Panel, Venice

Challenges on Mobility with IoT and Big Data

- **Moderator**
  Wael Bazzi, American University in Dubai, Dubai
- **Panelists**
  Jean-Pierre Richard, École Centrale de Lille, France
  Xiaohong Peng, Aston University, UK
  Nicola Fabiano, Studio Legale Fabiano, Italy
  Wael Bazzi, American University in Dubai, Dubai

→ Towards Energy Storage

- Need for balancing regular energy and clean energy
- Energy storage technologies
  - Picks (balancing)
  - Reliability (back-up)
  - Cost optimization and uniform consumption
- Cost for stored energy (dollar/euro/kilowatt)
- Cost
  - Regular energy + transportation
  - Stored energy + transportation
  - (Regular || Stored) energy + transportation

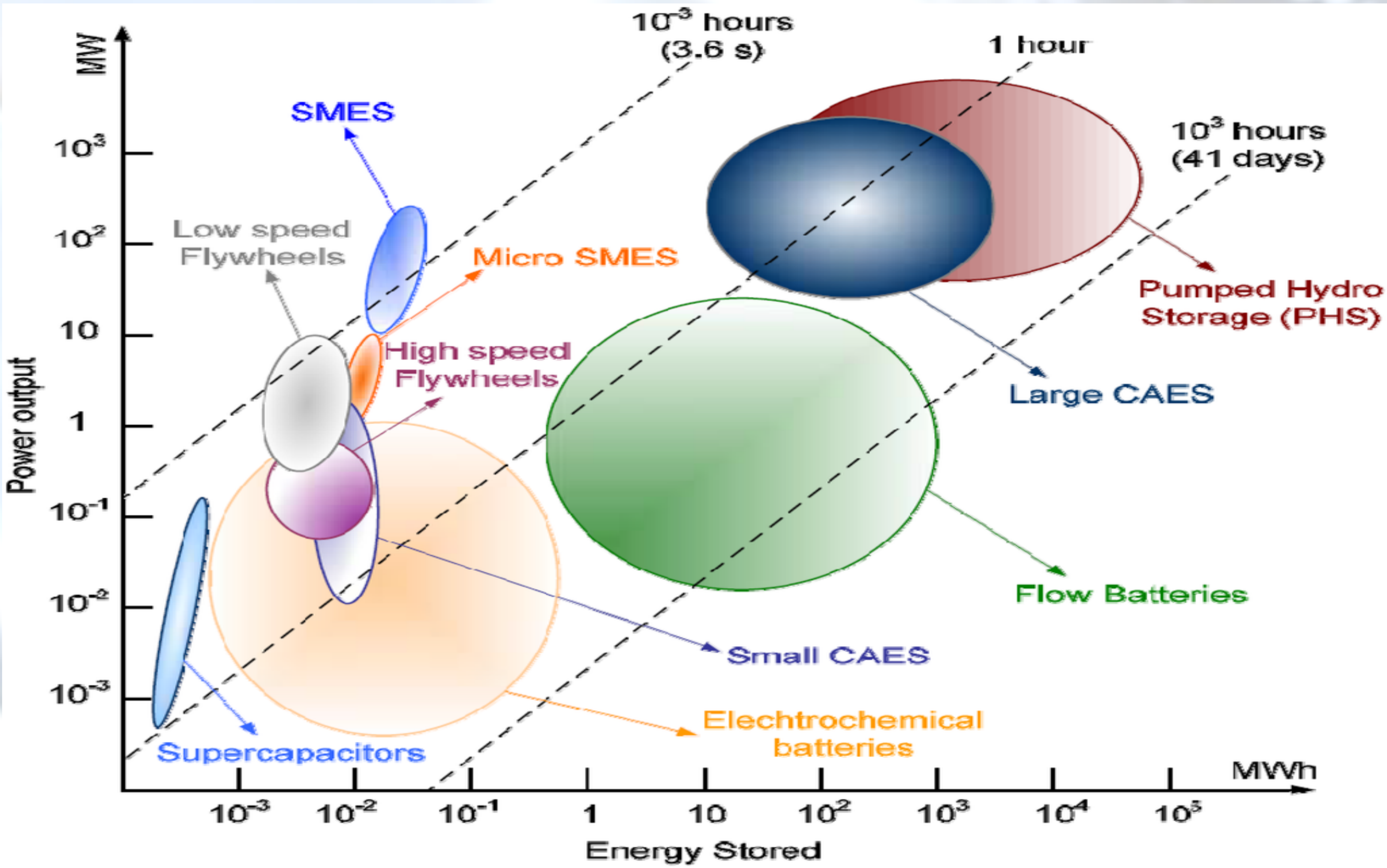
Energy Storage is Here

- **Small scale**
  - **Solar computers**
  - **Wearable devices**
  - **Solar stations**
- **Medium scale**
  - **Computers**
  - **Highway panels**
- **Large scale**
  - **Hospitals**
  - **Emergency activities**
  - **Inter-grids for wireless base-stations wireless**
  - **Inter-solar-power units**

Energy Storage Technologies

- **Solid State Batteries - a range of electrochemical storage solutions, including advanced chemistry batteries and capacitors**
- **Flow Batteries - batteries where the energy is stored directly in the electrolyte solution for longer cycle life, and quick response times**
- **Flywheels - mechanical devices that harness rotational energy to deliver instantaneous electricity**
- **Compressed Air Energy Storage - utilizing compressed air to create a potent energy reserve**
- **Thermal - capturing heat and cold to create energy on demand**
- **Pumped Hydro-Power - creating large-scale reservoirs of energy with water**
- **http://energystorage.org/energy-storage/energy-storage-technologies**

