



Building Smart Cities & Smart Infrastructures

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IoT Industry Development (Shanghai) Forum 2011



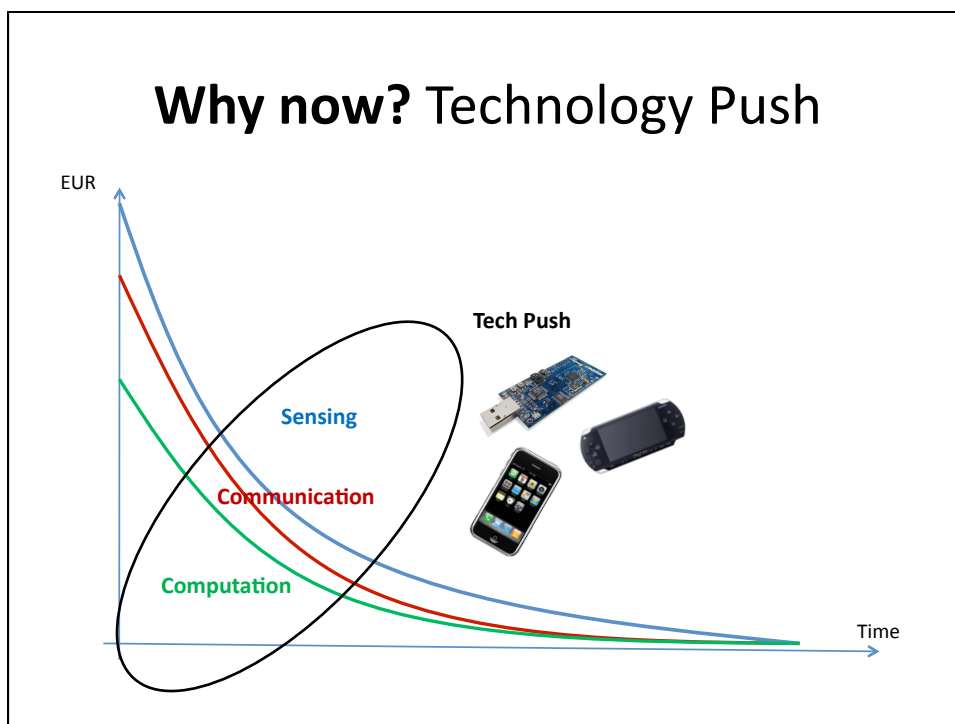
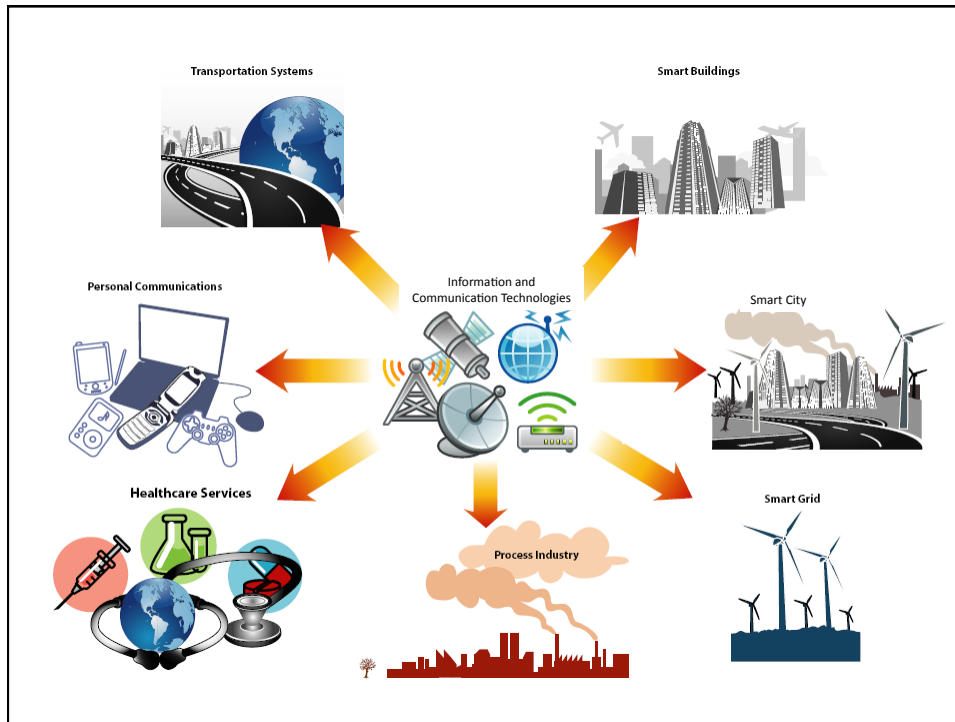
ROYAL INSTITUTE
OF TECHNOLOGY

