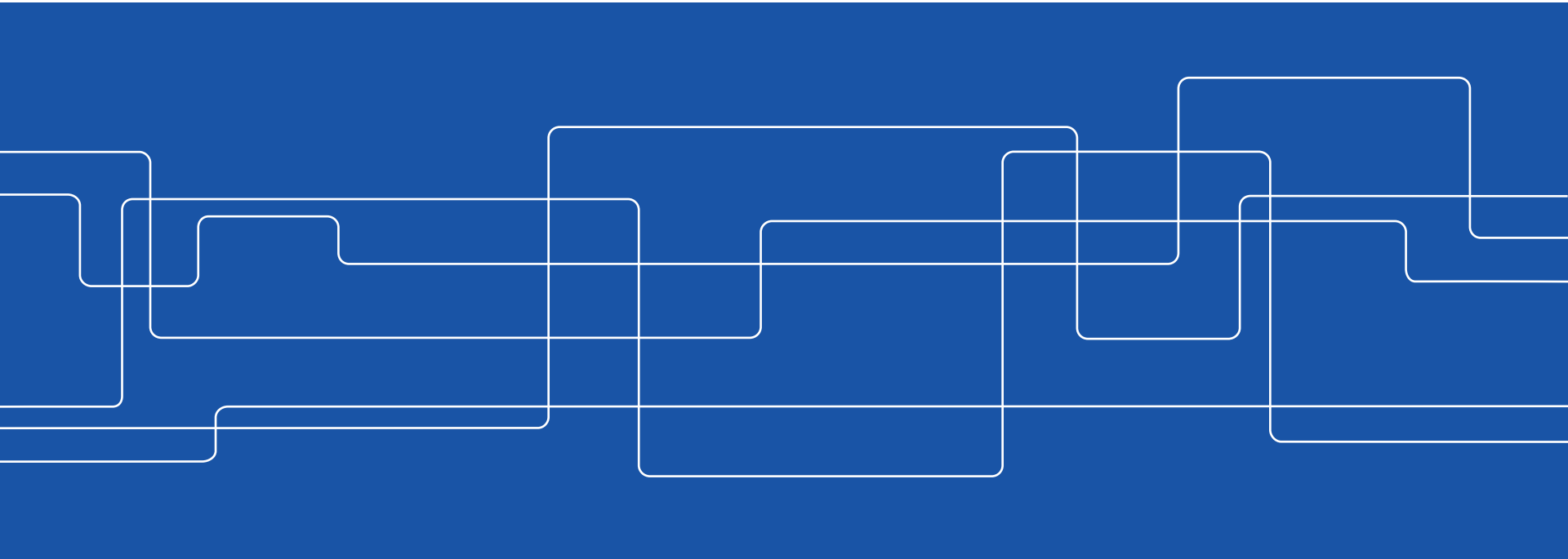
KTH ROYAL INSTITUTE
OF TECHNOLOGY

ACCESS-FORCES Workshop on Cyber-Physical Systems

KTH, Stockholm, October 26-27, 2015

Organizing Committee:
Henrik Sandberg, Per Enqvist, Johan Karlsson, Saurabh Amin



Welcome to the ACCESS-FORCES Workshop on Cyber-Physical Systems

- What is CPS?
- What is new at ACCESS and KTH?
- Goals of the workshop
- Program

What is a Cyber-Physical System (CPS)?

- A system of **collaborating computational elements controlling physical entities**

- Embedded systems a precursor with focus on computational elements
  - “The fact is that even the simplest C program is not predictable and reliable in the context of CPS because the program does not express aspects of the behavior that are essential to the system.”

- Challenging because **physical components** of CPS introduce **safety and reliability requirements** qualitatively different from those in general purpose computing

[Edward A. Lee: Cyber Physical Systems: Design Challenges, 2008]

What is a Cyber-Physical System (CPS)?

- Examples:
  - high confidence medical devices and systems
  - assisted living
  - traffic control and safety
  - advanced automotive systems
  - energy conservation
  - critical infrastructure control (electric power, water resources, and communications systems for example)
  - distributed robotics (telepresence, telemedicine),
  - smart structures
  - …

[Edward A. Lee: Cyber Physical Systems: Design Challenges, 2008]

What is New at ACCESS and KTH?

