Capacity Building and the "Tactile Internet"

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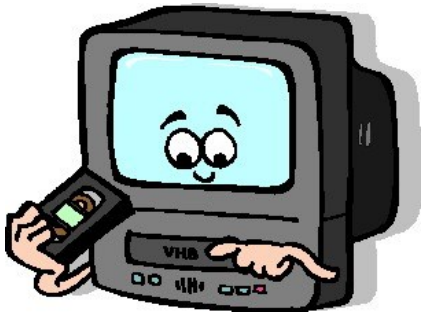
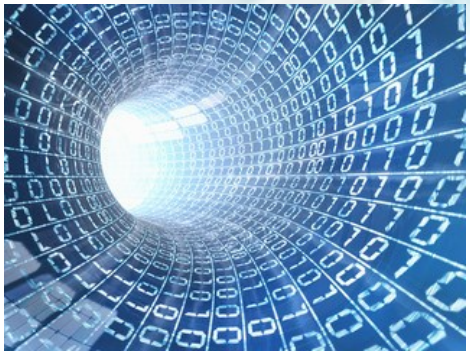
What is the "Tactile Internet"?

Current Internet

- Providing (broadly):
  - Visual content.
  - Auditory content.
  - Limited control information (e.g., non real-time; loose feedback loops).
  - Data exchanges (e.g., synchronization of servers, information resources, etc.).





What is the "Tactile Internet"?

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(Future) Tactile Internet

- Haptic information:
  - Touch.
  - Kinesthetic (e.g., force-feedback).
- Probably should be termed "Haptic Internet", but "Tactile" seems to have stuck for at least the last couple of years and we maintain it.
- Use of manual skills over the Internet possible through this:

Internet of Skills!

Internet of Skills

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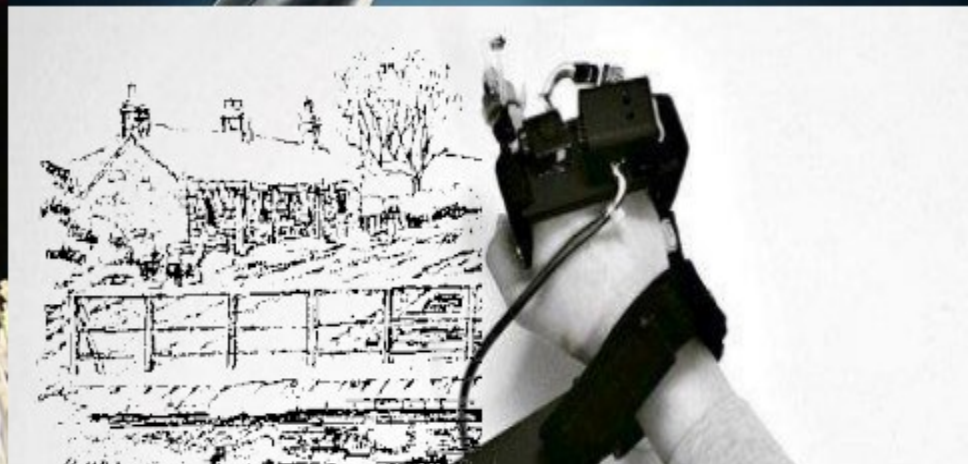

Internet of Skills – Remote Surgery?

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Co-Design with Prof Prokar (5ms challenge)

Internet of Skills – Remote Surgery?