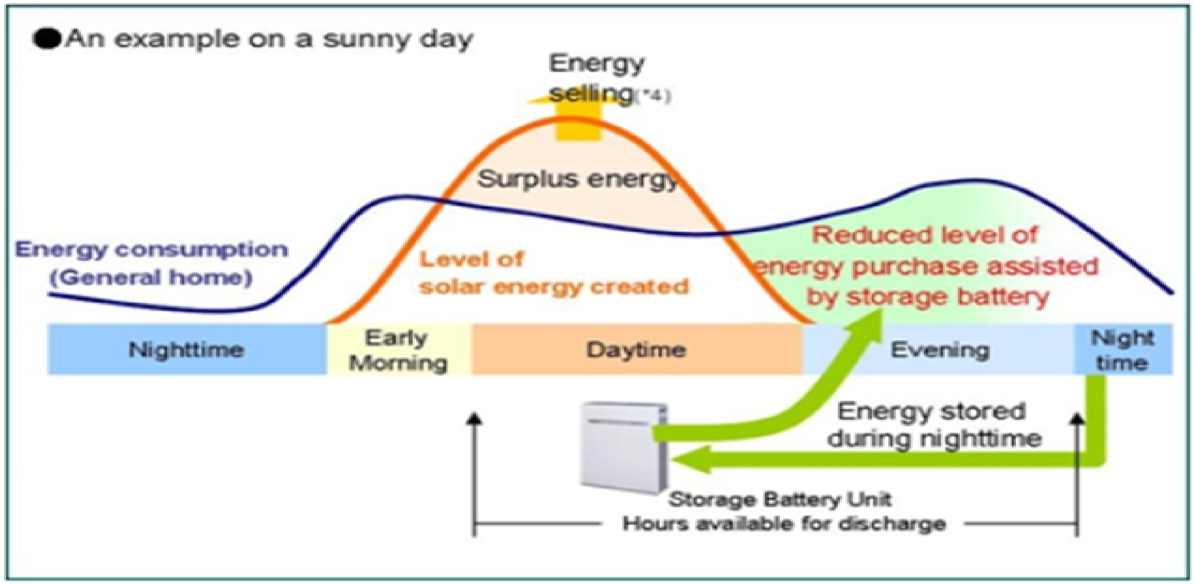
Energy/Power



Consumption balancing

Economy Prioritized Mode

- The user can reasonably reduce peak power demand by making use of the nighttime power supply from the grid without compromising the amenity.
- The user can also enjoy economic advantage of charging the battery using low-cost nighttime power supply and discharging during peak hours. It makes reduction level of energy purchase.



*4: The battery does not discharge any energy while selling the surplus solar energy.

Case study: Skylar

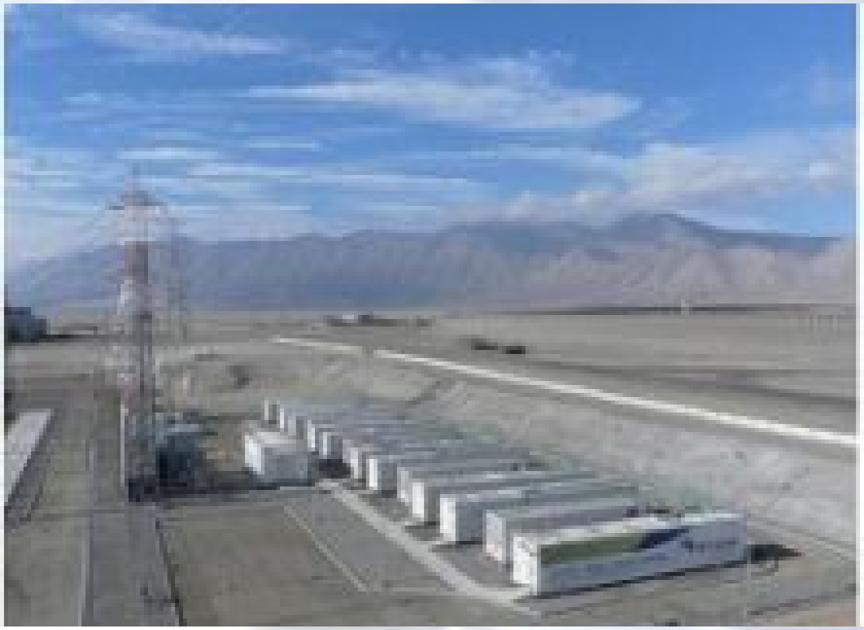
- Energy Markets [Skylar Energy: American Way, May 2016]
- Supply Mix (renewable energy sources, such as solar and wind)
- Renewable energy sources are intermittent (not consistently, at demand)
- Power storage (utility scale battery systems)
- Energy storage market ~ 2% in USA
- Battery costs will drop by 40% through 2020
- System 2MW –> 150 MW

Example 1

http://energystorage.org/energy-storage/case-studies/aes-energy-storage-angamos-battery-energy-storage-system-bess

AES Energy Storage Angamos Battery Energy Storage System (BESS)

544MW thermal power plant in the town of Mejillones in Northern Chile



Example 2

- **Earning Revenue via Multiple Value Streams: Kaheawa Windfarm Dynamic Power Resource (DPR®) Energy Storage**

First Wind built a second phase to the Kaheawa Wind Project (KWP II) adding an incremental 21 MW of wind generation on the island of Maui on the Maui Electric Company's 69 kV electric system.

