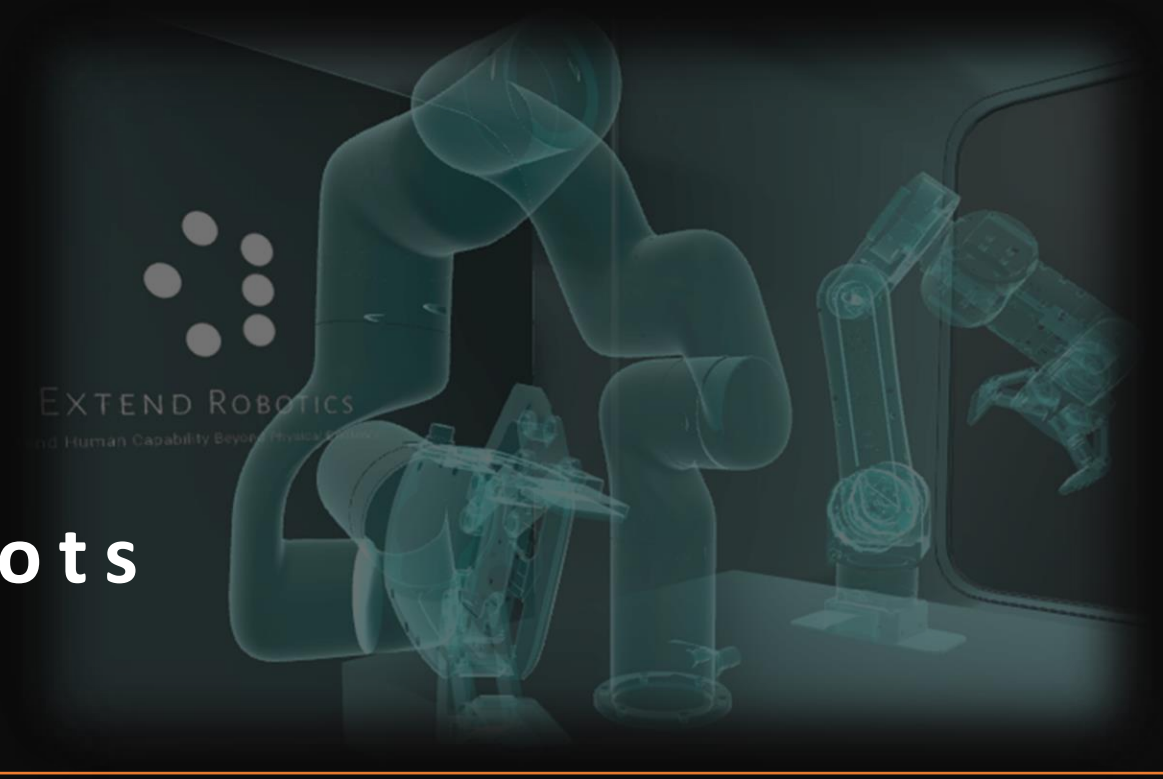
Democratise Use of Robots at Scale

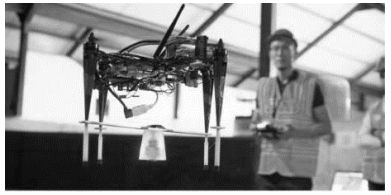


Robotics Software Company from Imperial Collage London, UK

EXTEND ROBOTICS

About Extend Robotics

Dr Chang Liu
CEO, Chief Designer
Research associate in **Imperial College London** and **University of Southampton**,
Head of robotics at **Inkonova**



- Our Believe in Extending Human Capabilities Beyond Physical Presence.
- We develop immersive Human-robot Interface Software for non-robotic expert to intuitively teleoperate and program robots from remote locations.
- We're a UK startup founded in 2019. Technical founders are PostDoc, PhD of Imperial College London, Principal Engineer in nuclear, defense robotics, Commercial leadership from Telecom and Oil&Gas industries.

