

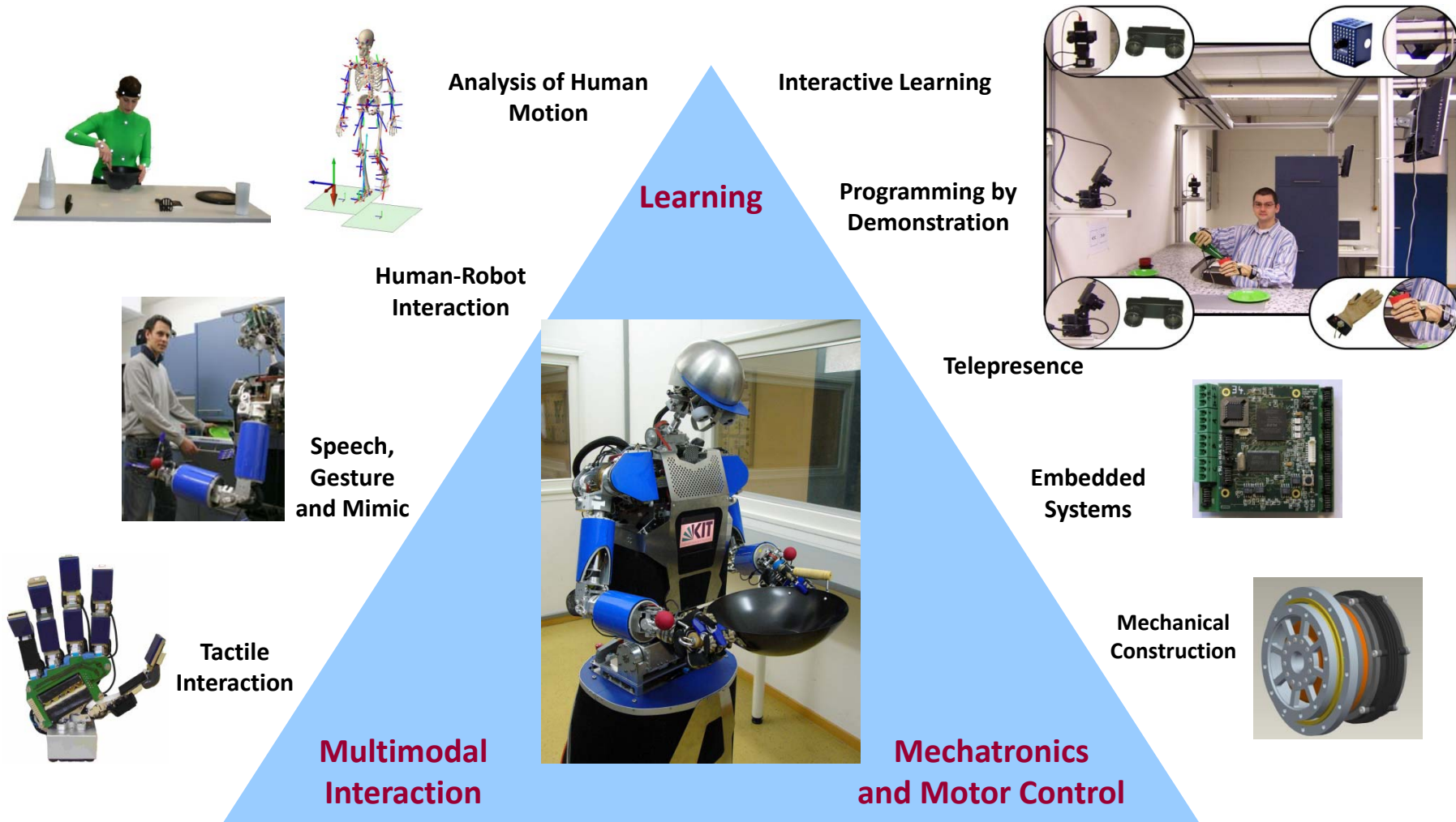
Anthropomatics

Science of the Symbiosis between Humans and Machines

Strategic Goal and Mission

- **Design, implement and evaluate highly usable and acceptable humanoid systems to improve human's quality of live**
 - Humanoid robot systems that coexist with humans as assistants and companions at different ages, situations, activities and environments
 - Robot systems for augmenting human capabilities (speech translation, prosthesis, telepresence, ...)
 - Core technologies (sensors, actuators, embedded systems, ...) for human-centred application
 - Robot technologies for manufacturing and production
 - Cognitive information processing in technical systems

