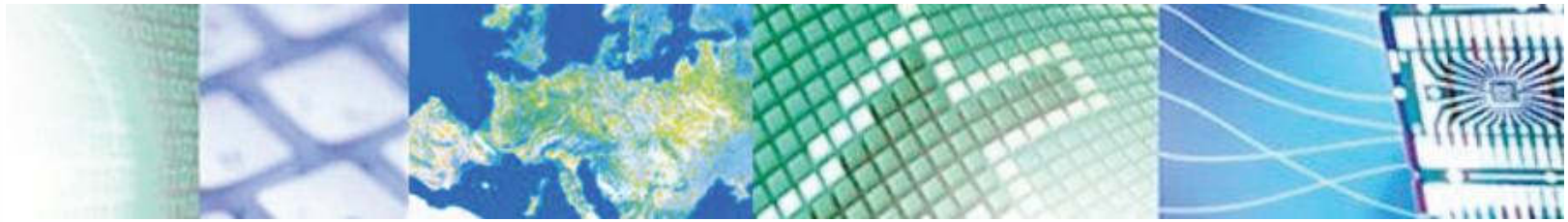

CHIST-ERA Projects Seminar
Cross Topics
Resilient Trustworthy Cyber-Physical Systems (RTCPS)

Speaker

Awais Rashid

(Lancaster University, UK)

Brussels, March 22-23, 2017

FUNDING OPPORTUNITIES from the FUTURE & EMERGING TECHNOLOGIES scheme

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Resilient, Trustworthy Cyber-Physical Systems

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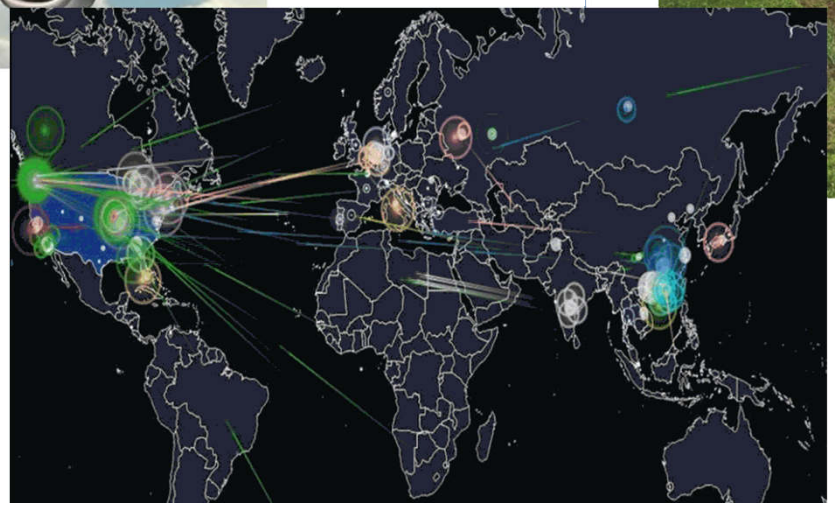
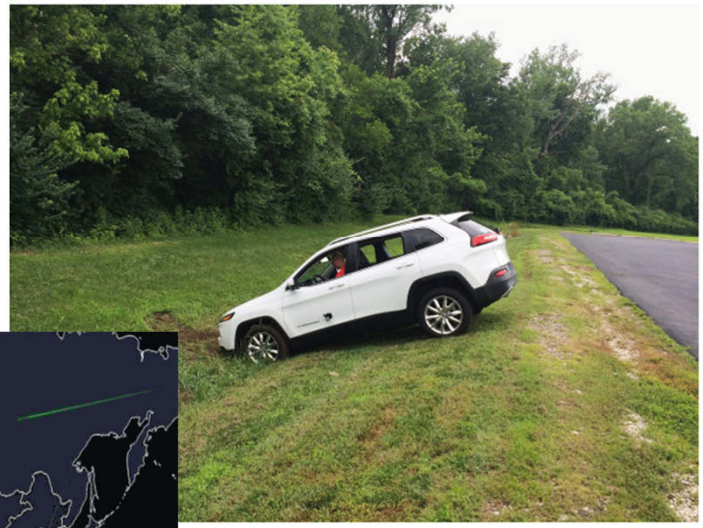
FBI: Hacker claimed to have taken over flight's engine controls