2020 → **2021**

Originated from Imperial College London

IEEE SPECTRUM
Remote Birthday celebration in pandemic (London – Reading)

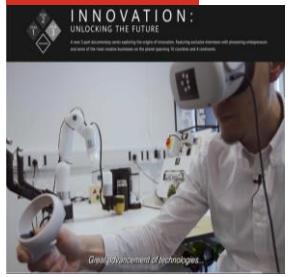
Robotics & Innovation
Virtual reality controlled robotic arm pulls pint in Extend Robotics demo

UKTN
British startup launches human-like VR-controlled robotic arm

UKRI Innovate UK
Industrial Strategy Challenge (respond to Global Disruption)

CGTN
Rise of the Robots? What to expect from tech in 2021
Updated 2021.01.01 23:28 GMT+8
Jemima Walker

The Economist
HUAWEI

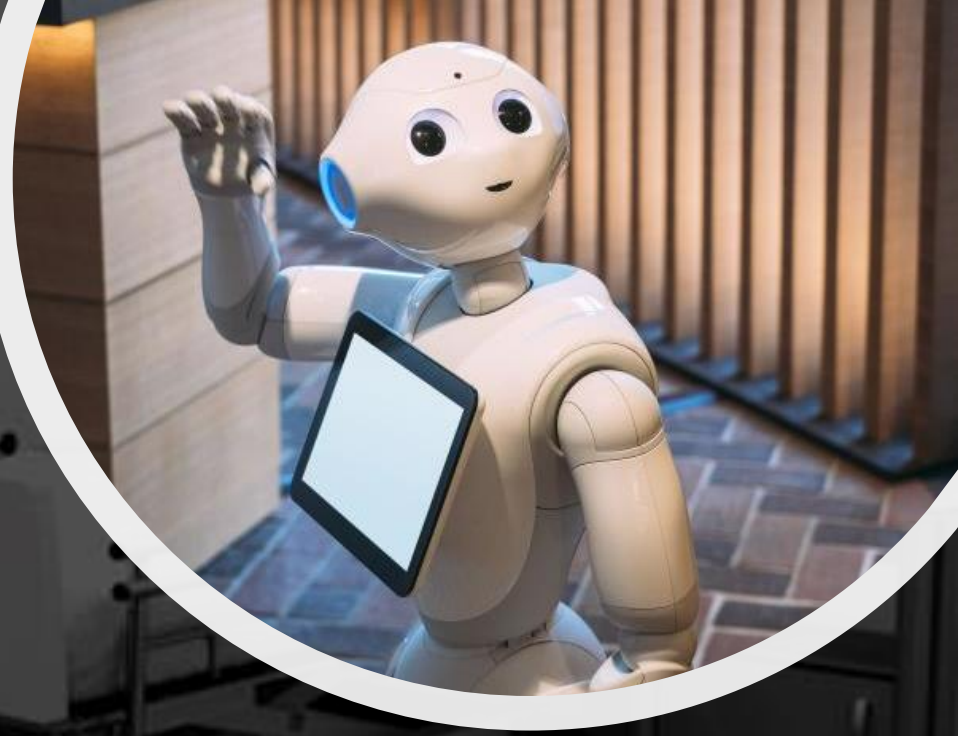


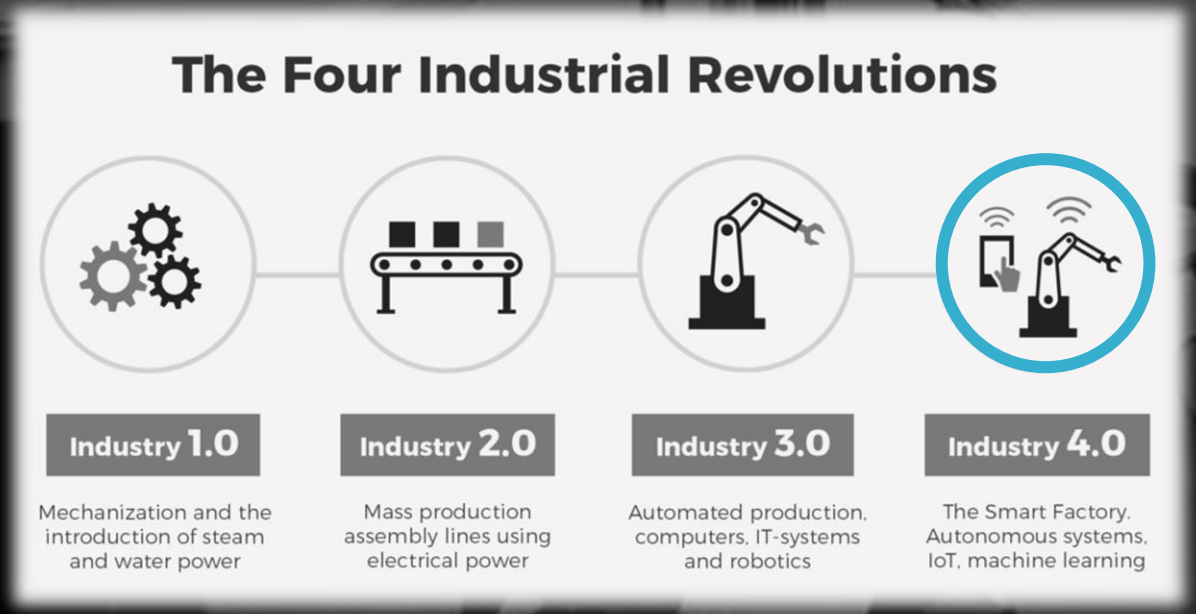
HORIZON 2020
VOJEXT

Visualization of **Point cloud VR** for **construction**

Imperial College London White City Incubator
CATAPULT Digital
CATAPULT Satellite Applications
Britbots.
UKRI Innovate UK

Service robot in the forefront of Industry 4.0





Sales of **service robotics** has exceeded $17 billion in 2019 and is forecast to reach $40bn in 2023.
(what is service robot, what is Industry 4.0) (**link**, **link**, **link**)

Service Robotics in Industry 4.0

Voice from user (Video) (click picture below for more videos)

Real-world contingent Situations

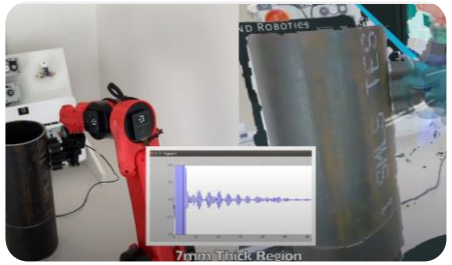
- Intelligent tasks
- In Dynamic environments
- With advanced connectivity

Healthcare

Medical Assistance

- Closed suction tracheal tube change (Innovate UK)

Industrial



Inspection & maintenance

- Nuclear waste handling
- Wind turbine cabinet
- Valve leak detection
- NDE contact-based inspection
- Train/railway inspection

Logistic

Loading & unloading

- Medical supply transfer
- Drone payload handling