Current research activities at KIT



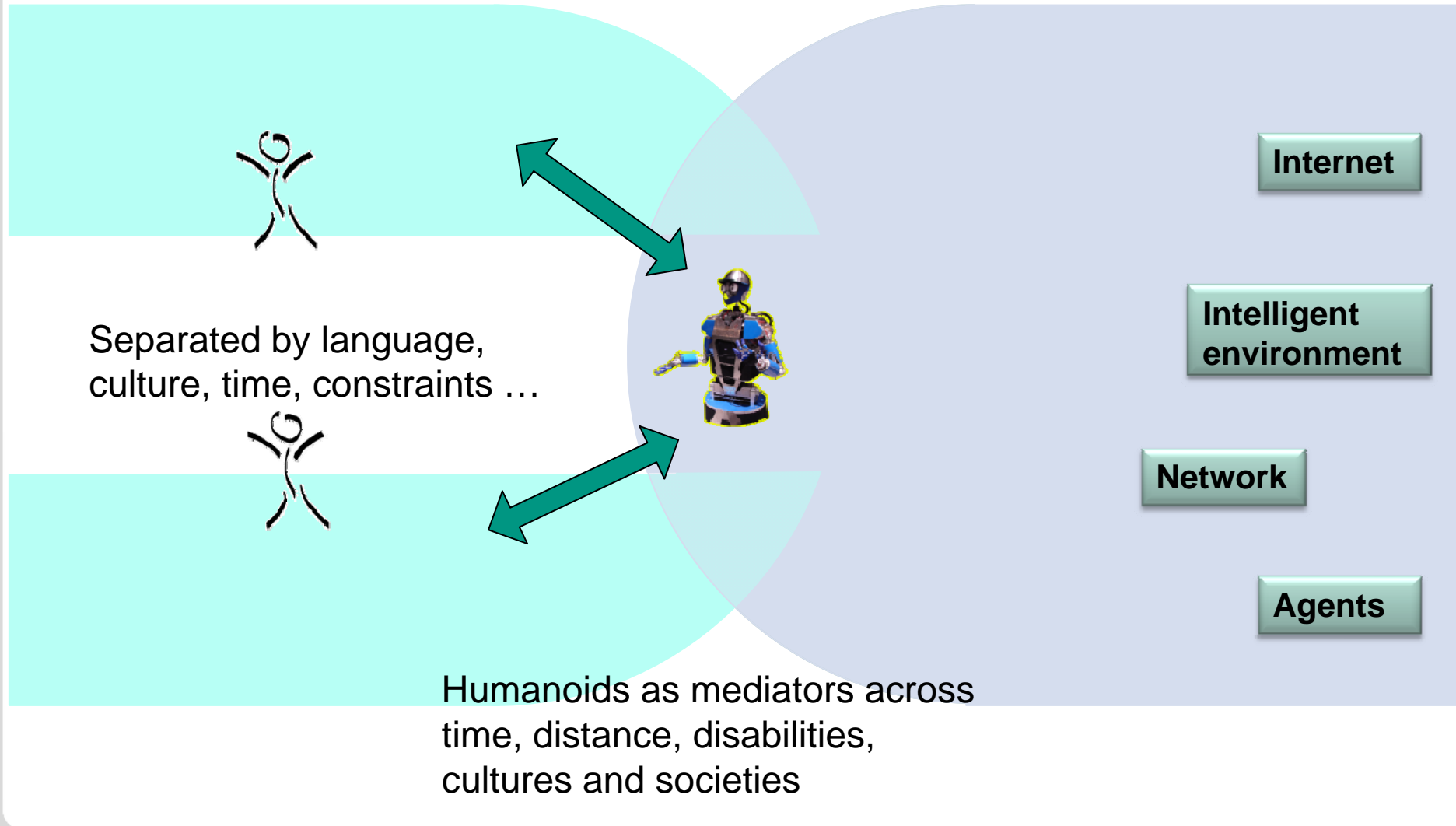
Limitations and shortcuts

- Systems are designed for “**sunshine**” environments with limited scope and simple tasks.
- The **transferability** of the developed skills and abilities to varying contexts and tasks without costly redesign of specific solutions is still **impossible**:
 - How to define *measurable* and *scalable* challenges in an open scenario under *changing conditions*,
 - How to define *metrics* and *benchmarks* that highlight and focus on *transferability* rather than *performance*
 - How to define frameworks and representations which allow for *learning* of new skills, *adapting* already acquired skills, for *switching* between different learning modalities or combining multiple forms of learning.
 - Representational differences between high-level AI planning and low-level robotics/vision