- ACCESS Linnaeus Centre turns 10 years old, and is reorganized

- The Swedish Civil Contingencies Agency (MSB) funds a new 5-year KTH center:
  - CERCES - Center for Resilient Critical Infrastructures

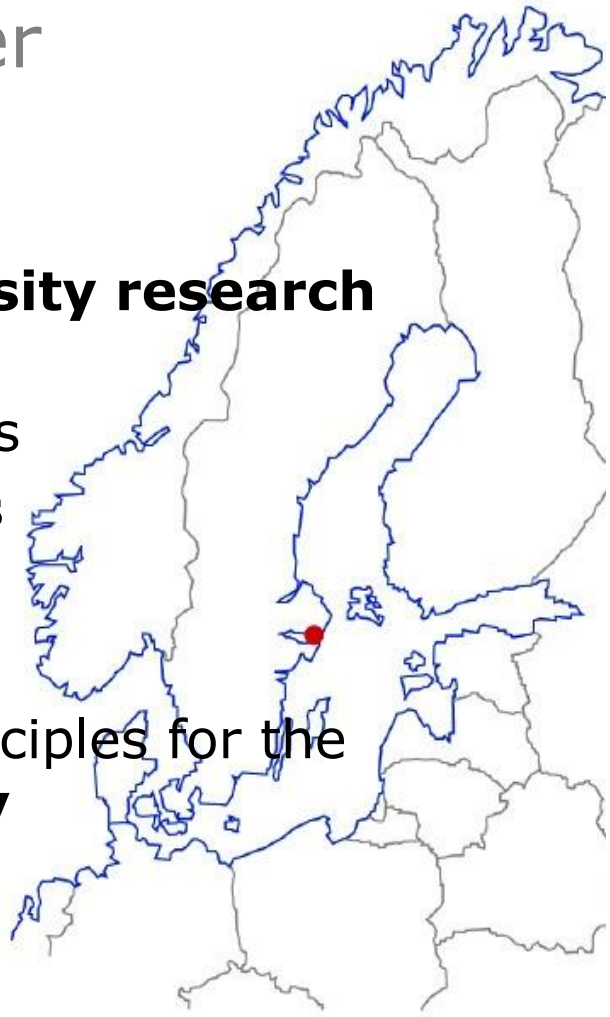
- The Knut and Alice Wallenberg Foundation funds a new national 10 year program:
  - WASP - Wallenberg Autonomous Systems Program

KTH Linnaeus Center ACCESS

Karl H. Johansson (kallej@kth.se), Director
Mikael Skoglund (skoglund@kth.se), Director Grad School

> "*[ACCESS] is the largest and leading research center in its field in Europe, being able to generate world-class research and being highly attractive for international recruitments and exchanges.*"
>
> MID-TERM EVALUATION REPORT 2012

ACCESS Linnaeus Center



- ACCESS was established from VR grant 2006
- Developed into **a leading European university research center** in networked systems
  - 36 faculty, 30 postdocs, >100 PhD students
- Graduate school with **>50 graduated PhD's**
- **Faculty renewal** and mobility programs

