VR/AR/MR in Telepresence Robot Empowered Smart Lab

TRESL(MR) Team

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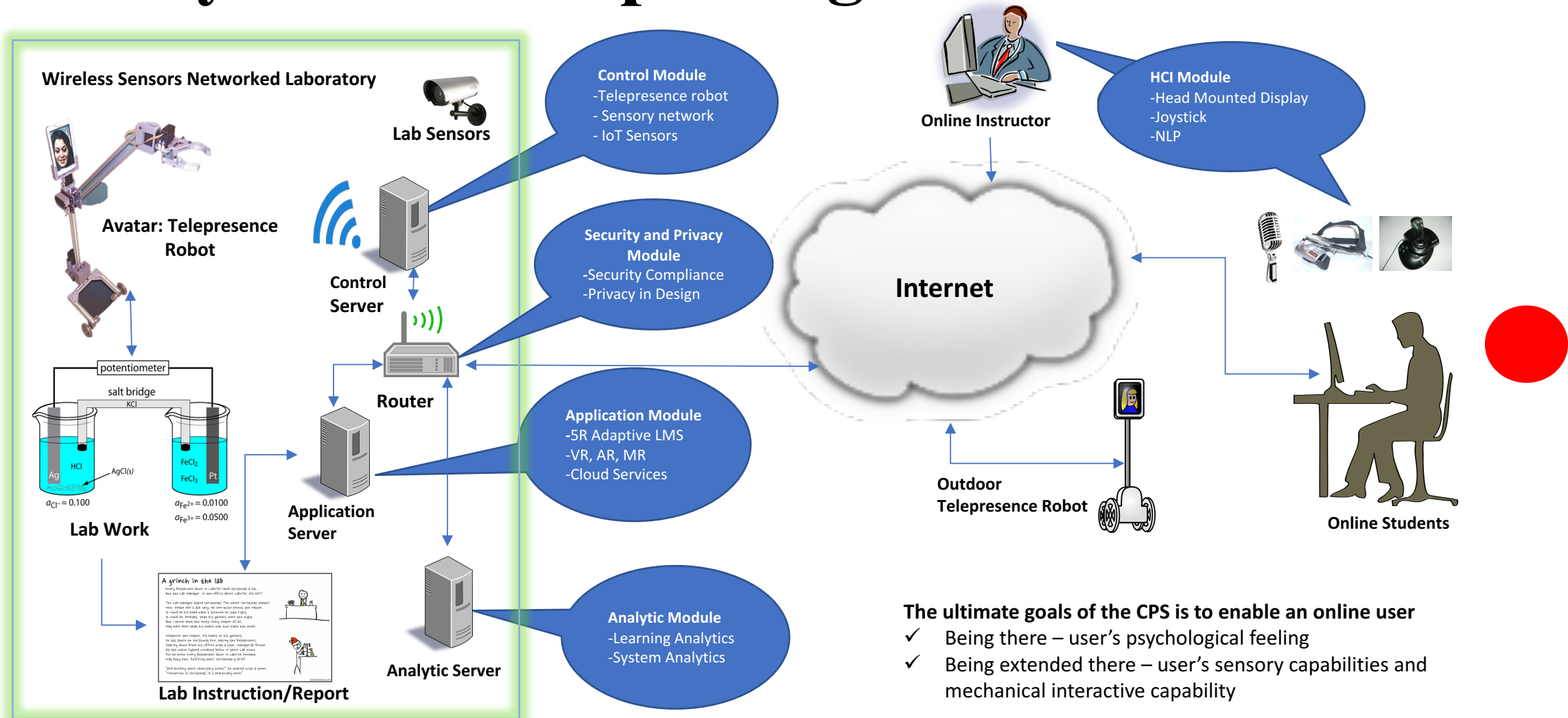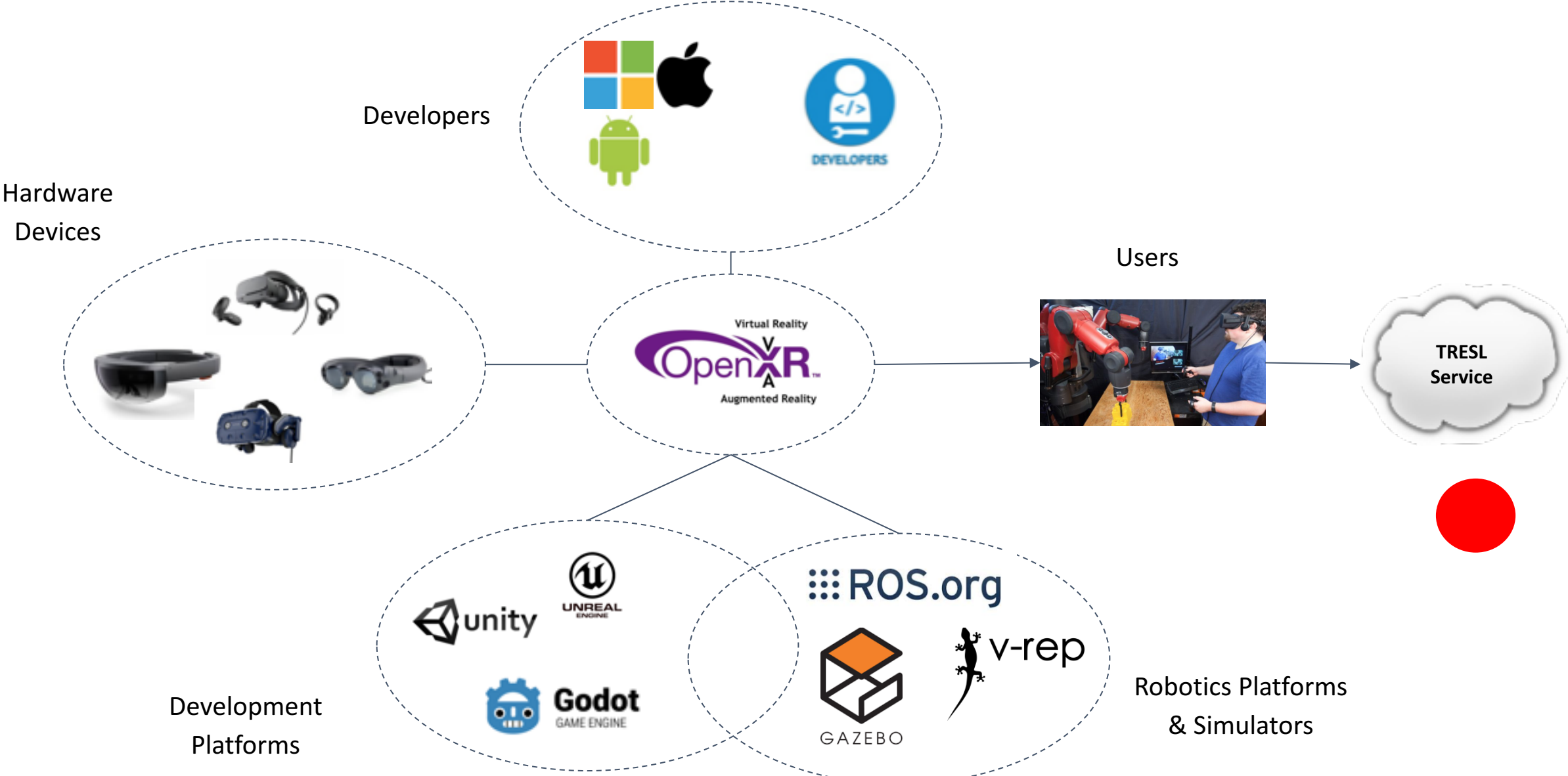
RealTwin   **GaiaNet**