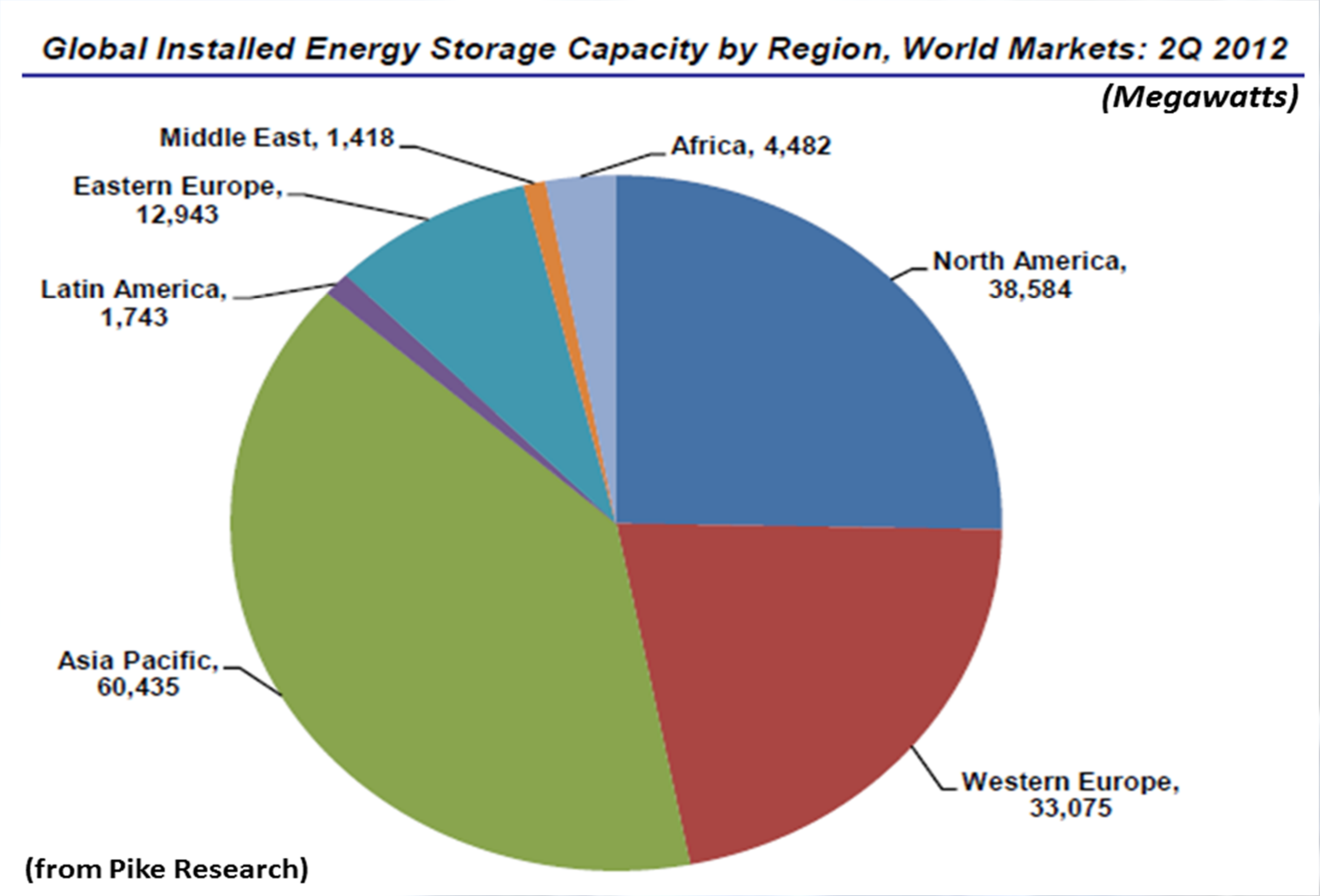
In order to mitigate the effects of wind volatility on an island grid, Xtreme Power designed a 10 MW Dynamic Power Resource® (DPR) to integrate with the 21 MW KWP II facility operating on a 80-200 MW grid.