By Evan Perez, CNN
Updated 0219 GMT (0919 HKT) May 19, 2015



After Jeep Hack, Chrysler Recalls 1.4M Vehicles for Bug Fix

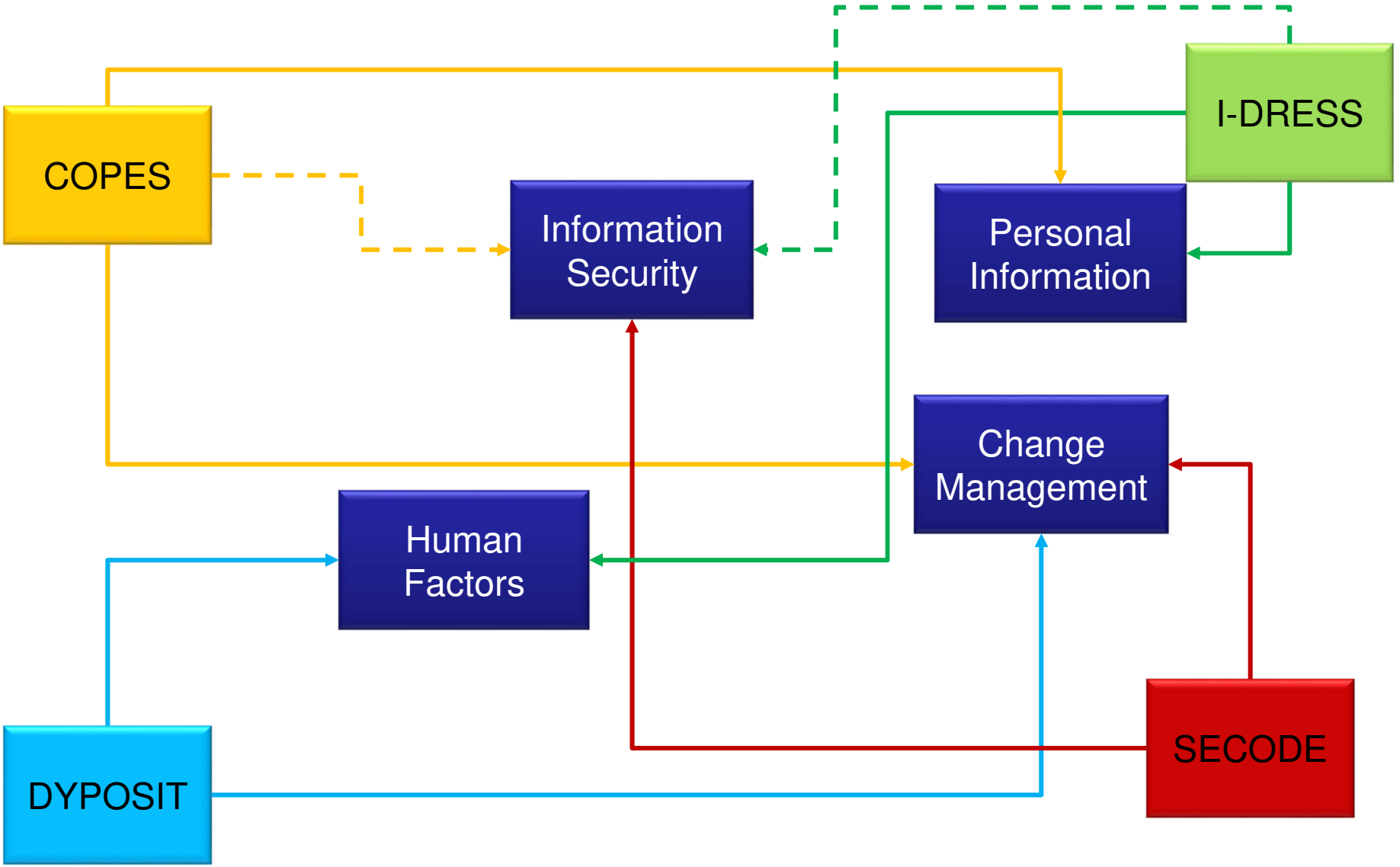
AFTER JEEP HACK, CHRYSLER RECALLS 1.4M VEHICLES FOR BUG FIX



Four projects in RTCPS

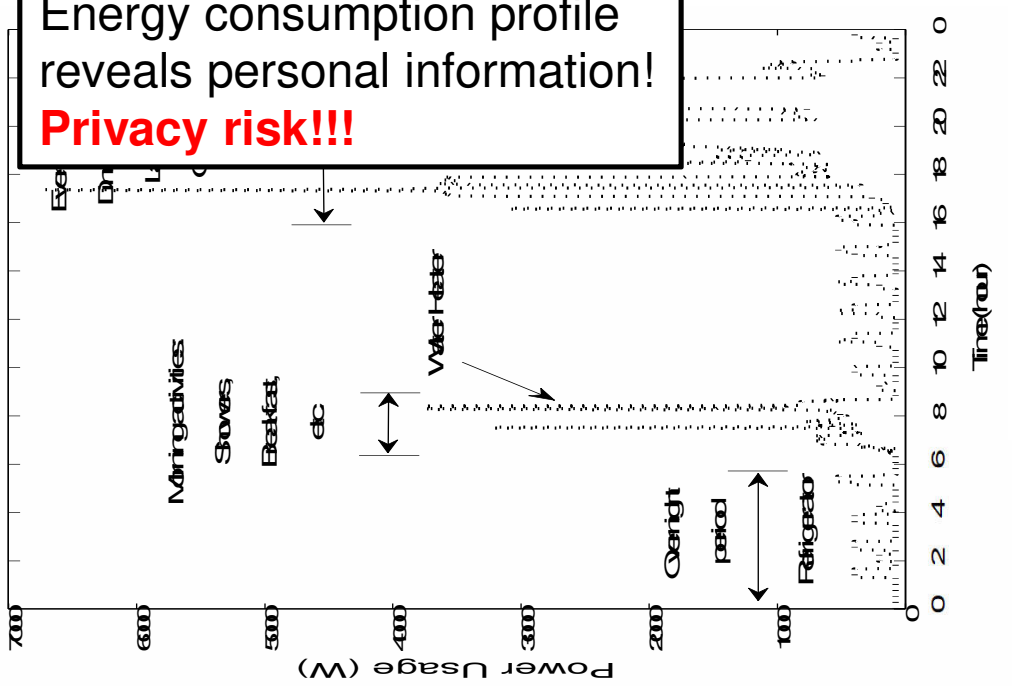
- **COPES: Consumer-centric Privacy in Smart Energy Grids**
