UiO : Department of Technology Systems
University of Oslo

Teknologitimen, Senter for Rettsinformatikk (SERI), 3Apr2018, Oslo

Sensor technology -
Applications and Challenges

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IoTSec.no - SCOTT.IoTSec.no

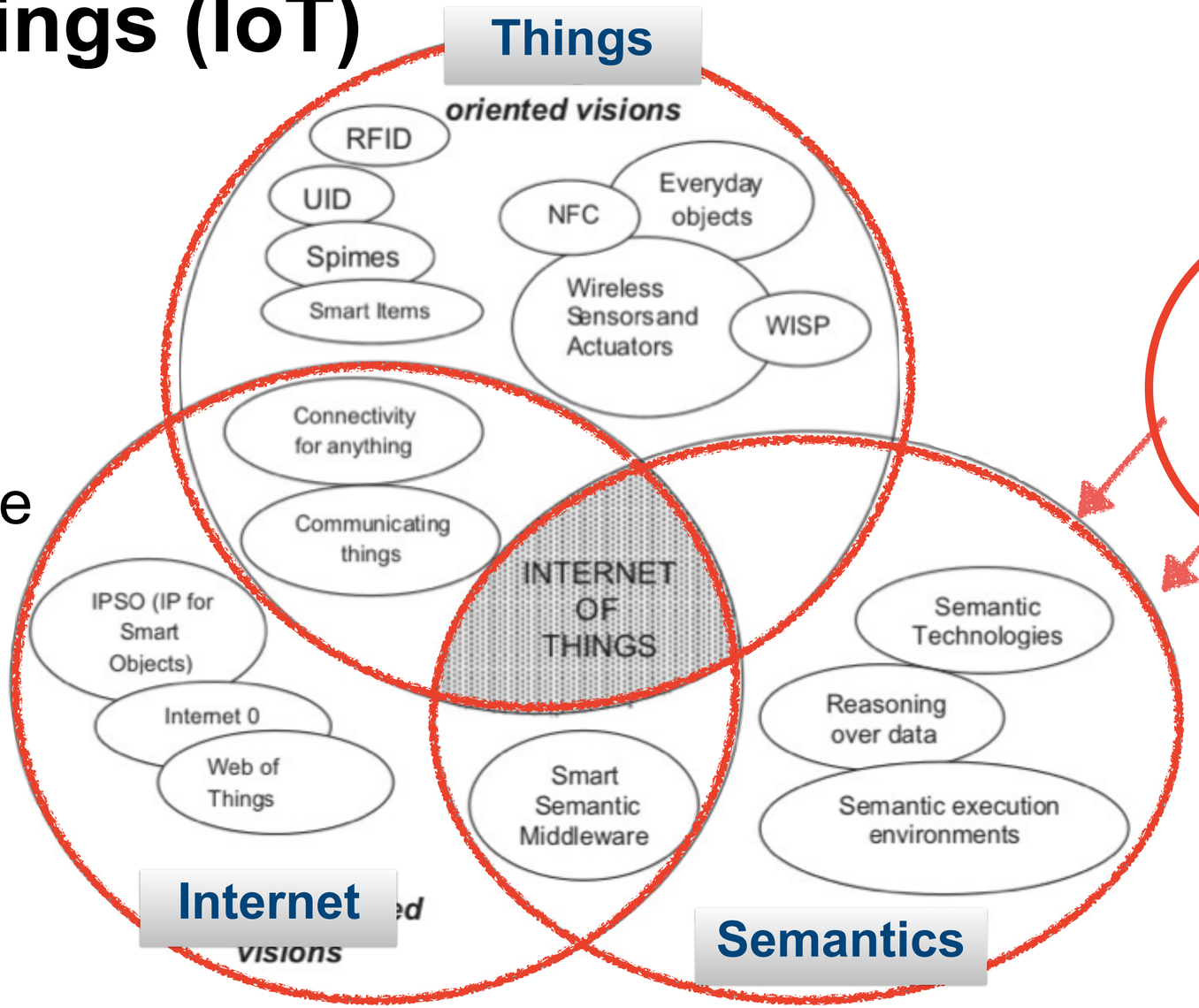
“The last time I was connected by wire was at birth” - our when Internet of Things (IoT) meets people

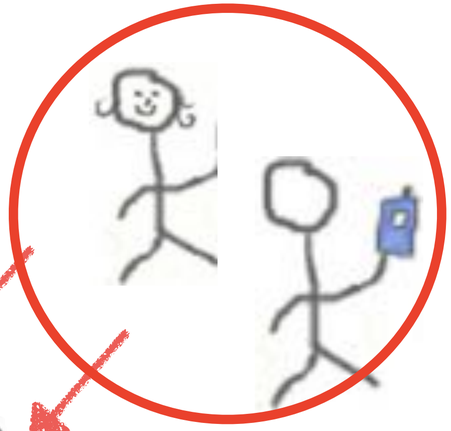
- Internet has changed, IoT will accelerate
  - the ecosystem of making business
  - automated processes
- The Nordic Model - Opportunities
- Security in IoT
  - “teach our sensors to talk Norwegian”
  - The changing role of security in HMS -> HMSS
  - new paradigm: measurable security
  - security classes “design”
- related to projects:
  - Security in IoT for Smart Grids: IoTSec.no
  - Secure Trusted IoT: SCOTT.IoTSec.no,

Source: L. Atzori et al., The Internet of Things: A survey, Comput. Netw. (2010), doi:10.1016/

The Internet of Things (IoT)

- IoT =
  - Things +
  - Internet +
  - Semantics
- Things that communicate
  - with Things: computer,
  - understand the meaning,
  - takes own decisions