KTH ACCESS Linnaeus Center

One of Europe's largest university research centers in communication and networked systems including IoT & CPS

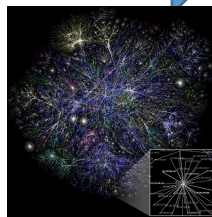
- 35 faculty, 20 postdocs, 100 PhD students
- 10 year basic funding by Swedish Research Council
- Annual research budget over 10 MEUR
- Graduate School, Mobility Program
- Extensive industrial and international collaborations





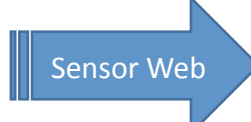
Towards Smart Infrastructures

- Internet
- WWW
- Ubiquitous computing



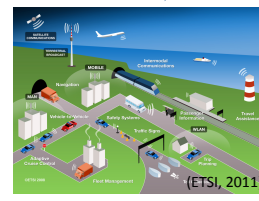
The Internet

- Remote sensing
- Monitoring environments
- Wireless sensor networks



Monitoring natural phenomena

- Closing the loop
- Critical infrastructures
- Humans in the loop



Smart infrastructures

Characterstics of Smart Infrastructures

Unprecedented scale

Mission-critical

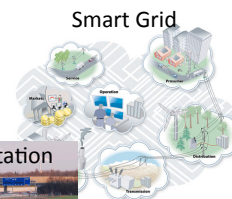
Trusted



eHealth

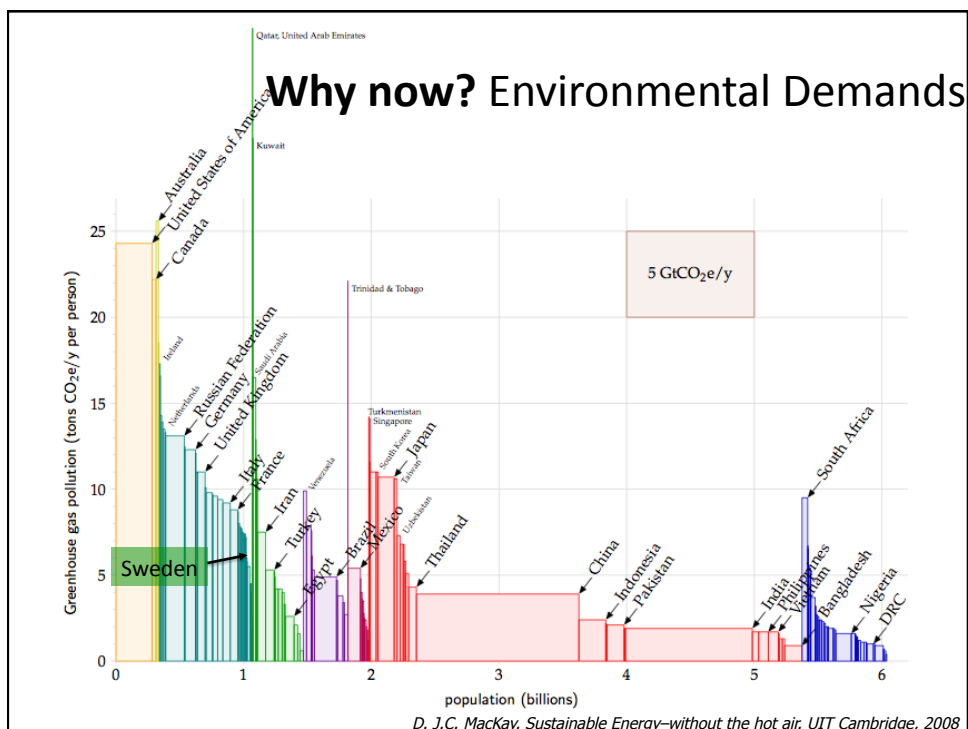


Intelligent Transportation



Smart Grid





An IoT Agenda

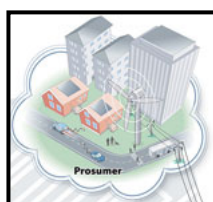
Intelligent Transportation



SCANIA



Smart City



ABB