- **DYPOSIT: Dynamic Policies for Shared Cyber- Physical Infrastructures under Attack**
- **I-DRESS: Assistive Interactive Robotic System for Support in Dressing**
- **SECODE: Secure Codes to Thwart Cyber- physical Attacks**

Not an anarcho-syndicalist collective!



COPES approach to Smart Meter Privacy

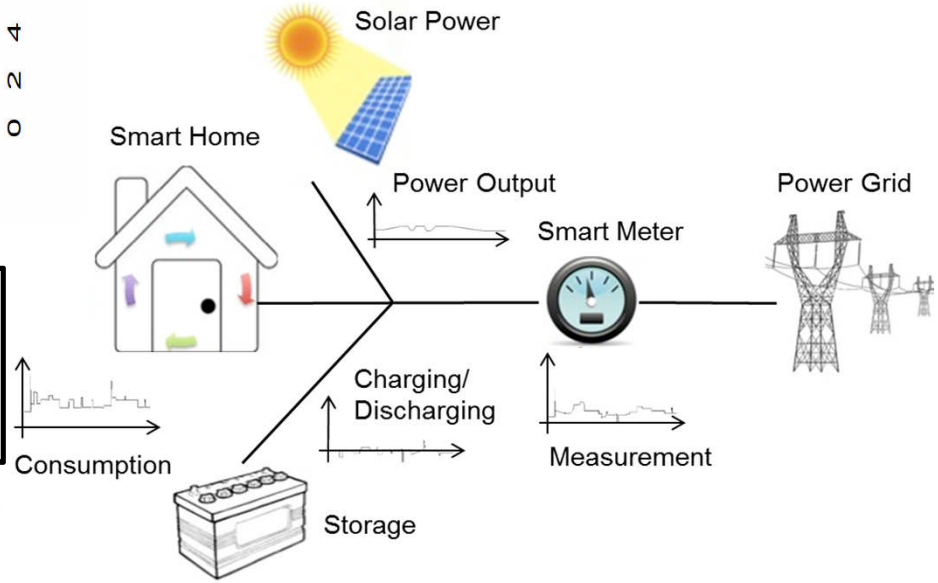
Energy consumption profile reveals personal information!
Privacy risk!!!