Example 3

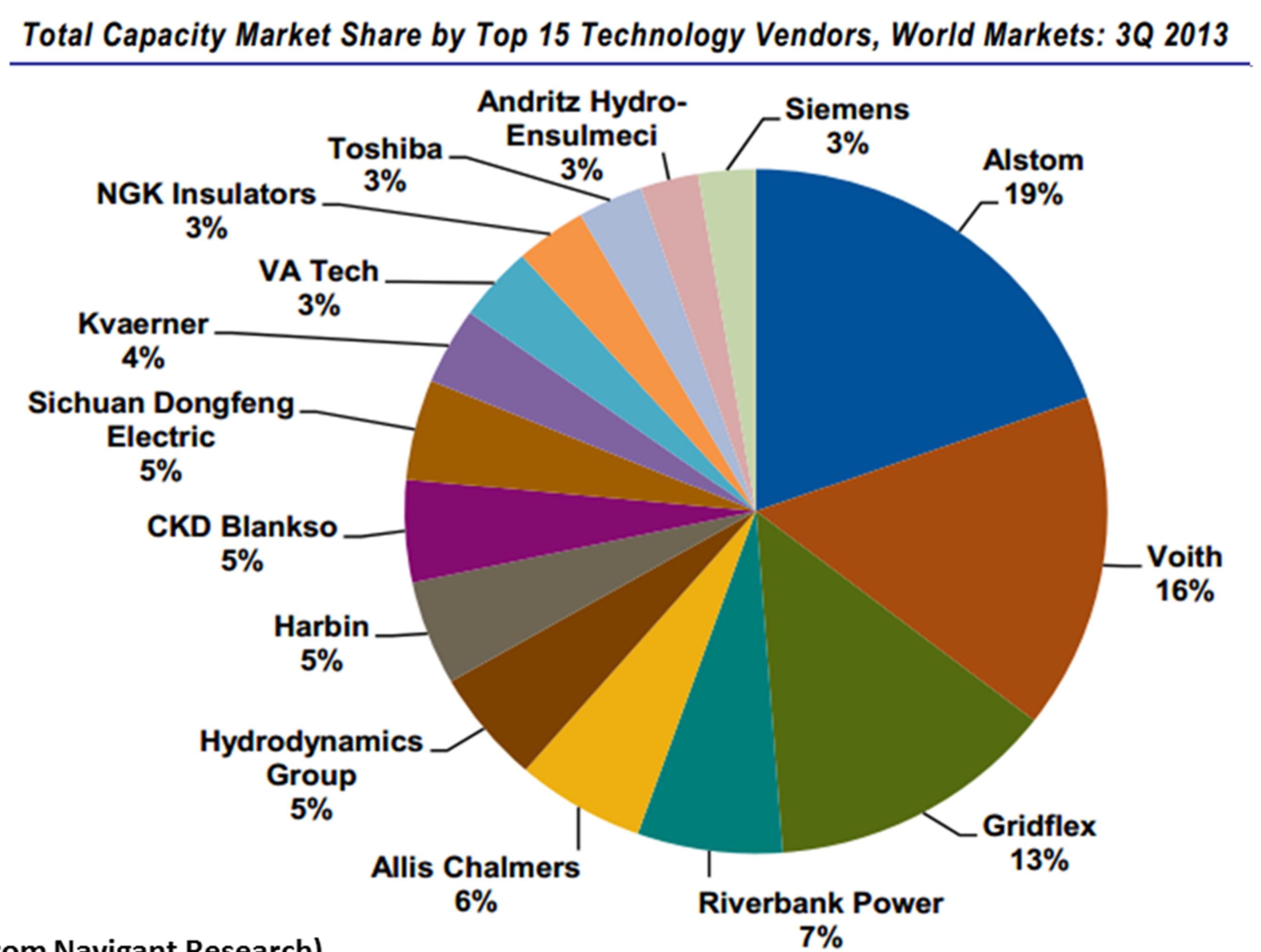
- Long-Duration Energy Storage on a Grid Scale: Highview Power Storage LAES

- **Liquid Air Energy Storage (LAES) is sometimes referred to as Cryogenic Energy Storage (CES). The word “cryogenic” refers to a gas in a liquid state at very low temperatures. The working fluid is Liquefied Air or Liquid Nitrogen (78% of air). The systems share similar performance characteristics to pumped hydro and can harness industrial low-grade waste heat/waste cold from co-located processes, converting it to power. Size range extends from around 5MW/15MWh to >50MW/250MWh and with capacity and energy being de-coupled, the systems are very well suited to long duration applications.**

Statistics i



Statistics ii



(from Navigant Research)

Technologies and costs i

TECHNOLOGIES

http://www.iec.ch/whitepaper/pdf/iecWP-energystorage-LR-en.pdf

COST FOR EVERGY STORAGE: $/KW

http://prod.sandia.gov/techlib/access-control.cgi/2011/112730.pdf

http://www.osti.gov/scitech/servlets/purl/453759/

http://www.sciencedirect.com/science/article/pii/S0306261914010290

Technologies and costs ii

- Long-duration storage,
  frequent discharge, storage: 4-8 h, 1 cycle/day x 250 days/year

  Long-duration storage,
- infrequent discharge, storage: 4-8 h, 20 times/year

  Short-duration storage,
  frequent discharge, storage .25-1h , 4 x 15 minutes of cycling x (250 days/year = 1000 cycles/year)

  Short-duration storage,
  infrequent discharge, storage .25-1h , 20 times/year

- ? ROI + 5, 10, ? Years
- Environmental impact | cost of maintenance
- Health impact | cost of health insurance

- Costs of energy storage systems depend not only on the type of technology, but also on the planned operation and especially the hours of storage needed. Calculating the present worth of life-cycle costs makes it possible to compare benefit values estimated on the same basis.

Challenges

- **Costs**
  - **Technology**
  - **Applications**
- **Social acceptance**
  - **Environmental studies**
  - **Ecology**
  - **Health**
- **Governmental enforced regulations**
  - **Green certificate**
  - **Cost compensation**