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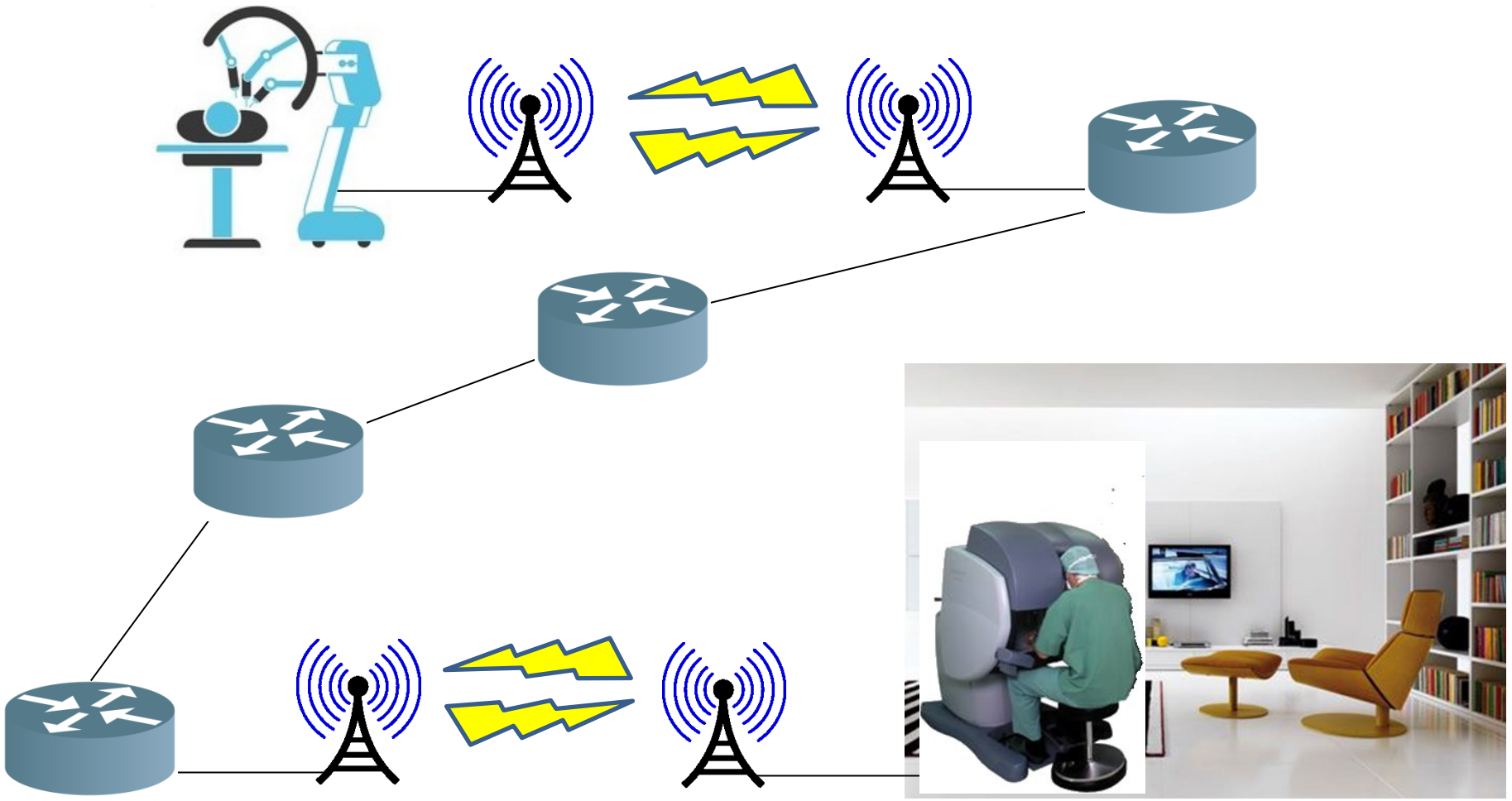

Internet of Skills – Remote Manufacturing?

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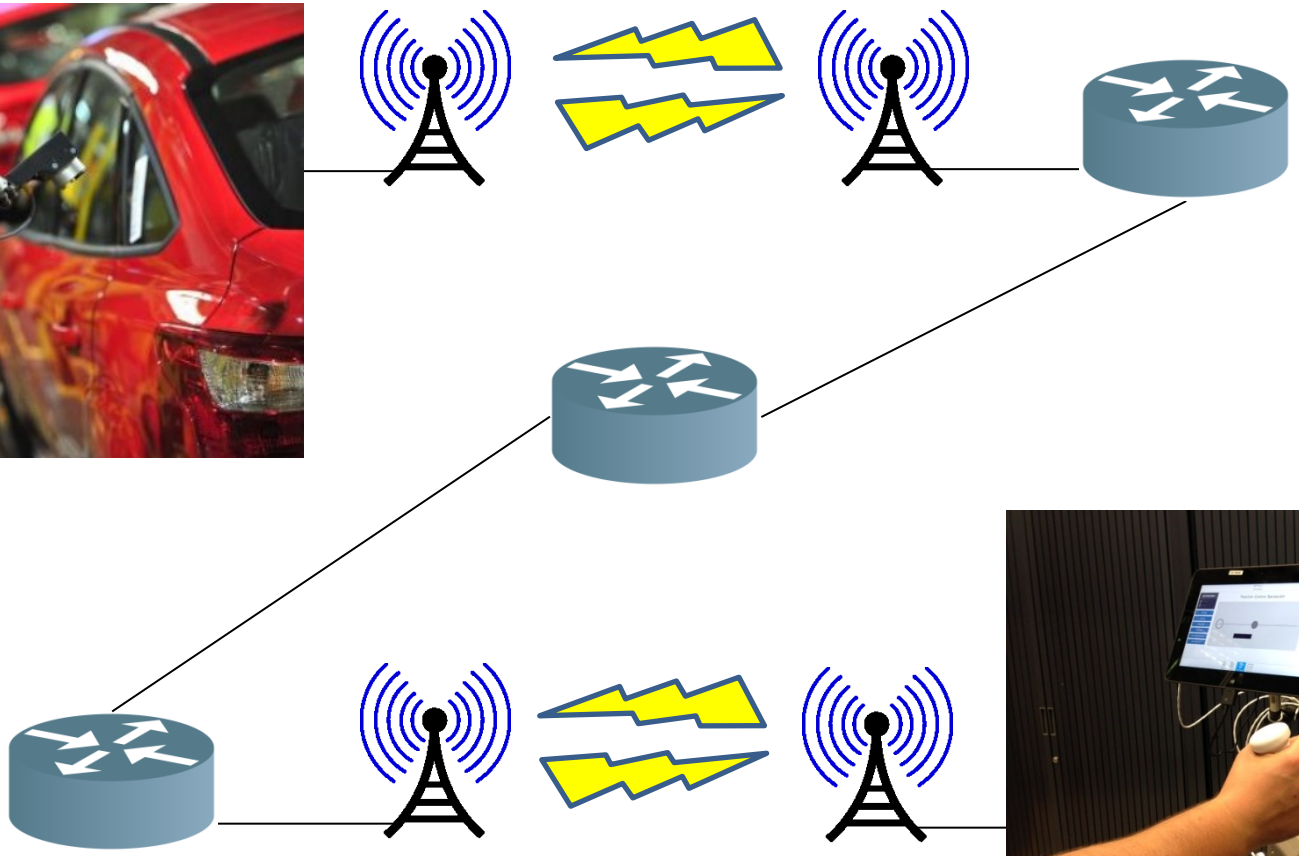