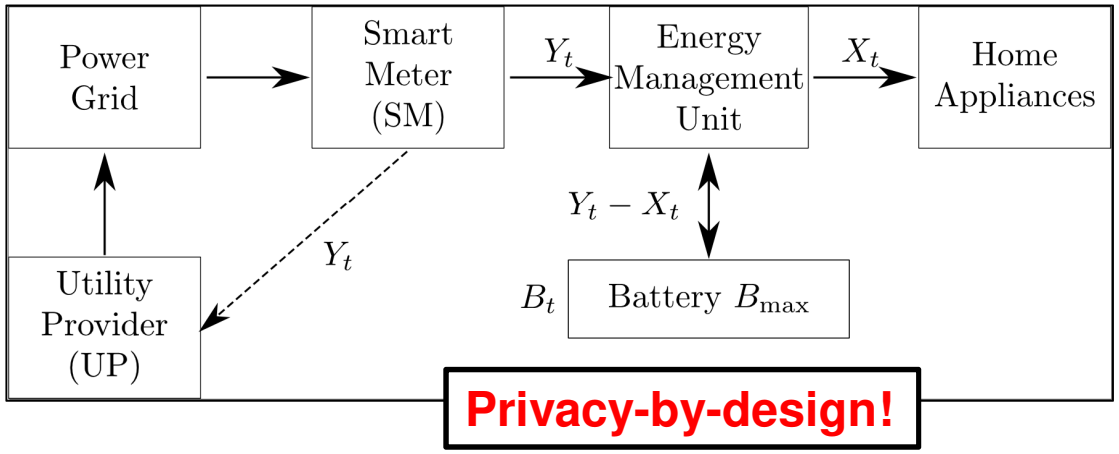
(Updated) EU General Data Protection Regulation strongly protects private life

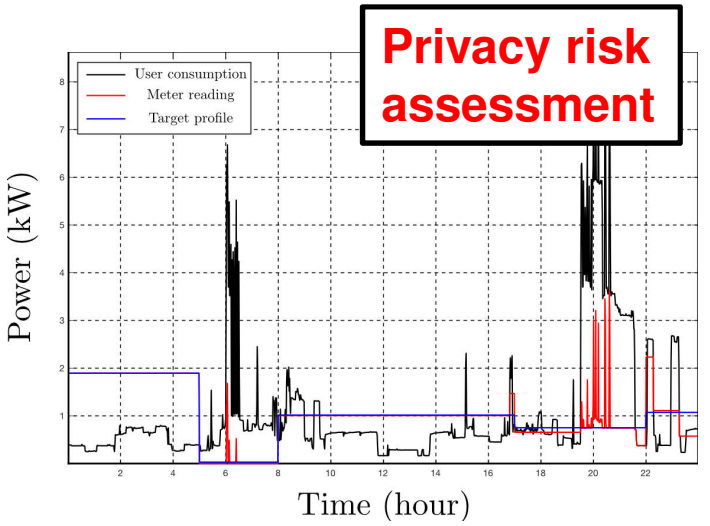
- Potential show stopper

COPES approach: Manipulate actual energy prosumption profile using energy storage & alternative sources



Major Results: SM Privacy Measures and Privacy Enhancing Technology

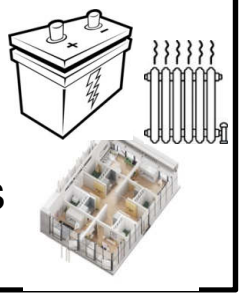




- **Design of several energy flow control algorithms considering**
  - ✓ Different privacy measures (past focus)
  - ✓ Utility (e.g. energy-cost) – privacy trade-off (future focus)