Thanks

Thanks

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INTERNET 2018

June 24, 2018 to June 28, 2018 - Venice, Italy

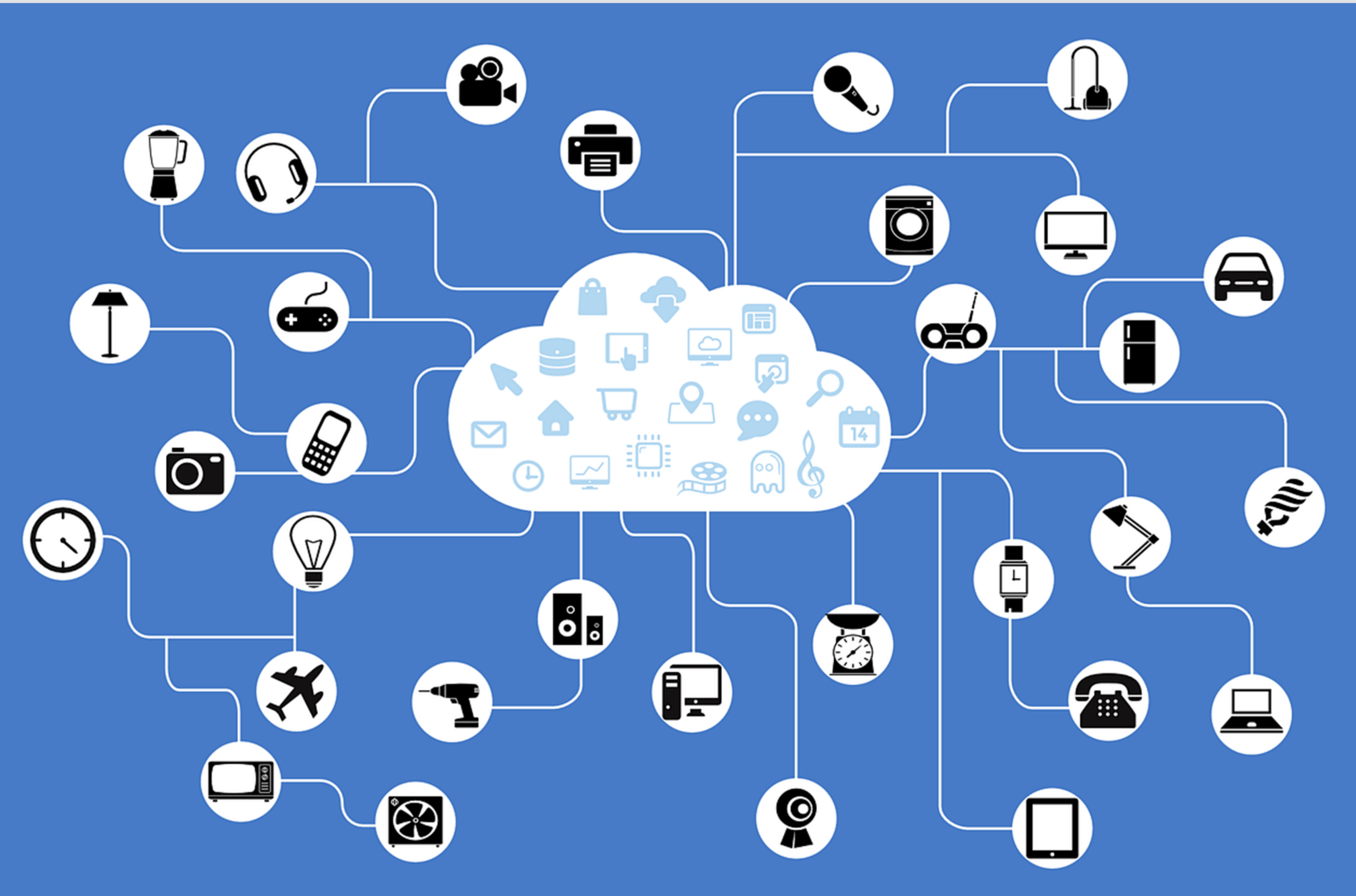
Panel

Panel ICWMC/VEHICULAR/INTERNET

Theme: Challenges on Mobility with IoT and Big Data

Panelist:

Dr. Nicola Fabiano, Studio Legale Fabiano, Rome, Italy nicola@fabiano.law




IoT ecosystem

↓

Blockchain as a service

Blockchain

- **The Regulations**
- **The blockchain applications**

European Commission

#DSM

Digital Single Market

HOW CAN EUROPE BENEFIT FROM BLOCKCHAIN TECHNOLOGIES?

WHAT IS BLOCKCHAIN?

#EUBlockchain

Blockchain is the best known **distributed ledger technology**. A ledger is a database which keeps a final and definitive record of transactions. Records, once stored, cannot be tampered without leaving behind a clear track. Blockchain enables a ledger to be held in a network across a series of nodes, which avoids one centralised location and the need for intermediaries' services. This is particularly helpful for providing **trust**, **traceability** and **security** in systems that exchange data or assets. There is a lot of potential for blockchain to be used in many different areas such as financial services, supply chains or healthcare.

Until today, the venture capital industry has invested around **€1.2 billion** in more than 1,100 startups; 300 of them are European.

Initial Coin Offerings (ICOs) which represent new ways for financing blockchain ventures are booming (moving **from €250 million in 2016** to around **€3 billion in 2017**).

10% of global GDP could be stored, via digital assets, through blockchain technology in less than 10 years.*

POTENTIAL SECTORS (BEYOND VIRTUAL CURRENCIES)

By **governments** for citizens' ID management, taxation reporting, development aid management, eVoting and regulatory compliance (RegTech).