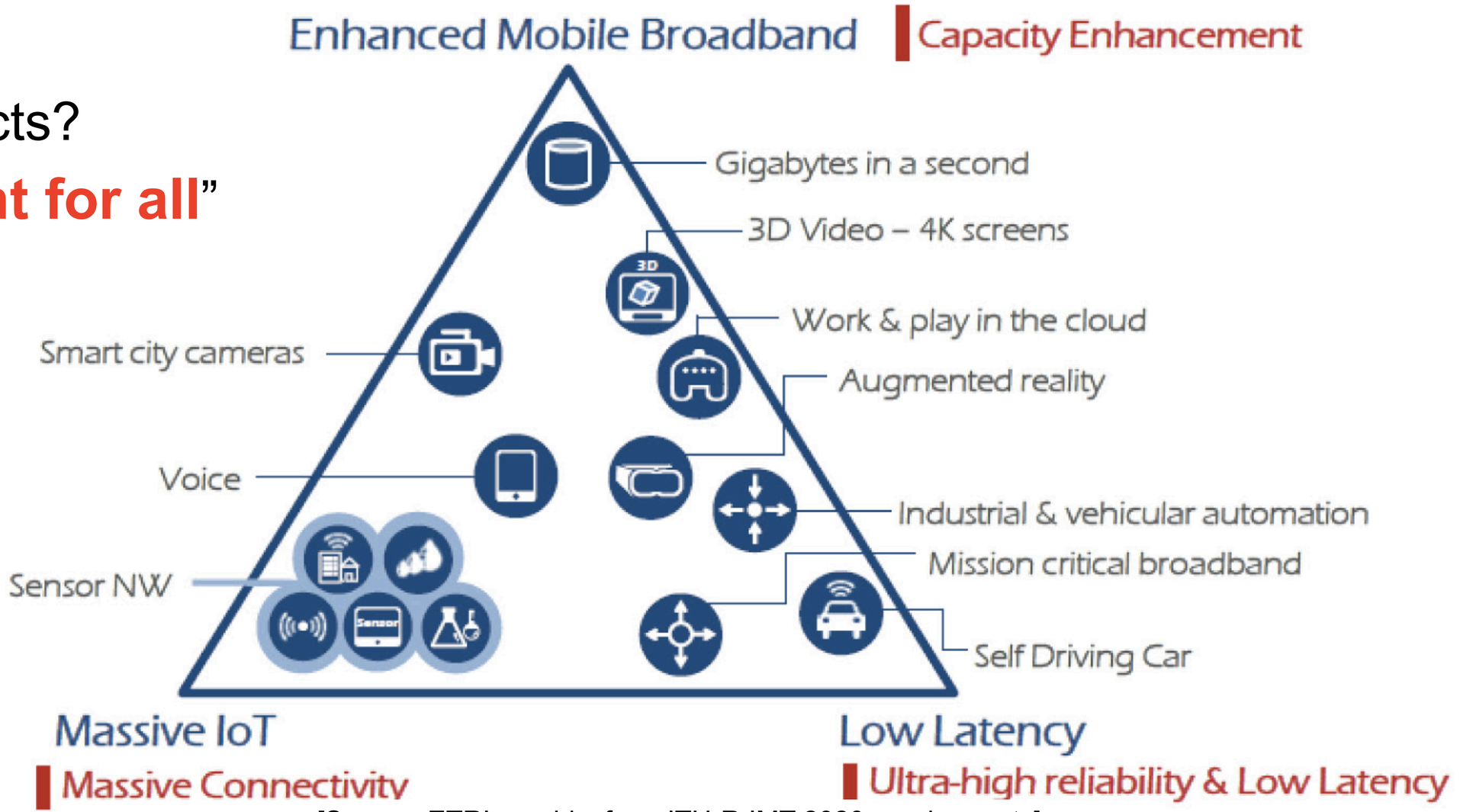


* security
* privacy
* dependability
* context-aware
* personalised

Fig. 1. "Internet of Things" paradigm as a result of the convergence of different visions.

5G = Mobile Broadband+ IoT + Industrial Networks

- Societal aspects?
- "**Internet light for all**"



[Source: ETRI graphic, from ITU-R IMT 2020 requirements]

The change of Business Models

- Car industry: Liability in IoT driven business models
- Energy: Cost of providing of Energy -> Cost of Reliable Network
- Telecom: uO (MicroOperator), Partnership

http://www.scmagazine.com/iot-security-forcing-business-model-changes-panel-says/article/448668/

SC Magazine > News > IoT security forcing business model changes, panel says

Teri Robinson, Associate Editor

Follow @TeriRnNY

October 22, 2015

IoT security forcing business model changes, panel says

Share this article:

To secure the Internet of Things and to build trust with customers, the way that vendors approach manufacturing, distributing and supporting devices and solutions must change, a panel of security pros said Monday at the National Cyber Security Alliance's (NCSA's) Cybersecurity Summit held at Nasdaq.

"Business models will have to change. We used to build them [products], ship them and forget about them until we had to service them," said John Ellis, founder and managing director of Ellis & Associates. "We've moved to a new world where we have to ship and remember."

Volvo to 'accept full liability' for crashes with its driverless cars

But decide on rules so we can make the dang vehicles

)UT-LAW.COM 68 22 78

ability" for collisions involving its autonomous vehicles, the company has

The “sharing economy” for energy companies?

Ved å bygge internett for alle, og ved å skape relevante og uunnværlige digitale tjenester, kan vi bidra til en bedre verden, skriver Sigve Brekke.

FOTO: Heiko Junge, NTB scanpix

IKT er den nye oljen! | Sigve Brekke

[Source: aftenposten.no]

Sharing Economy: “Telenor will create a digital ecosystem in Pakistan”

Home About Visit esmartsystems.com

Prosumer bidding and scheduling in electricity markets

12. January 2016 Ukategorisert Administrator

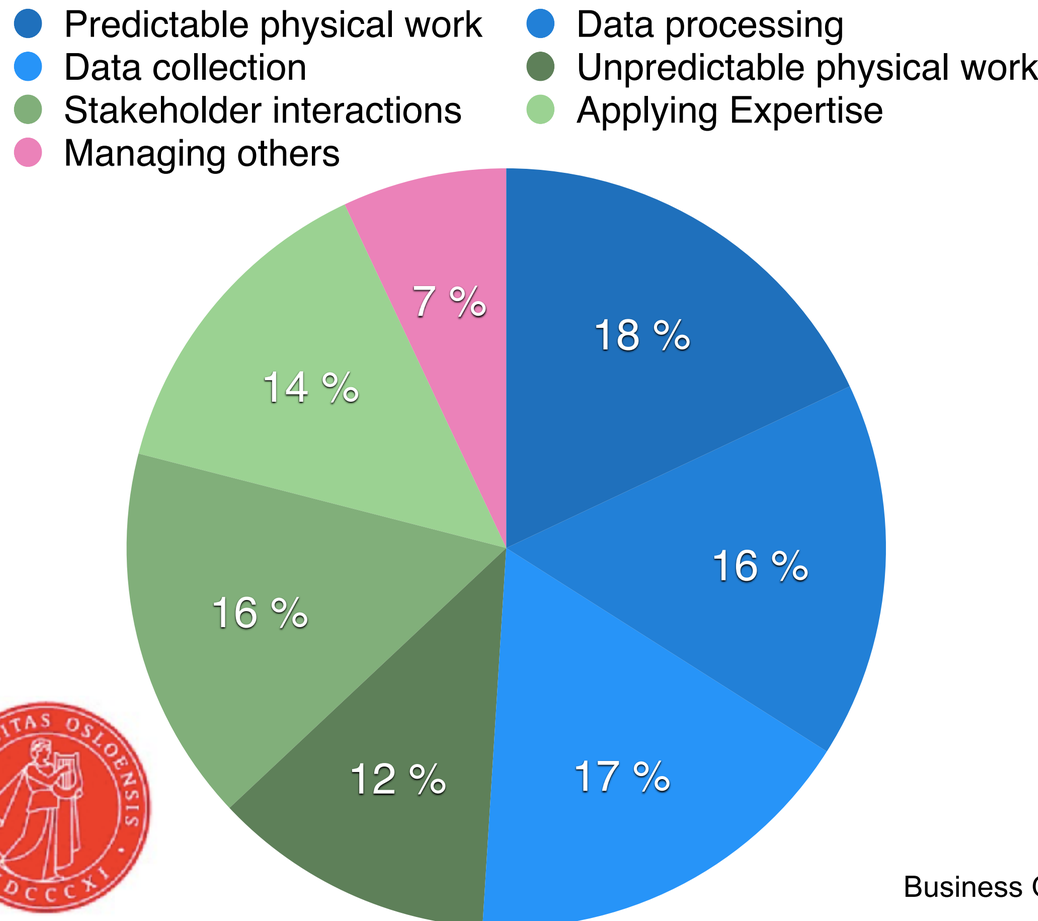
[Source: eSmartSystems.com]

