Stone Age of the Internet of Things

Dr. Francine Berman
Chair, Research Data Alliance / United States
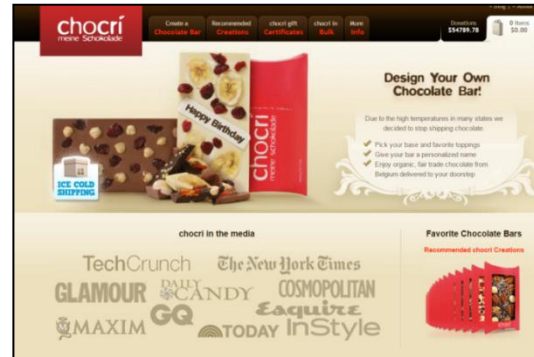Hamilton Distinguished Professor, RPI

Francine Berman

Internet of Things Vision: Empower People Through Technology and Technology Through Intelligence
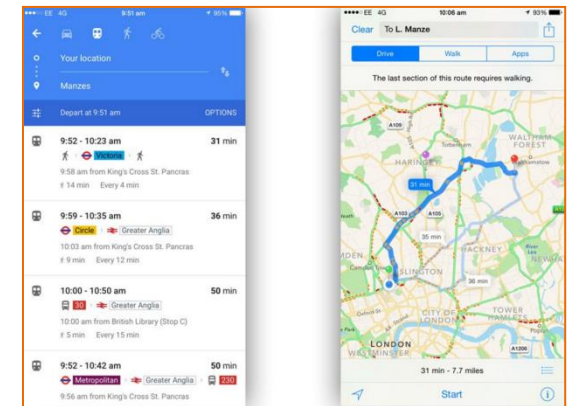

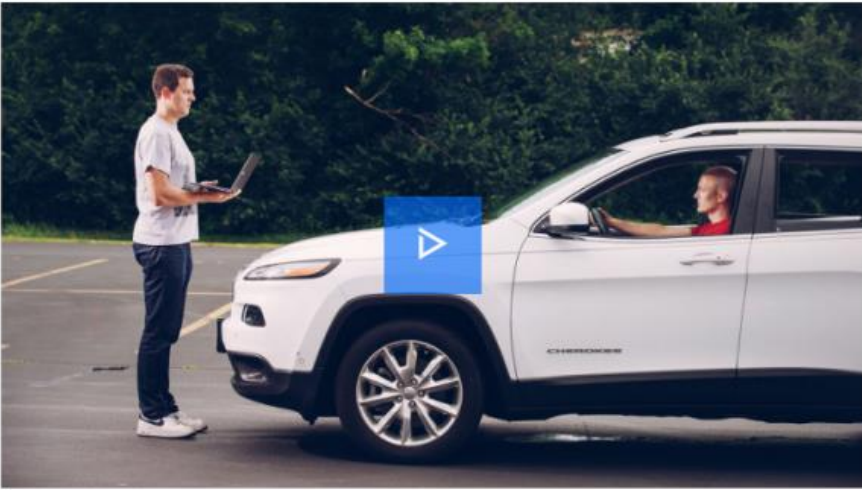Adaptive Systems

Customization / Personalization

Monitoring

Smart Technologies

Optimization

Who Makes the Rules in the IoT?

ANDY GREENBERG SECURITY 07.21.15 6:00 AM

HACKERS REMOTELY KILL A JEEP ON THE HIGHWAY—WITH ME IN IT

I WAS DRIVING 70 mph on the edge of downtown St. Louis when the exploit began to take hold.

Though I hadn't touched the dashboard, the vents in the Jeep Cherokee started blasting cold air at the maximum setting, chilling the sweat on my back through the in-seat climate control system. Next the radio switched to the local hip hop station and began blaring Skee-lo at full volume. I spun the control knob left and hit the power button, to no

SHARE

FOCUS ON BUSINESS. WE HAVE AZURE COVERED.

OPINION BY PRESTON GRALLA

It's time to regulate baby monitors

The internet can survive nuclear war, but not toasters and sma[...] to act on the dangers of the IoT now.