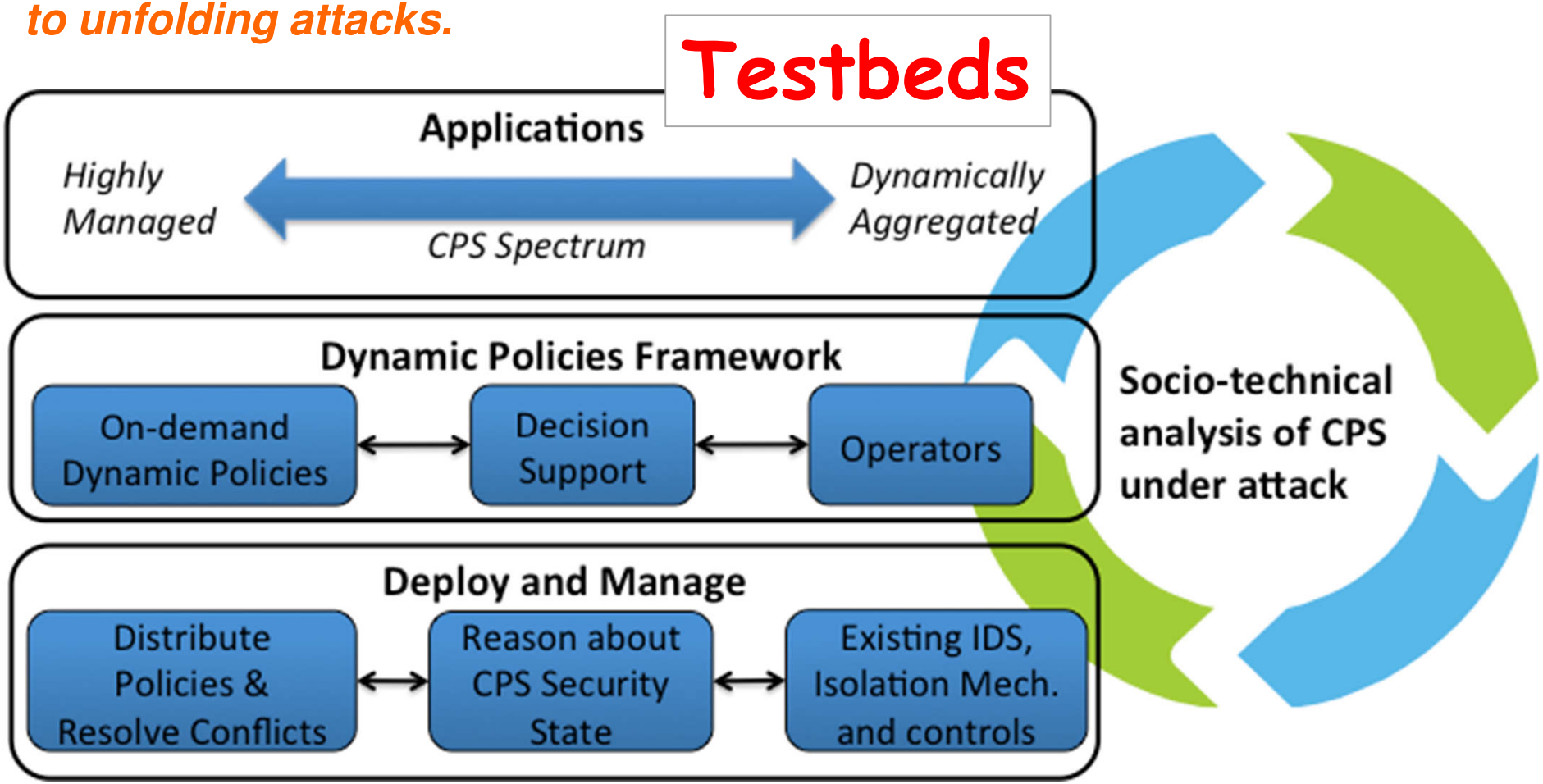
- 7 conference & 3 journal papers published/submitted
- Outreach to several agencies, companies & events + webpage
- 2 expert advisory roles

- 3 granted *follow-up research projects* on impact of energy storage technology
- Proof-of-concept experiments in KTH Live-In-Lab planned



DYPOSIT Approach to Security and Resilience

Security policies as living, evolving, objects that play a central role in reasoning about the security state of such a CPS and responding to unfolding attacks.



DYPOSIT: Key Results to Date

Attack Analysis
- Ethnography-style study of an actual cyber-physical system
- Testbed analysis and implementation of a range of attacks

Attack Detection
- SimaticScan: A specialised vulnerability scanner
- SENAMI: Selective, non-invasive, active monitoring for intrusion detection

Dynamic Policy Models
- Model for dynamic change in an ICS configuration
- Reason about policies using refinement and composition operators

Platforms
- CerberOS operating system for IoT devices
- Secure application loading and strong isolation, contractually limited access to resources.

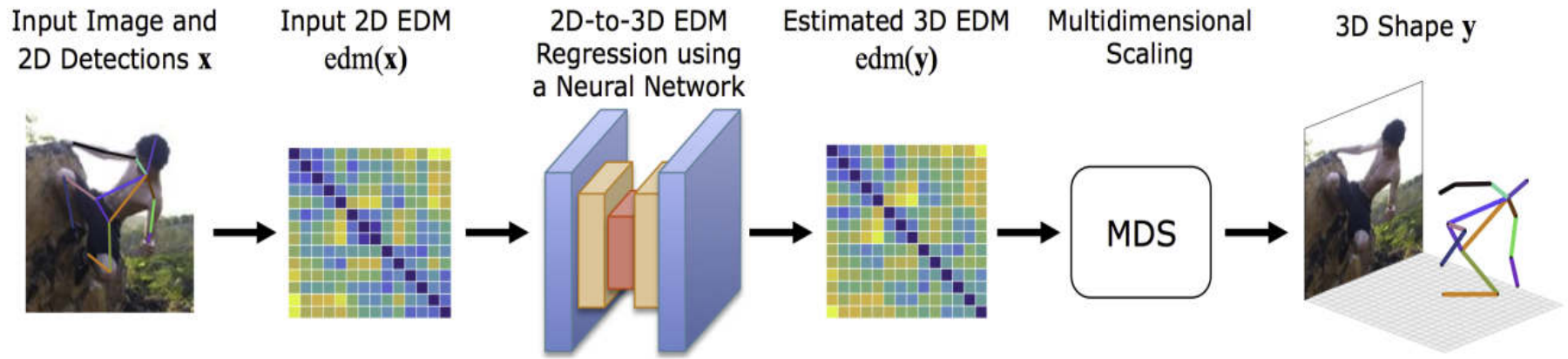
- 8 scientific publications
- International workshop on topic
- 4 keynotes and invited talks
- Additional testbed

