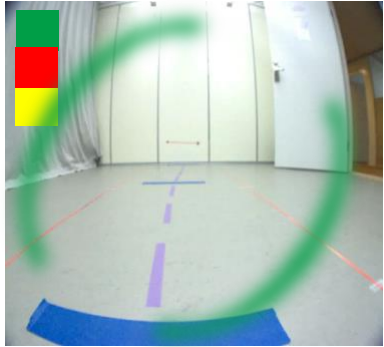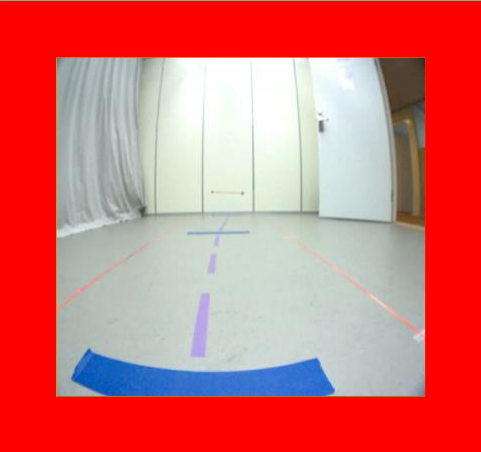Investigating video manipulating impacts on drivers performance

Plan developed for a field test
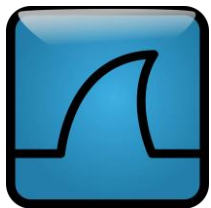
Study to be performed in early 2023

Study latency impacts

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Augmentations helpfulness

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Other consideration

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Wire-shark

2

The Various Types Of Traffic That QoS Measures

Bandwidth

Delay

Loss

Jitter

Real-time video streaming

Real-time video streaming

1

Future work

3

Human Visual Interact improve the system

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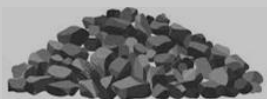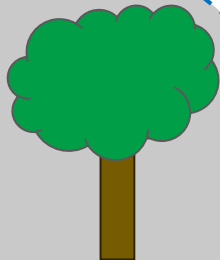
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