Don't Let Your Business Expire With Theirs

By Preston Gralla · Follow
Contributing Editor, Computerworld | Nov 2, 2016 4:00 AM PT

Credit: Thinkstock

The internet was designed to withstand a nuclear attack. But its creators never imagined that baby monitors, toasters and smart TVs could bring it to its knees. We need to make sure that the devices that make up the internet of things can't be used in the kind of attack that almost broke the internet late last month.

USA TODAY

NEWS SPORTS LIFE MONEY TECH TRAVEL OPINION 76° CROSSWORDS WASHINGTON VIDEO STOCKS APPS MORE

Alexa or not, voice-activated device called 911 during violent domestic dispute

John Bacon, USA TODAY Published 10:41 a.m. ET July 11, 2017 | Updated 3:29 p.m. ET July 19, 2017

POPULAR STORIES

Secret donations are helping to boost President Trump's agenda, fights with investigators
usatoday.com | 20 hours ago

Articles: https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highwayhttp://www.computerworld.com/article/3137472/internet-of-things/it-s-time-to-regulate-baby-monitors.html; https://www.usatoday.com/story/news/nation/2017/07/11/voice-activated-call-hails-911-during-violent-domestic-dispute/467199001/

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UNITED STATES

Realizing the vision of the IoT: Social rules and governance

- **Social rules help address:**

  - What is appropriate and inappropriate behavior? What happens as a consequence of inappropriate behavior?

  - What is the public good? Whose responsibility is it to promote the public good?

  - Who defines and enforces community and individual rights?

  - Who adjudicates conflicts and how?
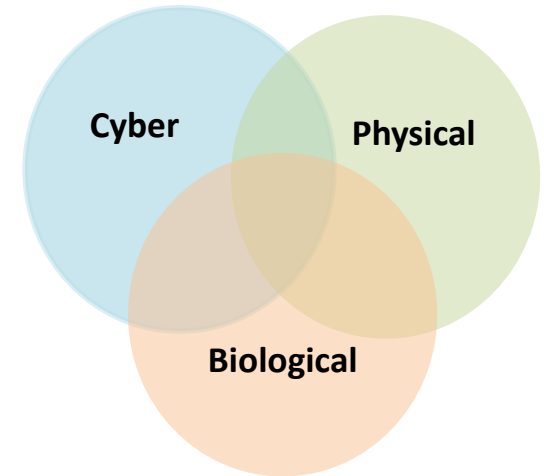
IoT rules will need to encompass all entities in the IoT
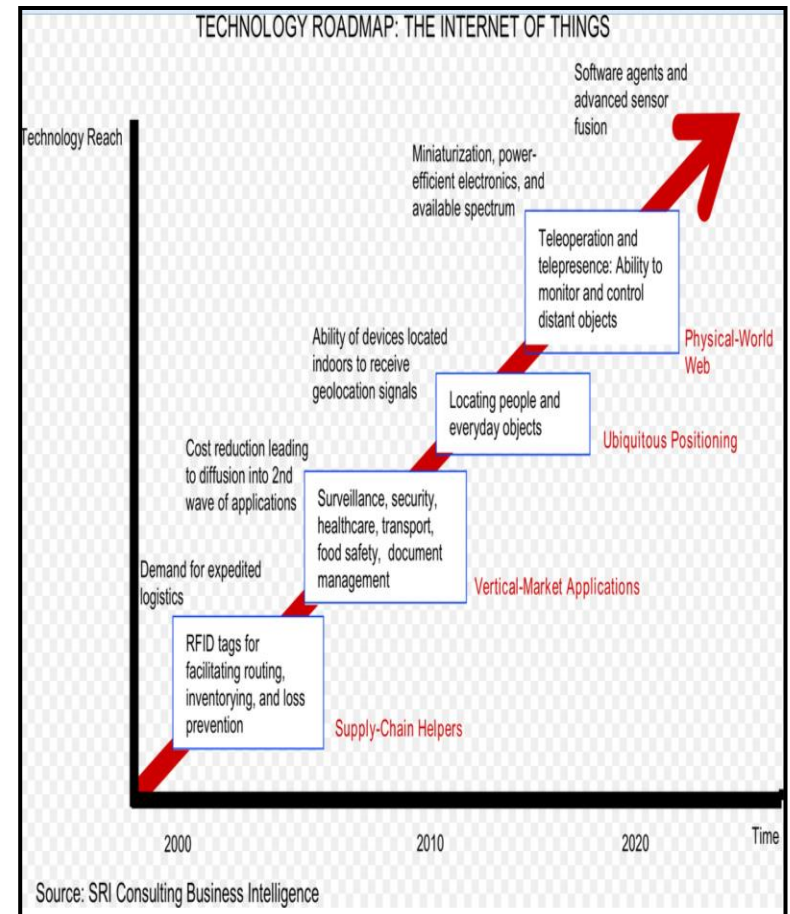
- **What does government do?**