- Software prototypes
  - ✓ CerberOS
  - ✓ SimaticScan
  - ✓ SENAMI

I-DRESS: Robotic Dressing Assistance

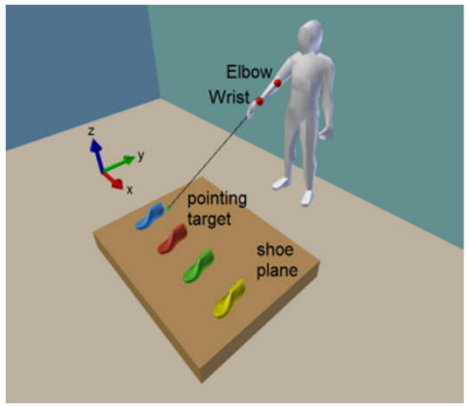
Aims of **I-DRESS** project

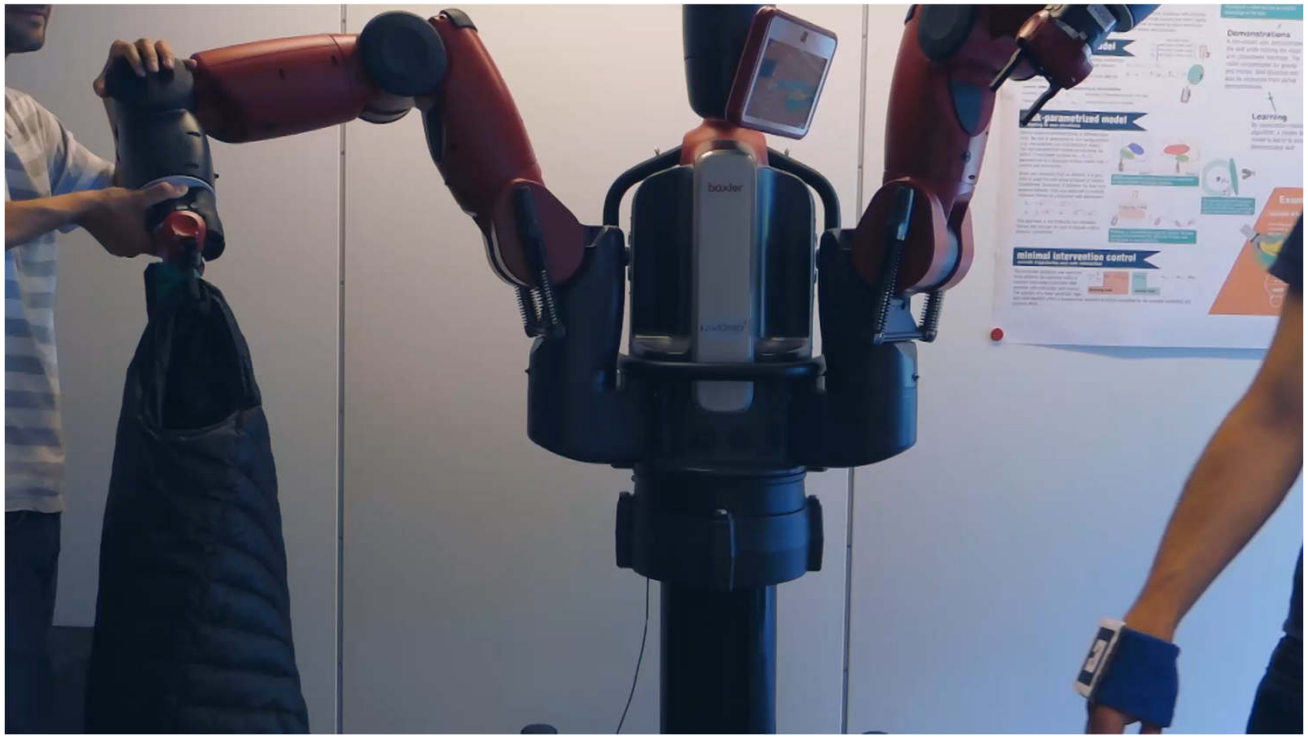
- Algorithms for pose and garment tracking
- Recognising user's attention and intentions
- Learning from Demonstration algorithms
- Hazard analysis for safe robot operation
- Multimodal user interface for safe physical interaction
- To integrate on a commercial robotic platform.