Public Security and Safety

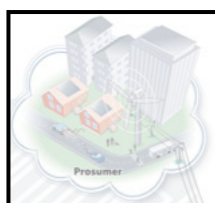


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Intelligent Transportation



Goods Transportation: Societal Perspective

- Goods transportation accounts for **30 % of CO₂ emissions**
15 % of greenhouse gas emissions of the global fossil fuel combustion

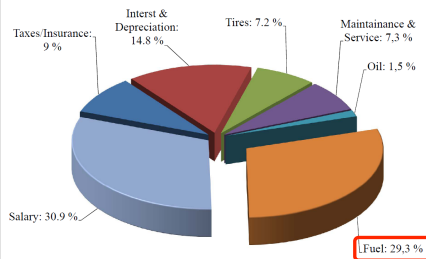


- Goods transport is projected to **increase by 50%** for 2000-2020

[International Transport Forum, 2010; European Commission, 2006]

Goods Transportation: Fleet Owners Perspective

Life cycle cost for a heavy duty vehicle in Europe



Total fuel cost 80 k€/year/HDV



[Schittler, 2003]

Automated Platooning as a Solution

- May trippl highway throughput
- May reduce fatalities by 10%
- May reduce emissions by 20%

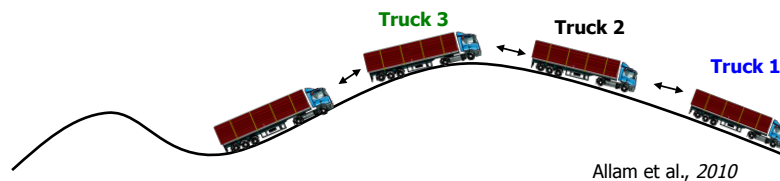
[Varaiya et al., PATH project, 2010; Robinson et al., 2010]



Collaborative Driving for Fuel Reduction



- Drive closer together to **reduce air drag** and prepare vehicles based on road and traffic information
- Enabled by new communication and sensor technologies
- Safety guarantees through automatic control

