5G Physiotherapist Robot

Physiobot5G

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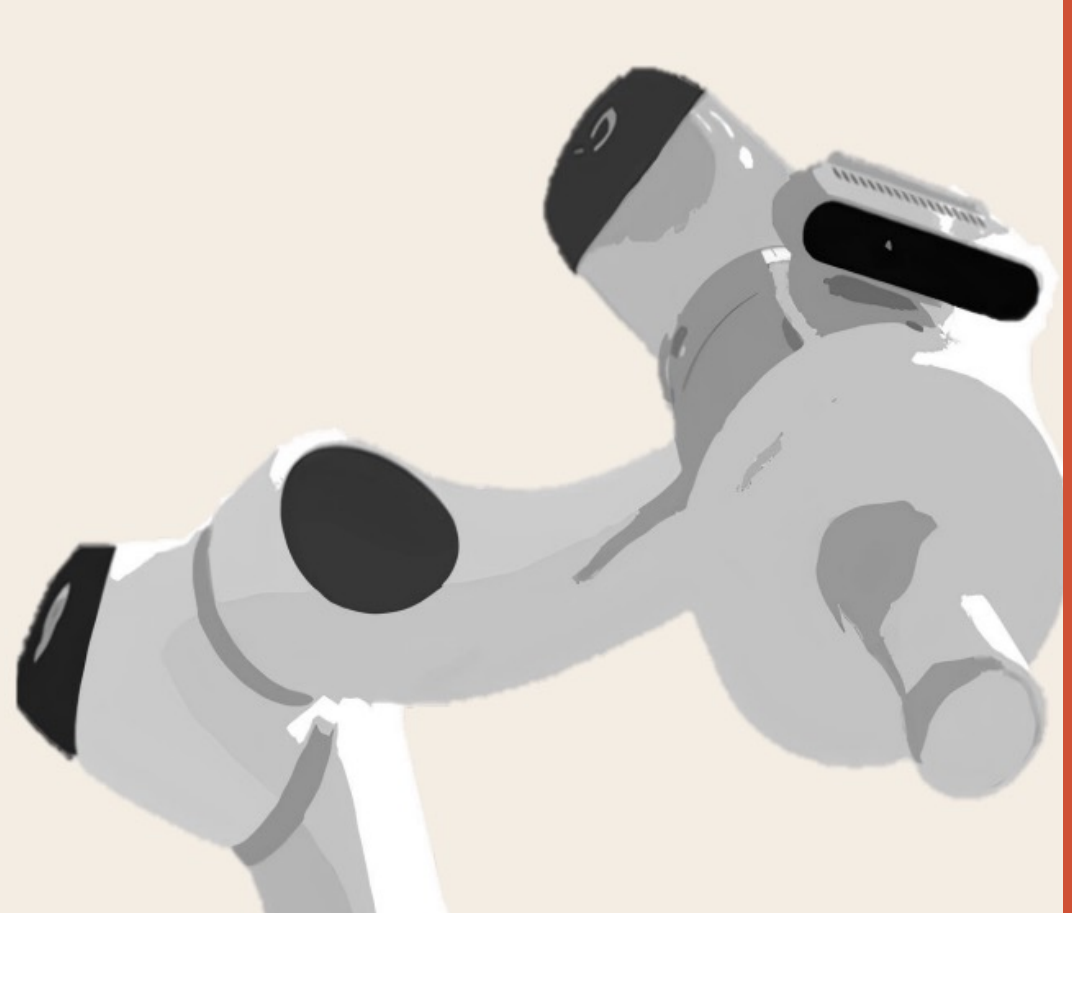
Canonical Robots

Review meeting



Experiment description

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CONCEPT AND OBJECTIVES

- **Canonical Robots** has developed the **Physiobot** that is a **robotic physiotherapy system solution**.
- The system works with a **3D model of the patient**. This allows to **decouple the treatment application from its definition**.
- We want to go a step further **and allow** also the **teleoperation of the system**.
- The **main objective** is the development of a **low latency teleoperation module** for the **Elfin cobot**.