The System Ultimate Goals

- "**Be There**", i.e. experience as if they were presented in the remote lab, and

- " **Act There**", i.e. extend their interactive capabilities, including sensing, communicating, and mechanical capabilities to do lab work and to interact with the lab environment.
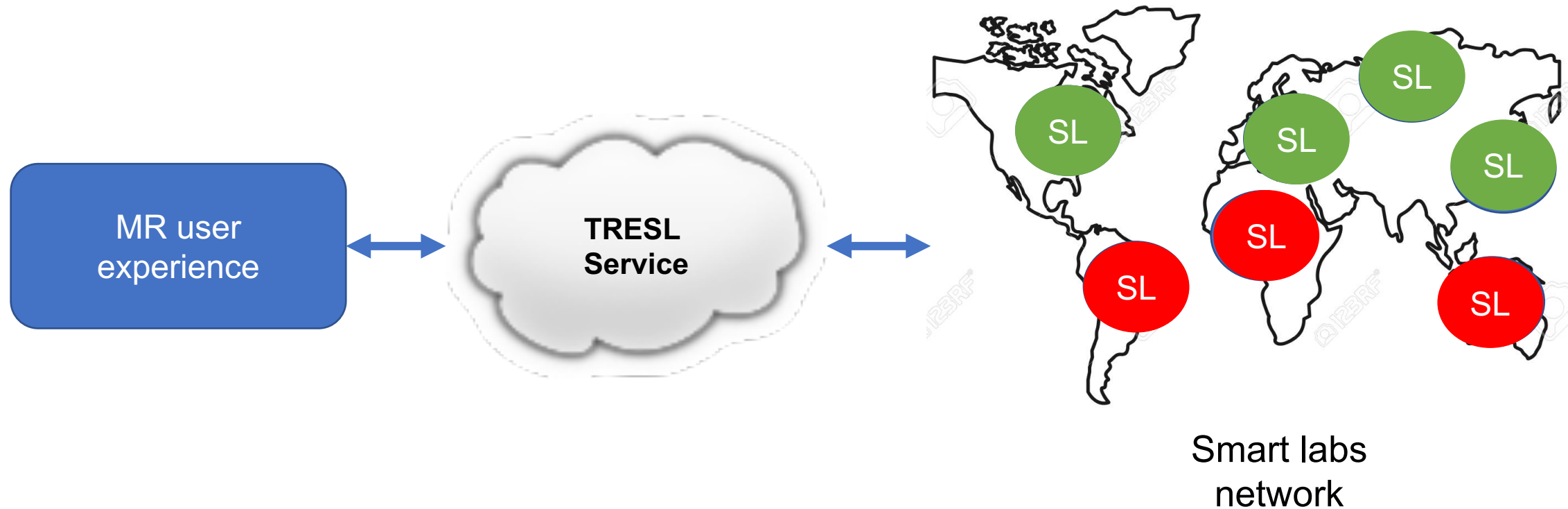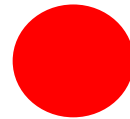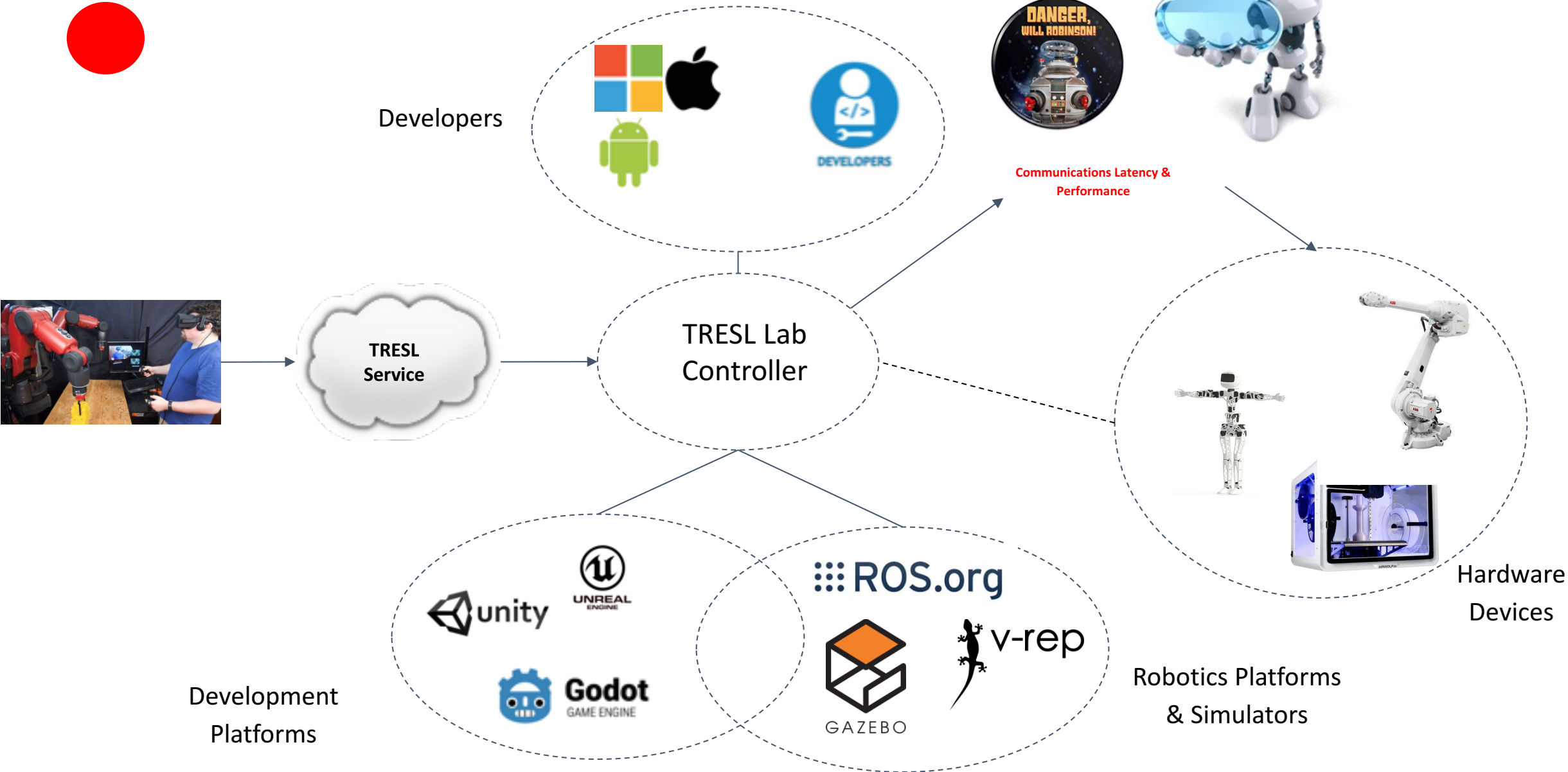
The System Concept Diagram