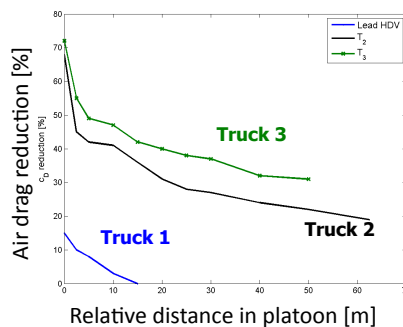


Allam et al., 2010

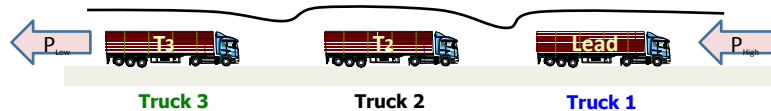


KTH Electrical Engineering

Air Drag Reduction in Platooning

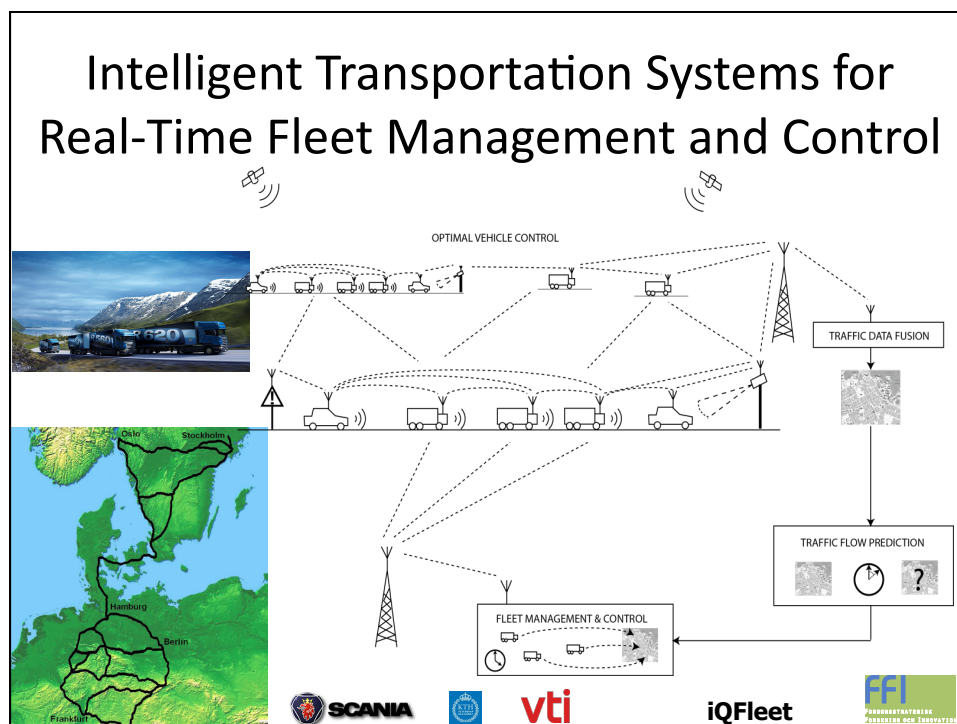
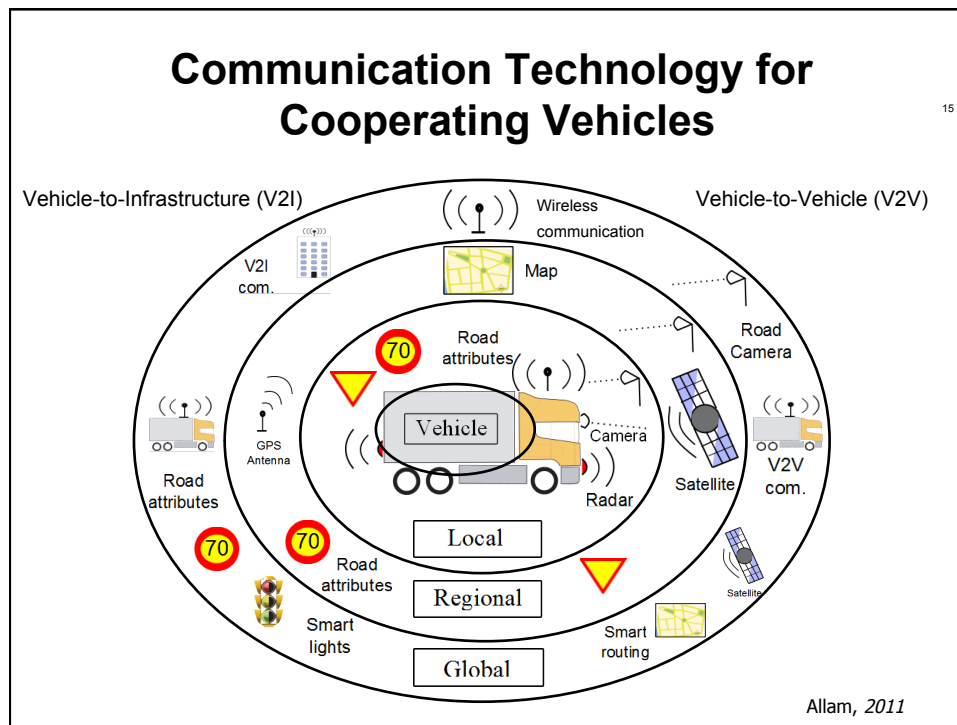