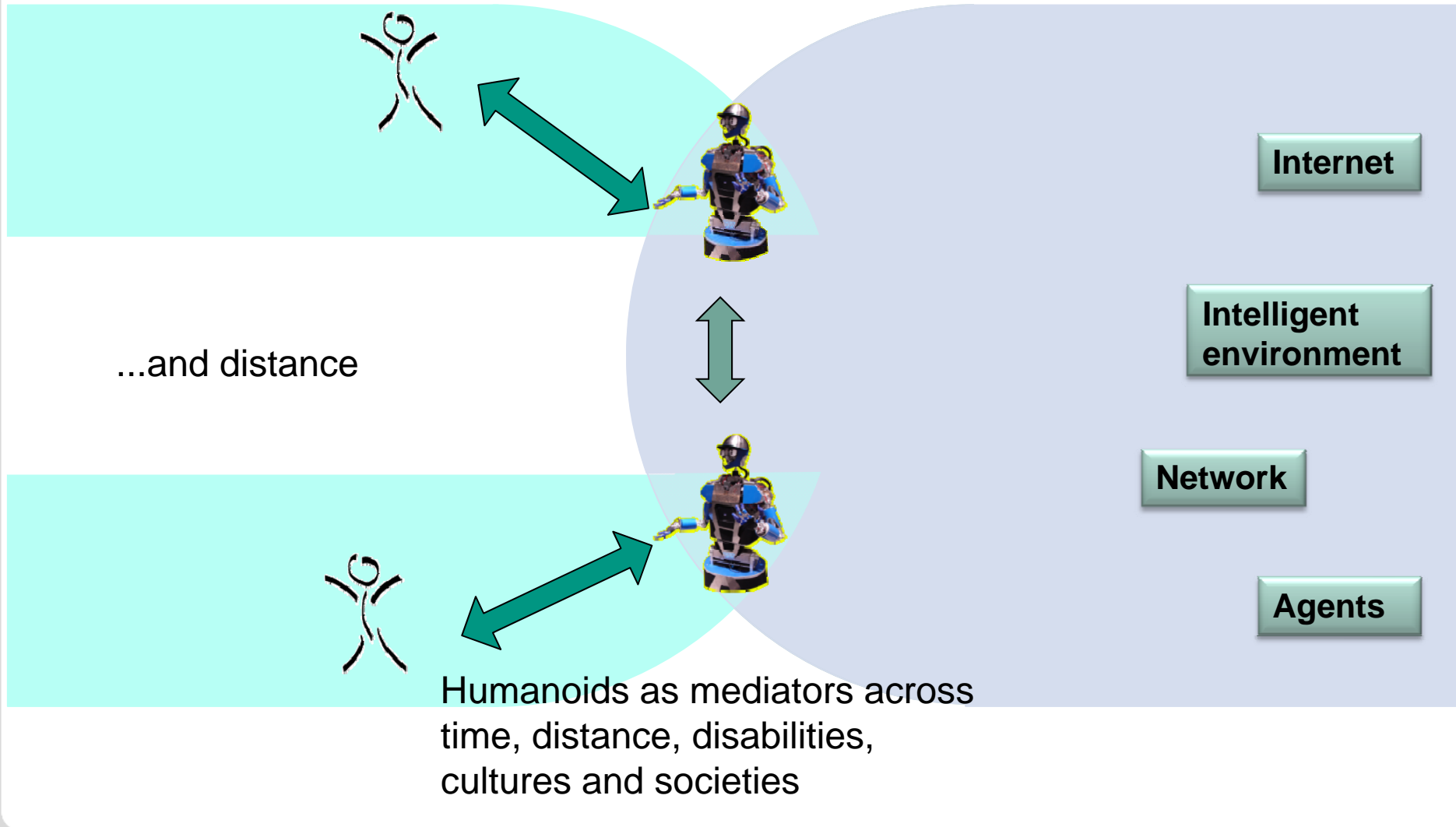
Long-term goals

- Humanoids as **companions and assistants** for citizens in different ages, situations, activities and environments in order to improve the quality of life
- **Knowledge representation and sharing** across distance, time and cultures
- **Internet of skills**: Skill learning and skill transfer between different embodiments
- **Interoperability**: Common/shared complex platforms with standard/common/open-software
- Understanding **cognitive** information processing