  - Government "is a political system by which a country or region is managed or controlled. The government is in charge of creating and regulating laws, managing the economy and enforcing policies." [Reference.com, https://www.reference.com/government-politics/government-f228d84d469d2f4c]

IoT Governance Structure will need to cover a lot of ground

- IoT will increasingly blend cyber systems, the physical / natural environment, and humans / biological systems.
    - Social rules will be needed that apply to all entities

- Governance structures will include policy, regulation, community practice

- Social structures need to evolve *with* technology but not limit innovation; **the time for national-scale discussion and the initial development of social and governance structures for the IoT is** *now*

TECHNOLOGY ROADMAP: THE INTERNET OF THINGS

Technology Reach

Software agents and advanced sensor fusion

Miniaturization, power-efficient electronics, and available spectrum

Teleoperation and telepresence: Ability to monitor and control distant objects

Ability of devices located indoors to receive geolocation signals

Locating people and everyday objects

Physical-World Web

Ubiquitous Positioning

Cost reduction leading to diffusion into 2nd wave of applications

Surveillance, security, healthcare, transport, food safety, document management

Demand for expedited logistics

RFID tags for facilitating routing, inventorying, and loss prevention

Vertical-Market Applications

Supply-Chain Helpers

2000   2010   2020   Time

Source: SRI Consulting Business Intelligence

Graph (public domain): en.wikipedia.org/wiki/Internet of Things#/media/File:Internet_of_Things.png

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What Would Governance Mean for the IoT?

Adapting the *World Governance Index* (based on the UN Millennium Declaration), critical themes for governance span key areas. In all instances, coordination of technical and social approaches needed
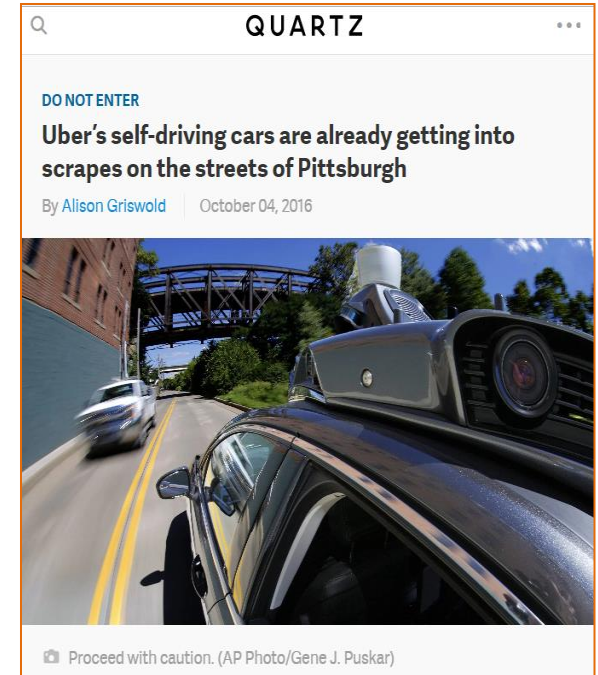
WGI Theme		IoT Areas Where Governance Structures Needed
Peace and Security	→	IoT Security, Trust, Safety, Crime
Democracy and Rule of Law	→	Legal framework for determining appropriate and inappropriate behavior
Human Rights and Participation	→	IoT "Bill of Rights"? – Right to Privacy, Right to control information, Right to opt out, etc. Framework for promoting "equality" and penalizing "discrimination"
Sustainable development	→	Architectures, standards, policy, infrastructure, etc. to promote evolutionary and sustainable growth
Human development	→	Digital ethics, use of technology to advance / actualize its participants and contribute to well-being

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Responsibility and Accountability in the IoT

QUARTZ

DO NOT ENTER
Uber's self-driving cars are already getting into scrapes on the streets of Pittsburgh

By Alison Griswold | October 04, 2016

Proceed with caution. (AP Photo/Gene J. Puskar)

Increasing autonomy brings questions of responsibility, accountability, privacy:

- Who is accountable when your self-driving car hits someone?