- Last mile delivery
- Warehouse handling

Service

Hospitality Service

- Bartender drink filling
- Goods stacking
- Kitchen work
- Care home robot remote access

Issues of Service Robot in Industry 4.0

Hard & Expensive to Setup

- Designed for Experts: Complicated, slow and unintuitive to operate by normal people (link, link)
- Expensive software to setup by experts
- A few times more expensive than robot hardware (link, link)

Full Automation is Unreliable in Real-world

- Waste more time fixing robot, instead of saving time (link)
- Current adoption is limited to repetitive and simple tasks (link)
- Hard to deal with intelligent tasks in dynamic environments (link)

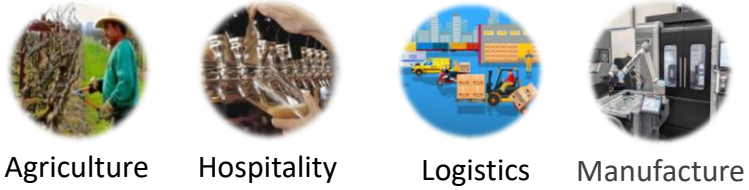
Safer, Faster and Cheaper Physical Tasks **Working Remotely**

- Liberate human from harsh/hazardous environment
  - Access to difficult / dangerous workspace
  - Reduce operation cost (facility downtime, PPE)

Space operation | Nuclear handling | High voltage maintenance | Contagion care | Infectious lab experiment | Construction

Replace human presence

- Break the geographical limitation
  - Save travel time and cost
  - Instant access to global labor and expertise (wage difference, reginal labor shortage)



Agriculture | Hospitality | Logistics | Manufacture

Utilize best-fit human resource without geographical limitation

EXTEND ROBOTICS

Fundamentally Revolutionise the Way People Interact with Robots

To enable everyone to work remotely on physical tasks

Traditional: Physical and professional, 2D equipment for Experts (Expensive)

Future: Virtual and gamified, 3D interface for Everyone (Affordable)