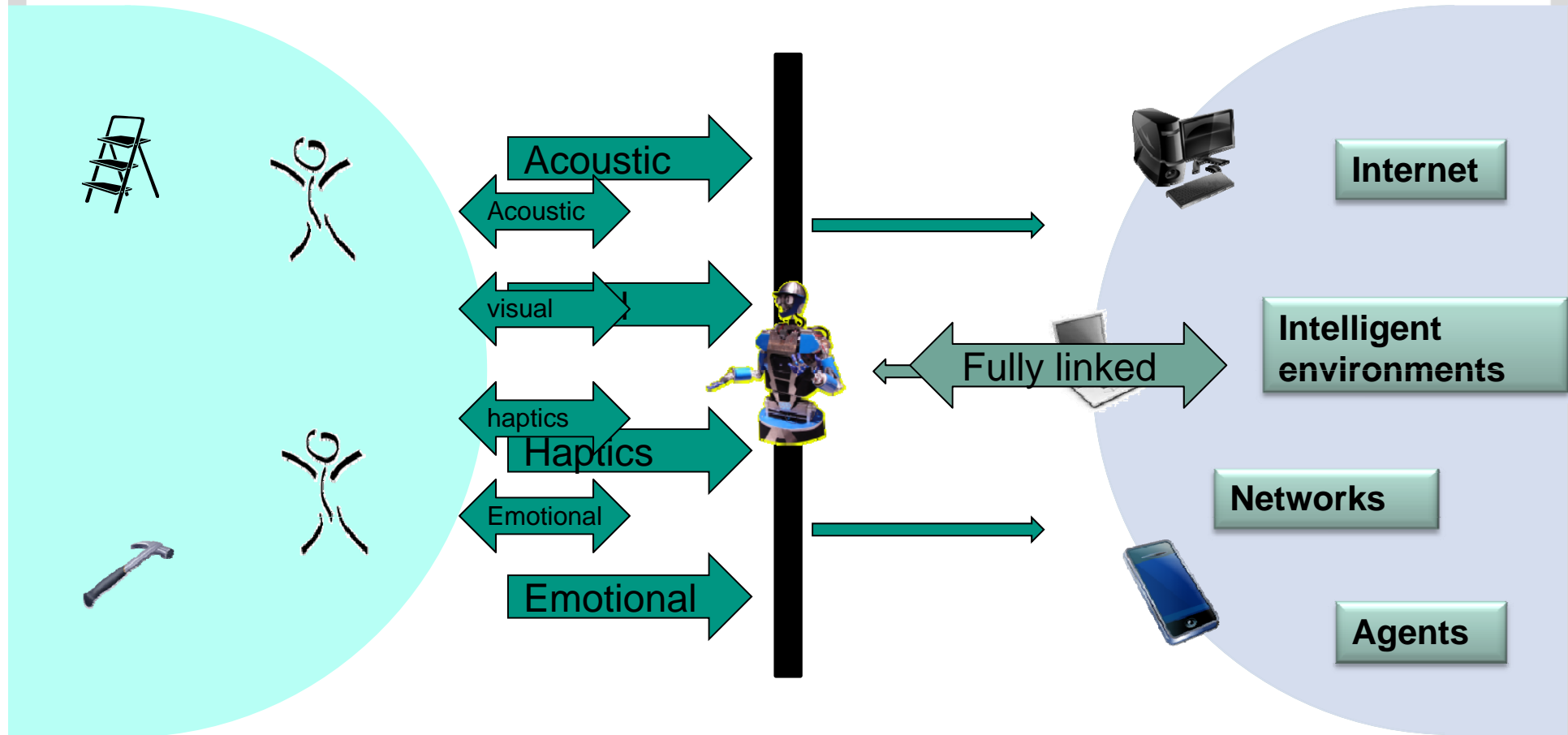
Humanoids als universal Interfaces



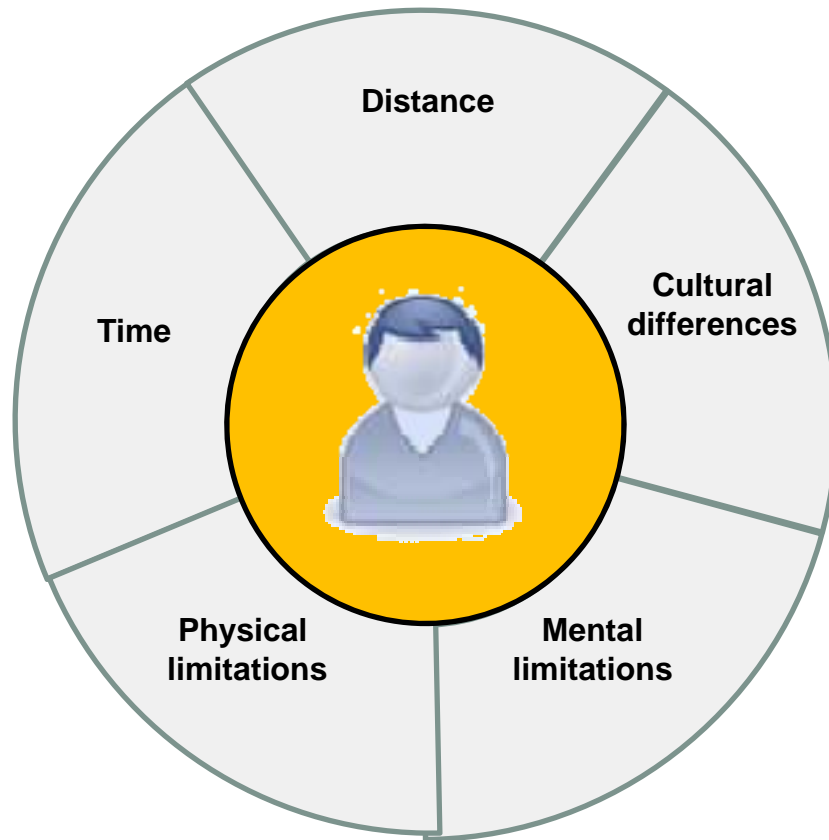
Humanoids als universal Interfaces



Humanoids as universal interface

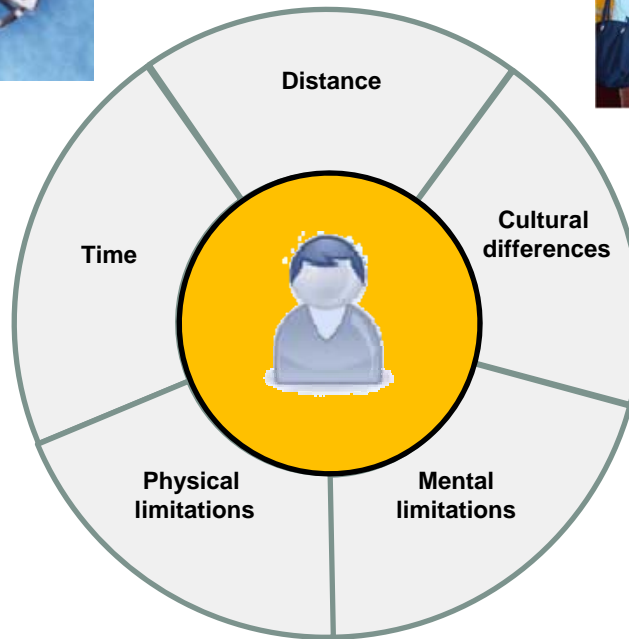


Challenges



- **Globalization**
Overcoming language and cultural differences
- **Resources shortage**
Overcoming of distances
- **Population aging**
Independent live despite physical and mental limitations