Automated processes

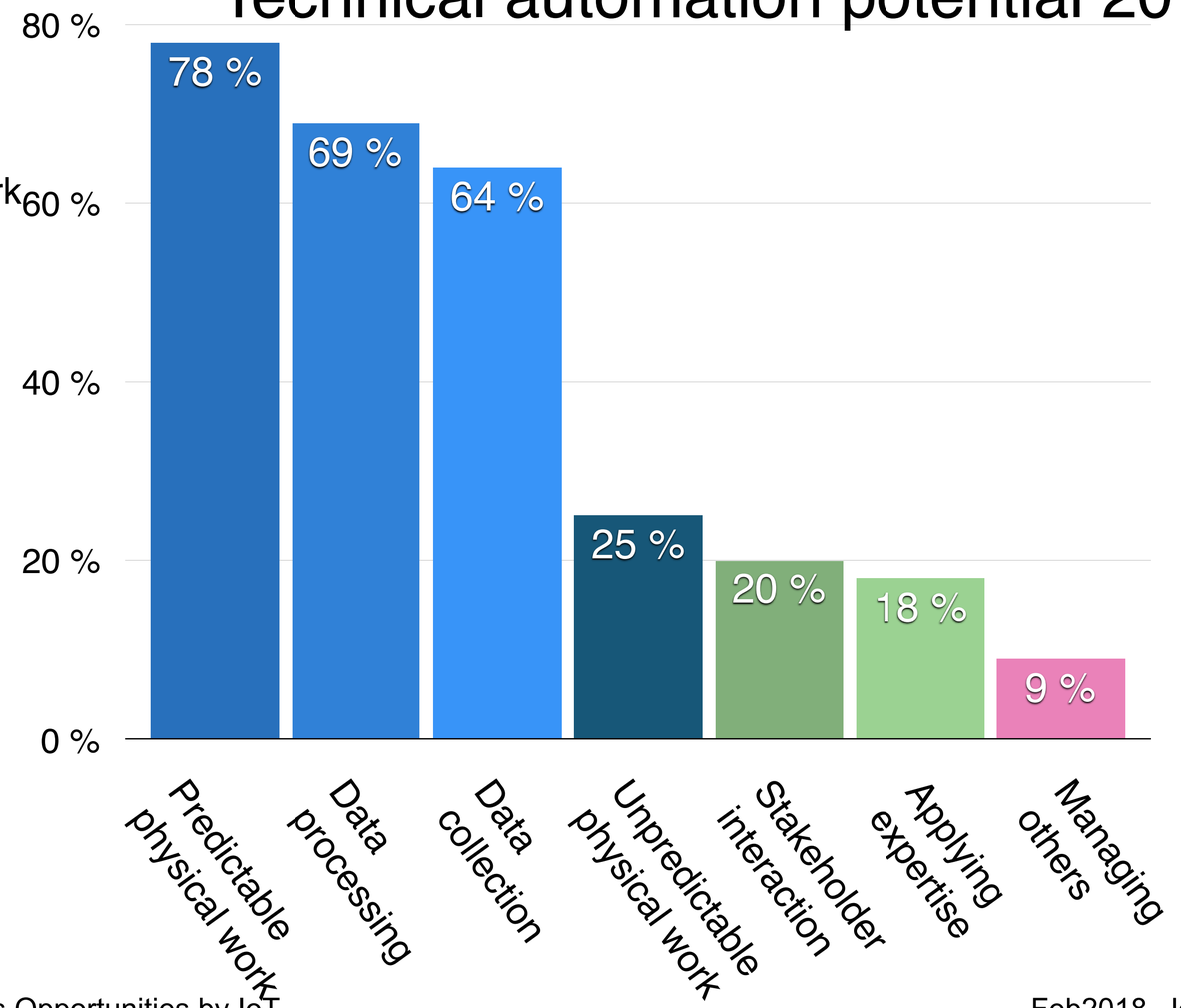
- Work force demand
- Blockchain, IOTA
- The state business model

The challenge from automation

USA work force time spent [%]



Technical automation potential 2016 [%]

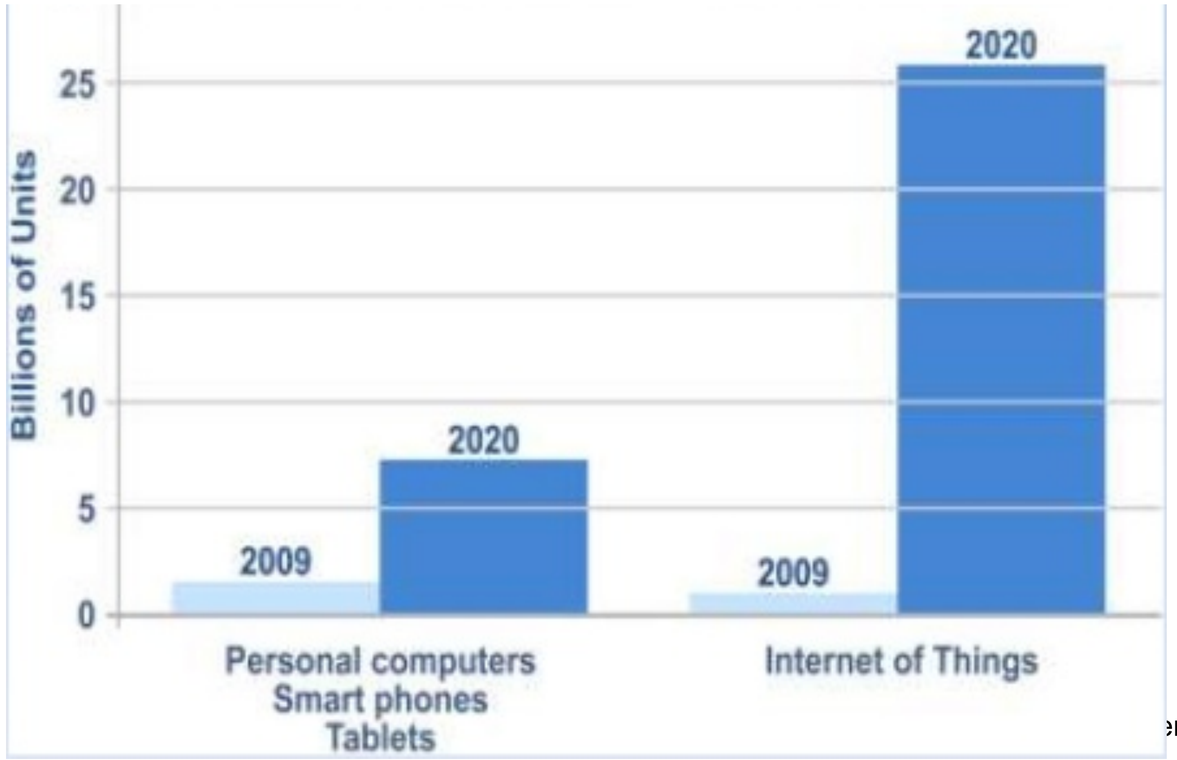


Source: EU commission(2015)