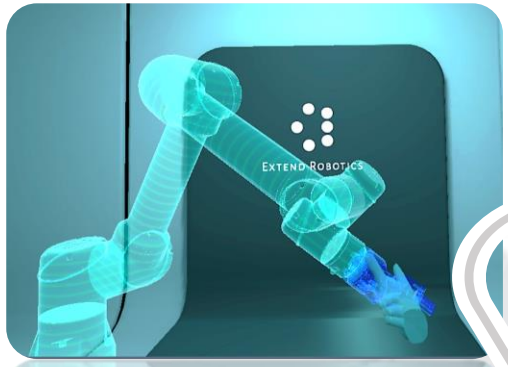
Next Gen VR Interface for Remote Robots
Patent Pending

Video Link

- Immersive 3D Perception
- Intuitive Gesture Control
- Semi-Automation
- Consumer Hardware

Extend AMAS Product

Advanced Mechanics Assistance System: Remote interface upgrade to existing commercial 3rd party robotic solutions



VR application running on consumer PC and consumer VR equipment

Extend AMAS App

VR-based human-robot **interface** software

SenseKits/RoboKit

Peripheral hardware connected to **3rd party robots,** for sensing and control

Network

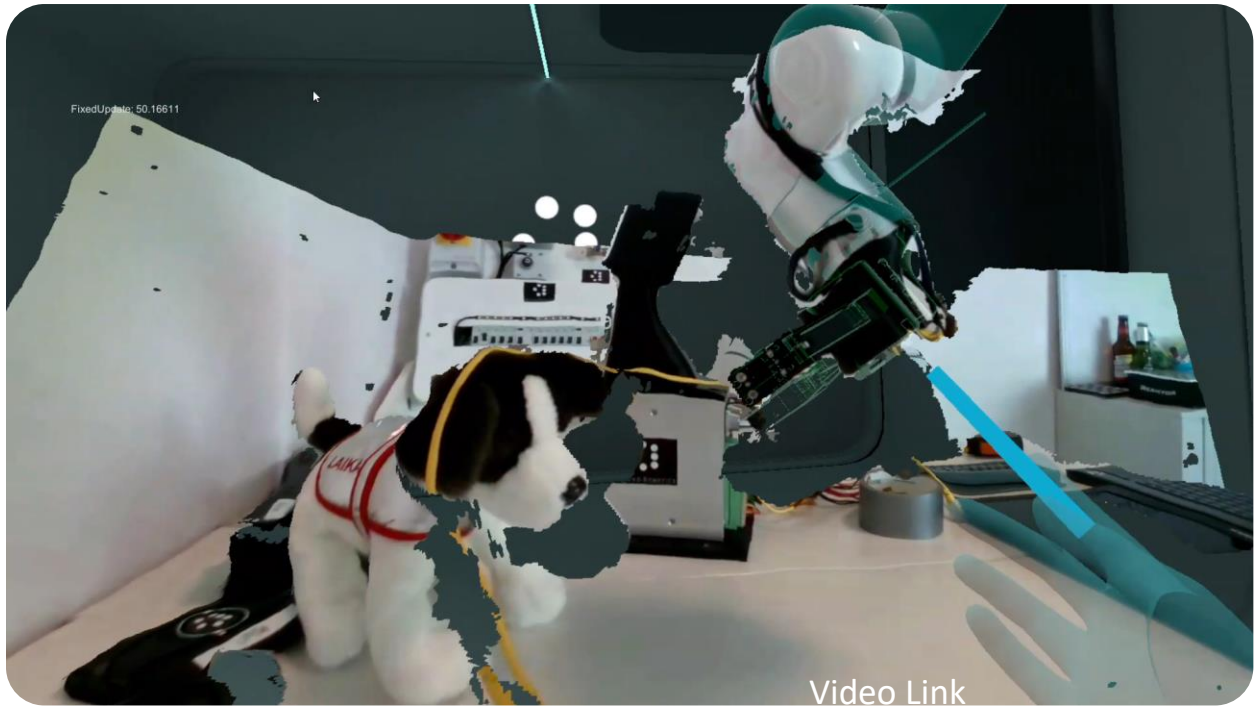
❖ **Imitation Engine** (future)