Challenges



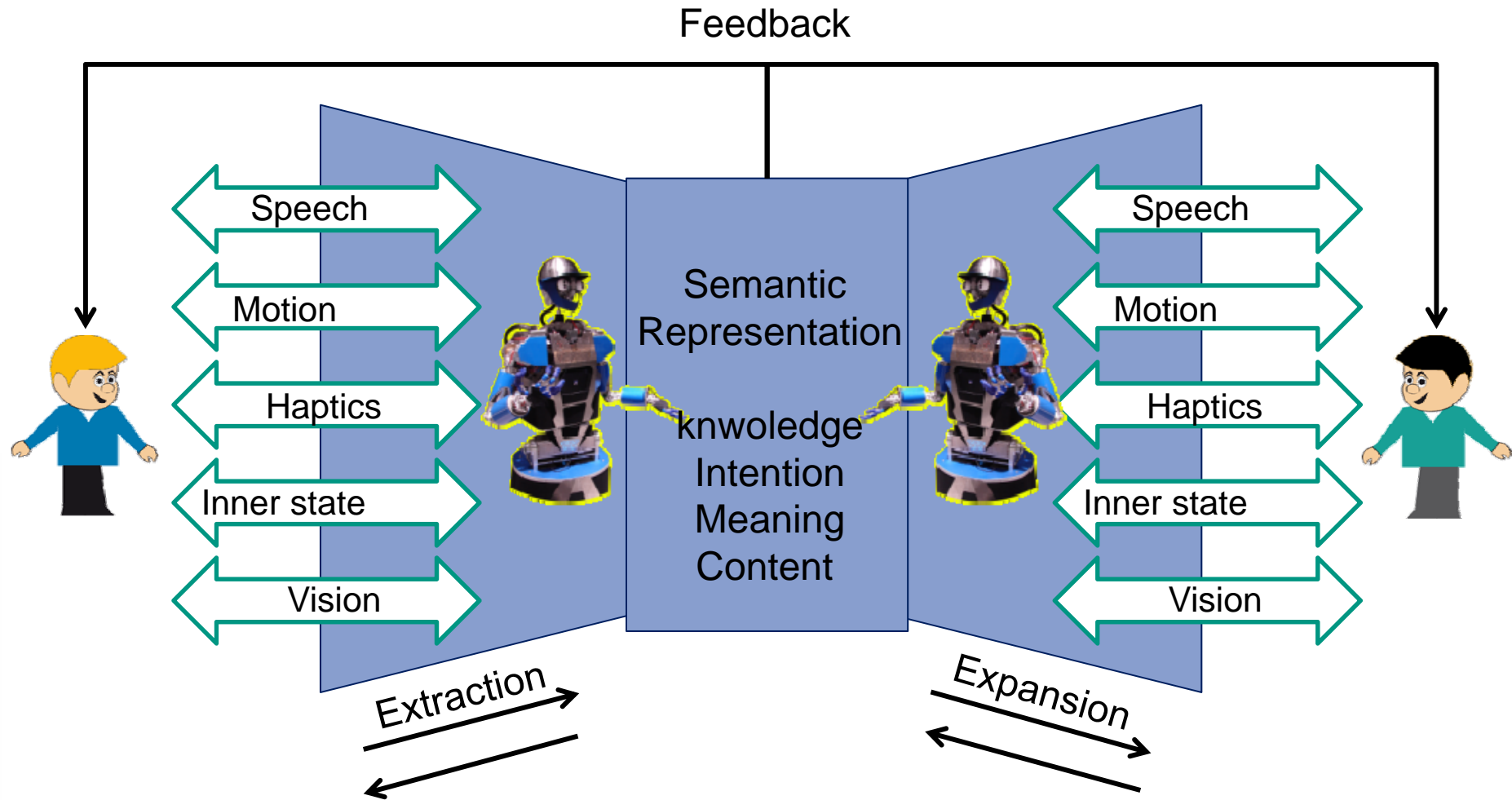
Humans increasing dependency on technology

Bottlenecks in human communication and interaction

Mediation through humanoids

- Conceptualization of the process which transfers multimodal information, such as facts, knowledge, skills, content, meaning, and behavior across different embodiments, i.e., from humans driven by neural representations to machines characterized by physical and digital information
- Transfer mechanism should preserve the originally intended meaning and modalities of the sender's message and will be generated at the receiver's side such that the original message can be perceived by humans with all senses