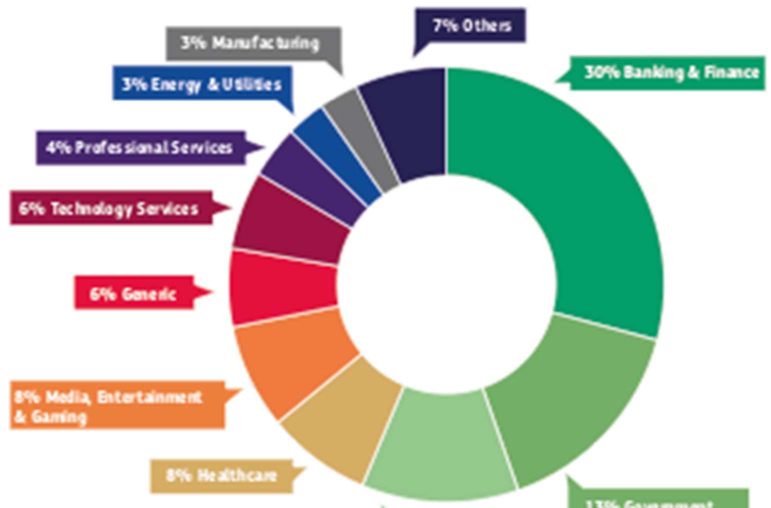
By **insurances** for automatic execution of contracts.

In **finance** for money transfer, peer-to-peer lending and transfer of securities.

For **media and intellectual property** to directly distribute music, videos and other content.

In healthcare to track transactions

Sectors currently using blockchain

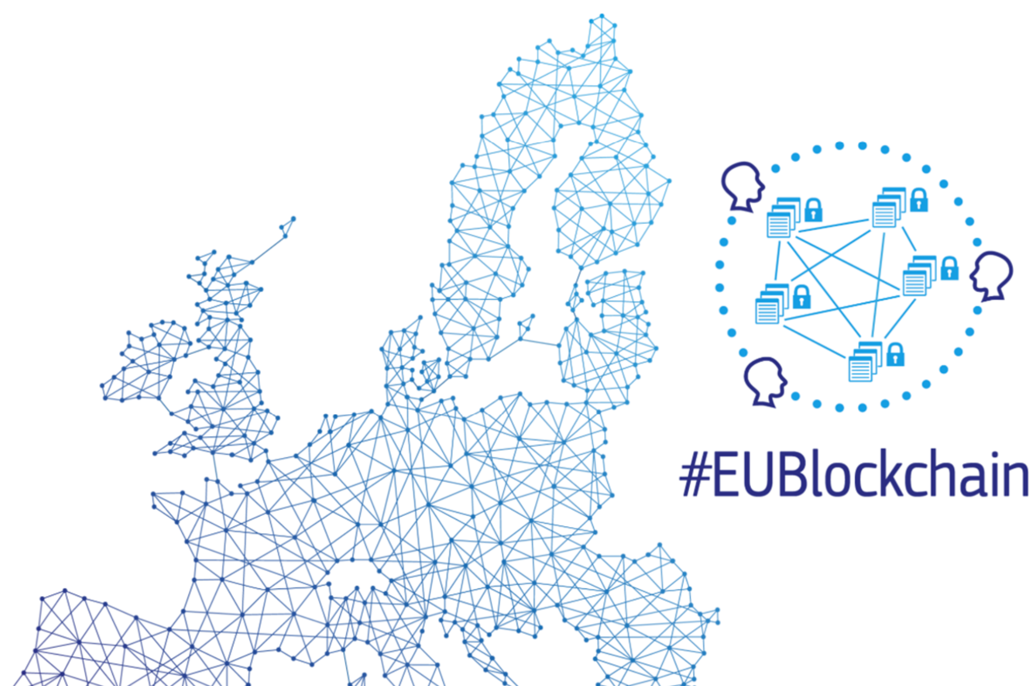


Financing Horizon 2020 Research & Innovation projects.
So far **€83 million** have been allocated by the EU in blockchain related projects, and potentially up to **€340 million** could be committed **from 2018 to 2020.**

Actively **participating in international standardisation** like in:
- ISO Technical Committee 307 on blockchain and Distributed Ledger Technologies,
- ITU-T Focus Group on DLT Distributed Ledger Technologies.

Testing blockchain solutions (through proof of concept) and **piloting projects in support to EU policies** in areas like regulatory compliance, tax and customs, energy, identity management,...

The European Commission aims to develop a common approach on Blockchain technology for the EU in the international arena.



Do you have any problem with communication/computational delays in the loops?

And if any, how do you cope with it?