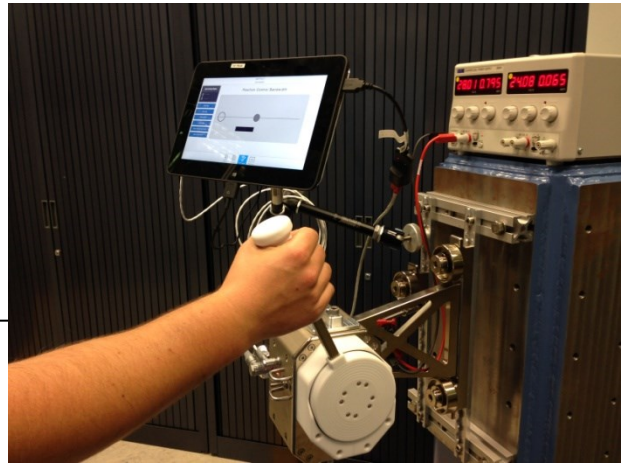

Internet of Skills – Remote Manufacturing?

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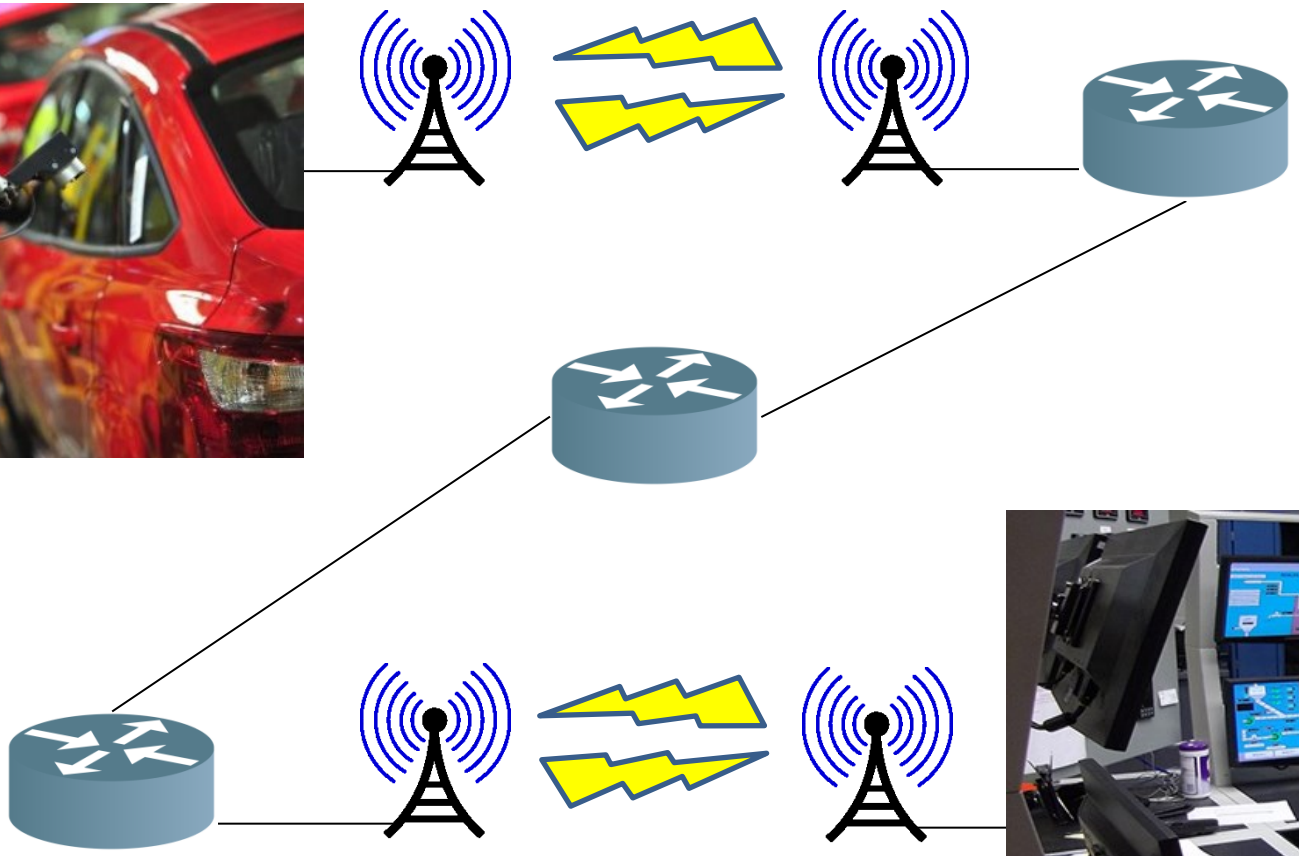