Concept of Mediation



Fundamentals of humanoid mediation

Naturalness

Multimodale Interaction

Speech

Speech recognition and translation

Haptics

Artificial skin
Haptic interfaces

Telepresence

Teleoperation

Biosignals

EMG based Protheses
Emotion recognition

Image processing

Smart Room
Image data fusion

Universalsness

Humanoid Robots

Platform

Architecture

Demonstrators



Adaptivity

Scientific fundamentals

Learning

Representations

Knowledge transfer

Machine Intelligence

Programming by demonstration

Systematic system design

Planning und control

Humanoid Mediation

Functional Mediation

Augmentation of human's functional capabilities

- Telepresence
- Grasping
- Manipulation
- Haptics
-

Scientific fundamentals

- Learning
- Representations
- Knowledge transfer
- Machine Intelligence



Humanoids

Social Mediation

Machine-aided human-human communication

- Speech
- Empathy
- Body language
- Culture and Ethics

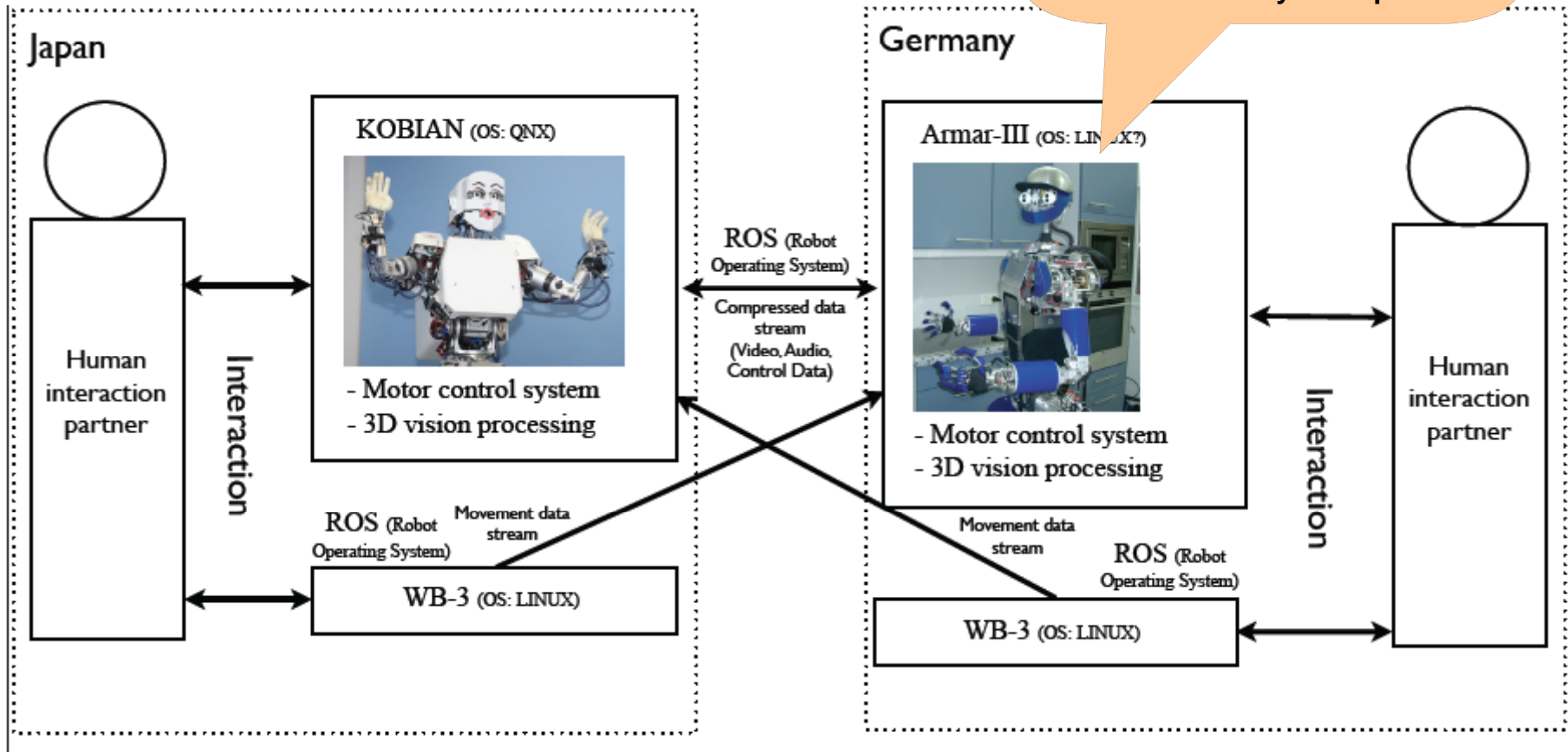
Humanoids

- Plattformen
- Architektur
- Demonstratoren

RoboSkype Experiment

Hello Kobian,
I would like to invite friends
for dinner tonight.

I would like to prepare Sushi
for them. Can you help me?



Joint work between Waseda University (Prof. Takanishi, Prof. Kobayashi) and KIT (T. Asfour, R. Dillmann and A. Waibel)



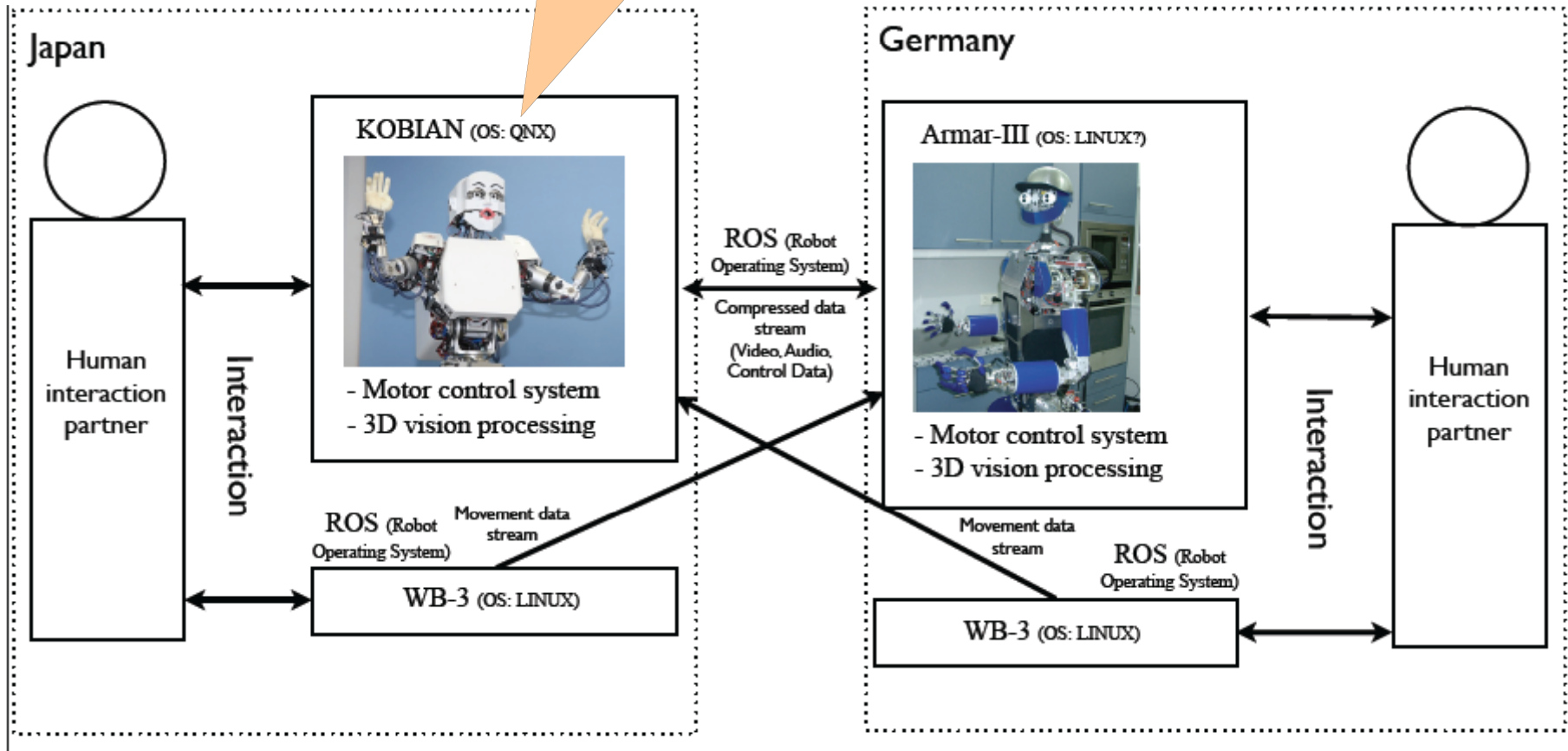
Hello Kobian!
Prof. Dillmann and Prof. Waibel will be over for
dinner tonight.
I would like to prepare Sushi for them. Can you
help me?



