



Human Autonomy in Emerging Technology Systems

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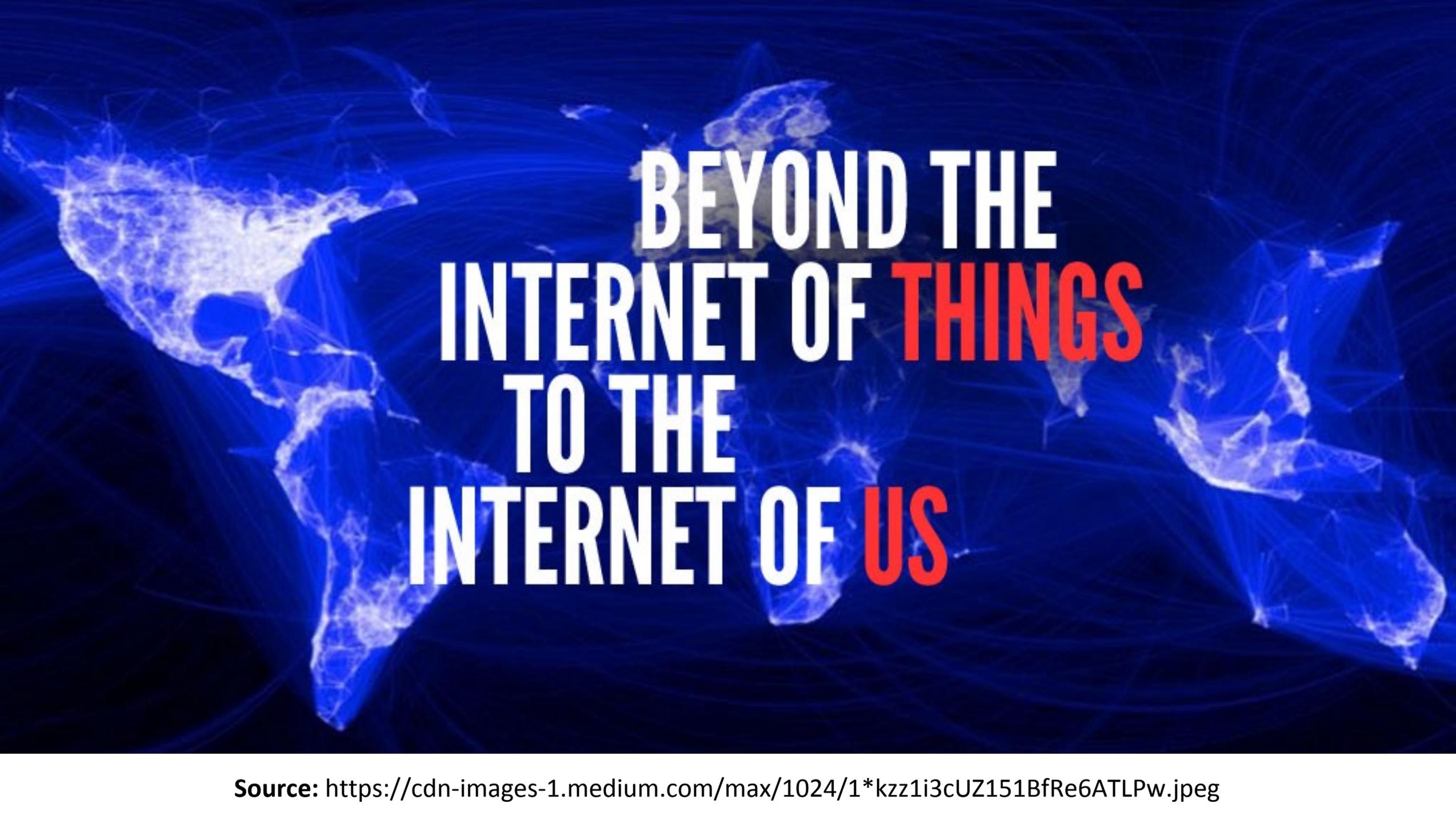
**Australian Privacy
Foundation**

A close-up portrait of Kevin Ashton, a man with a beard and blue eyes, wearing a dark suit jacket over a light-colored shirt. He is looking slightly to the left of the camera with a neutral expression. The background is a blurred indoor setting with warm lighting.

"If we had computers that knew everything there was to know about things -- using data they gathered without any help from us -- we would be able to track and count everything and greatly reduce waste, loss and cost."

Kevin Ashton

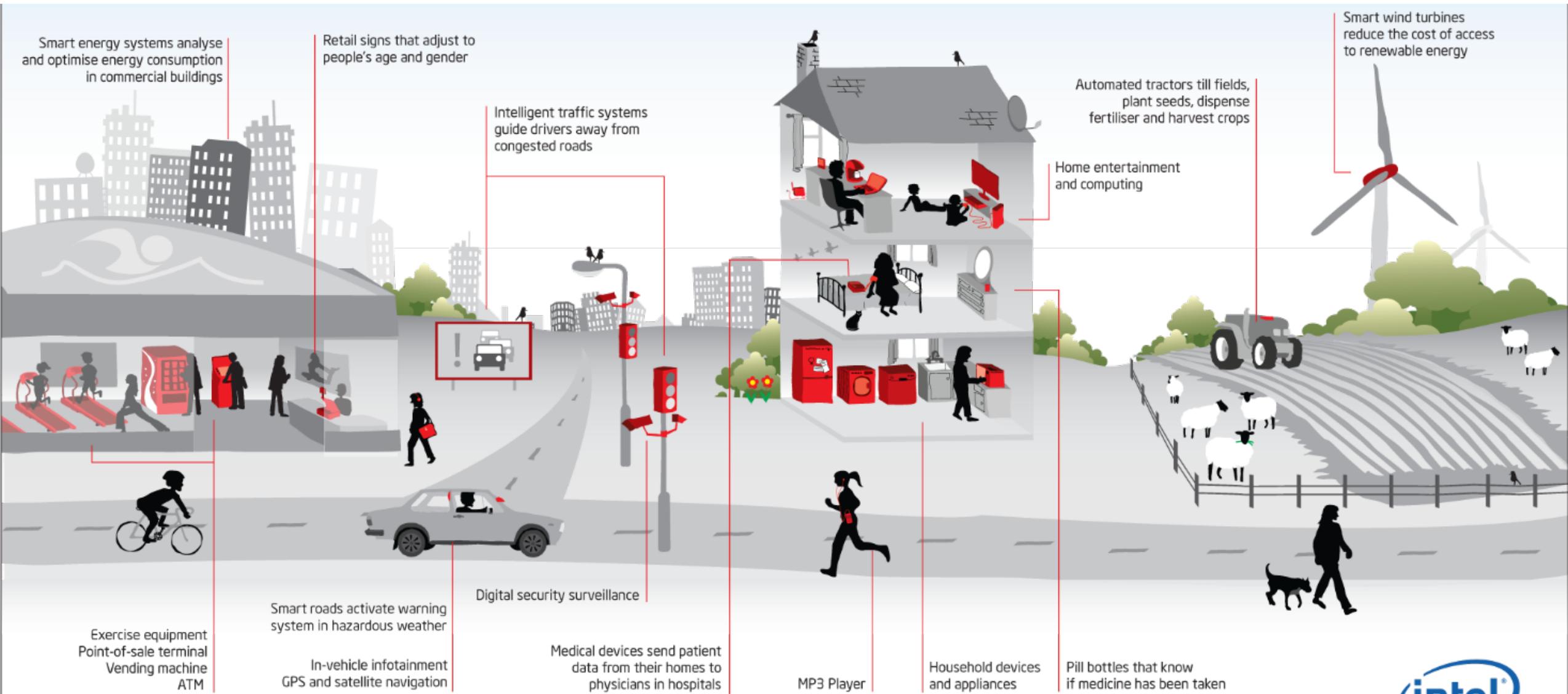
Cofounder, Auto-ID Center at MIT



**BEYOND THE
INTERNET OF THINGS
TO THE
INTERNET OF US**

Source: https://cdn-images-1.medium.com/max/1024/1*kzz1i3cUZ151BfRe6ATLPw.jpeg

It's a Smart World



- Static 🚩

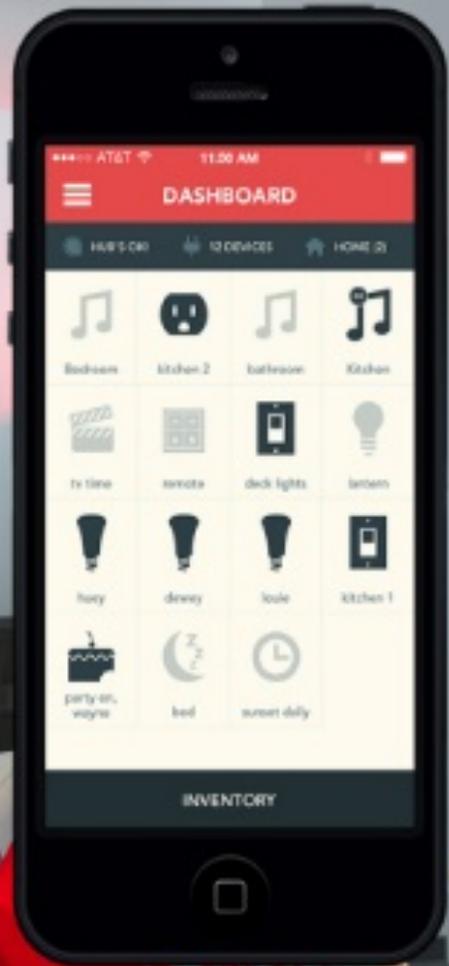
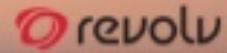
- Buildings and infrastructure are relatively stable