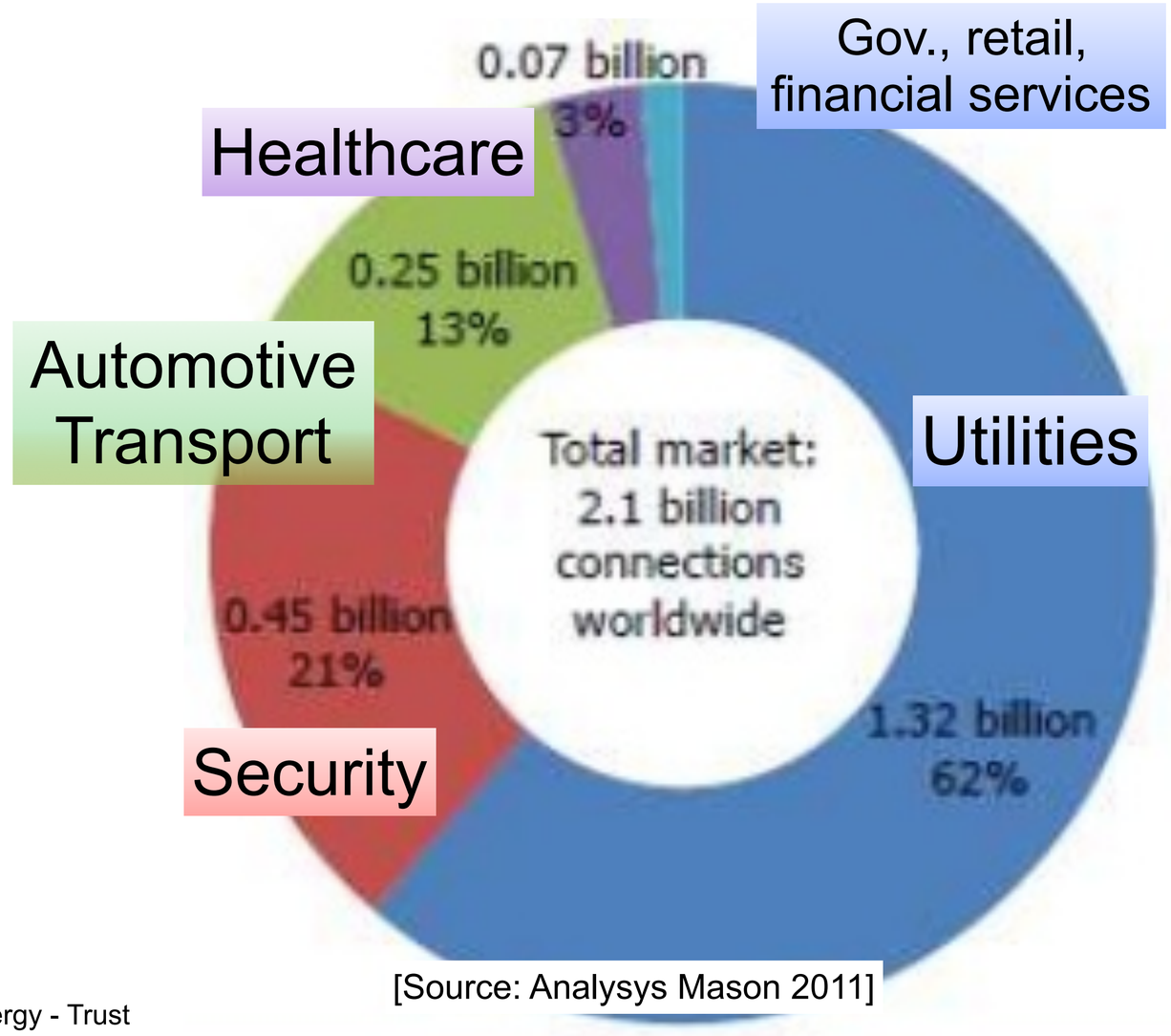
Application Areas

- Utilities: Smart Home, Smart City,
- Security, Health-care
- Automotive, Transport

IoT - 10 x impact of Internet



Commercial & Consumer M2M Device Connections Worldwide 2020



[Source: Analysys Mason 2011]

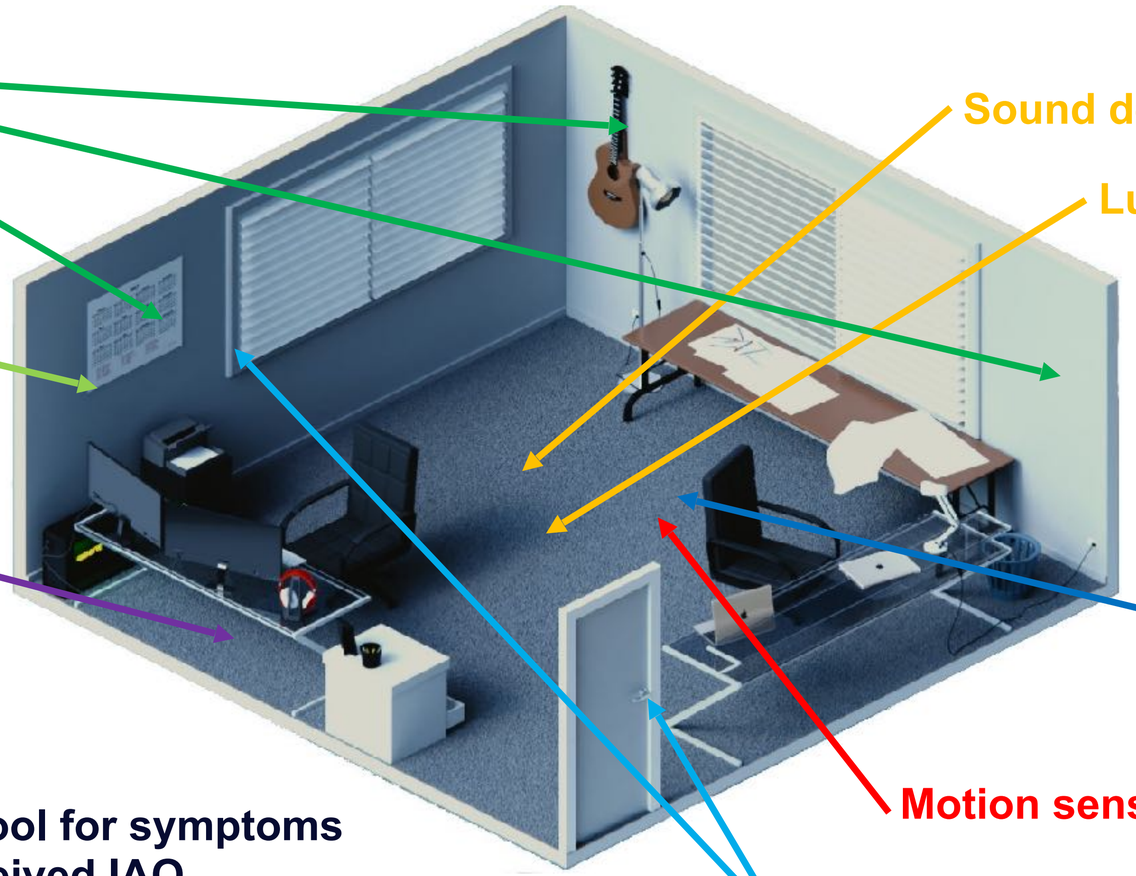
Pilot setups: office room example

T/H/P measurements from several spots

Gas measurements (CO, CO2, SO2, NO2, C2HO, tVOC)

Particles (several sizes)

+ Self-reporting tool for symptoms and perceived IAQ



Sound detection (noise)

Luminosity

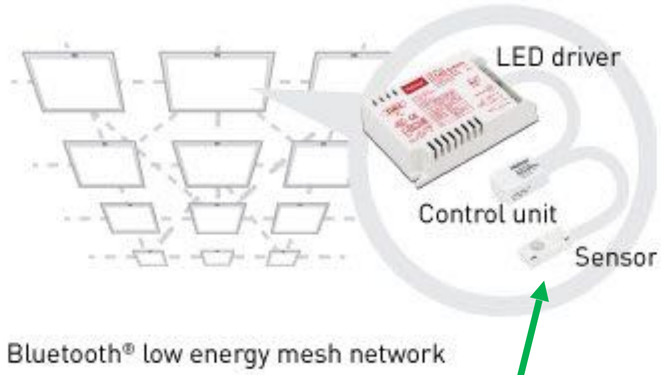
Depth camera (movements in the 3D spaces)

Motion sensor (PIR)

Latch sensor for windows/doors

[Source:Jani Koivusaari, VTT, SCOTT-project.eu]

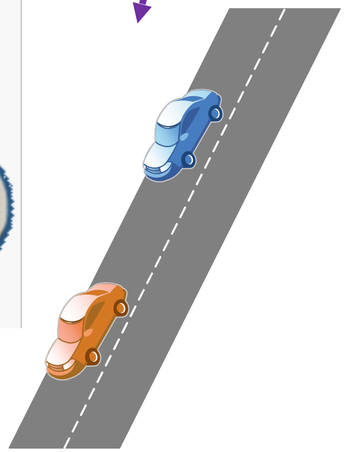
Pilot setups: auxiliary data sources



Luminosity and presence data from installed smart lighting

Weather data monitoring from an unobsturcted location (e.g. building roof)