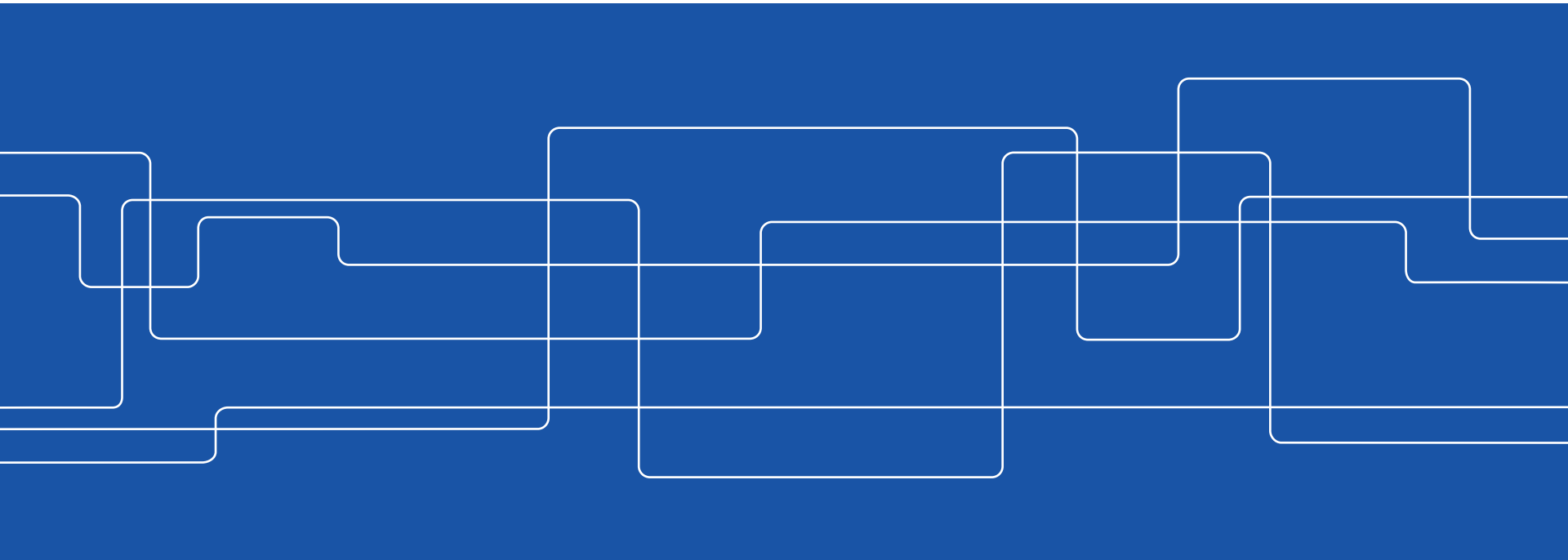
- **Research program** on the fundamental principles for the design of the future **interconnected society**
- **Application projects** on
  - Smart mobility
  - Smart energy grid
  - Multimedia communications

New Thematic Areas

- Cyber-physical systems
  - Henrik Sandberg (hsan@kth.se), TA leader
- Software-defined networking
  - Viktoria Fodor (vjfodor@kth.se), TA leader
- Data analytics
  - Joakim Jaldén (jalden@kth.se), TA leader
- Security, privacy, and trust
  - Panos Papadimitratos (papadim@kth.se), TA leader
- Industry relations
  - James Gross (jamesgr@kth.se), Industry liaison

Center for Resilient Critical Infrastructures (CERCES)

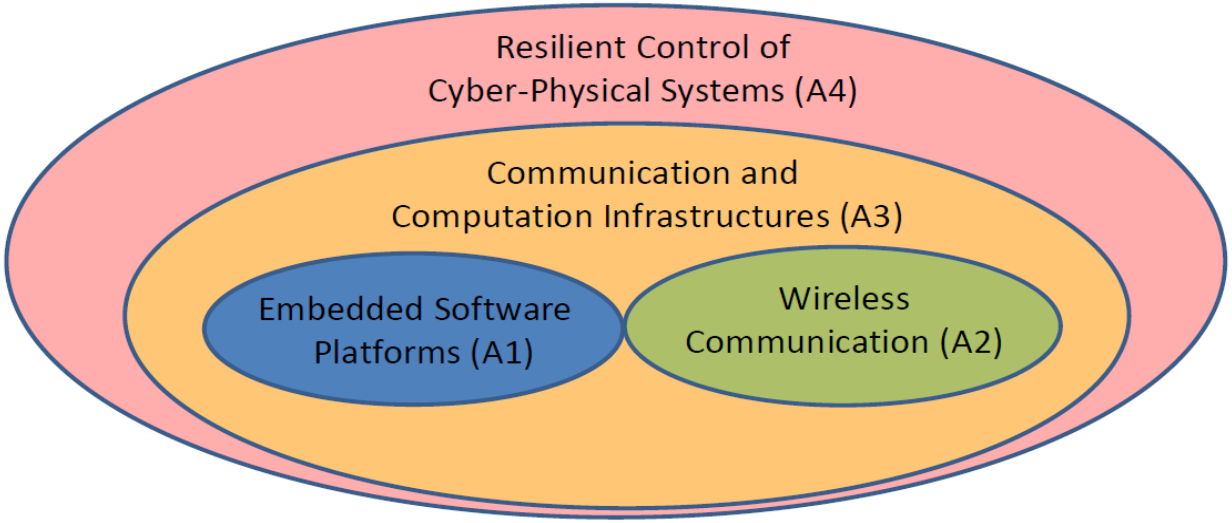
Henrik Sandberg (PI), Mads Dam (co-PI),
György Dán (co-PI), Ragnar Thobaben (co-PI)