Jean-Pierre Richard

centralelille

ICWMC/VEHICULAR PANEL

« Challenges on mobility with IoT and Big Data – 26 June 2018 - Venice

Région Hauts-de-France

Université de Lille

CRIStAL Centre de Recherche en Informatique, Signal et Automatique de Lille

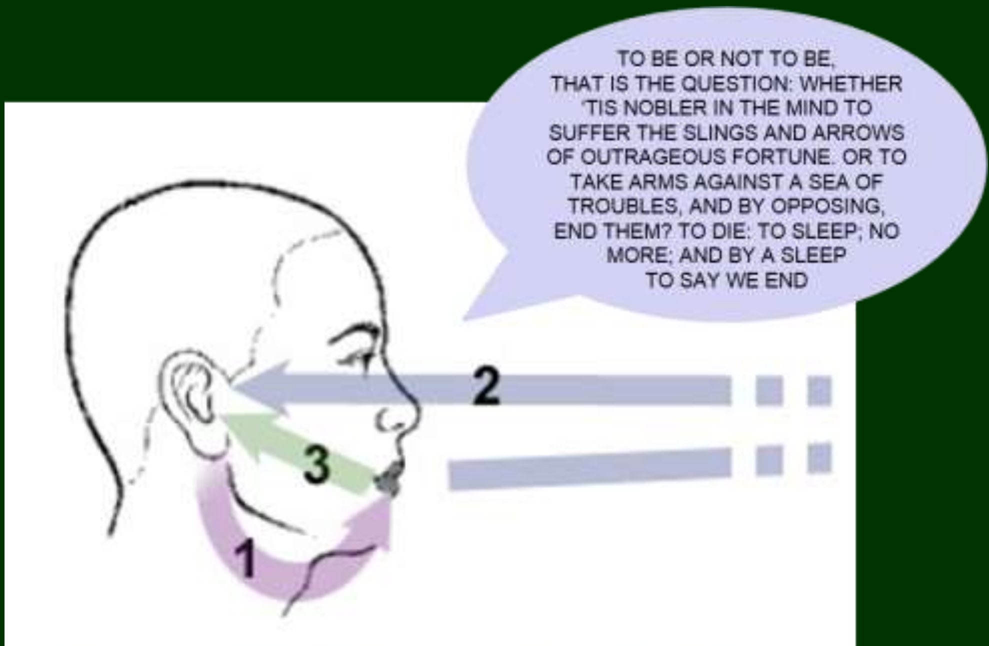
Inria informatics mathematics

cnrs

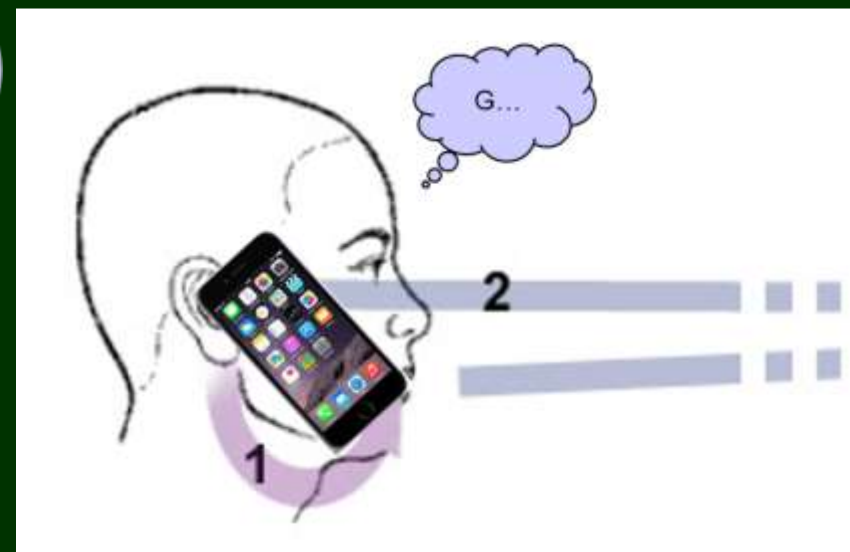
Overview

- Some situations and problems (→ me)
- Your situations, problems, way you solve them? (→ you)

Situation 1: networked control ;)