Experiment description

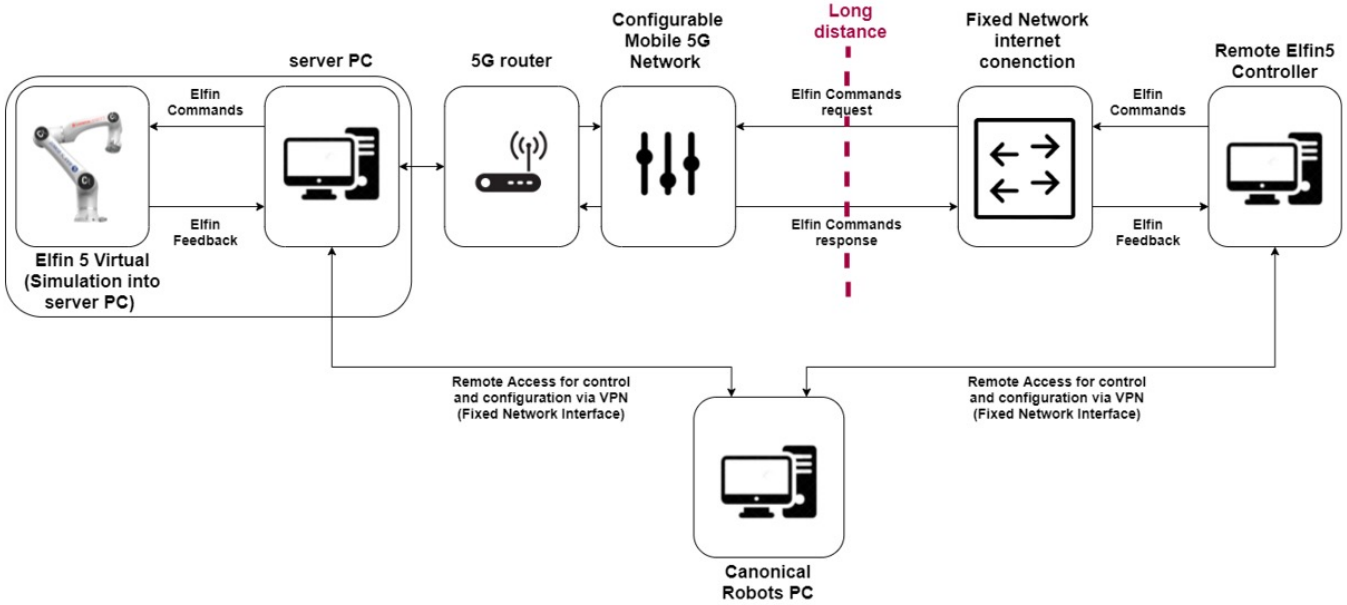
BACKGROUND AND MOTIVATION

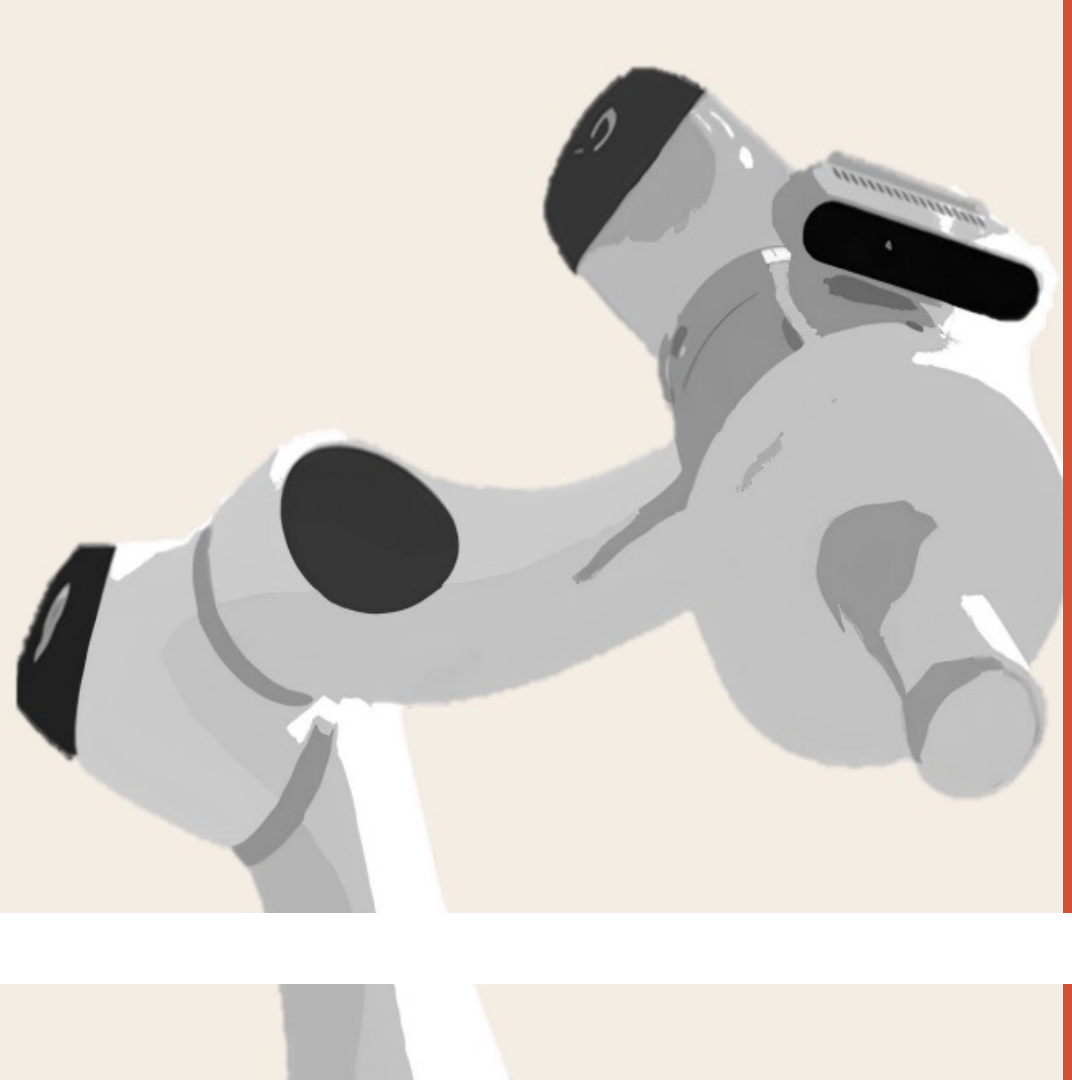
- The goal of our **Physiobot** solution is to make **physiotherapy more accessible**.
- In this regard, we have not only to **virtualize** the **treatment definition**. But also we have to make possible to **enable** the **physical intervention through teleoperation of the physician**.
- We found this developement worthwhile through some of our **clients** that have **already requested this feature**.

Experiment description

EXPERIMENT SETUP

5G set-up deployed at the UMA campus for testing of the low latency cobot teleoperation module





Project results

Project results

1.1 MEASUREMENTS

- **Robot status fluctuation time (RSFT)** – the status of the robot is sent to the remote controller each **80ms**. This metric is defined as de deviation in milliseconds from each time 80ms timeslot.

- **Command roundtrip time (CRT)** - this is the **elapsed time** between the command from the **remote controller** is sent to the **robot local node** and at the moment the confirmation message comes back to the remote controller.

Project results

1.2 MEASUREMENTS

- **The RSFT remains within the range of 10ms.**
- **The CTR is in all configurations bellow our target goal of 70ms. Although there is a quite significant improvement for 5G configurations compared to 4G (~ 15ms).**
- **System scales well with network traffic until it reaches values close to network saturation.**