CERCES – Center for Resilient Critical Infrastructures

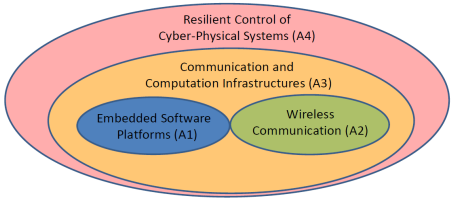
- Newly formed MSB-funded project at KTH (20 MSEK, 2015-2020): 4 faculty, 4 PhD students, 2 postdocs
- **Focus:** Resilience of Industrial Control Systems for critical infrastructures (power systems, traffic systems, water distribution, etc.)
- **Threats:** Cyber attacks, malfunctioning and heterogeneous IT, security by obscurity, “isolated” infrastructures, wireless
- **KTH:** Automatic Control, Communication Networks, Communication Theory, and Theoretical Computer Science
- **FOI/MSB:** NCS3 - Nationellt centrum för säkerhet i styrsystem för samhällsviktig verksamhet
- **Industrial Reference Group:** In progress

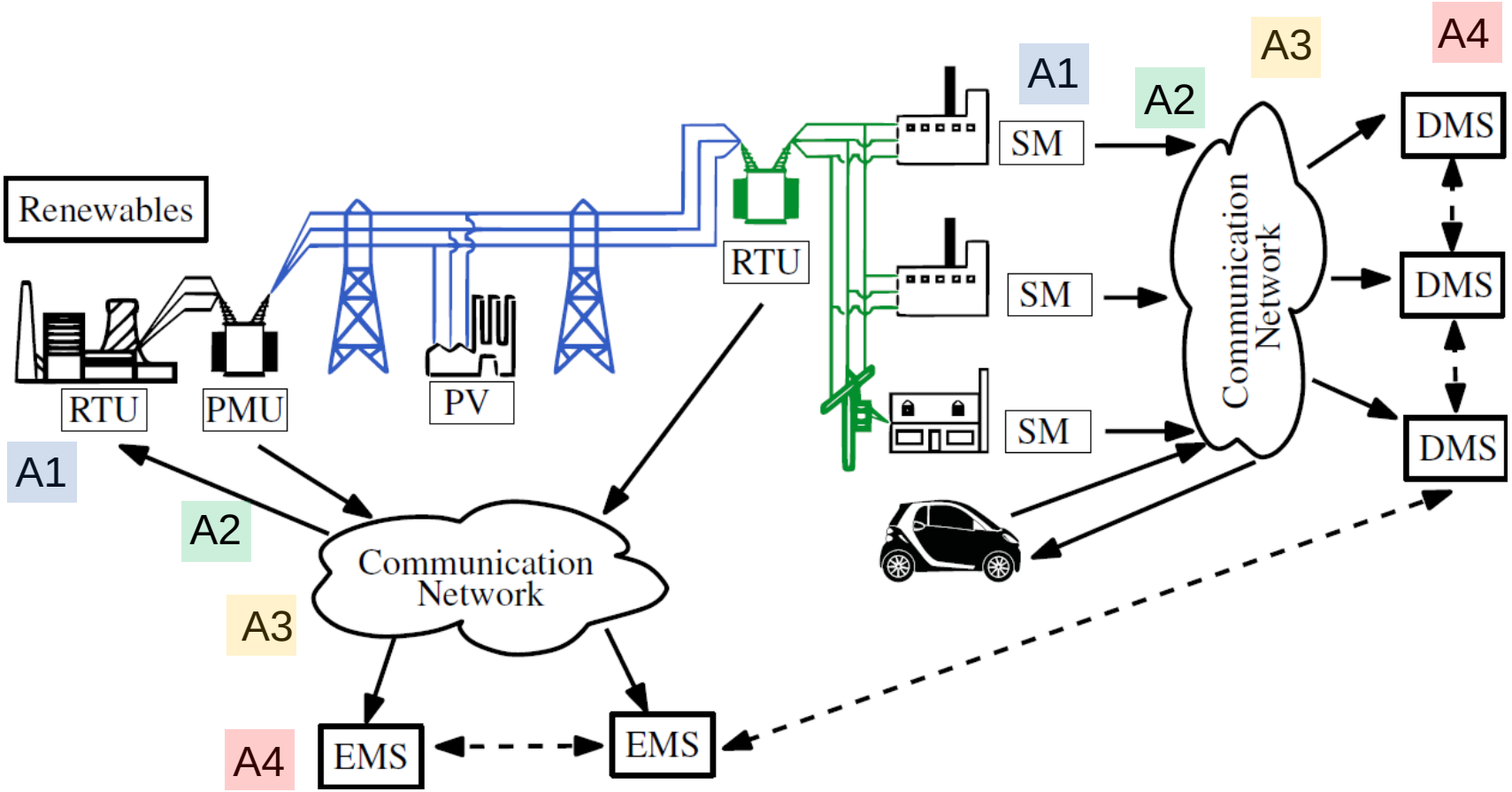
CERCES Main Research Areas



- **Area 1**: Embedded Software Platforms
  - Mads Dam (mfd@kth.se)
- **Area 2:** Wireless Communication
  - Ragnar Thobaben (ragnart@kth.se)
- **Area 3:** Communication and Computation infrastructure
  - György Dán (gyuri@kth.se)
- **Area 4**: Resilient Control of Cyber-Physical Systems
  - Henrik Sandberg (hsan@kth.se)

Example: The Smart Grid





Wallenberg Autonomous Systems Program

Lars Nielsen, Linköping University

David Sands, Chalmers

Bo Wahlberg (bo@kth.se), KTH

Karl-Erik Årzén, Lund University

WASP

- Sweden's largest individual research program ever

  (1.8 billion SEK over ten years)
- Key values: *research excellence* and *industrial relevance*
- Research on Autonomous Systems and Software .

Start-up: 25 PhD students and 21 industrial PhD students in 6 projects

4 professor recruitment packages

First WASP Research Projects

- Software Engineering for Smart Systems