Cloud infrastructure with data-driven **AI** for fully automation

EXTEND ROBOTICS

World’s Best Volumetric Telepresence & Interactive Digital Twin

Human-Robot Interface Software for ultimate **immersion** and **intuitiveness**



ROS unity oculus

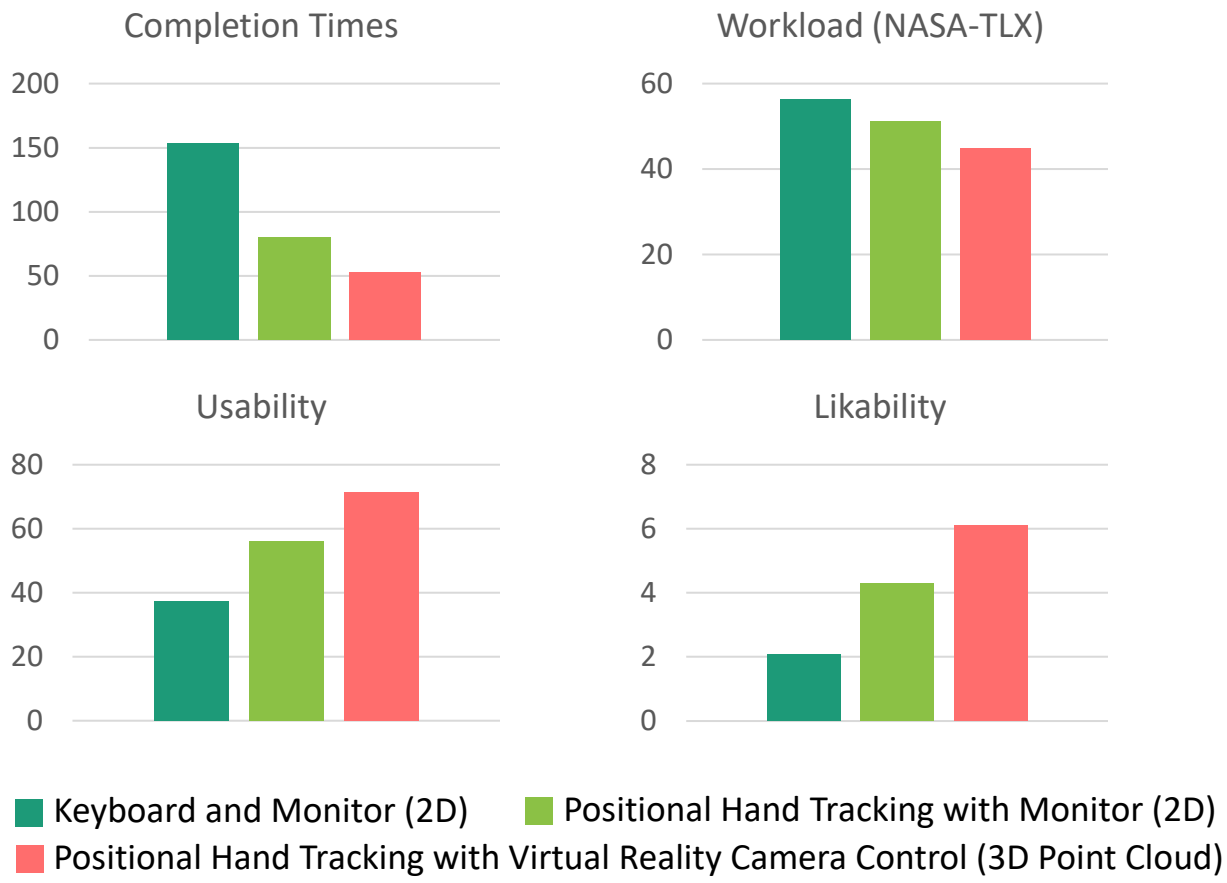
- Accurate Geometry perception
- 6 Degree of Freedom (DoF) Flexible viewing angle
- No motion sickness
- Digital twin gesture control
- Integrated semi automation

More demo videos

EXTEND ROBOTICS

AMAS: Advanced Mechanics Assistance System

Why VR? -Comparison between teleoperation technologies



VR-based 3D perception and intuitive positional control

- Faster completion times
- Lower cognitive workload
- Higher usability and user satisfaction

Less accidents

Higher efficiency

<Comparing Robot Grasping Teleoperation across Desktop and Virtual Reality with ROS Reality> -- Humans To Robots Lab, Brown University

AMAS: Advanced Mechanics Assistance System

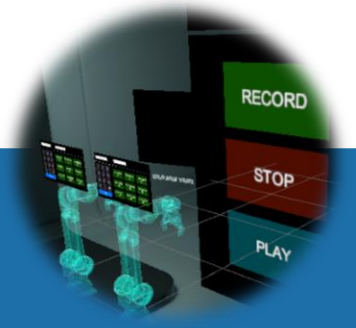
Human-Robot Interface Combines **Real-time Volumetric Telepresence** with **Interactive Digital Twin**