- Dynamic

- People and things generally move

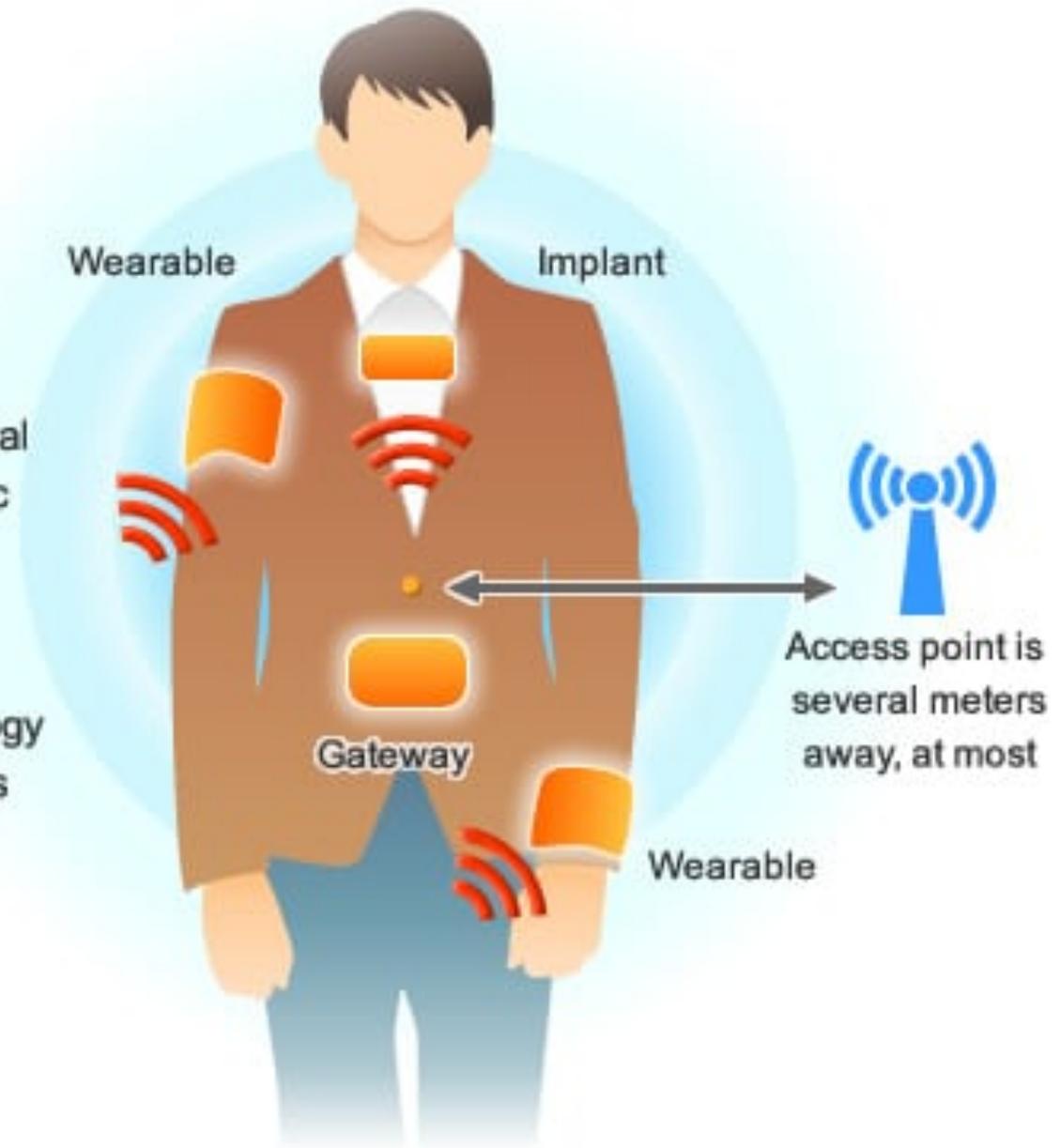


EXPERIENCE THE
UNIFIED CONNECTED HOME

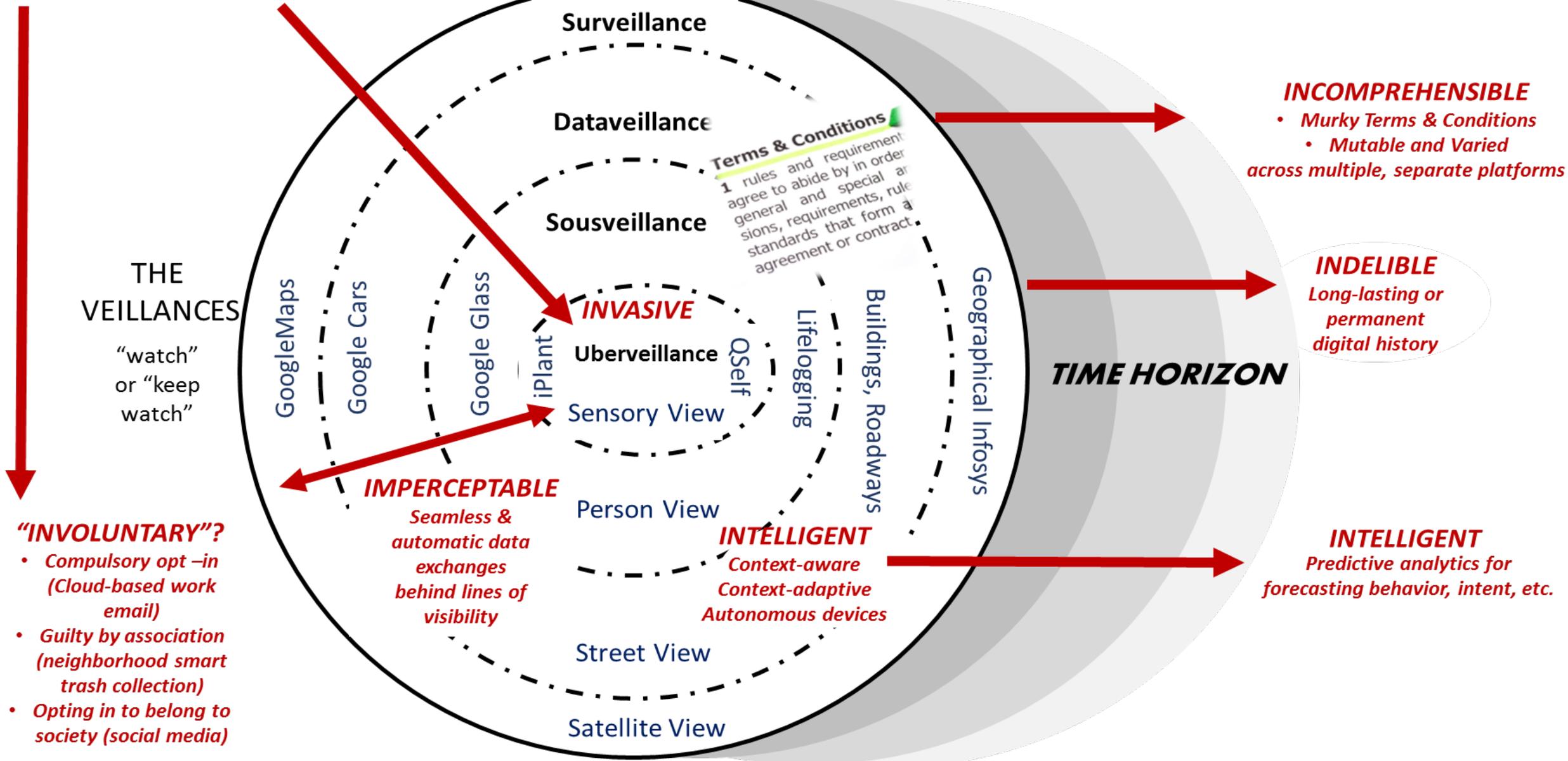


Body Area Network (BAN)

- Short-range wireless network for an individual
- Consists of wearable or implanted electronic devices that transmit ID or sensor data to a gateway device.
- Uses either electric-field, electric-current, or electromagnetic communication technology
- Connects to an external access point that is not more than several meters distant



SOCIETAL CONTEXT



"Etching Closer to UBERVEILLANCE", Michael, Michael & Perakslis, 2016

UBERVEILLANCE

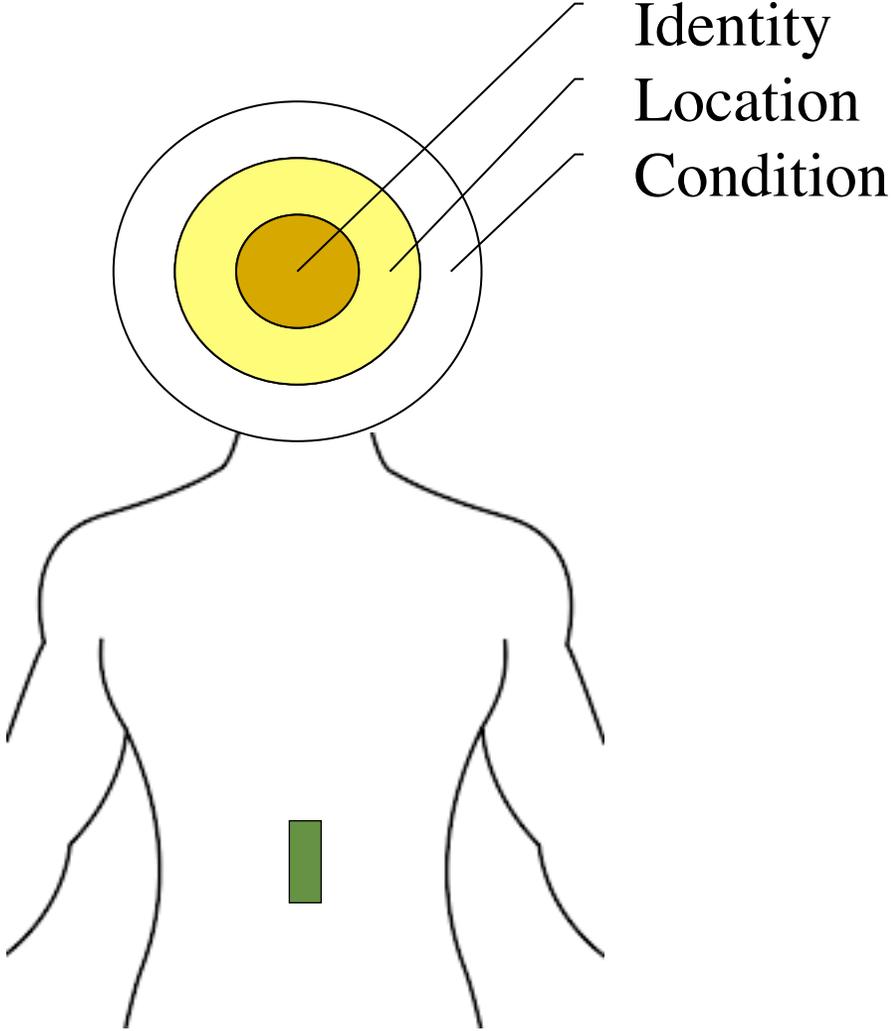
Embedded Surveillance Devices

<http://www.uberveillance.com>

- Coined by Dr M.G. Michael in 2006
- “Objects” are embedded inside “subjects”
- From iMac to iPod, from iPhone to iPad → iPlant
- Who (ID), where (location), what condition (physiological)?
- Related to situational awareness and predictive profiling
- All-seeing and all-knowing but context will always be missing



The Blackbox Beneath the Skin



PODCAST | Next Generation Defence Technologies | Fight Recorder

Welcome to the newly branded Next Generation Defence Technologies podcast series.