- What policy / regulation / rights are needed in a "car - net" environment where vehicles communicate with one another to make autonomous / group decisions?

- How should autonomous systems decide between multiple bad options?

Image from http://www.businessinsider.com/apple-catastrophically-late-to-self-driving-car-game-2017-4 Eric Risberg; article from https://qz.com/798092/a-self-driving-uber-car-went-the-wrong-way-on-a-one-way-street-in-pittsburgh/

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How should we effectively regulate autonomous systems to benefit individuals, organizations, and society?
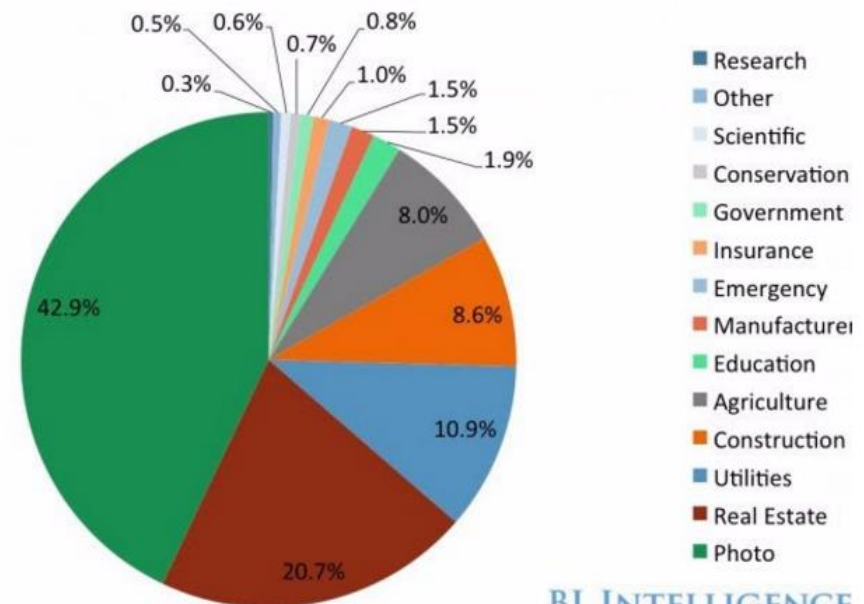
States with bills about self-driving vehicles
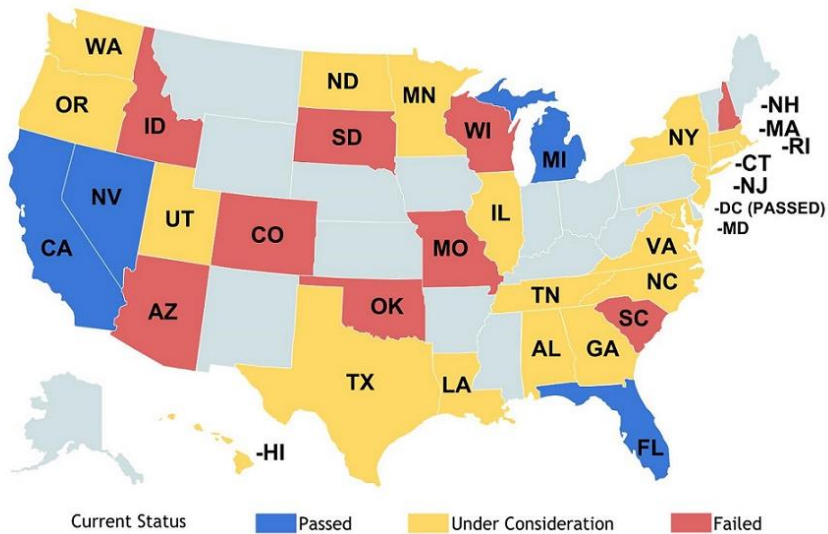
http://cyberlaw.stanford.edu/wiki/index.php/Automated_Drivir
gislative_and_Regulatory_Action

Top Industries Using Drones
% Of Section 333 Exemptions Issued in US

Source: FAA, The Verge Drone Project, 2015

BI INTELLIGENCE

http://www.roboticstomorrow.com/news/2016/04/06/ieee-standards-
association-introduces-global-initiative-for-ethical-considerations-in-the-
design-of-autonomous-systems/7917/

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Openness and Privacy

- Who should control / access information about you?