Volumetric Telepresence

- 3D holographic mesh from HD Point Cloud streaming
- Low latency real-time (150 ms)
- Accurate sense of depth
- Flexible view-points
- 0 motion sickness
- High network tolerance (from 4 mbps)

Interactive Digital Twin

- Low latency real-time control (50ms)
- Fully Interactable Digital Twin robotic arm
- Intuitive user Gesture input 20 DoF (head, 2 arms, 2 gripers)
- Multi-robot & multi-operator collaborative control



Semi-Automation

- Multi-session motion recording and replay
- Non-expert operation
- One click export motion record
- TCP APIs for client app to trigger replay

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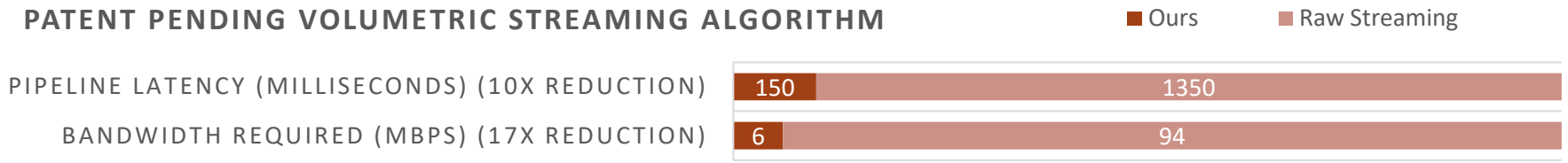
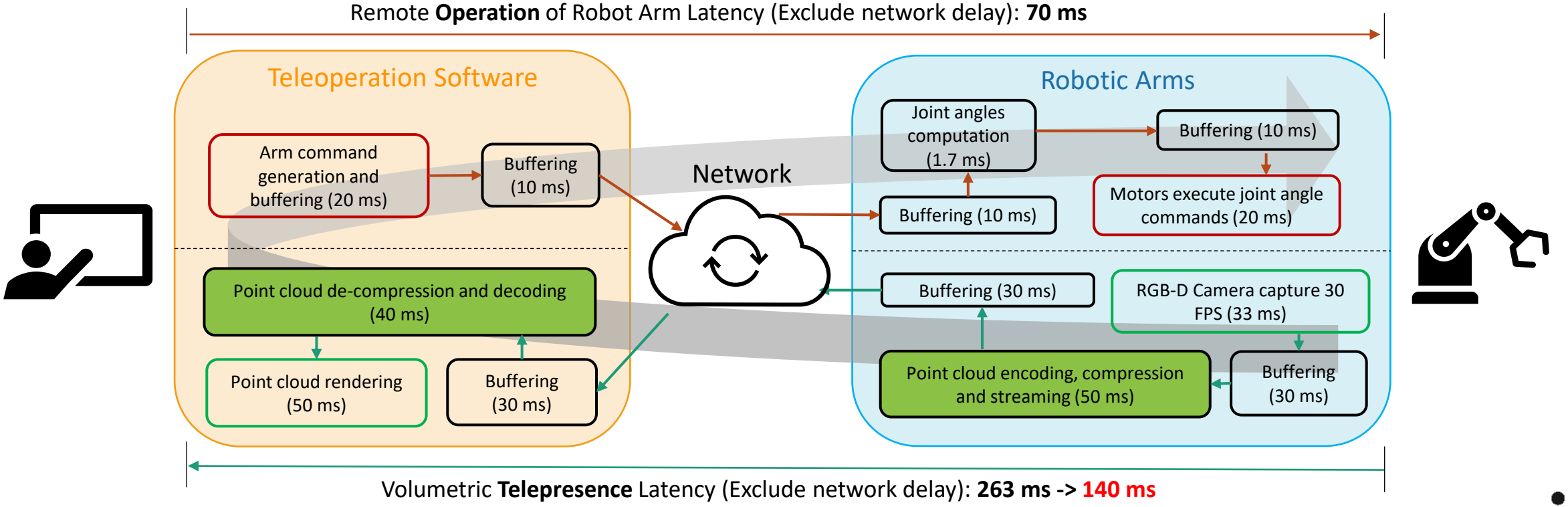
AMAS: Ultra low latency for real time operation



VOJEXT
Value of Joint Experimentation in Digital Technologies for Manufacturing and Construction



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Thank you!

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