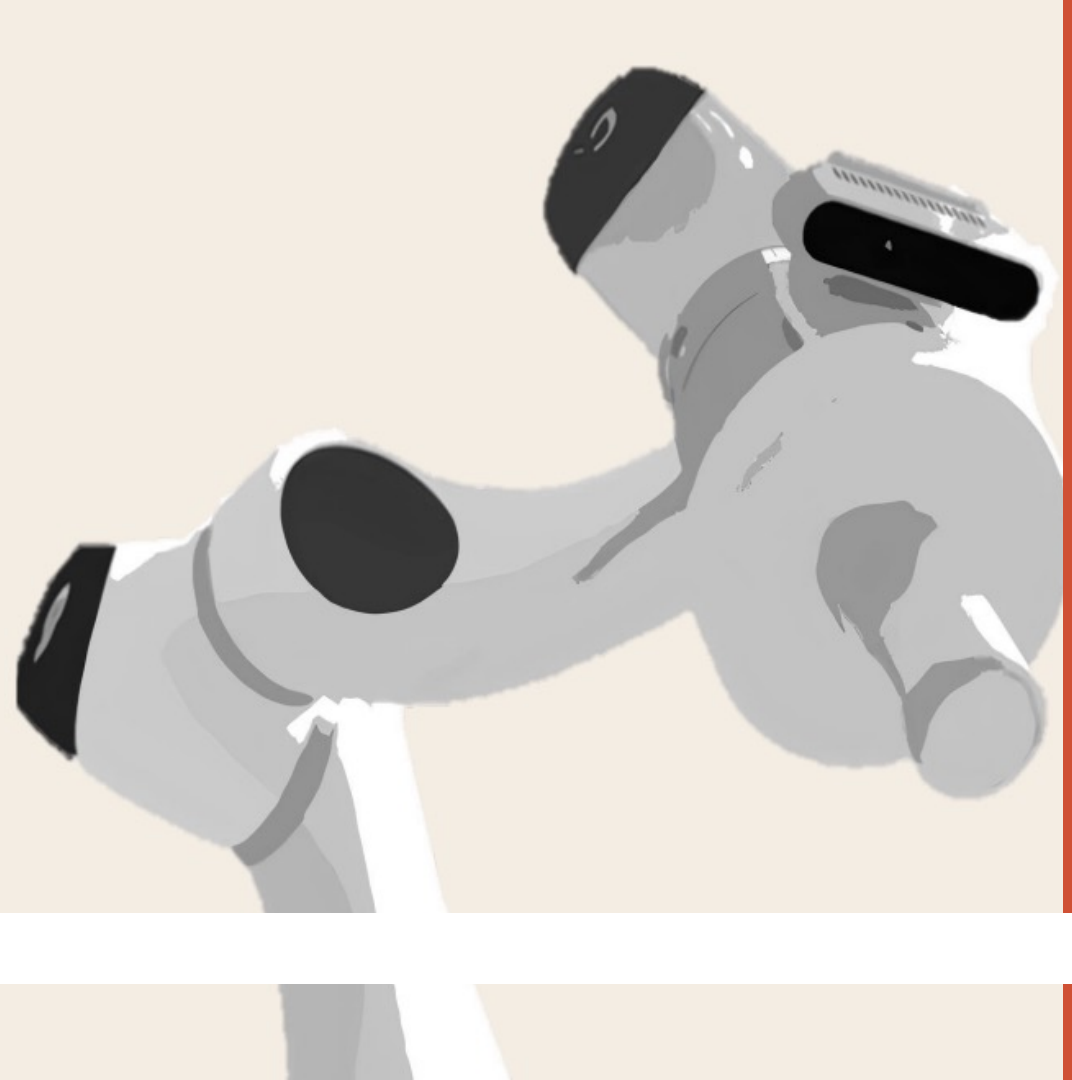
Project results

LESSONS LEARNED

- This results confirm the **viability** of the **cobot teleoperation** for the Physiobot.

- We consider to **use the UDP** protocol **instead of TCP**.

- Detected **need** of a **watchdog implementation** to **prevent** the **robot teleoperation** on **low quality connection conditions**.



Business impact

Business impact

IMPACT ON OUR BUSSINESS

The experiment impact of the teleoperation technology for the Elfin robot is threefold:

- Increasing of the perceived value of the **Canonical Robot** brand thanks to the continuous development of R&D technologies.
- Enhance the **appealing and versatility** of our **Physiobot** product by allowing remote teleoperation and management of the system.
- As **distributors of the Elfin robot**, we can offer this teleoperation technology to our clients. This **increases the differentiation** value to the Elfin robot and provides a greater sells margin of this product.

Business impact

HOW FED4FIRE HELPED US?

- Have **access** to the **experimentation facilities**.
- Allowed to have access to **tools** to test.
- Help to **design the exeperiment** providing **technical expertise** that is outside of our core competencies.