$$F_{\text{air}} = \frac{1}{2} c_D(d) A_a \rho_a v^2$$



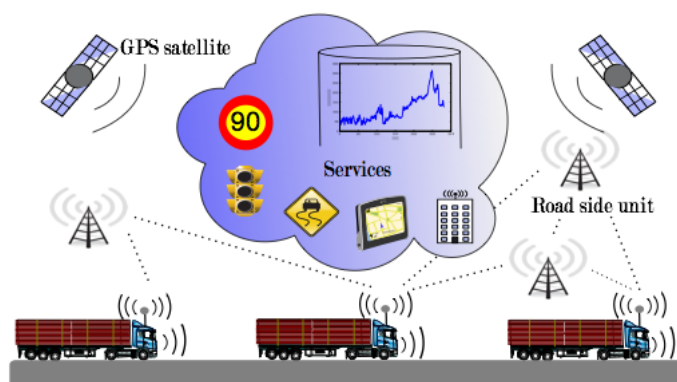
- Fuel saving potential 5-10%
- Large-scale European tests 2012

Wolf-Heinrich and Ahmed, 1998; Allam et al., 2011

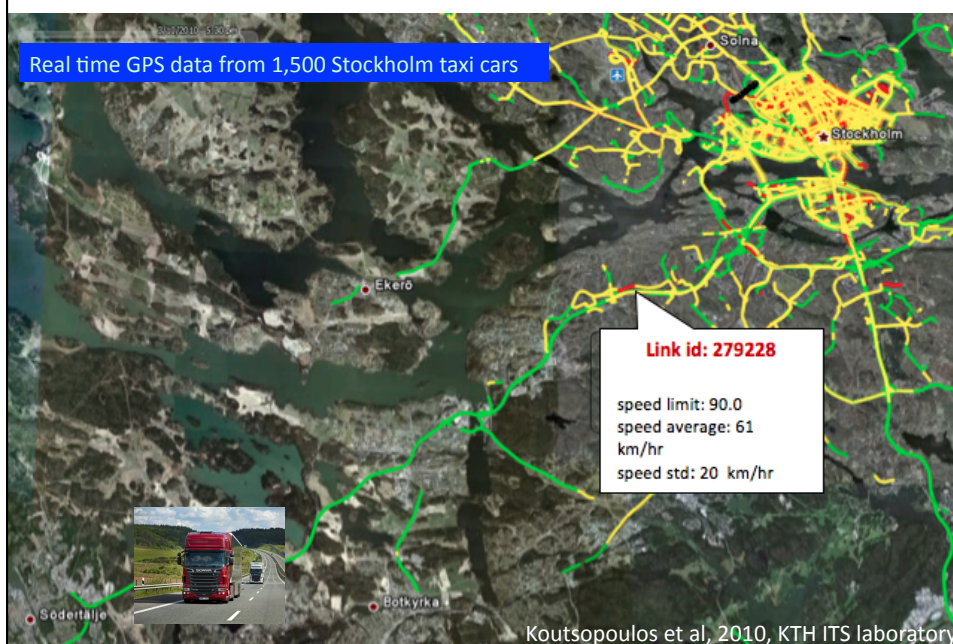


Real-time Services for Transportation

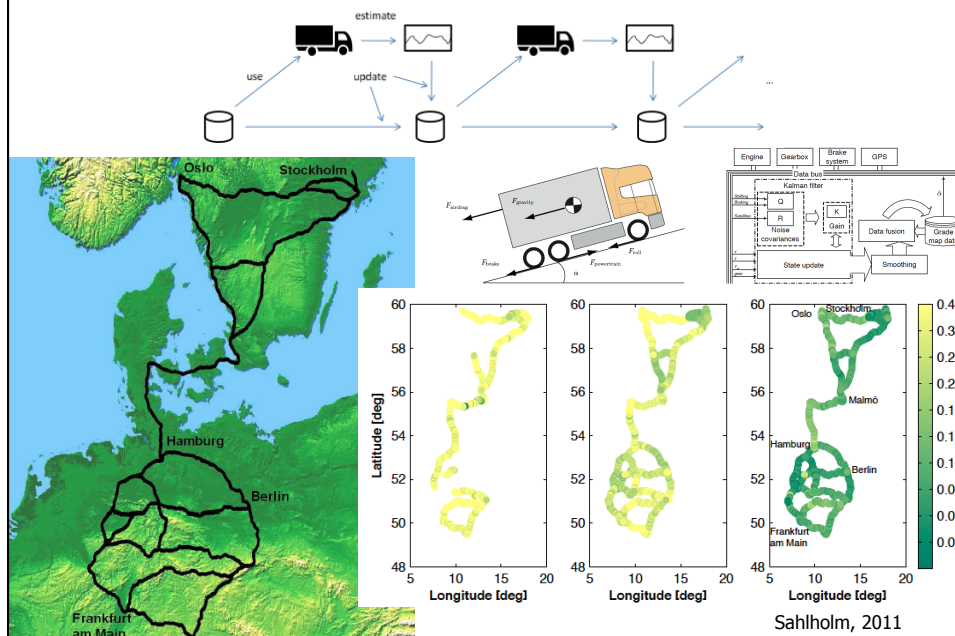
- Vehicle-to-vehicle and vehicle-to-infrastructure communications enable new set of mobile applications
- Systematic design and operation tools to handle complexity