I'm Alison Caldwell and I work for Defence Science and Technology or DST. This podcast is about the work of DST's amazing scientists and their partners who are working together on emerging technologies for Defence under the Next Generation Technologies Fund.

The Next Gen Tech Fund is well into its second year, focusing on fundamental research and development of future game-changing concepts for Defence.

This podcast is about the Fight Recorder, a project being developed by DST in conjunction with two small startups, Myriota in Adelaide and iMeasureU in New Zealand.

It's being led by DST scientist Nick Beagley, the Program Lead of Enhanced Human



MORE INFO

PODCAST TYPE
Audio

PUBLISH DATE
September 2018

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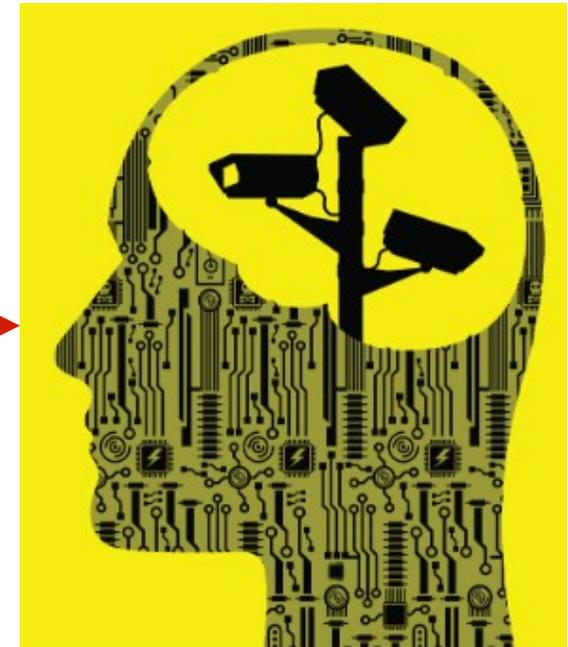
<https://www.dst.defence.gov.au/podcast/next-generation-defence-technologies-fight-recorder>

Hacking the Human Heart

- Physiological → Neurological

- Axis of Access

- Misinformation
- Misinterpretation of data
- Information manipulation



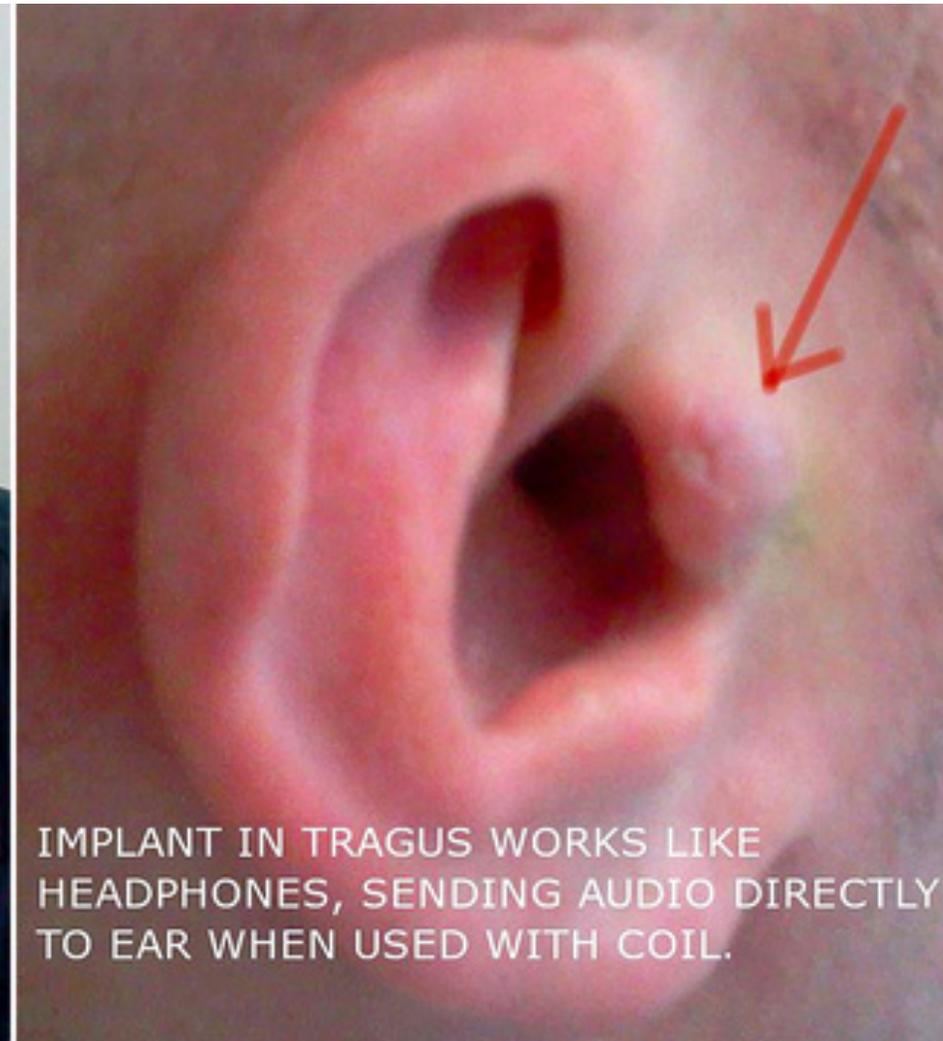
Courtesy of Bird Machine

KASPERSKY lab

THE SECURITY OF BIOHACKING

An open research project between Kaspersky Lab and BioNyfiken

Rich Lee's Insertables



Source: <https://www.gizmodo.com.au/2013/06/this-guy-has-an-invisible-headphone-implanted-in-his-ear/>

HOME

WHAT IS LOVETRON 9000?

CONTACT

Lovetron 9000

Join the next generation of high-tech intimacy and love-making.

Sign Up Today To Learn More

The future is waiting...

UKI (/yoo kee/) is an implantable NFC platform for identity, security, cryptography, and payment applications.