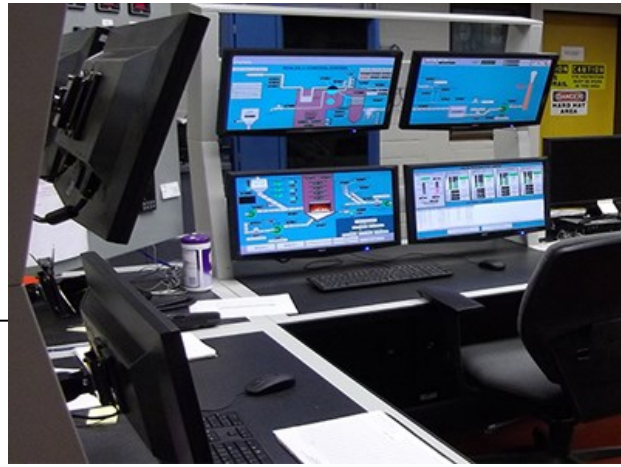

Internet of Skills – Remote Training?

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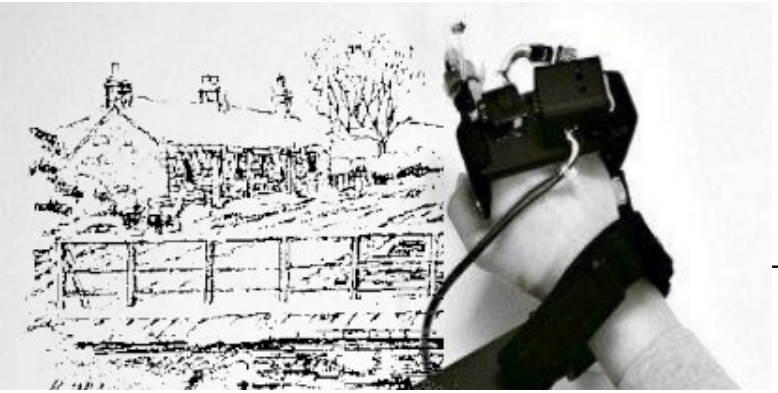