Business impact

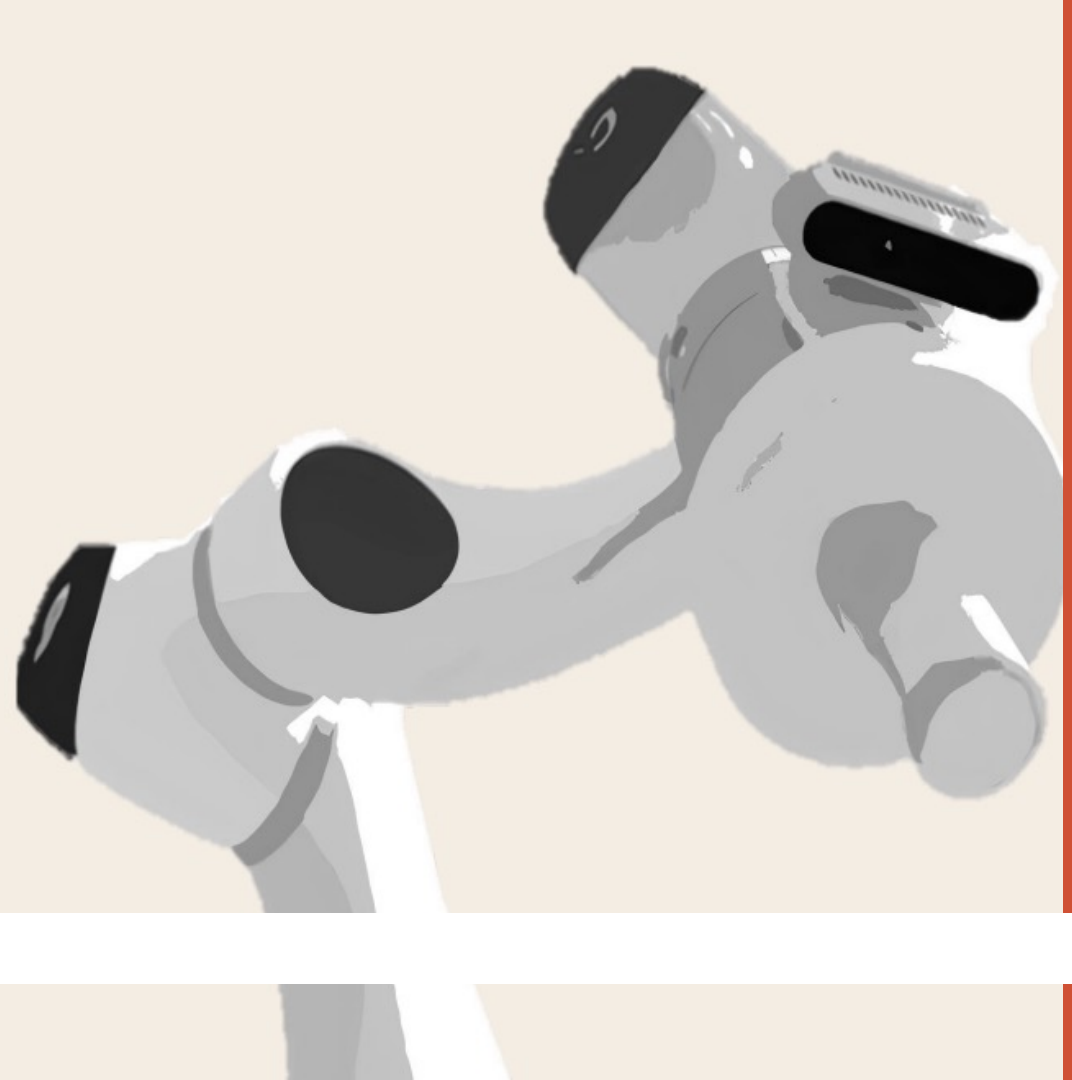
VALUE PERCEIVED

- We have **gained knowlege** in the **cobot teleoperation** space.
- We have **validated, tested and developed** the core technology **for** the **Physiobot teleoperation**. This allows us to put a **one year timeframe** for the inclusion of this technology in this application.
- We have gained a **differentation value for the Elfin cobot line**. This is key factor in a commercial crowed space.

Business impact

WHY DID WE COME TO FED4FIRE?

- We have considered the teleoperation of our robots before but I seemed **too risky** for the company to develop such technology.
- Besides the lack of infrastructure, the **benchmarking of communications and design of experiments** is **out of Canonical Robot expertise**.
- For this reason we have seen this experiment as a great **opportunity** to **realistically develop this technology**.