Security & Privacy



Transit ticketing



Openticketing

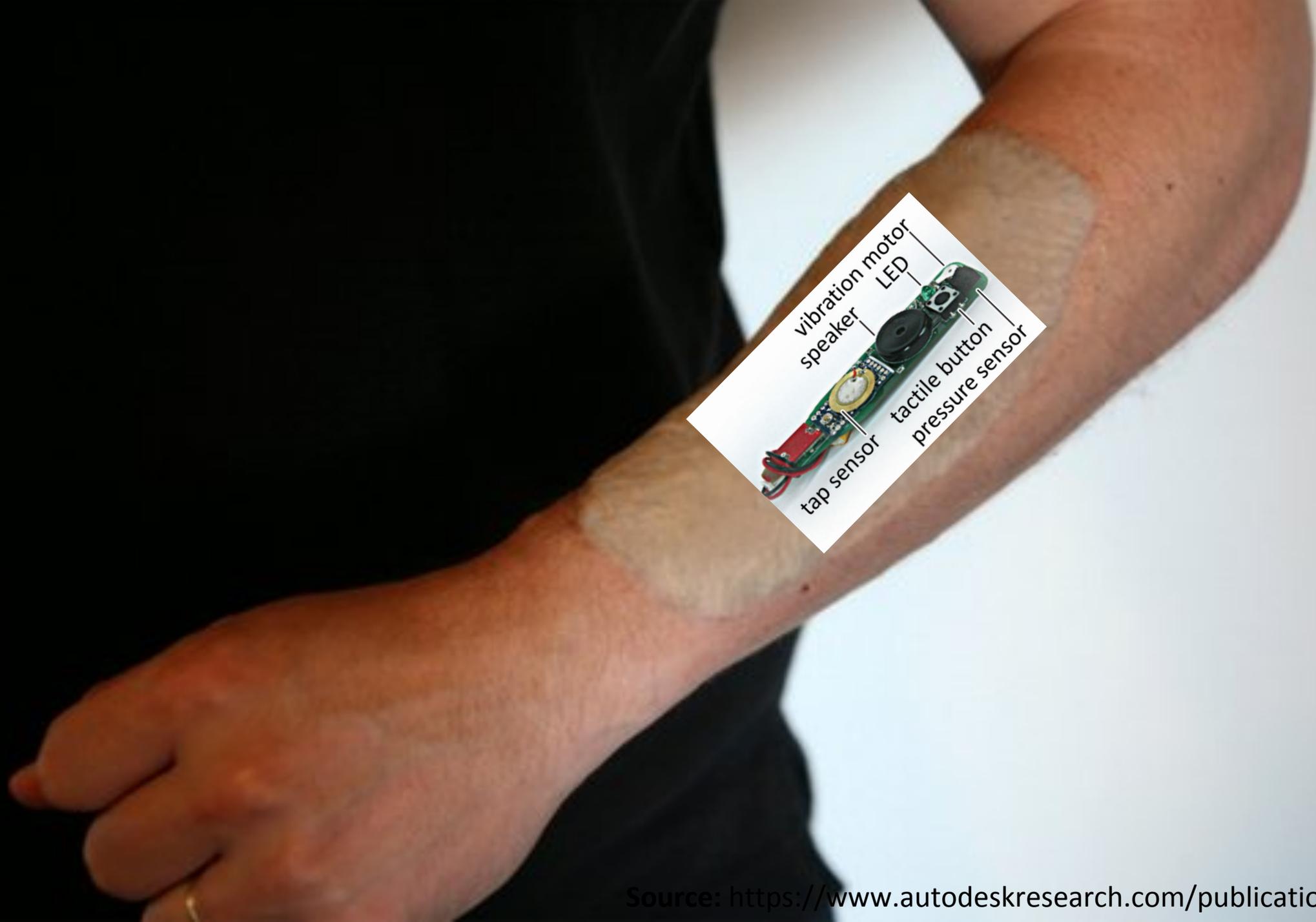


Bitcoins

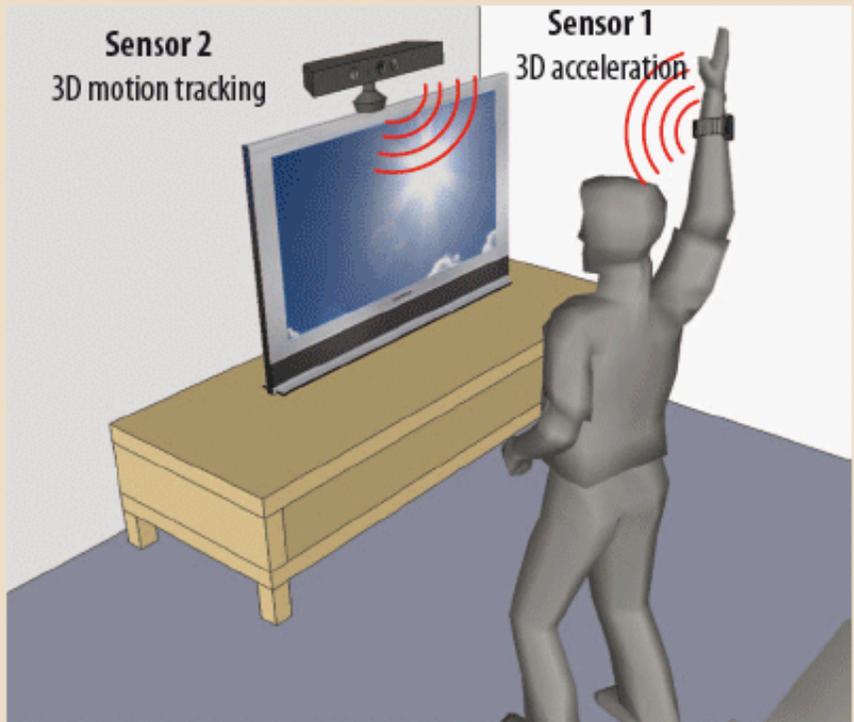


Access Control





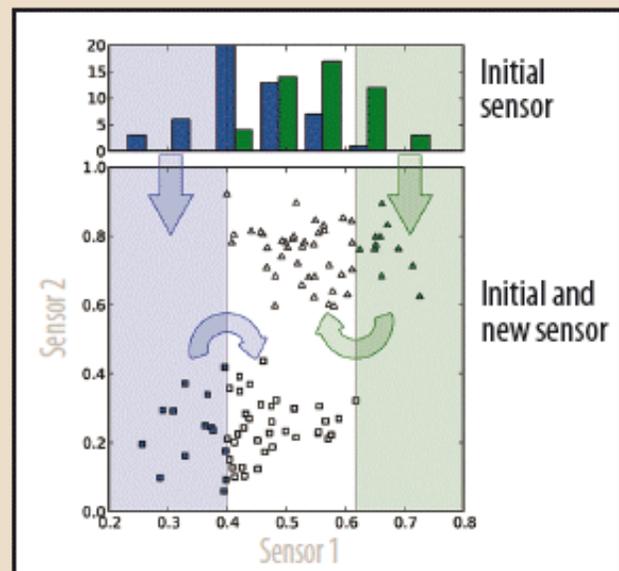
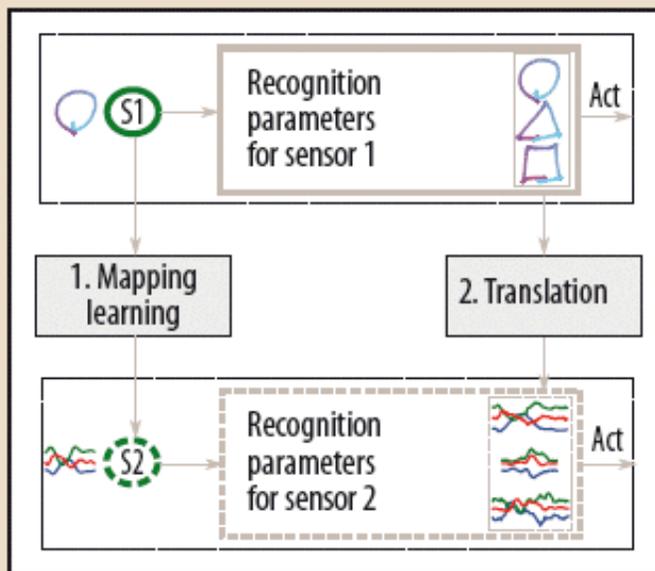
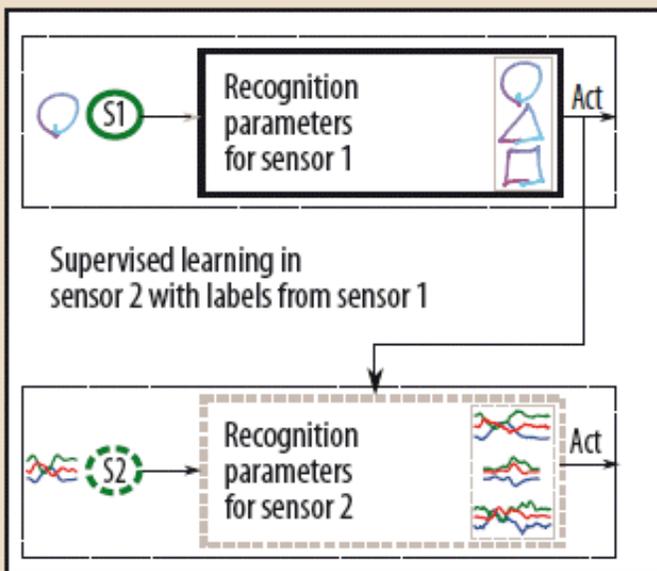
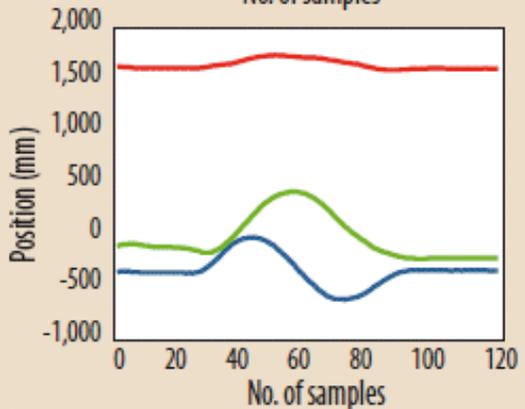
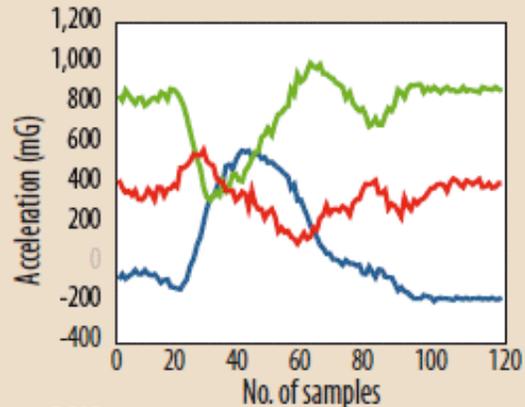
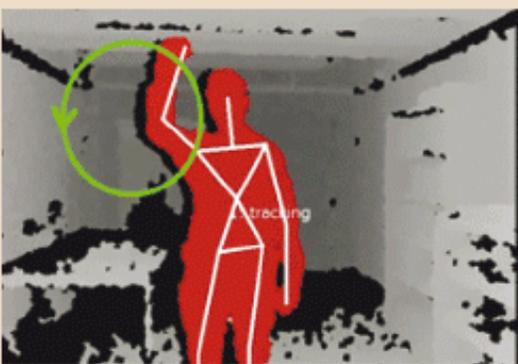
vibration motor
speaker
LED
tap sensor
tactile button
pressure sensor