- What are your rights to:
    - The data you generate?
    - The data that is generated about you?
    - Other people's data?

- Who should be able to view/use your data and data about you (and under what circumstances)?
    - Companies? Bots? The Government?
    - In an emergency? When a crime is suspected? Any time?

- When should the public good be more important than individual privacy?

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Rights

- **What should your rights be in the IoT?**

  – Right to be forgotten?

  – Right to privacy?

  – Right to delete your data?

  – Right to opt out?

  – Right to prevail over the behavior / intention of autonomous systems?

- **How would we enforce these rights in practice?**
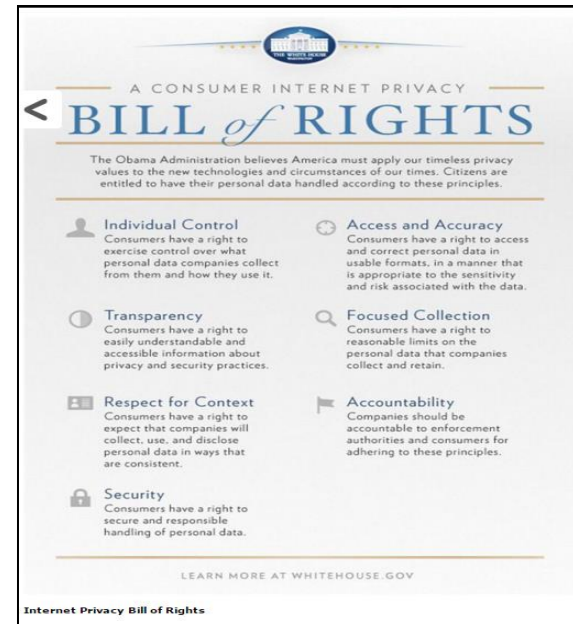
Can you opt out of the IoT?

- More environments will use **surveillance, monitoring, on-line access** to operate, customize experience, keep us safe, drive efficiency / profitability, etc.

  – What happens when environments are monitored by default?

  – What happens when services, products are only available through the IoT?

Which Decisions Should be Made by Technology?

- IoT autonomous systems will increasingly manage behavior in the background

- Which decisions should be made by technology and when should there be a human in the loop?

  - Whose interests should systems represent?

  - Who is accountable for decisions made by autonomous systems?

- How do we ensure that autonomous systems don't limit our choices?

Internet fridge. Photograph: PR

https://www.theguardian.com/science/alexs-adventures-in-numberland/2014/sep/08/when-fridges-attack-the-new-ethics-of-the-internet-of-things

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Who prevails -- humans or robots?
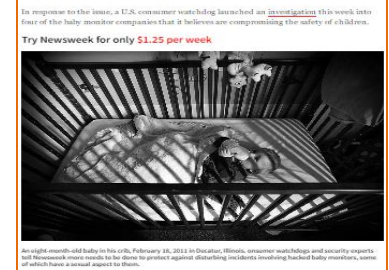## Asimov's Rules for Robots

Over 50 years ago, Isaac Asimov introduced
laws of robotics:

0.   A robot may not harm humanity, or,
by inaction, allow humanity to come to harm.

1. A robot may not injure a human being or,
through inaction, allow a human being to come to harm.

2. A robot must obey the orders given it by human beings except where such
orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not
conflict with the First or Second Laws.
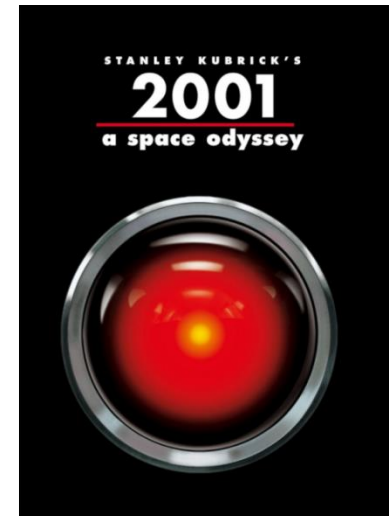
**When should human rights prevail over the rights of technological systems?
How do we regulate / enforce this?**