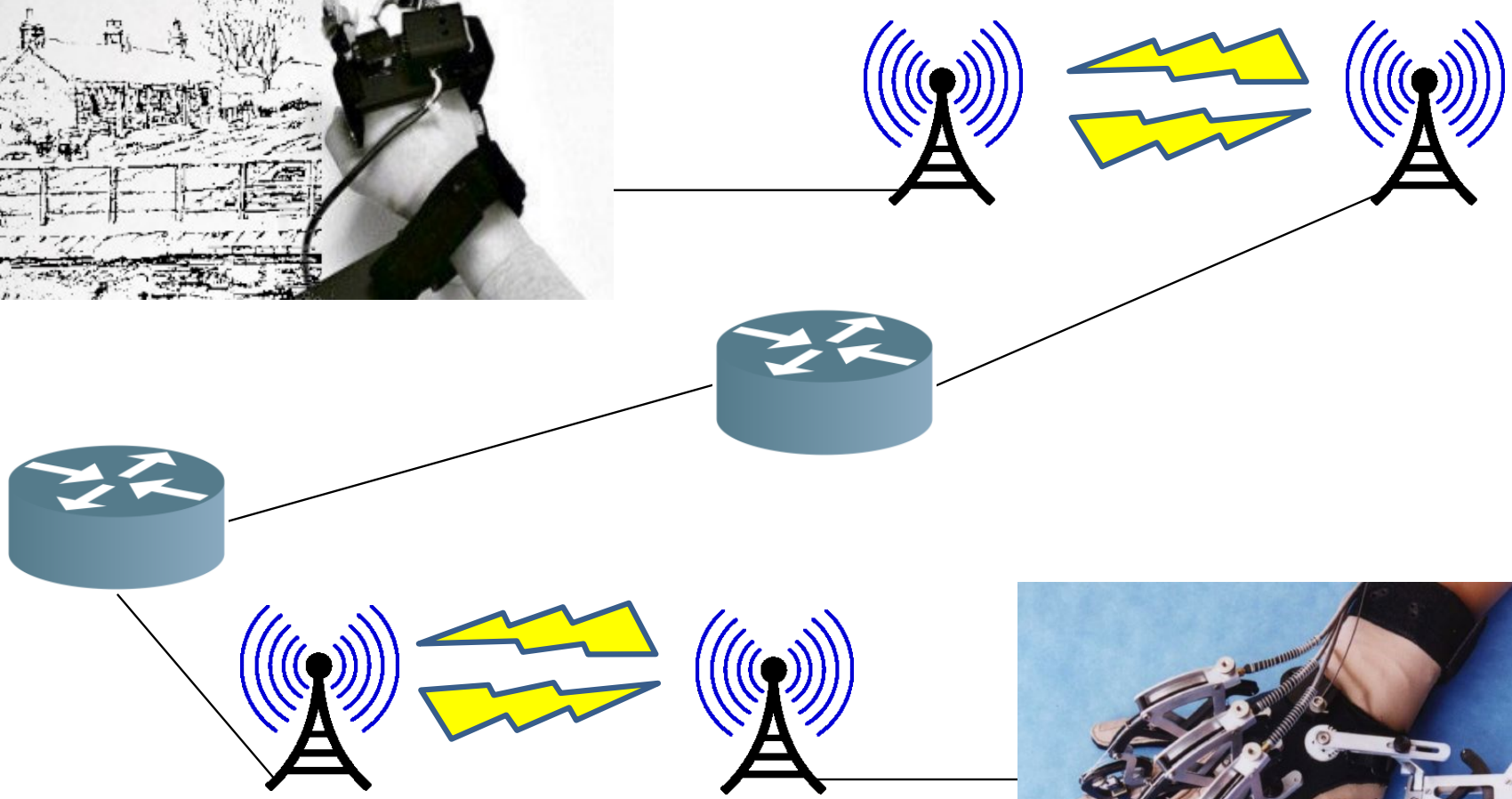

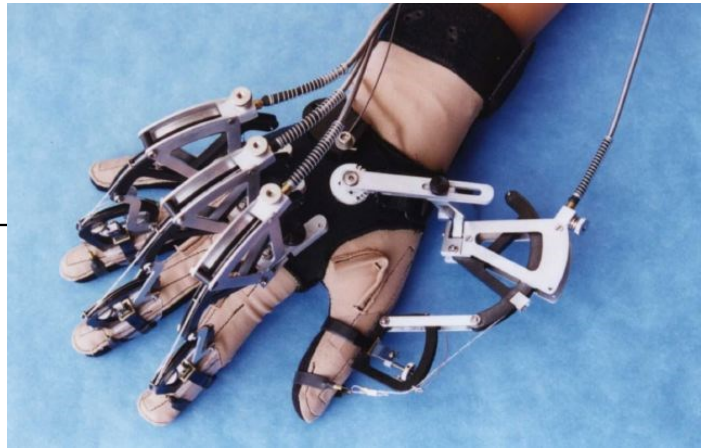

Internet of Skills – Haptics

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We mean: The complete perception of form, position, surface texture, stiffness, friction, temperature, etc.