S1: Acceleration



S2: Position

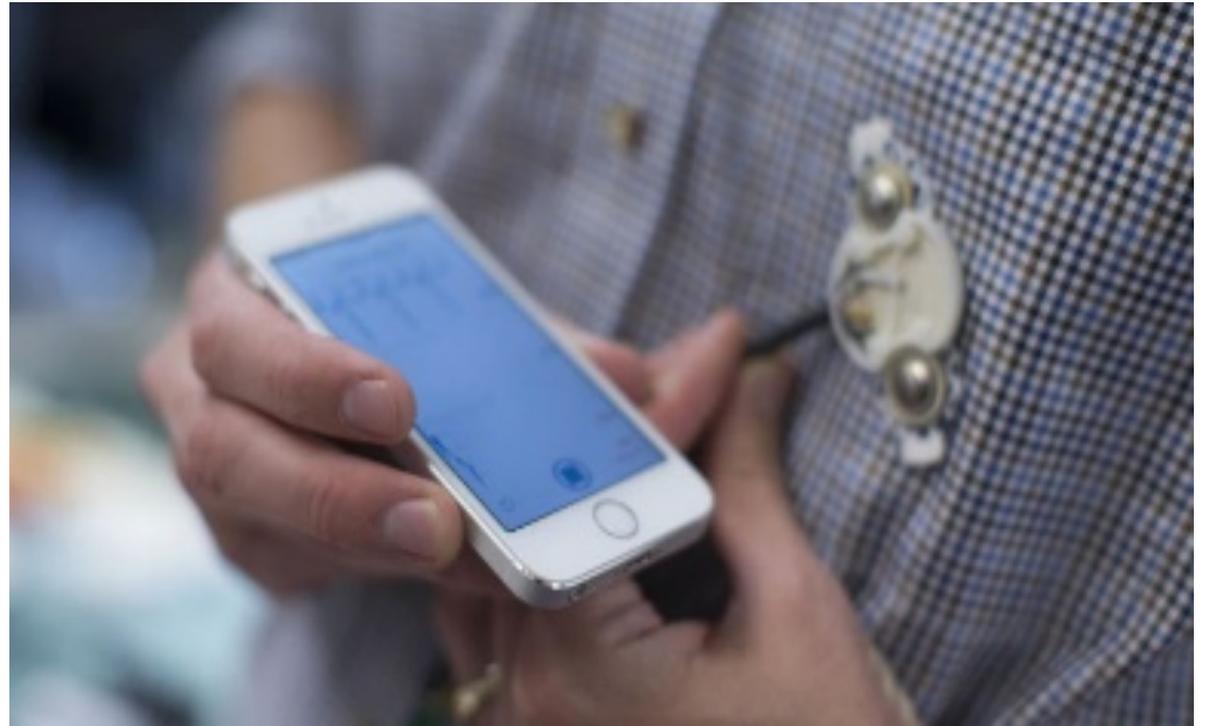


Source: <https://www.computer.org/csdl/mags/co/2013/02/mco2013020036.html>

Tethering Two Wearable (on body) Devices



<https://www.scansku.com/>



http://www.richmond.com/news/article_a4b118d5-65da-5399-bca8-c0661b6448b1.html



Daar heb je al wat gegevens.



VIVOKEY

Deep Brain
Neurostimulators



Cochlear Implants



Gastric
Stimulators



Cardiac Defibrillators/
Pacemakers



Foot Drop
Implants

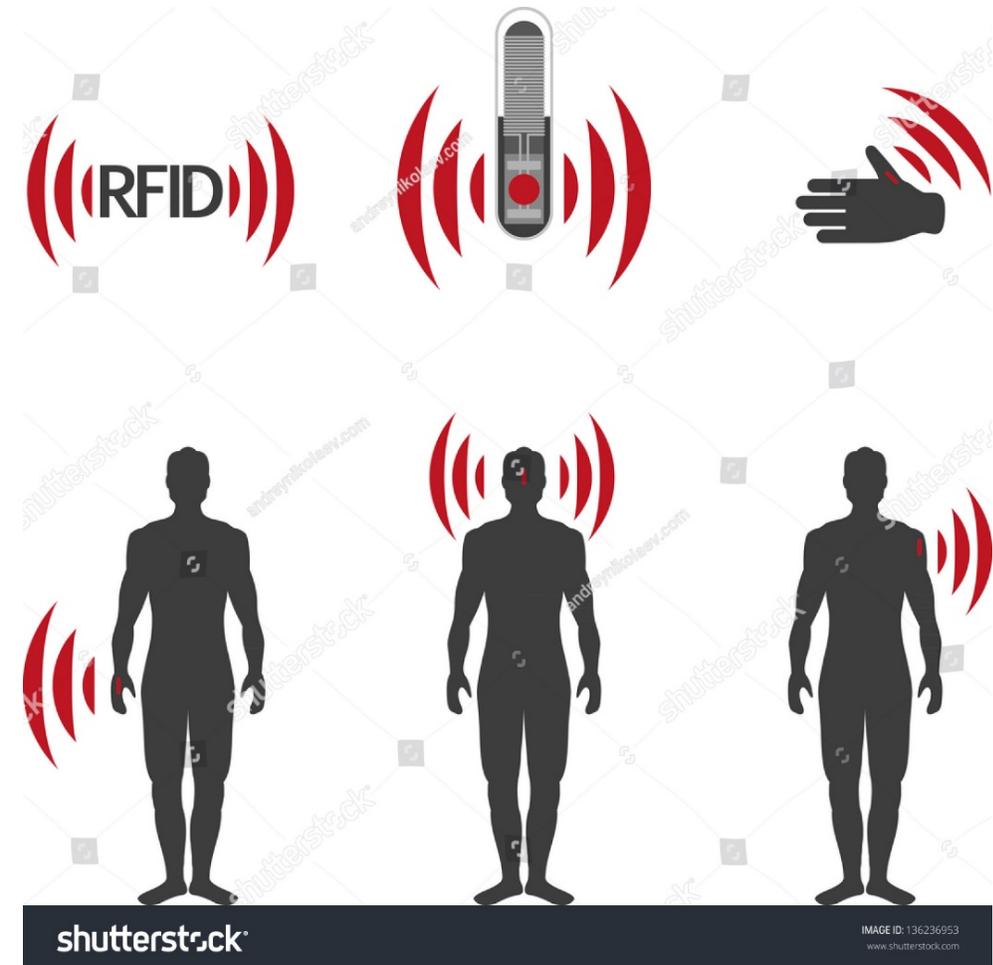
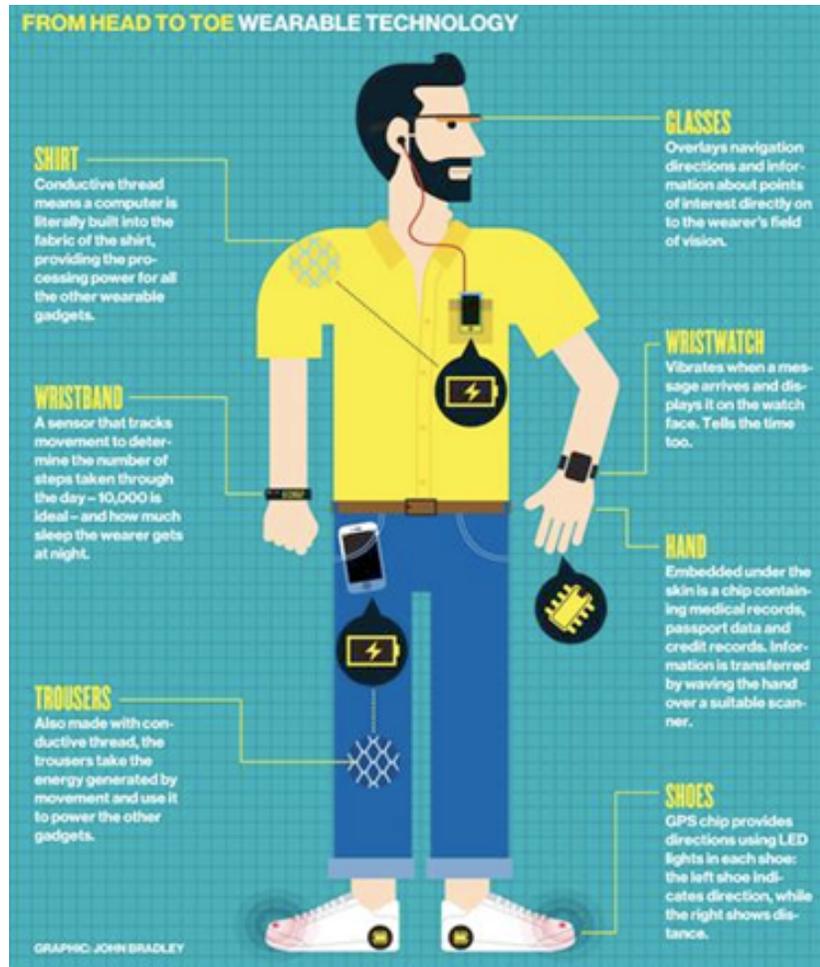