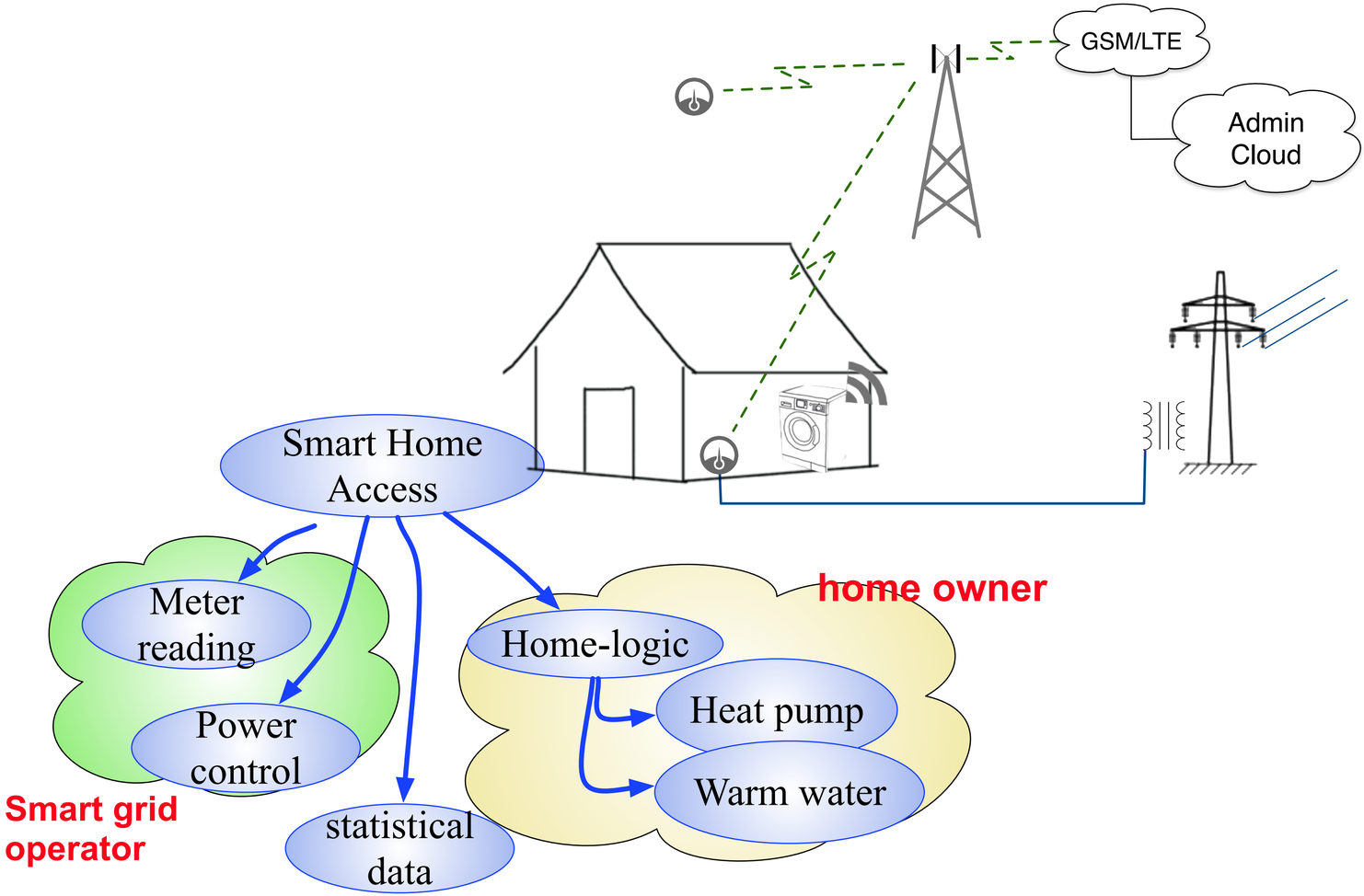
Air quality data monitoring in proximity to the building and the nearest probable pollution source (e.g. nearest road)



[Source:Jani Koivusaari, VTT, SCOTT-project.eu]

Semantic attribute based access control (S-ABAC)

- Lifting the security class through S-ABAC
- Access to information
  - ➡who (sensor, person, service)
  - ➡what kind of information
  - ➡from where
- Attribute-based access
  - ➡role (in organisation, home)
  - ➡device, network
  - ➡security tokens
- Rules inferring access rights



Attributes: roles, access, device, reputation, behaviour, ...

Security, Privacy

- Security Classes
- Privacy Label

Addressing the Threat Dimension for IoT

- Hollande (FR), Merkel (DE) had their mobile being monitored
- «and we believe it is not happening in Norway?

[source: www.rediff.com]

18. Dezember 2014, 18:14 Uhr Abhören von Handys

So lässt sich das UMTS-Netz knacken

Zwei Hacker zeigen, UMTS-Antenne lassen sich knacken (Foto: dpa)

[source: Süddeutsche Zeitung, 18Dec2014]

Significance

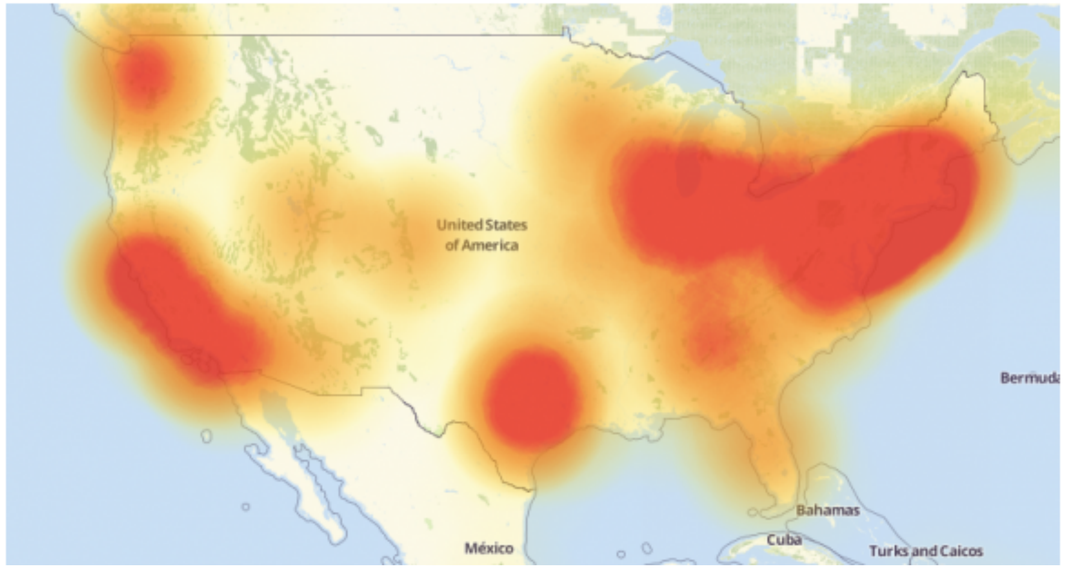
IoT security challenges

- Mirai attack
  - ➡ “security by obscurity”
  - ➡ different security viewpoint
- “it is just the beginning”

21 OCT 16 Hacked Cameras, DVRs Powered Today’s Massive Internet Outage *16Oct2016*

A massive and sustained Internet attack that has caused outages and network congestion today for a large number of Web sites was launched with the help of hacked “Internet of Things” (IoT) devices, such as CCTV video cameras and digital video recorders, new data suggests.

Earlier today cyber criminals began training their attack cannons on **Dyn**, an Internet infrastructure company that provides critical technology services to some of the Internet’s top destinations. The attack began creating problems for Internet users reaching an array of sites, including Twitter, Amazon, Tumblr, Reddit, Spotify and Netflix.