こんにちは、コビアン！
今夜のディナーにディルマン先生とワイベル先生が来ま
す。
私は彼らに寿司を用意したい。手伝ってくれますか？

RoboSkype !

はい、わかりました。
お寿司を作るには、お米とお酢、
魚、海苔、そして醤油が必要です。





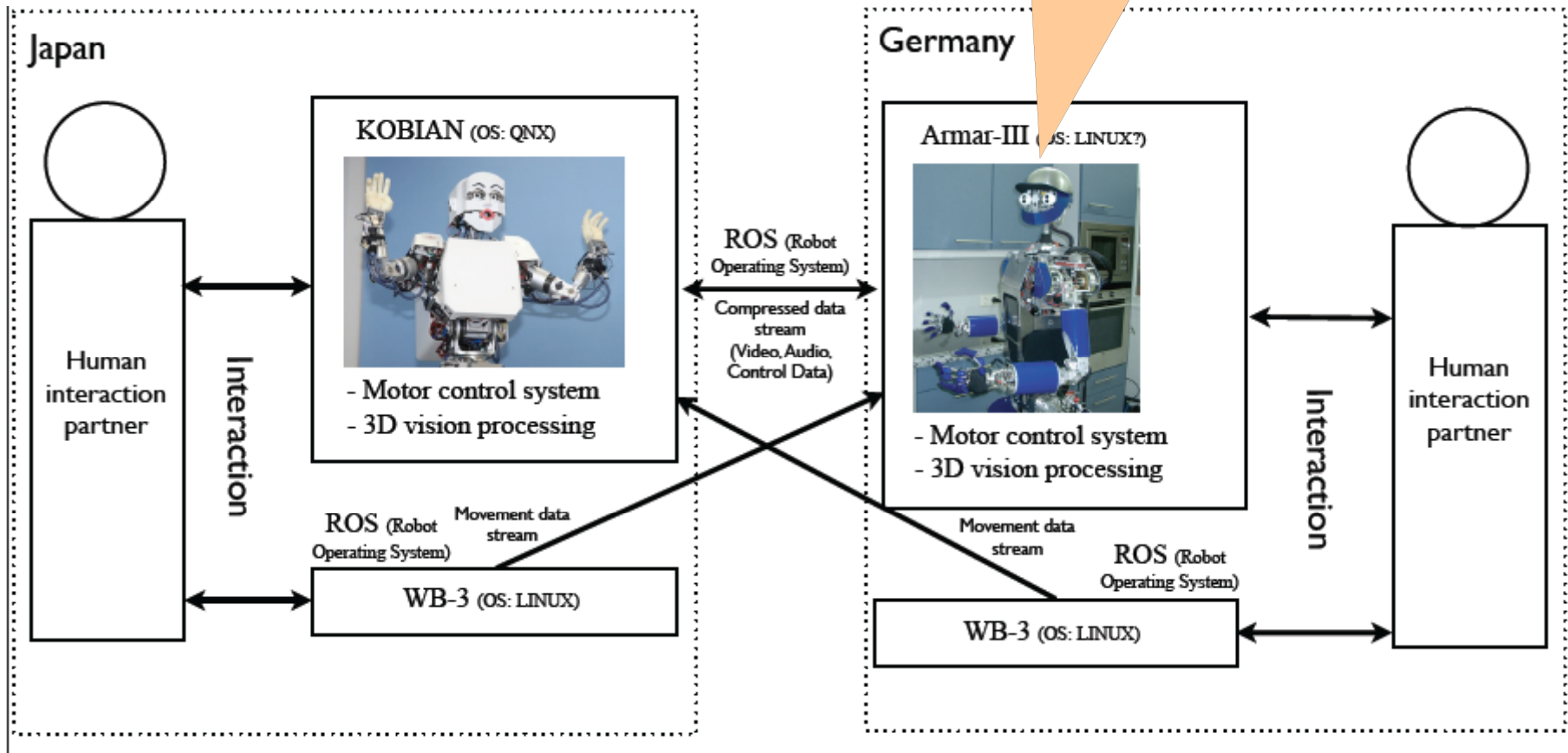
はい、わかりました。
お寿司を作るには、お米とお酢、
魚、海苔、そして醤油が必要です。



Yes, I understand.
You need vinegar, rice, fish, nori and soy sauce
to make it.