Insulin Pumps

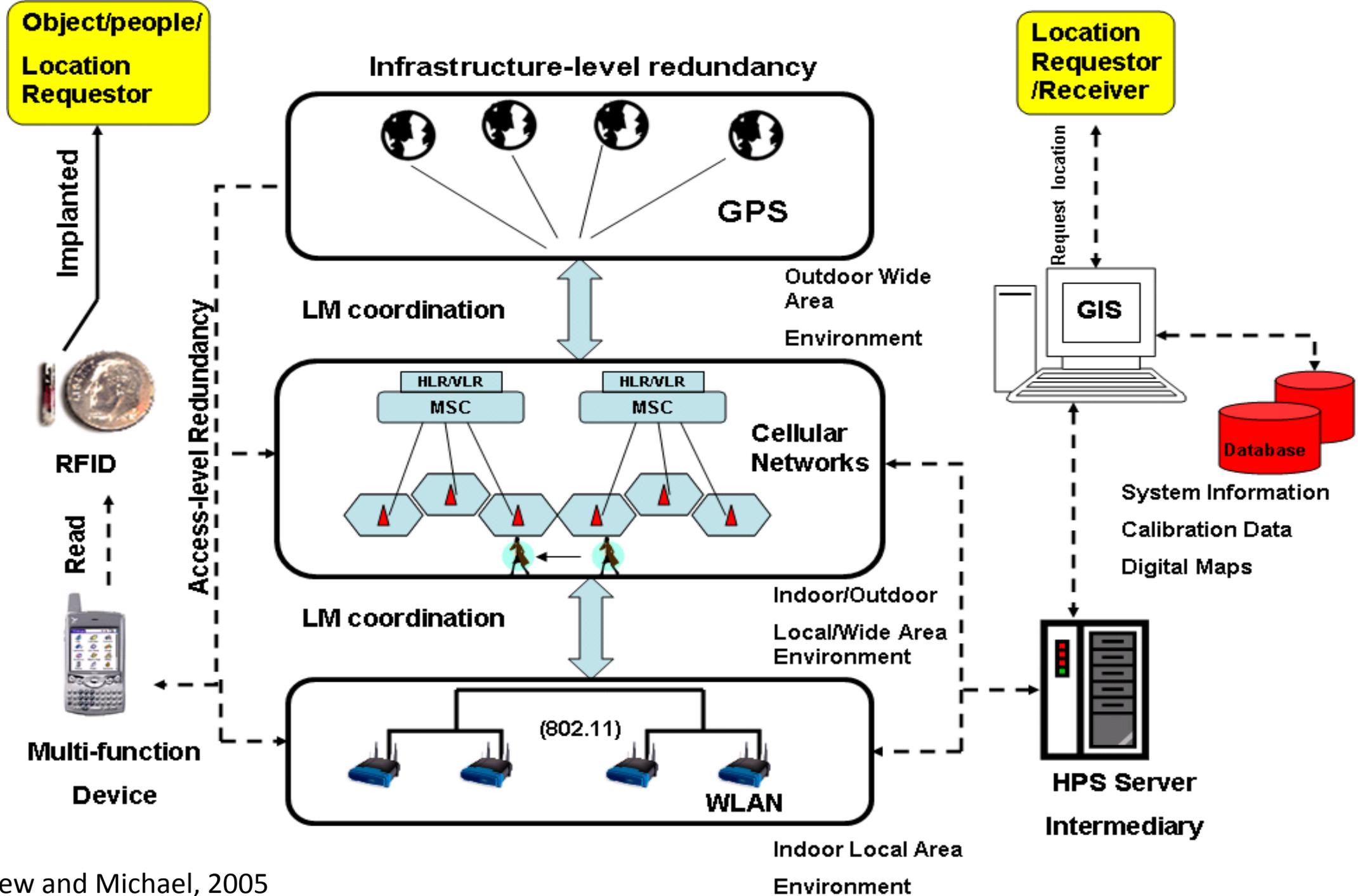


Source: <https://groups.csail.mit.edu/netmit/IMDShield/>

Rise of Electrophorus (K. Michael, 2002)

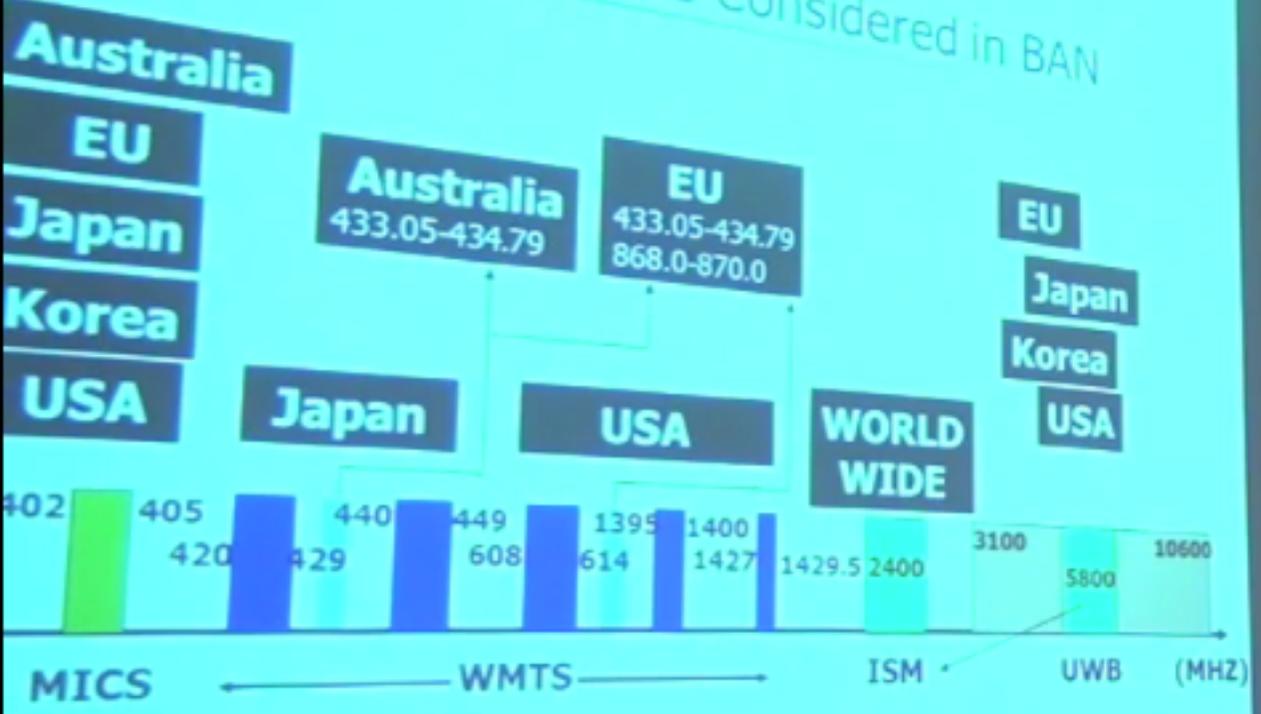


Michael, K., "The automatic identification trajectory: from the ENIAC to chip implants", in *Internet Commerce: digital models for business*, E. Lawrence et al., John Wiley and Sons, Queensland, pp. 131-134, 136 (2002).



Source: Chew and Michael, 2005

Frequency Bands Considered in BAN



Visualization of the Impact of an Aortic Valve Implant on Body Surface Propagation



Signal strength without
the valve implant

Signal strength with
the valve implant



IEEE 802.15.6 Standard

- The **IEEE 802.15.6 standard** is the latest international standard for Wireless Body Area Network (WBAN).
- WBAN supports a variety of real-time health monitoring and consumer electronics applications.
- The latest international standard for WBAN is the **IEEE 802.15.6 standard** which aims to provide an international standard for low power, short range, and extremely reliable wireless communication within the surrounding area of the human body, supporting a vast range of data rates for different applications.
- Short-range, wireless communications in the vicinity of, or inside, a human body (but not limited to humans) are specified in this standard. It uses existing industrial scientific medical (ISM) bands as well as frequency bands approved by national medical and/or regulatory authorities. Support for quality of service (QoS), extremely low power, and data rates up to 10 Mbps is required while simultaneously complying with strict non-interference guidelines where needed.
- This standard considers effects on portable antennas due to the presence of a person (varying with male, female, skinny, heavy, etc.), radiation pattern shaping to minimize the specific absorption rate (SAR) into the body, and changes in characteristics as a result of the user motions.

Telemetry of War (Martin Libicki, 1996)

- Information toward the production of operational intelligence is a function of knowledge about...
 - **where** is the opponent's troops, their weaponry, their industry
 - **what** is the opponent's troop level of capability in terms of firepower and training
 - **who** is the chief decision-maker that controls the movement and actions of the opponent's troops
 - **when** will the opponent's troops or weapons go into action; and
 - **why** is the opponent motivated to conduct such hostilities and,
 - **how** can we influence their actions toward our desired outcome.

R.E. Burnett, The Human Information Appliance in Combat, Intelligence, and Diplomacy Space (2013)

<https://ieeexplore.ieee.org/document/6524126>



Medtronic Wants to Implant Sensors in Everyone

By [Eliza Strickland](#)

Posted 10 Jun 2014 | 13:00 GMT



“Brain Implants in the Military”
2016 Workshop followed by
Special Issue in *IEEE Technology
and Society Magazine*, 2017

*IEEE Transactions on Technology
and Society* (2pp, 6pp, 10pp)

SCIENCE

DARPA teams begin work on tiny brain implant to
treat PTSD

By [Adrienne Jeffries](#) | [@adrieffries](#) | May 28, 2014, 12:59pm EDT
Source [DARPA](#)



Humans and Limits

- **“I question if technology has progressed to the point where the human condition is now the limiting factor — physically and psychologically.”**
 - <https://technologyandsociety.org/implantable-technologies-in-the-military-sector/>

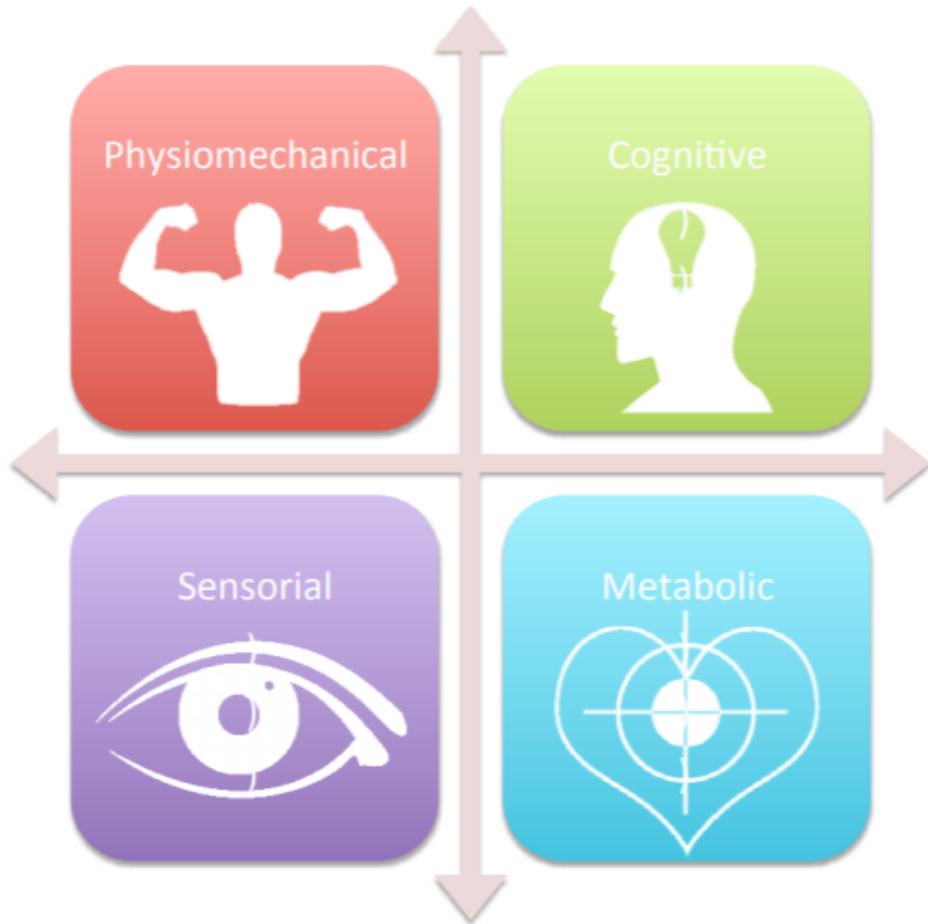


From C3 – C9: Command, Control and Communications and...