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Technology has no ethics: It's up to humans to develop systems and social structures needed to make the most from technology

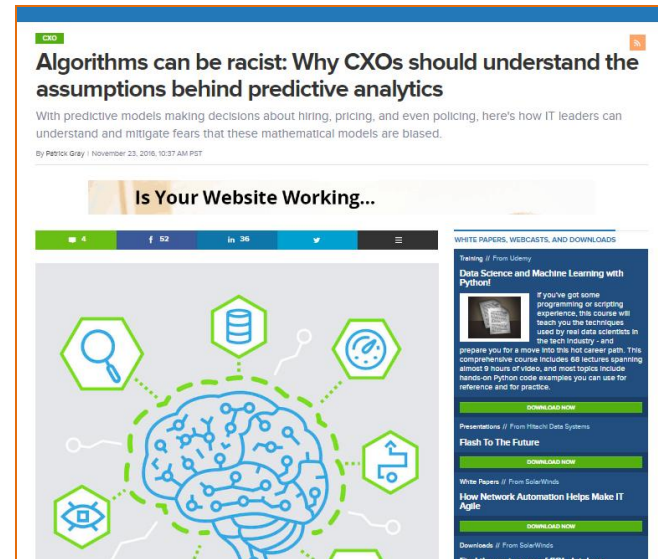http://contractingbusiness.com/residential-hvac/email-still-best-social-network-marketing-tool
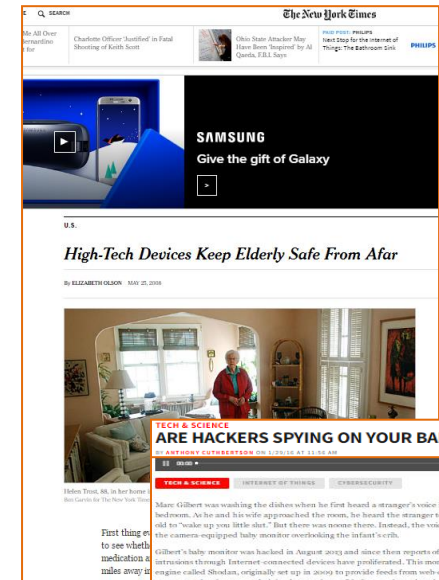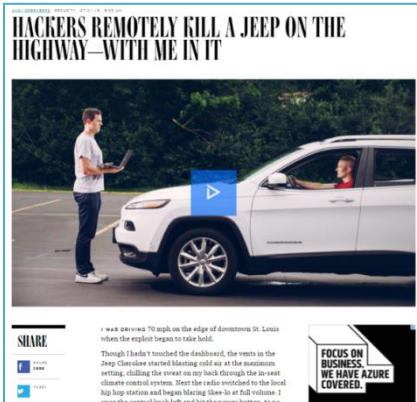
IoT Ethics

- How do we **design technology** to make / support ethical choices? Do we need *artificial ethics technologies* to complement artificial intelligence?

  – Whose ethics should they be?

- What **policies / regulation / governance structures** are needed to promote the ethical use of technology in the IoT?

- How do we define the **"common good"** in highly heterogeneous environments?

Articles: http://www.techrepublic.com/article/algorithms-can-be-racist-why-cxos-should-understand-the-assumptions-behind-predictive-analytics/ , http://standards.ieee.org/news/2016/ieee_autonomous_systems.html

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IoT governance should grow with IoT technical capabilities

- Need for increasing focus on IoT **social principles, socially-conscious technical design, experimental prototypes, policy options**

- Need for cultivation of **deep partnership between public and private sectors** to evolve effective architectures and IoT system implementations that support individual rights and the public good

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"Future Work": Is the IoT a new kind of social system?

- IoT → "community" of devices, humans, systems, organizations, groups, hybrids

    – What is the ethnography of the IoT?

    – Who are its "citizens"? What are their "rights"? What happens if your toaster can vote?

    – What should its ethical code be? What is the "common good"?

    – How will the IoT impact the planet? Can we design the IoT to promote global sustainability?

Social and technical development of the IoT must go hand-in-hand to achieve the vision of the IoT

Thank you!

Francine Berman