Traffic Prediction from Large Mobile Sensor Network



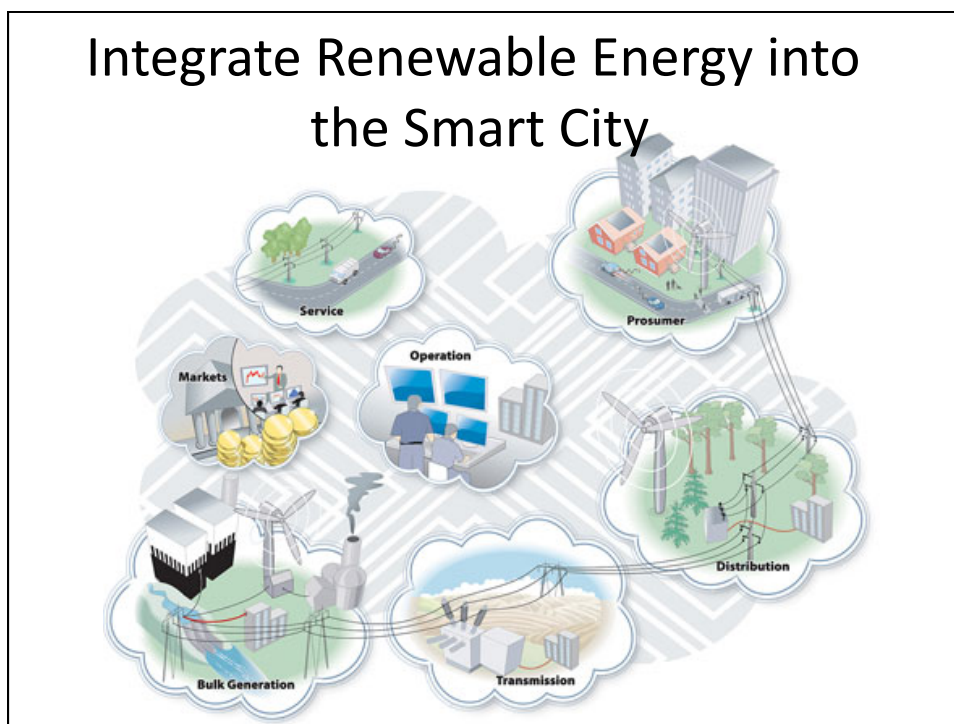
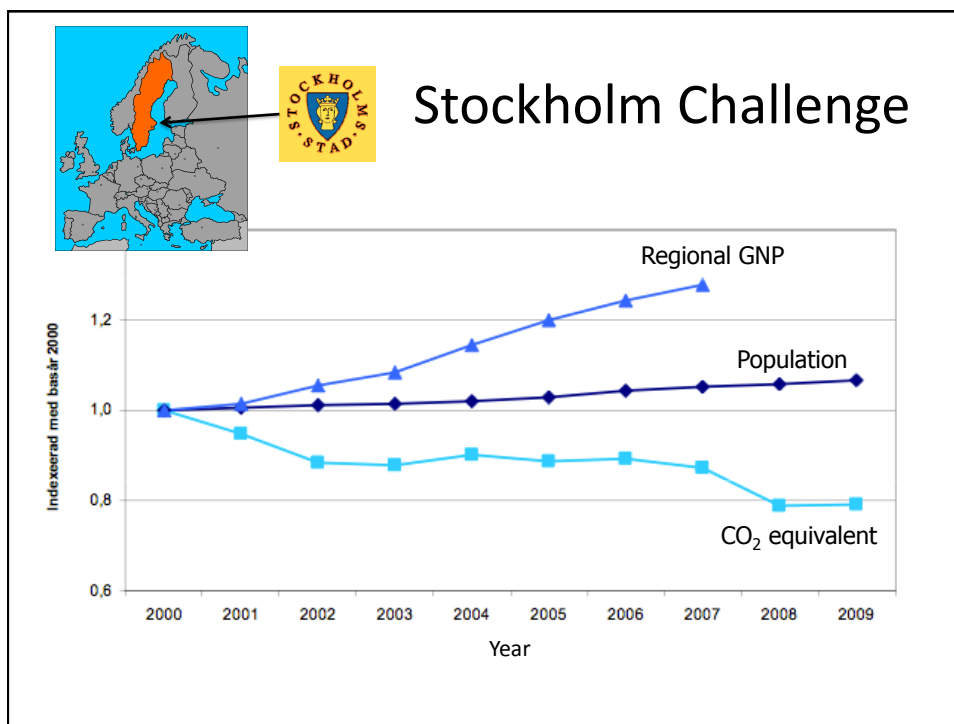
Collaborative Road Grade Estimation



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Smart City





Stockholm Royal Seaport

2010

- Oil depot
- Container terminal
- Ports
- Gas plant

2030

- 10,000 new homes
- 30,000 new work spaces
- 600,000 m² commercial space
- Modern port and cruise terminal
- 236 hectares sustainable urban district
- Walking distance to city centre