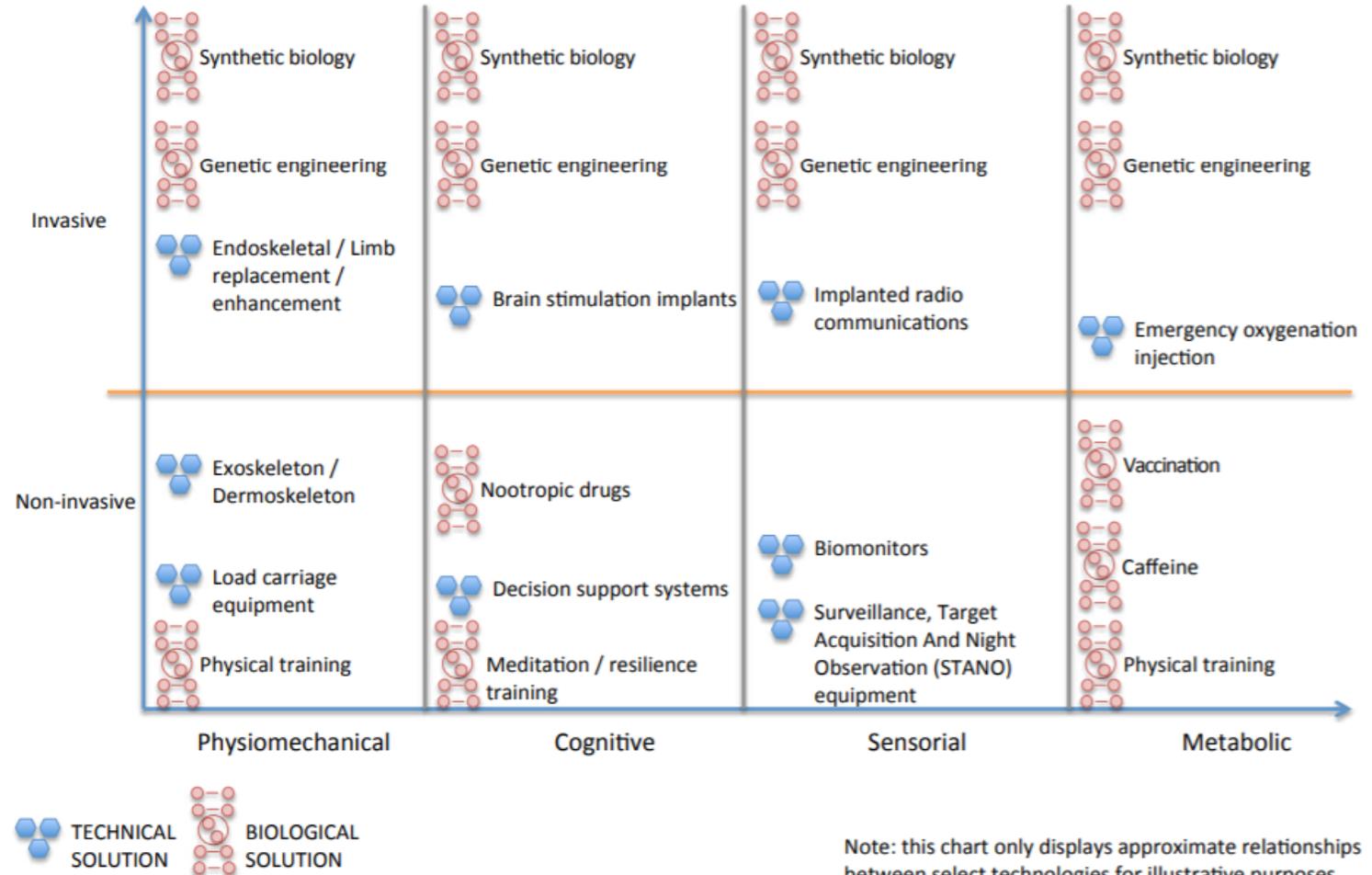
- **C4 is Cyber security** — if we embrace C3, we then also need to ensure that implantable technologies-and their hosts — are secure, especially from cyber-attacks.
- **C5 is Capability** — what is the real capability we are trying to build in the military context; a super-athlete, a super-spy, etc.? This raises a myriad of ethical questions relative to intent.
- **C6 is Capacity/Condition** — there must be a “body solution” to match the technology solution. Having been “enhanced” by the implantable, does the “human appliance” (as R.E. Burnett described the host) have the physical capacity (body strength, muscle tone, etc.) and mental condition to perform to the expectations expected to achieve the mission. If not, this could give rise to CSD beforehand, failure during operation (through physical exhaustion or mental stress), or PTSD post-event.
- **C7 is Consideration (or Consciousness)** — where C6 addresses the “body solution,” C7 addresses the “personality solution.” Is the “human appliance” a good match for the implantable and the intended result?
- **C8 is Compromise** — what level of freedom (i.e., autonomy) is given to the “human appliance” to exercise judgement over the effects (and commands) of the implantable?
- **C9 is Confidence** — the “human appliance” must have confidence in oneself and confidence in the technology of the implantable to achieve the tasked mission, which plays back to vulnerability and the superhero mentality (i.e., C4, C5, and C6).

Extending our Limits

Personal Augmentation Domains



Overview of Personal Augmentation

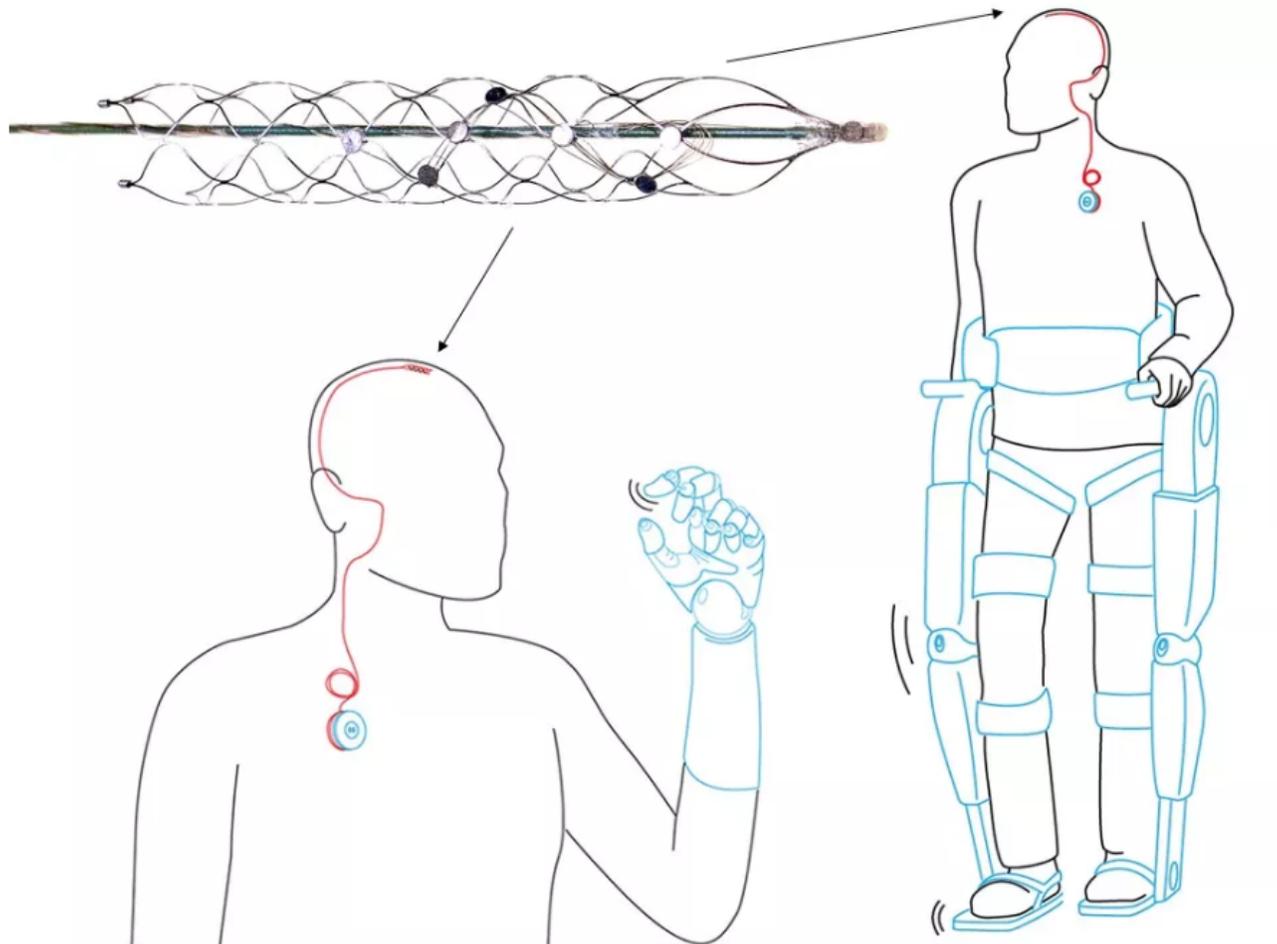


Note: this chart only displays approximate relationships between select technologies for illustrative purposes

Synchron

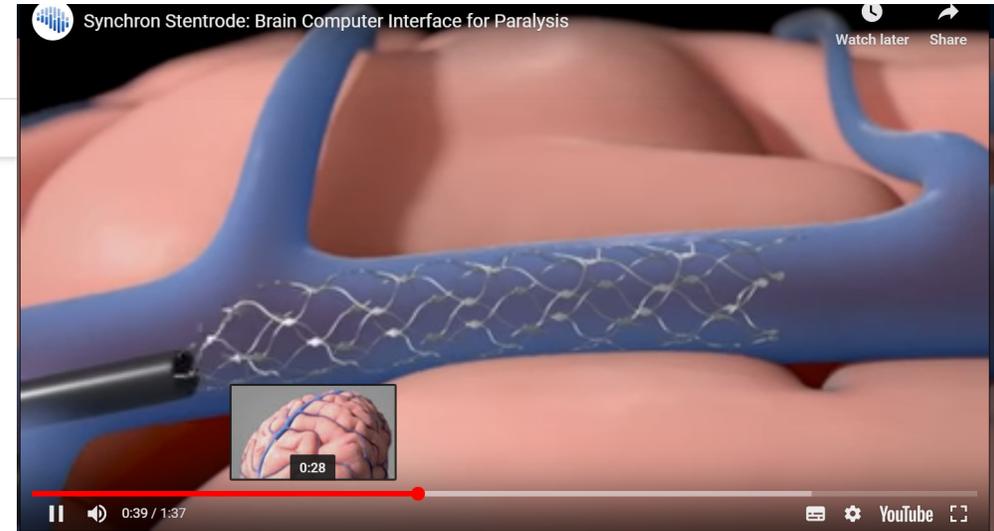
PURSUIT

Melbourne's medicine, science, veterinary science and engineering faculties.