I-DRESS Achievements

- Pose and gesture detection algorithms
- Human-Human-Interaction testing
- Discrimination between garments using force
- Learning by demonstration (video)





SECODE Goals

- **To use Codes to thwart Cyber-physical Attacks:**
  - ✓ Specify and design error correction codes suitable for an efficient protection of sensitive information in the context of Internet of Things (IoT) and connected objects.
  - ✓ The protection based on codes is to avoid/mitigate:
    - **Passive attacks,**
    - **Active attacks**
  - ✓ Study and Use of LCD (Linear Complementary Codes) or LCP (Linear Complementary Pairs) codes, well suited for masking protection

SECODE outcomes/challenges

- **Enhance the Code Theory:**
  - ✓ Design of "Linear Complementary Dual" LCD codes
- **Assess the security level based on Code:**
  - ✓ What are the Security parameters against Physical attacks ?
- **Implement a Cyber-physical protected platform:**
  - ✓ Based on modified LLVM
  - ✓ Automatic insertion of protection based on codes

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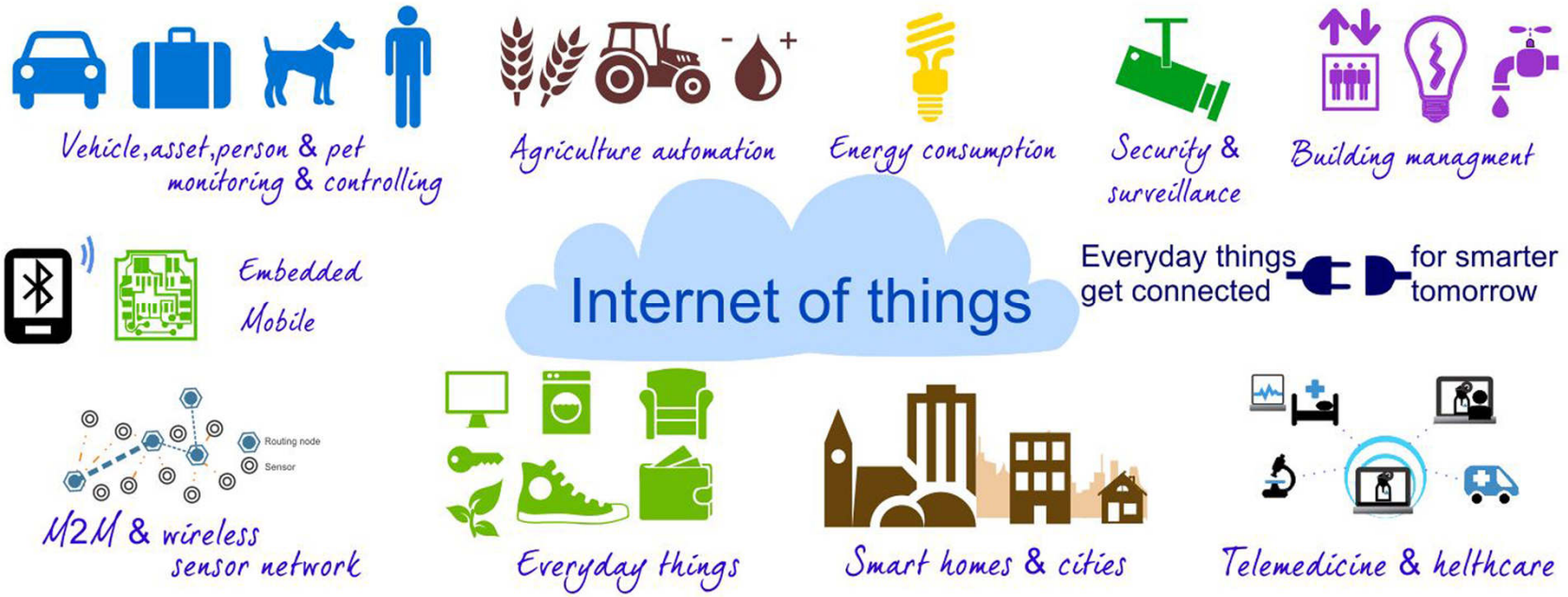
Future Challenges: Digitalisation

Estimated 50bn connected devices!



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Even more digitalisation!

Estimated 35 zeta-bytes (35×10^{21}) of digital records!