Feedback

Feedback

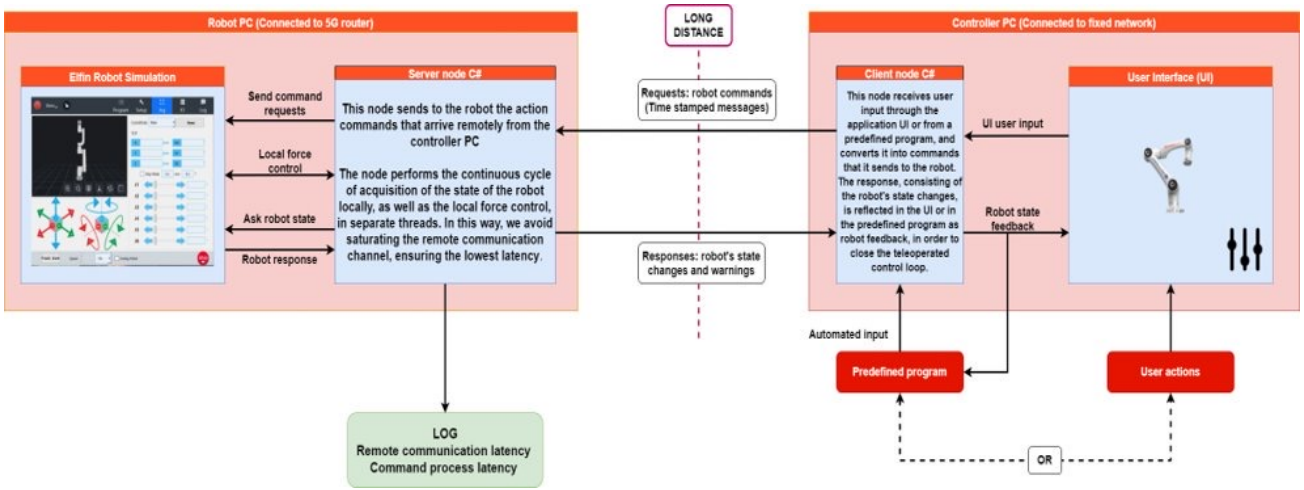
1.1 - USED RESOURCES AND TOOLS

- For the **Physiobot5G** experiment we have used the **Triangle testbed** of the Fed4FIRE+ infraestructure.
- Move specifically we have used a **private 5G deployment at University of Malaga**.
- The **cobot teleoperation module** under test has been **deployed on the servers at the university of Malaga**.

Feedback

1.2 - USED RESOURCES AND TOOLS

- **IPer2 software tool** to generate the background IP traffic. In our experiment use case, we used **Iperf** to simulate different **background IP traffic** conditions an measured the **latency** on the communication through the **TCP protocol**, between the remote node and the Elfin robot simulator running on the server node.



Feedback

2.1 - ADDED VALUE OF FED4FIRE

- The **overhead** due to administration and preparation meetings **was very little compared** with the time dedicated to the actual experiment, so for us has been very productive.

- The **setup** of the experiment was a **fairly simple** process. The testbed made things much easier for us when starting our experiment. It was necessary to install and fine-tune several software components on the computer offered by the testbed in order to carry out the experiment.

- The **tools** that were loaned to us by the testbed **were enough** to obtain the conclusions we needed from the experiment.

- A great **advantage** for us of this Fed4FIRE experiment is **the convenience and simplicity** of having to dela just with **one service provider**.

Feedback

2.2 - ADDED VALUE OF FED4FIRE

- The experience of dealing with a single **service provider** was very gratifying because **responses** from our point of contact were **fast, clarifying, simple and very helpful**.
- The **point of contact** provided also **expertise for preparing and conducting the experiment**. This was crucial for our company because the telecommunication domain is not part of our core competencies.
- Although the funding was not enough to **carry out the experiment with a physical robot**, in the end it was **not strictly necessary**.
- We **only requested Triangle testbed**. There was some technical failure when setting up the 5G connection, but was quickly solved.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Co-funded by the Swiss Confederation

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THANK YOU FOR YOUR ATTENTION

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