Wireless Sensors Networked Laboratory

Avatar: Telepresence Robot

potentiometer

salt bridge

KCl

$a_{Cl^-} = 0.100$

$a_{Fe^{2+}} = 0.0100$
$a_{Fe^{3+}} = 0.0500$

Lab Work

Lab Sensors

Control Server

Router

Application Server

Analytic Server

Lab Instruction/Report

Control Module
-Telepresence robot
- Sensory network
- IoT Sensors

Security and Privacy Module
-Security Compliance
-Privacy in Design

Application Module
-5R Adaptive LMS
-VR, AR, MR
-Cloud Services

Analytic Module
-Learning Analytics
-System Analytics

Internet

Online Instructor

HCI Module
-Head Mounted Display
-Joystick
-NLP

Outdoor Telepresence Robot

Online Students

The ultimate goals of the CPS is to enable an online user
- ✓ Being there – user's psychological feeling
- ✓ Being extended there – user's sensory capabilities and mechanical interactive capability

How It Works: TRESL Remote User side

Developers

Hardware Devices

Users

TRESL Service

OpenXR — Virtual Reality / Augmented Reality

Development Platforms

Robotics Platforms & Simulators

Feasibility test against the Smart labs network

MR user experience

TRESL Service

SL SL SL SL SL SL SL

Smart labs network

Ready to conduct actual experiment

How It Works: Smart Lab side

Developers

Cloud Robotics

Communications Latency & Performance

TRESL Service

TRESL Lab Controller

Hardware Devices

Development Platforms

Robotics Platforms & Simulators

Value proposition

- **Re-use** and **sharing** of **simulations**, **digital assets**, **equipment**, **real estate**

- **Reduction** of **capital** and **operational expenses**

- Crowdsourcing: Pooling **civic/academic objectives** and **resources**, **decentralized collaboration** capabilities (active matchmaking)

- **Optimized processes** complied to **universal standards** & **best practices**
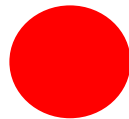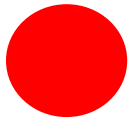
Scope and Interests

- **VR**, **AR** and **MR** Theory and Development
- HCI Interface Design in **HiLCPS**
- HCI in Robot **Telepresence** and **Teleoperation**
- HCI in **Remote Real-Time Control System**
- HCI Security and Privacy
- **Visualization** and **Simulation** of Real-Time Control Systems
- Sensors and **Sensory Systems** in HiLCPS
- **Testing** and **validation** of HCI in HiLCPS applications
- **Standards**, **protocols**, and **methodologies** for HiLCPS and IoT
- **Context-aware sensing** and **computing** in IoT-based HiLCPS
- HiLCPS and wearable devices tracking
- User experience in HCI
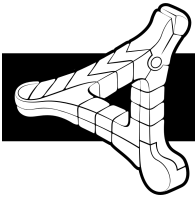
BACKFEED contribution

- Lab reputation = # of experiments conducted weighted by user evaluation

- User evaluation = Rating both "Be there" and "Act there" experience

- Tokens are rewards for .