RoboSkype !

Okay. But I don't know what nori is.





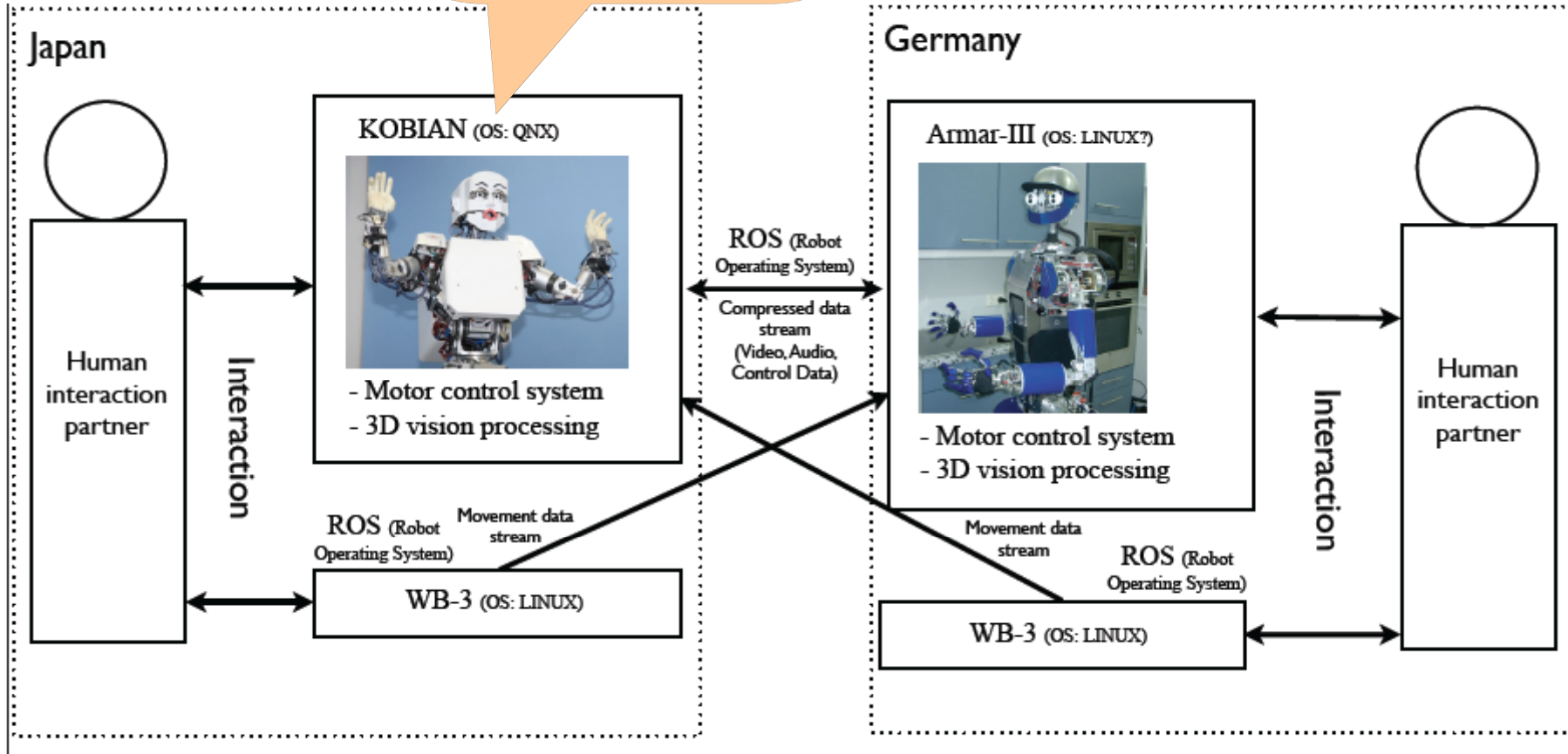
O.k., but I don't know what nori is.



わかりました。でも、私は海苔が何か知りません。

RoboSkype !

海苔は海藻の一種を紙のように薄く加工したものです。これでご飯を巻いて食べます。





海苔は海藻の一種を紙の
ように薄く加工したものです。
これでご飯を巻いて食べます。



Nori is a kind of sea weed and it looks like paper.
We eat rice by wrapping it in nori.

Humanoid mediators

Humanoids from different cultures will serve as mediators to transfer skills and task knowledge across distance and cultural barriers.

■ Human → Robot

- Imitation learning and Programming by Demonstration
- Skill and task knowledge learning from observation
- Verbal-based advice and explanation to help the robot to categorize its sensorimotor experience

■ Robot → Robot

- Interoperability between robots (human/mediators) → Middleware
- Supervised skill and task learning in teleoperative manipulation tasks
- Robot learn from little experience and/or use the experience and knowledge of other robots to learn new capabilities faster

■ Robot → Human

- Humanoids teach humans new skills and tasks through demonstration (e.g. a European user learns to prepare Sushi based on knowledge provided by a Japanese Sushi chef).

■ Thanks for your attention