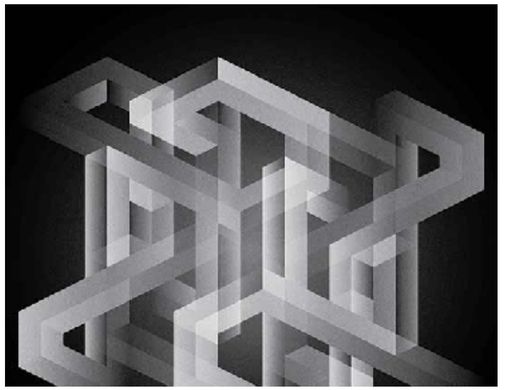


[Source: https://krebsonsecurity.com/2016/10/hacked-cameras-dvrs-powered-todays-massive-internet-outage/]

Blockchain, IOTA, and automated money

- ☑ Increased security in micro-data handling
- ☑ Trust enabler for IoT data

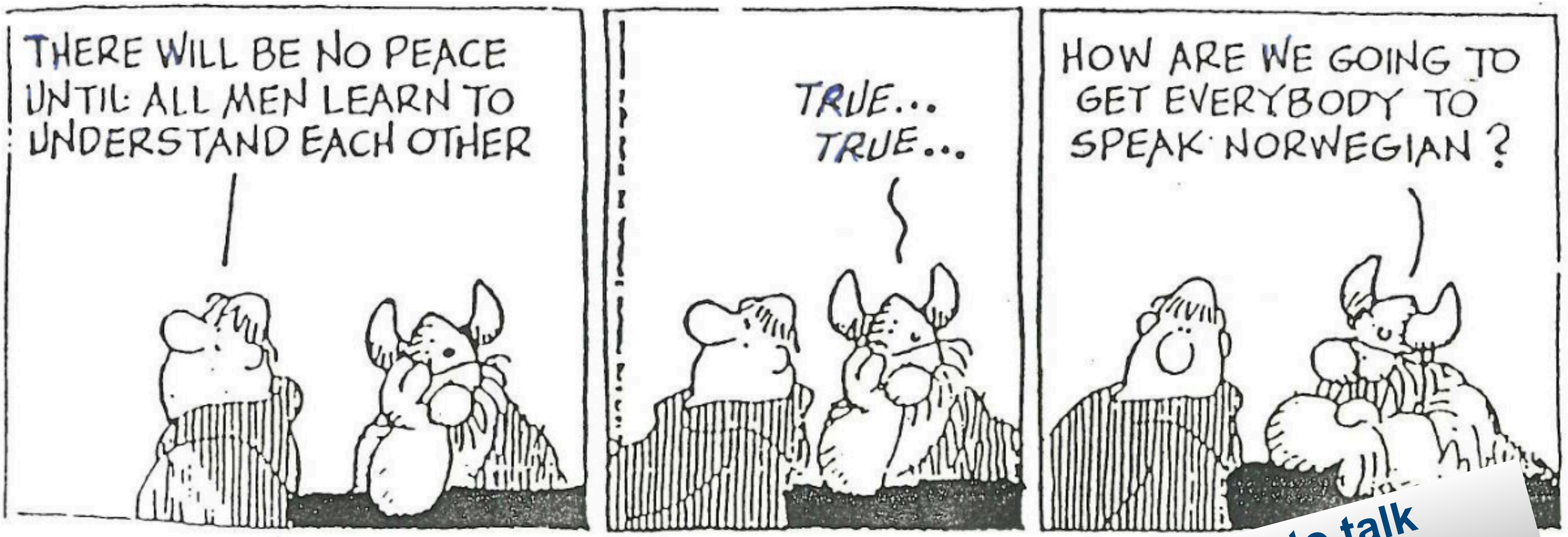
- ☐ No trustworthy organisation backing crypto currencies
- ☐ US$ covered by U.S. Department of Justice, U.S. Treasury, the Federal Reserve
  - ➡ centralized digital currencies



Price Manipulation in the Bitcoin Ecosystem

Neil Gandal [a] ✉, JT Hamrick [b] ✉, Tyler Moore [b] ✉, Tali Oberman [a] ✉

The Blockchain Will Do to the Financial System What the Internet Did to Media



teach our sensors to talk Norwegian

SCOTT key message
"elevator pitch"

largest security project in EU

57 partners from 12 countries

80 M€ budget
35 M€ EU&national

8 partners from Norway

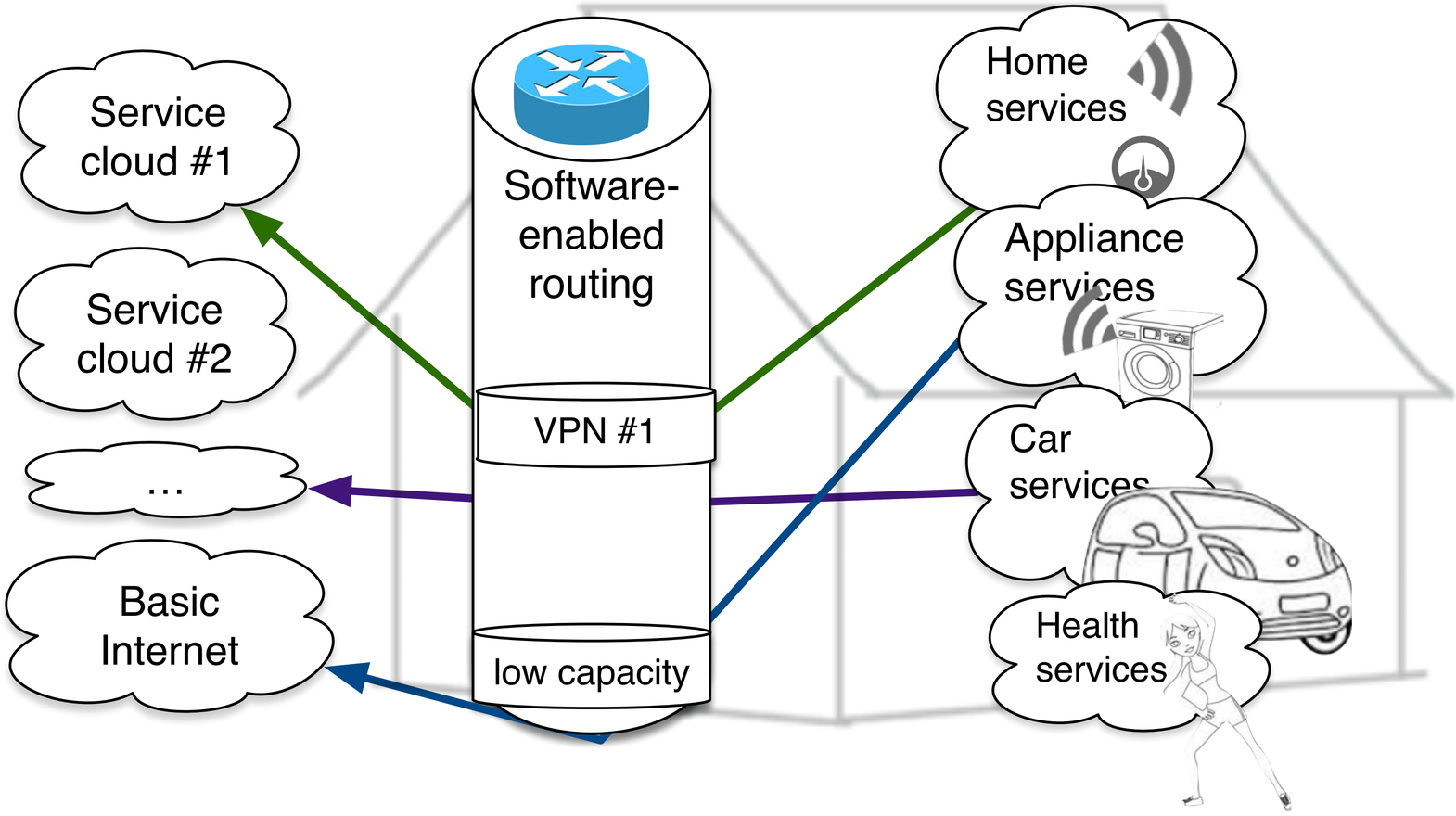
IoT is the game changer and driver for digitalisation, and SCOTT contributes through:

- **Answer the IoT need for a new and more advanced security paradigm through security classes**
- **Create a Convincing privacy assessment through privacy labelling**
- **Establish a clear link between security and safety**

Automotive
Home
Rail
5G
Avionics

Learn from Industrial Automation and Mobile Networks

- "What to secure?"
- Network segregation
  - ➡ *Network slicing*
- From Confidentiality, Integrity, Availability (CIA)
- to Availability, Integrity, Confidentiality (AIC)



The economic perspective

- The big 5 IT companies have a GDP as big as that of France
- Amazon largest sector in terms of revenue is selling of data
  - ➡ 20% of revenue

- How can SMEs compete?
  - ➡ Each service and device gets a privacy label

- Four areas for Privacy Label
  - ➡ which data are collected
  - ➡ sharing to my phone, my cloud, public cloud,...
  - ➡ data communication integrity and storage
  - ➡ further distribution of data, ownership of data, further processing

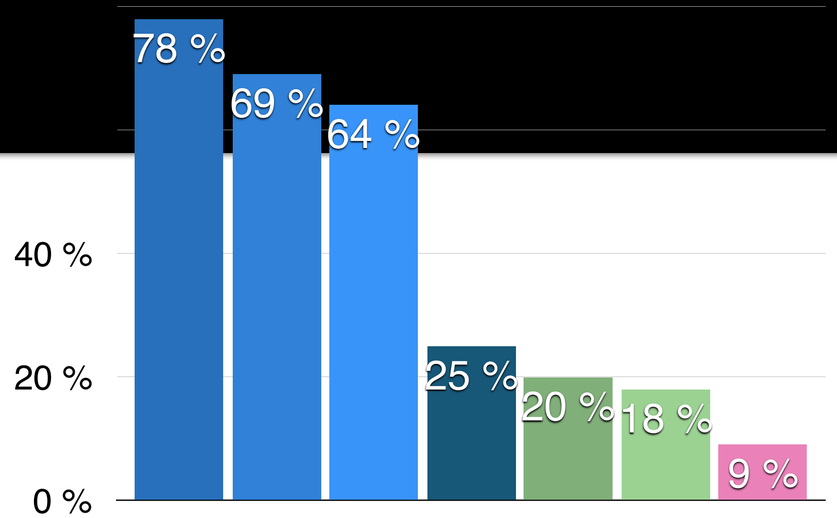
Privacy Label (A-F)

- easy visibility
- customer focus
- transparent

privacylabel.IoTSec.no

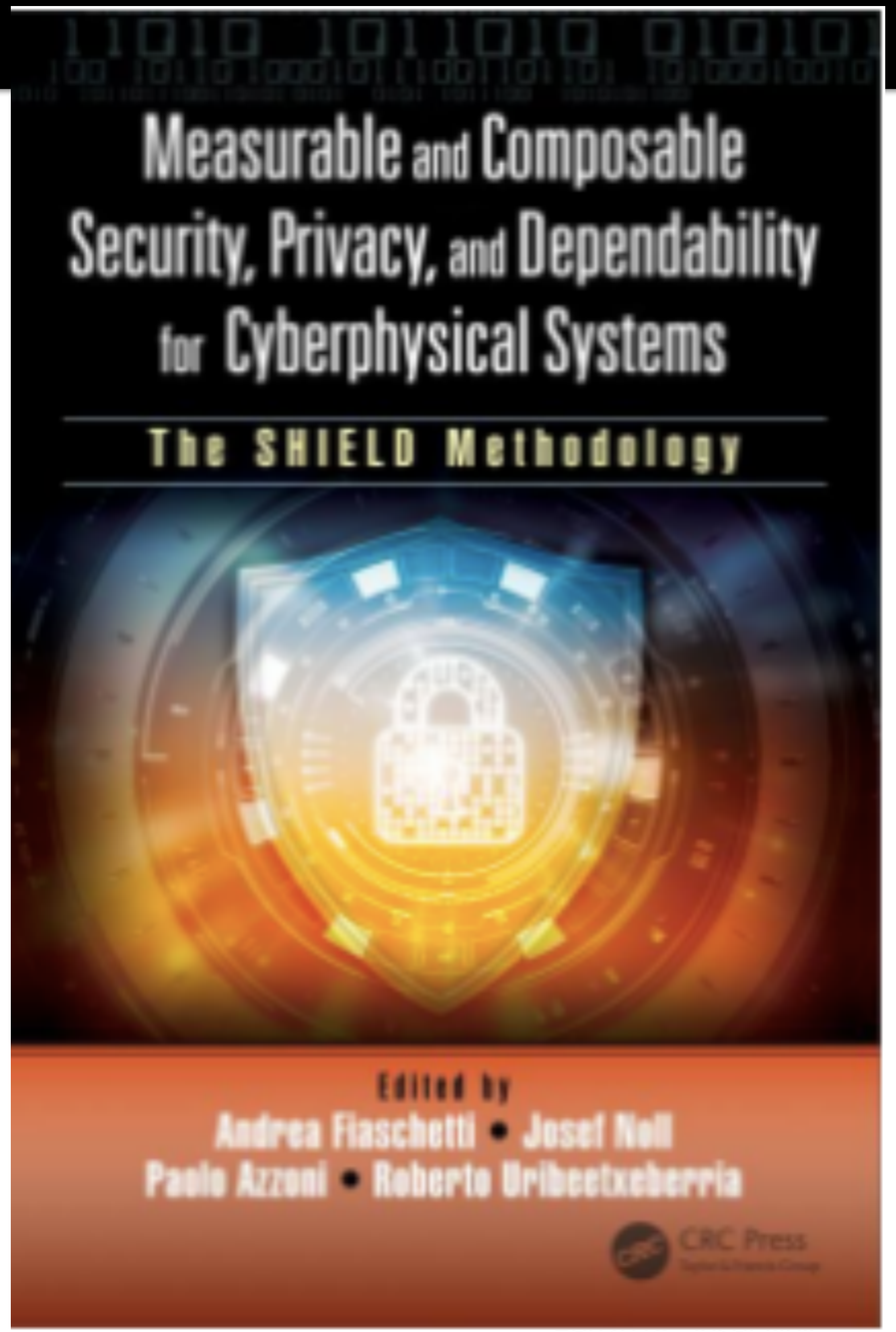
Conclusions

- Things (IoT) are driving the digital societies
- IoT: Business merger
  - ➡ Internet + Semantics + Things = IoT
  - ➡ Digitisation of the Society
- IoT ecosystem
  - ➡ Promote the Nordic system
  - ➡ Security classes, accountable security
- Addressing the challenges
  - ➡ Privacy label (A++, A+…D)
  - ➡ business advantage for SMEs