- Autonomous Cloud
- Integrating Perception, Learning and Verification in Interactive Autonomous Systems
- Human Interaction and Communication with Sensor Rich and Autonomy Populated Environments
- Localization and Scalability for Distributed Autonomous Systems
- Automated Transport Systems

Goals of the Workshop

- Several new, large, long-term projects: Organizing and **focusing our future research and collaborative efforts**
- Opportunity to **connect** with the CPS center FORCES in the US, and with leading academic and industrial researchers in Europe and America
- Opportunity to discuss intriguing and important **research challenges**, present **new results**, and future **joint research collaborations**
- Activities: Single track presentations, a poster session, and group discussion sessions

	Mon	Tue
8:00	8:00 Coffee	8:00 Coffee
9:00	8:30 Welcome: Henrik Sandberg (KTH) 8:45 Saurabh Amin (MIT) 9:30 Henrik Ohlsson (C3 Energy)	8:30 Alessandro Abate (Oxford U.) 9:15 Ling Shi (HKUST)
10:00	10:00 Coffee break	10:00 Coffee break
11:00	10:30 Linus Thrybom (ABB) 11:00 Erik Herzog (SAAB)	10.30: Group work
12:00	11:30 Lunch buffet and poster session	11:30 Martin Törngren (KTH)
13:00	12:30 Poster session continues	12:15 Lunch at Syster o Bror
14:00	13:30 Maria Henningsson (Modelon) 14:00 Mats Näslund (Ericsson)	13:45 Serdar Yuksel (Queen's U.) 14:30 Lillian Ratliff (UC Berkeley)
15:00	14:30 Coffee break 14.45: Introduction to group work	
16:00	15.40: Group work	15.30: Group Presentations
17:00	16:30 Coffee break 16:45 Claudio De Persis (Groningen U.)	16:30 Coffee break 16:45 Xiaoming Hu (KTH) 17:15 Henrik Sandberg (KTH) + closing
18:00		
19:00	19:00 Dinner at Hasselbacken	
20:00		