Kinesthetic Perception

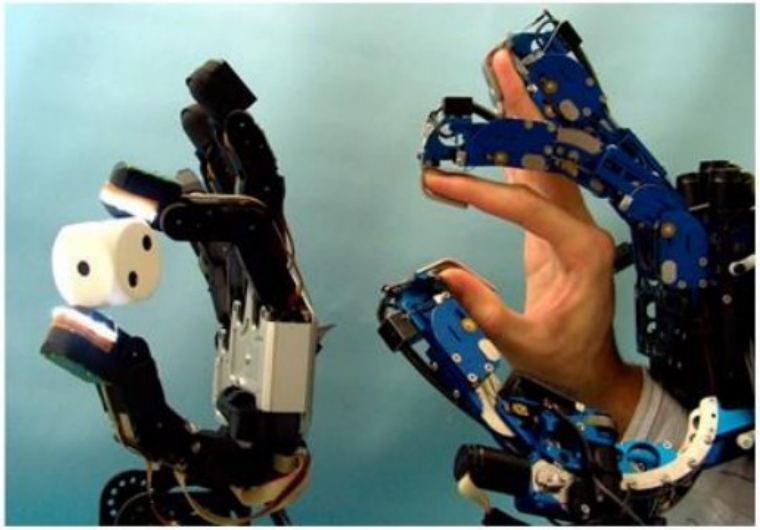

Image Source: Katsunari Sato,
Dept. of MEIP, The University of Tokyo/Japan

position & forces

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Tactile Perception

sense of touch of the skin

Internet of Skills – Haptics

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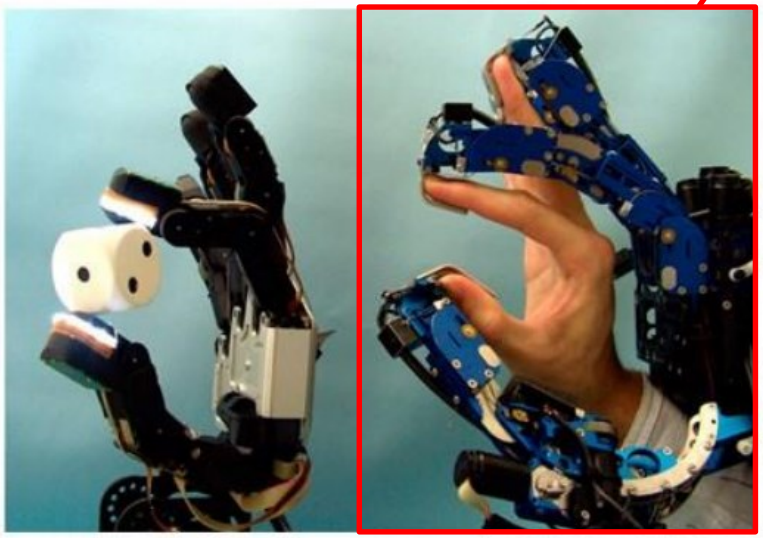
Kinesthetic user-interaction example

Kinesthetic Perception



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position & forces

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Tactile Perception

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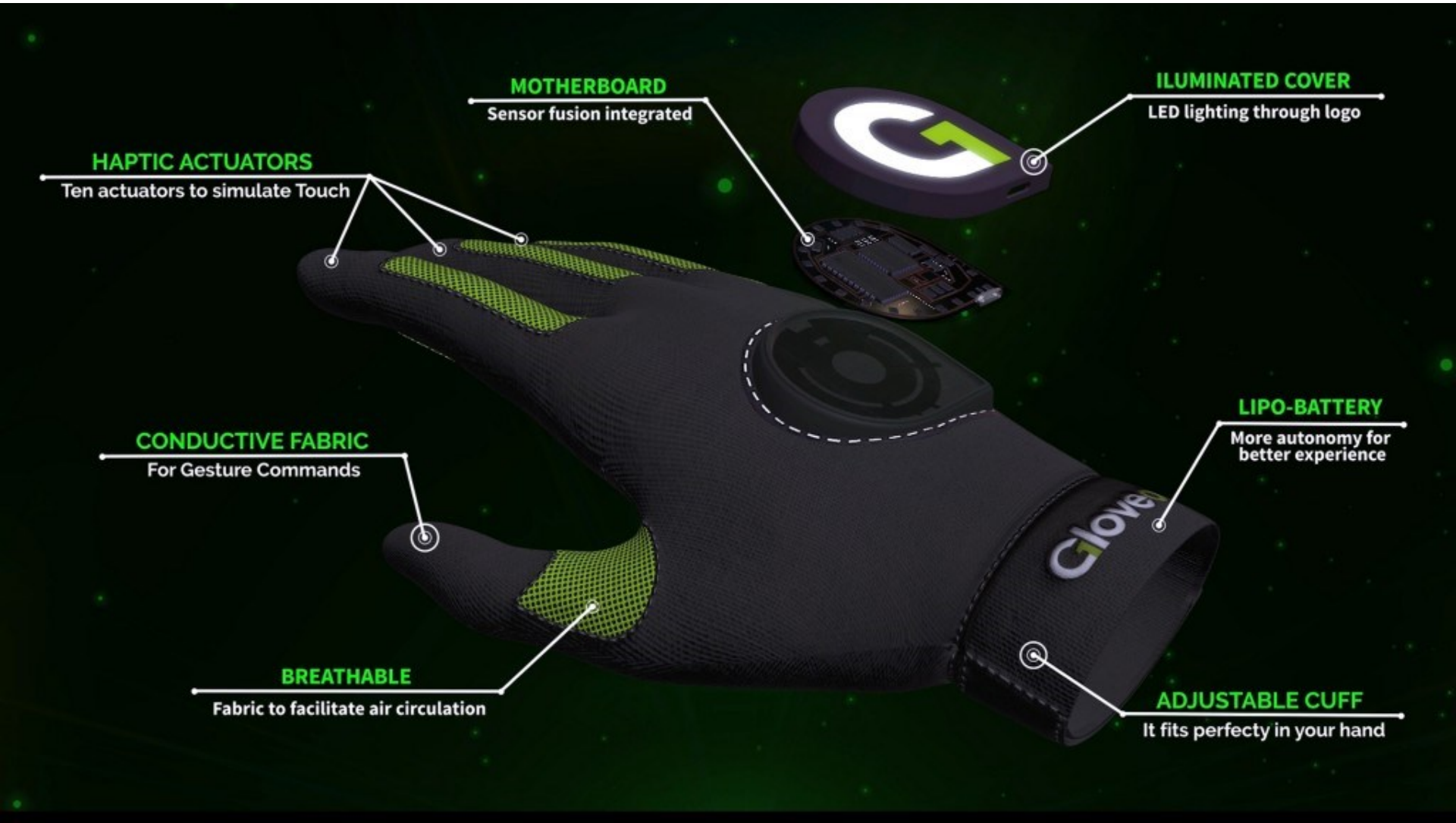
Internet of Skills – Haptics