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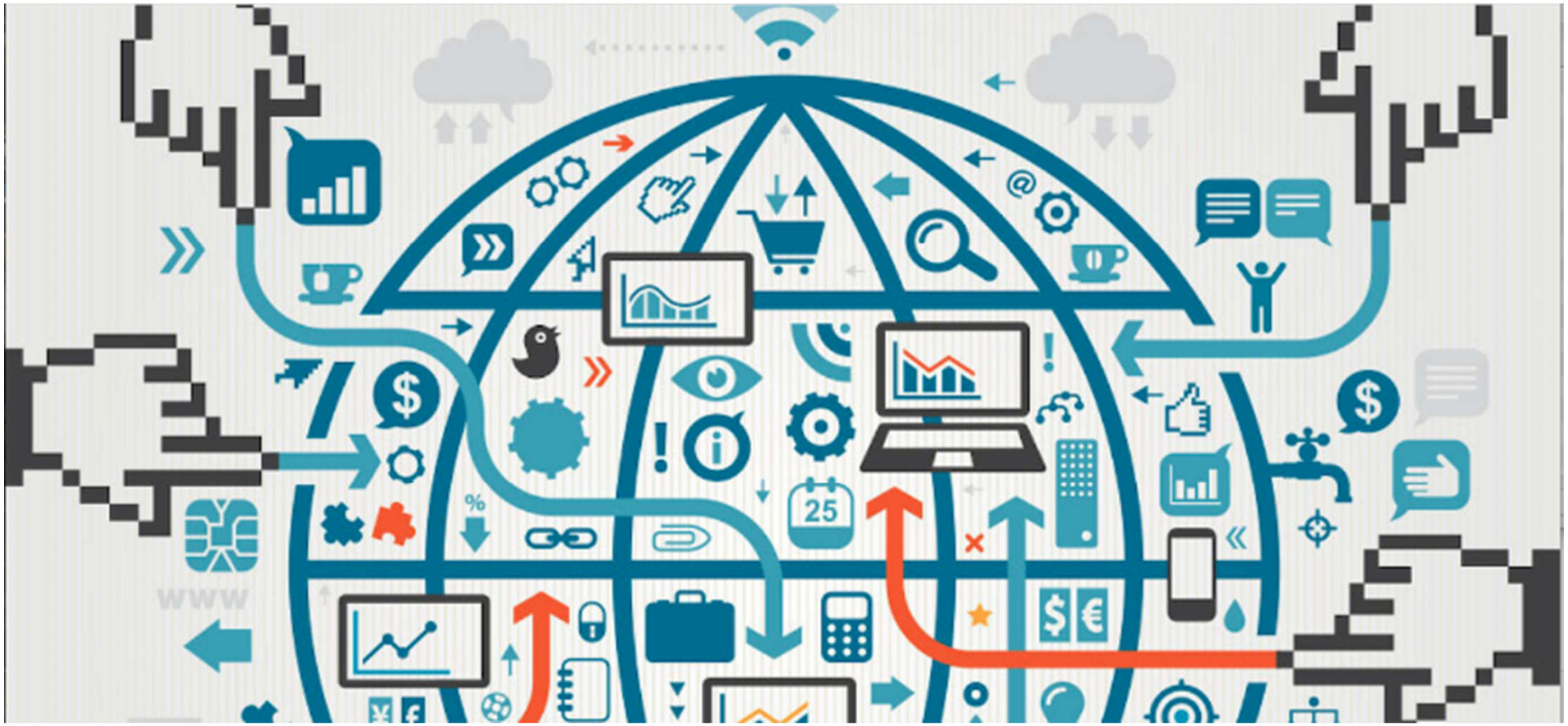
And hyper-connectivity!



Future Research Direction for RTCPS

- **Digitalisation – Security and Privacy Ergonomics by Design**
  - ✓ Gap between person's understanding and what goes on in the system
  - ✓ Human in-the-loop
    - **Automation vs. agent interaction**
    - **Leveraging the human as a resource**
  - ✓ System and software architectures
  - ✓ Skills gap
  - ✓ Socially engaged cyber-physical systems
    - **Security economics**
    - **Privacy dynamics**
- **Developing as a discipline and/or shaping the various disciplines**

Challenges and Opportunities

- **Privacy – little incentive for industry? (participatory data economy)**
- **Security – economic incentives for industry, finally! (critical infrastructure and systems)**

- **H2020 – Secure Societies**
  - ✓ Leverage existing security research
- **What is needed is more foundational focus (lower TRL)**
  - ✓ National and European funding programmes
  - ✓ Need multiple competencies across Europe (particular for smaller EU countries)

Security and Privacy Ergonomics

Questions

Questions ?