From a brown field area to a sustainable city district



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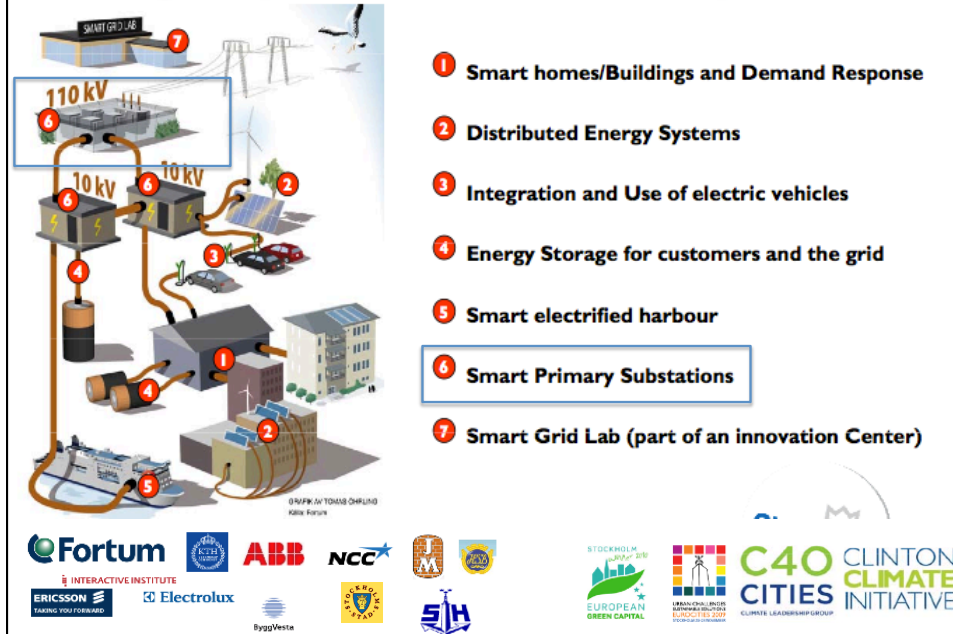
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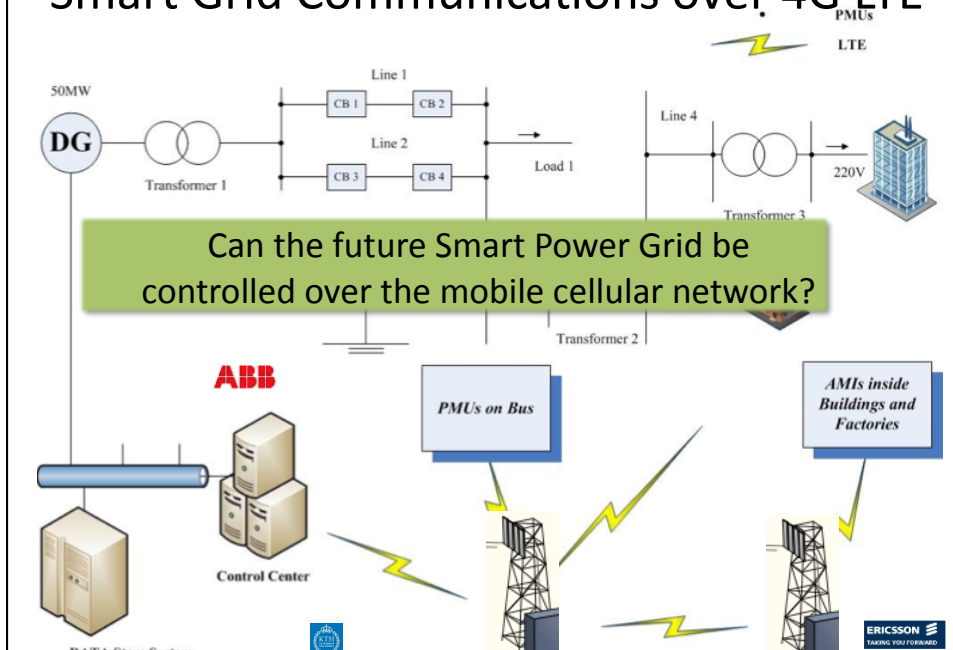
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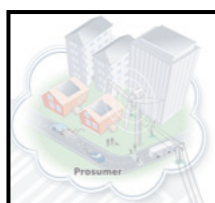
Smart Grid in the Stockholm Royal Seaport



Smart Grid Communications over 4G LTE



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Public Security and Safety



From Resilience and Security to Societal Cost

Cyber attacks & faults



Control system



Northeast U.S. Blackout of August 14th, 2003:
55 million people affected



Power network



Societal cost



<http://www.vikingproject.eu>

Tunnel disaster relief scenario

Wireless sensor networks to support rescue operation at tunnel accident



VIDEO



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Public Security and Safety



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Conclusions



- **Internet of Things** is an **enabling technology** to tackle grand challenges
 - Many **innovation and business opportunities** in
 - Intelligent transportation systems
 - Smart cities
 - Public security and safety
 - Health
 - Manufacturing and process industries
 - Etc
-
- Major research and development initiatives in Europe
 - Opportunities for **collaboration** between Shanghai and Stockholm



<http://www.ee.kth.se/~kallej>