"Gloveone"—Tactile (partly broader haptic) user-interaction example



Interaction of Academia with Industry

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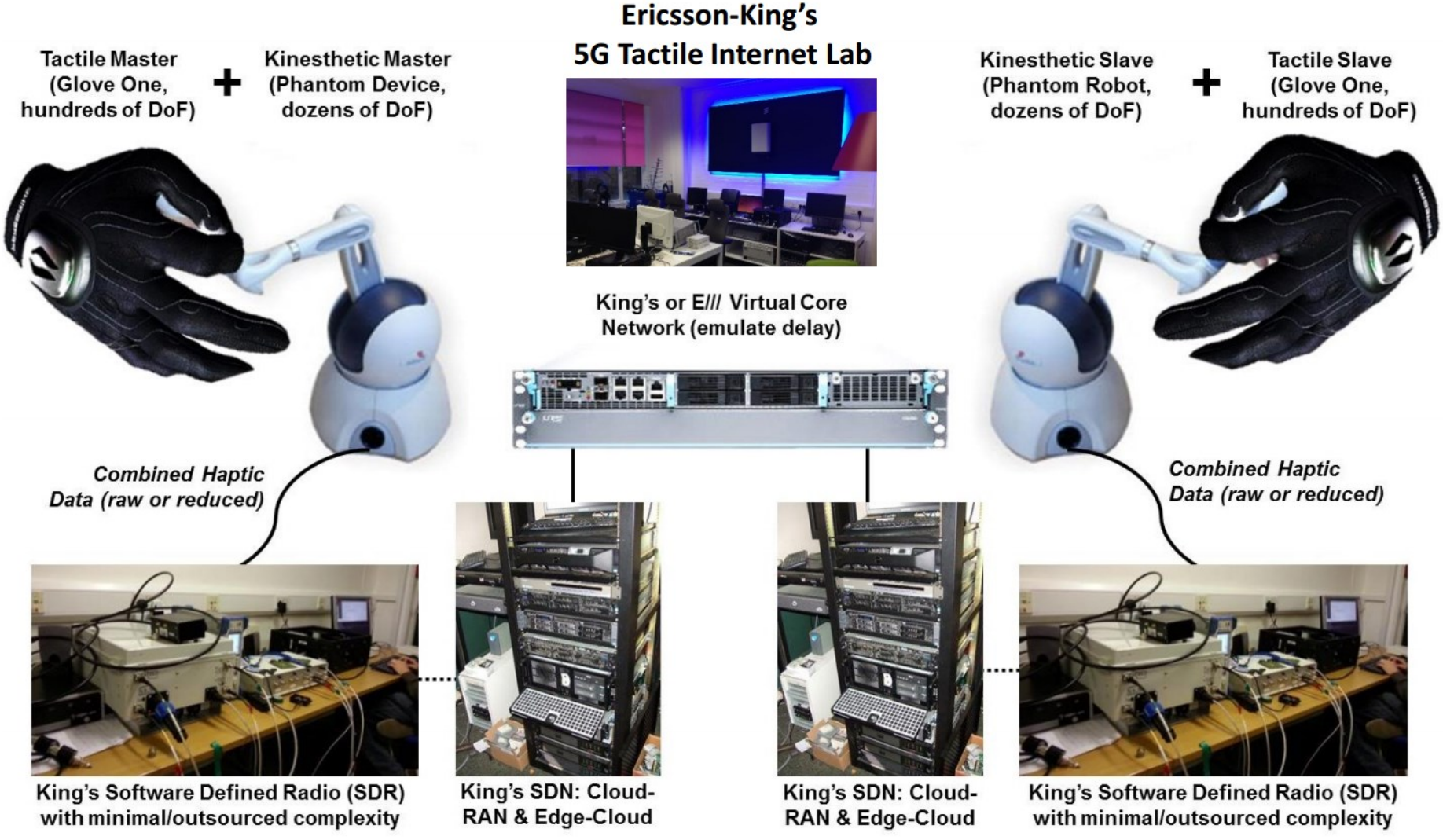
Example 1: IEEE Tactile Internet Standards, initiated/led by King's College, based on extensive standards profile

- IEEE 1918.1: http://grouper.ieee.org/groups/1918/1/.
- Baseline standard intended for completion (ballot) in mid-2018.
- Involves many of the top companies internationally, e.g.,
  - Ericsson, Toshiba, NEC, Nokia, many others, actively participating and contributing in various ways.
- Standardizing:
  - Definitions, use cases and requirements, architecture, functions, interfaces, among other items, for the Tactile Internet.
- Also new project under 1918.1 (1918.1.1) on Haptic Codecs for the Tactile Internet.