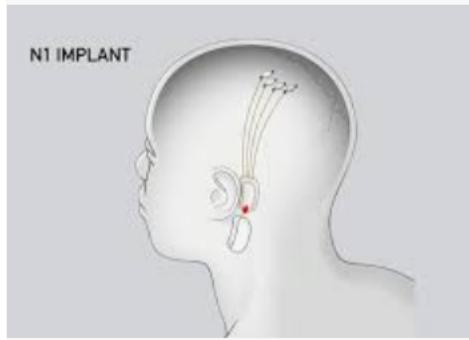


The stentrode can record brain signals from within a blood vessel next to the brain. These thoughts are captured, decoded and passed wirelessly through the skin to enable control of an exoskeleton.

<https://pursuit.unimelb.edu.au/articles/moving-with-the-power-of-thought>



Neuralink



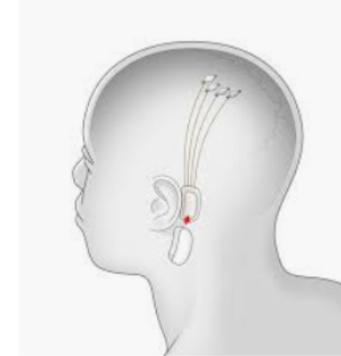
Elon Musk says Neuralink plans 2020 ...
cnet.com



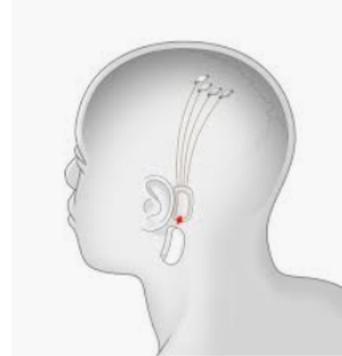
Elon Musk unveils Neuralink's plans ...
theverge.com



Neuralink - Wikipedia
en.wikipedia.org



begin outfitting human brai...
techcrunch.com



begin outfitting human brai...
techcrunch.com



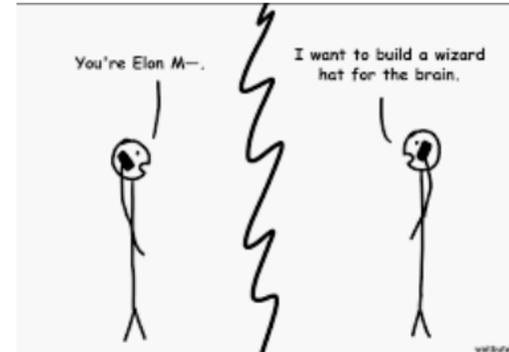
Elon Musk's Neuralink is building t...
thenextweb.com



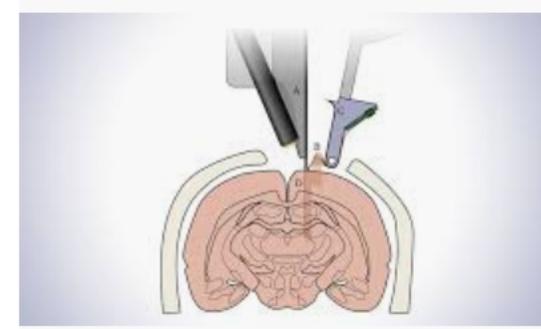
Elon Musk's Neuralink hopes to put ...
engadget.com



Elon Musk unveils Neuralink's ...
theverge.com



Neuralink and the Brain's Magical ...
waitbutwhy.com



Elon Musk's Neuralink to detail ...
cnet.com

“Neuralink didn’t come out of nowhere, there’s a long history of academic research here,” Hodak said at the presentation on Tuesday. “We’re, in the greatest sense, building on the shoulders of giants.” However, none of the existing technologies fit Neuralink’s goal of directly reading neural spikes in a minimally invasive way.

The system presented today, if it’s functional, may be a substantial advance over older technology. BrainGate relied on the [Utah Array](#), a series of stiff needles that allows for

up to 128 electrode channels. Not only is that fewer channels than Neuralink is promising — meaning less data from the brain is being picked up — it’s also stiffer than Neuralink’s

threads. The threads have flexibility: the brain shifts in the skull but the



Neuralink’s system embedded in a laboratory rat. |
Image: Neuralink

IEEE Neuroethics Framework

Recording/
Sensing

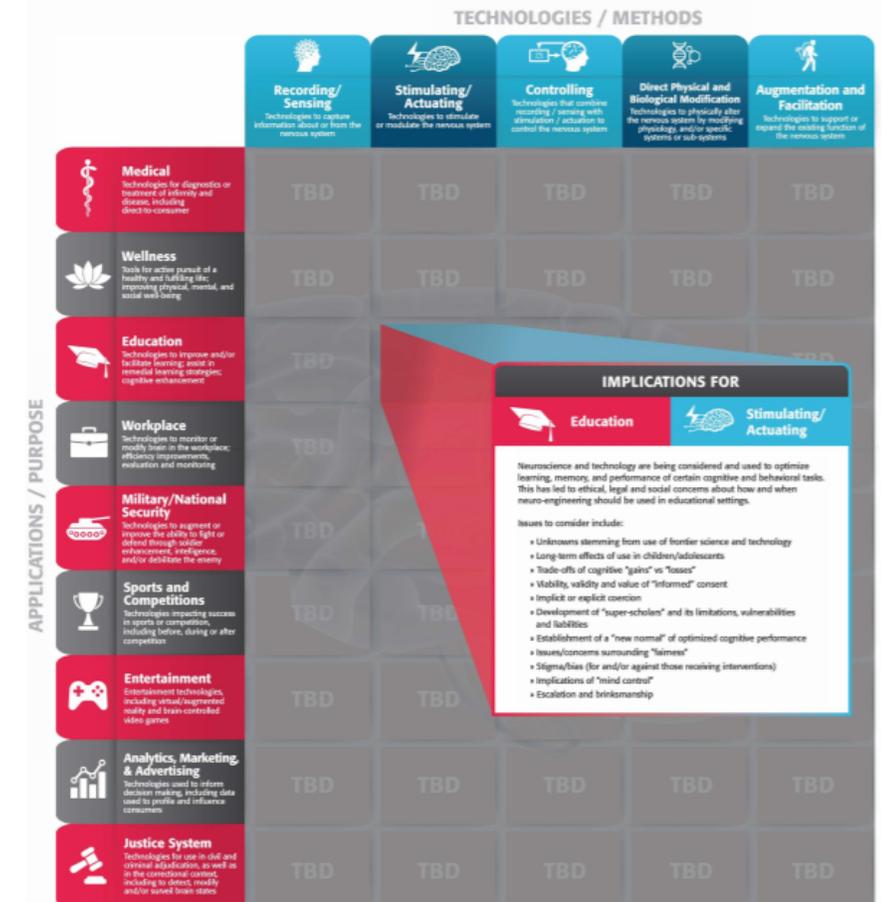
Stimulating/
Actuating

Controlling

Direct Physical/Biological
Modifications

Augmentation &
Facilitation

- Medical
- Wellness
- Education
- Workplaces
- Military/National Security
- Sports and Competitions
- Entertainment
- Analytics, Marketing & Advertising
- Justice Systems



<https://brain.ieee.org/publications/ieee-neuroethics-framework/>

Conclusion

- World rapidly evolving
- People thinking 'beyond'
- Companies investing
- Techno-utopianism
- Techno-fixes
- Inequality and skills gap widening
- People are necessary
- Autonomy IS important
- A new protocol/handshake required
- Many unknowns
- Opportunities, risks & realities

Hybrid Assessment Model	
Legitimate military purpose	the enhancement must be in support of a legitimate operational objective
Necessity	an enhancement's use must reasonably be expected to be necessary in order to achieve an objective
Benefits outweigh the risks	the operational benefits, as well as those to the warfighter, must outweigh the risks the enhancements pose
Maintenance of dignity	the enhancement must be implemented and operate in such a manner as to ensure that the warfighter may continue to live and operate in a manner that does not negatively affect his or her self-esteem
Minimization of burdens	the long-term burdens to the soldier must be minimized. Ideally, this requires enhancements to be reversible
Consent	candidates for enhancement must be volunteers and properly informed of the nature of the procedures to be undertaken, their effects, and long term consequences
Transparency	although security considerations may prevent the disclosure of the details relating to human enhancement, its pursuit should be disclosed to the public so as to ensure their understanding of the procedure's necessity and ensure that appropriate oversight is maintained
Fair distribution of risks and benefits	where possible, enhancements should be equitably distributed to ensure that no advantage is conferred in such a manner as to be deemed unfair by the greater military community, thereby adversely affecting morale, cohesion, and operational effectiveness
Chain of command accountability:	the chain of command must be held accountable for the processes that implement soldier enhancements so as to prevent abuses

Backup

- Focus on individual, human machine operator who is enhanced technologically (black box recorder, feedback loops, wearables, implantable, etc.)
- Human in the loop vs. human out of the loops
- Looking at cross overs between surveillance of individual and how that affects their decision making, as opposed to their reliance on devices
- Evolutionary change in next 20-30 years, process of consent, what does it mean, what do we gain access to?
- Autonomy of individuals - their human rights - can we have autonomy when they have interactions with devices
- How do devices alter people's decisions