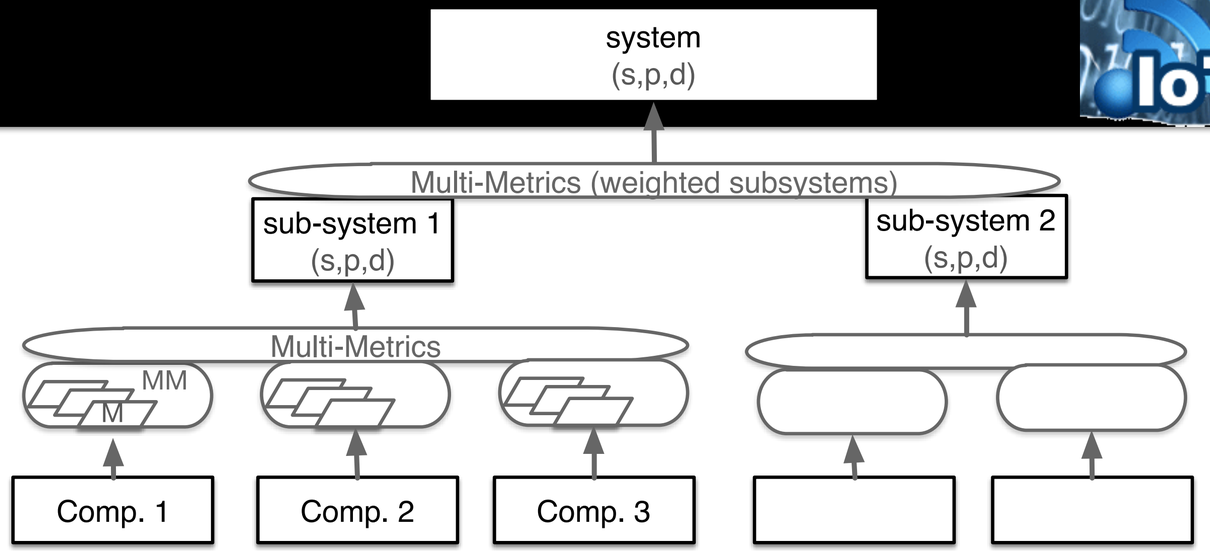
5	Class 5	Class 5	Class 5	Class 5
4	Class 4	Class 4	Class 4	Class 5
3	Class 3	Class 4	Class 4	Class 4
2	Class 1	Class 3	Class 3	Class 3
1	Class 1	Class 1	Class 2	Class 2
Impact/Exposure	1	2	3	4+

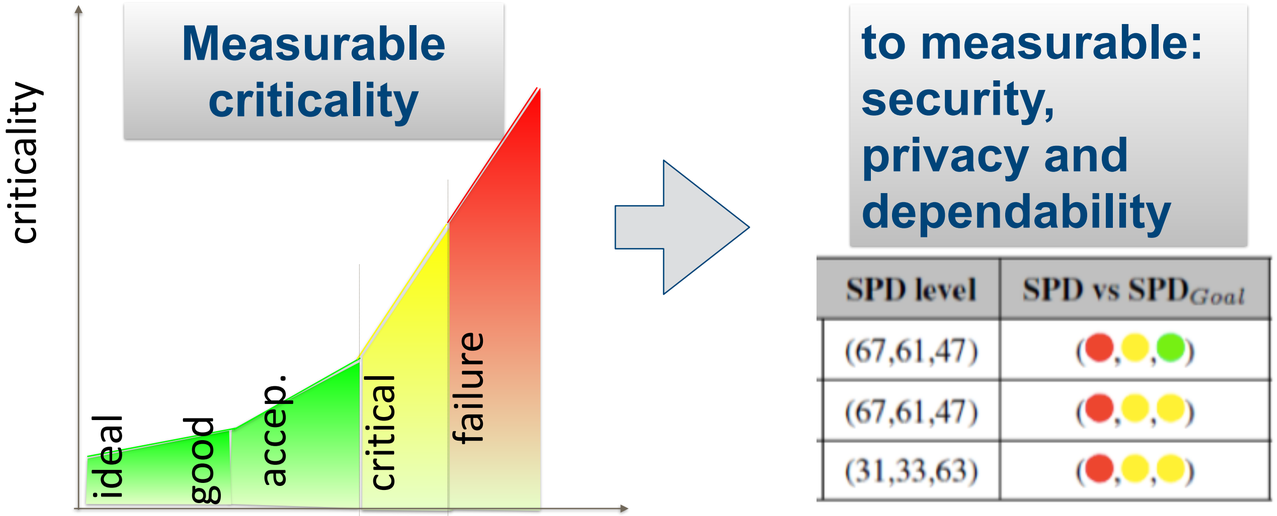
Further information



Accountable security

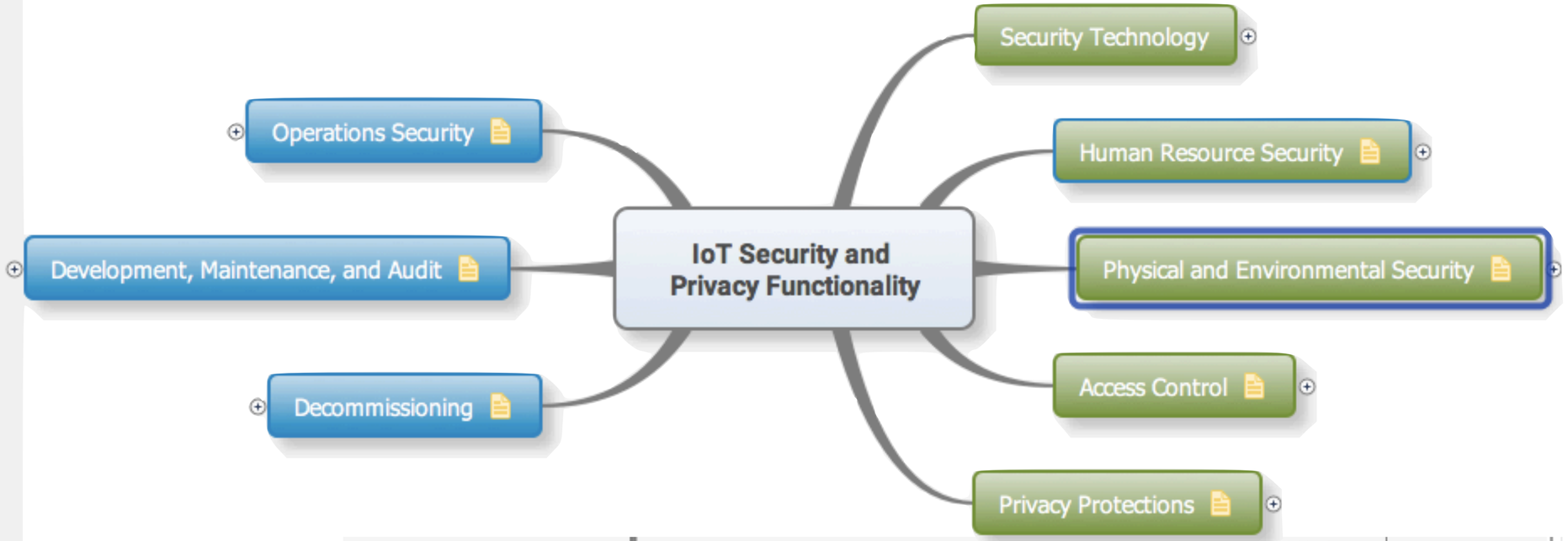
- Assessment
  - ➡ Comparison desired Class vs Calculated class
  - ➡ PROSA modelling
- Modelling
  - ➡ SPD Metrics, from criticality to SPD value
- Framework
  - ➡ Examples of applicability
- Measurable Security
  - ➡ Security is not 0/1





SPD level	SPD vs SPD_{Goal}
(67,61,47)	(●,●,●)
(67,61,47)	(●,●,●)
(31,33,63)	(●,●,●)

Security and Privacy Functionality



References:
https://www.owasp.org/index.php/IoT_Security_Guidance

Industrial Internet of Things Volume G4: Security Framework, 2016

Future-proofing the Connected World - Cloud Security Alliance, 2016

The trust matrix

- trust as a positive user attitude
  - ➡ engaging voluntarily
- security based trust issues
  - ➡ building trusted systems
- technological factors
  - ➡ data storage, distribution
  - ➡ insight
- human/societal factors
  - ➡ government
  - ➡ family, friends

SCOTT
Secure Connected Trustable Things

http://SCOTT.IoTSec.no

http://SCOTT-project.eu

Trust factor
Security
Privacy (social)
Acceptability
Usability
Reliability
Availability
Maintainability
Safety
Integrity
Confidentiality
Predictability
Reputation (social)
Configurability (social)
Consistency
Functionality