Interaction of Academia with Industry

Example 2: Ericsson—King's College London Tactile Internet Lab



Interaction of Academia with Industry

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Benefits for Academia

- Greater knowledge of where (in reality!) the technical directions are heading.
- Ability to push research ideas to industry. "Impact" (on industry, public good, etc.) is key metric of success of universities in the UK.
- Excellent reputation and profile with industry.
  - Enhanced funding opportunities, e.g., projects funded by or involving industry (more likely to be accepted).
  - Enhanced equipment provision/loaning from industry.
  - Enhanced prospects for graduate employment in industry.

Interaction of Academia with Industry

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Benefits for Industry

- PR gain through being associated with top institutions, seen as contributing to societal benefit.
- Exposure to top and most forward-thinking minds in particular technology areas—novel/revolutionary ideas.
- Sharing with academia such that when inputs are combined the whole is greater than the sum of its parts.
- Greater scope for publications—publicity, recognition.
- Provide path for some of the brightest graduates to progress to a company—recruitment and visibility for selection of staff as part of interaction process.

Capacity Building

Current Internet

- Learning based on written and other intellectual (visual/auditory) content.

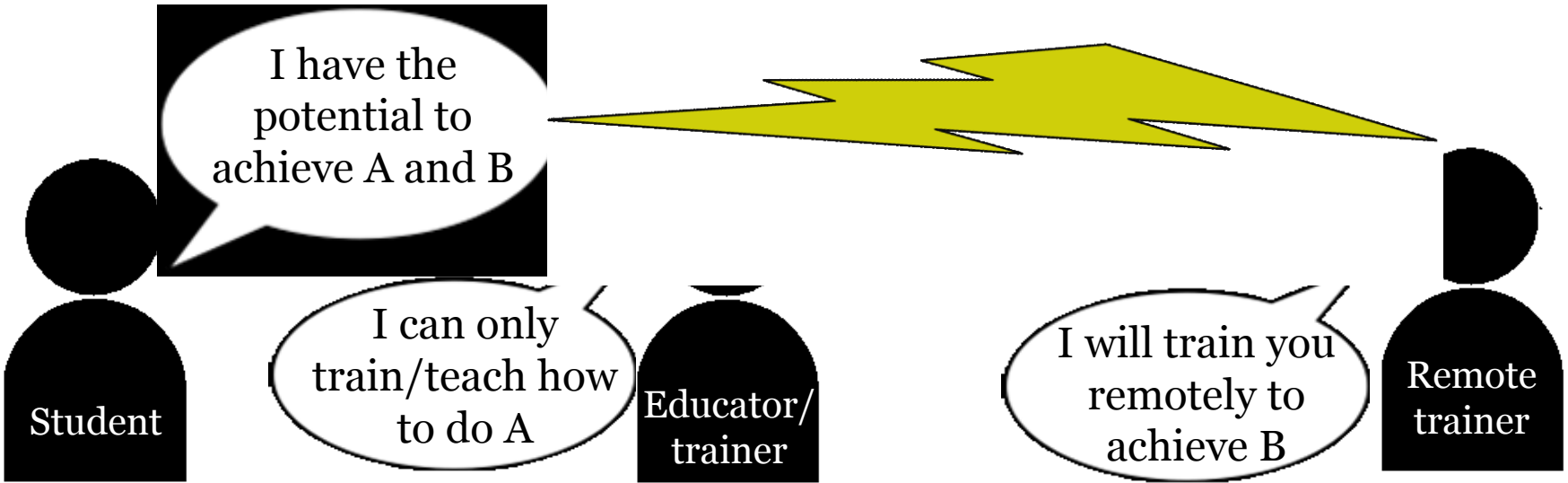
(Future) Tactile Internet

- Teaching/learning of manual skills (can also be combined with intellectual knowledge). E.g.,
  - Surgery example (as a very specific application).
  - Manufacturing/factory working.
  - Electronics/electronic repair.
  - Use of tools, operating machinery.
  - Laboratory tasks (can be to some extent manual).
  - Skilled arts (e.g., playing musical instrument, painted art work, crafts, etc.).

Capacity Building

(Future) Tactile Internet (continued)

- Strongly associated with efforts to enhance prospects/potential of distance learning.
  - A key way to achieve a far greater reach of some of the top experts globally.
  - Ensuring that *all* the potentials of the people are realized → profound economic and social/societal benefit



And Finally…

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How can we achieve the Tactile Internet?

- Tactile Internet associated with some of the most challenging capabilities of 5G → latency <5ms or <1ms in some cases, ultra-reliability, security, others.
- Set appropriate IMT-2020 requirements, spectrum, etc., at regulatory level, standardize to achieve economies of scale.

Call for participation (towards standardization)

- Leading a major IEEE standards working group on the "Tactile Internet".
- Encourage participation: including at regulatory level, to guide or learn on 5G requirements definition, and generally influence standards effort based on IMT-2020 directions.
- Contact me if interested in participating!

That's all (from me)...

Thank you!

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