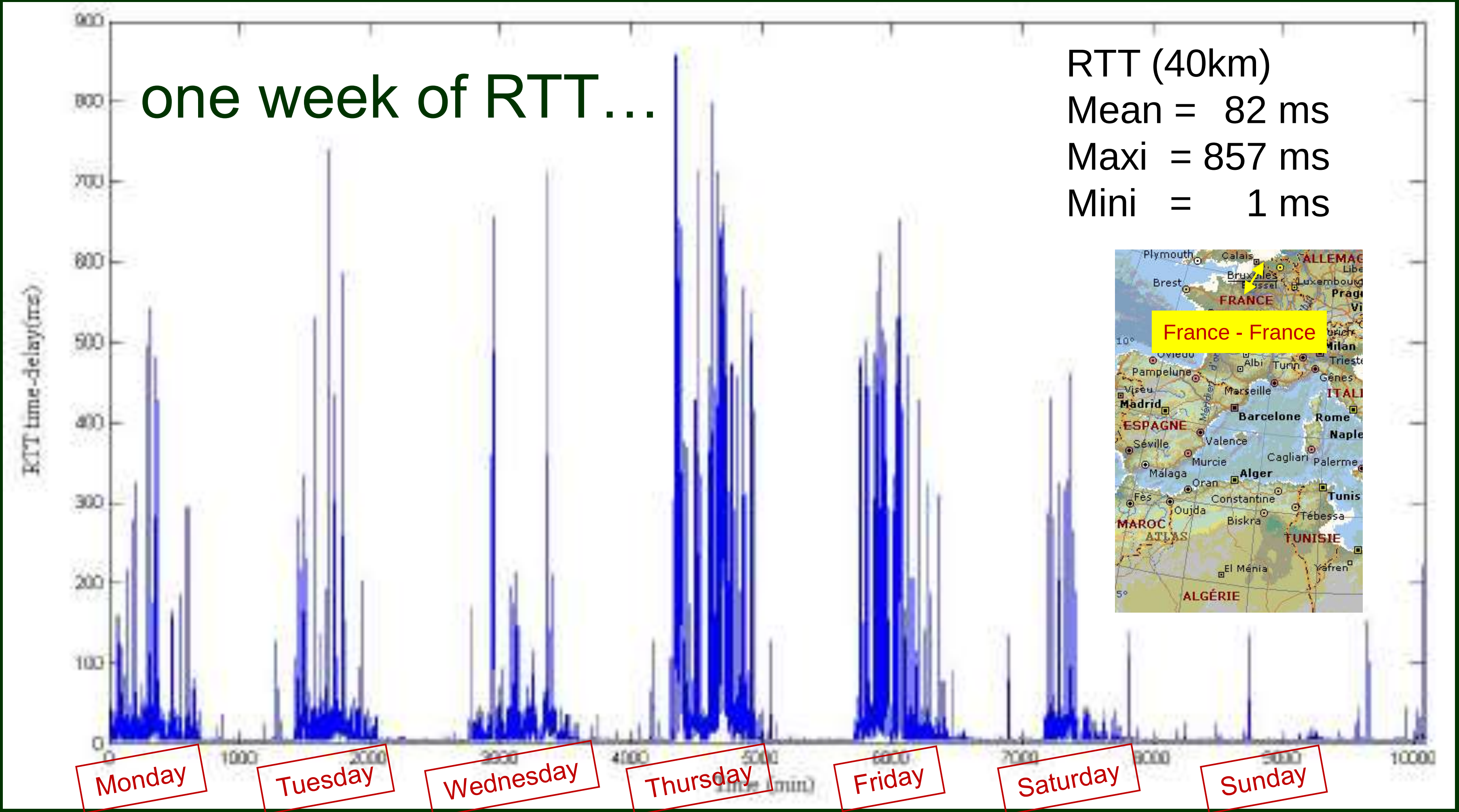
Natural loop of audio-phonatory control



Networked loop of audio-phonatory control

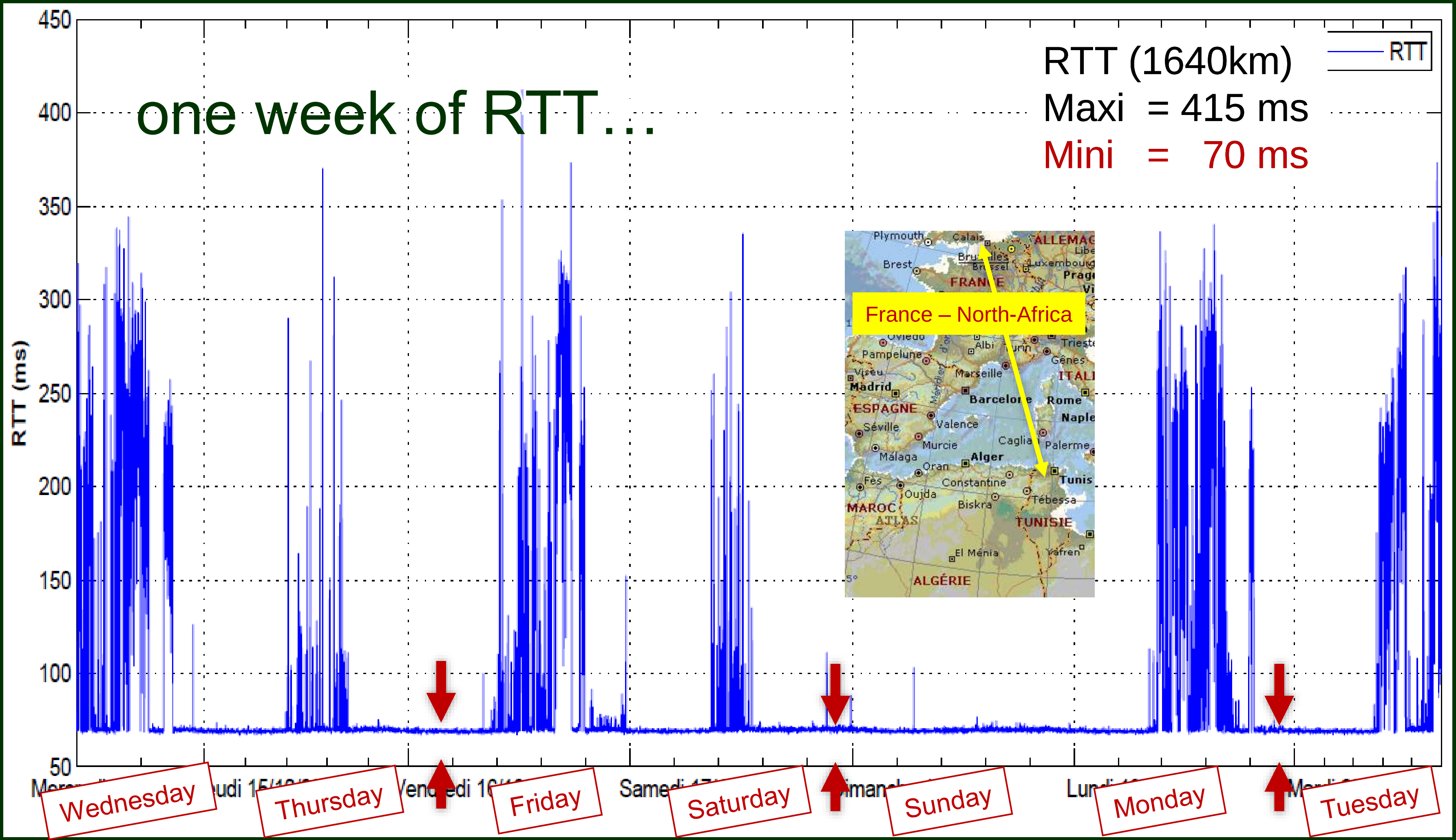
Situation 2: computation time…

Situation 3: Internet transmission delay



Lille-Lens (France, 40 km) – Source: PhD WJ. Jiang 2008

Situation 3: Internet transmission delay



Tunis-Lille (1640 km) – Source: S. Belhaj, ENSIT 2009

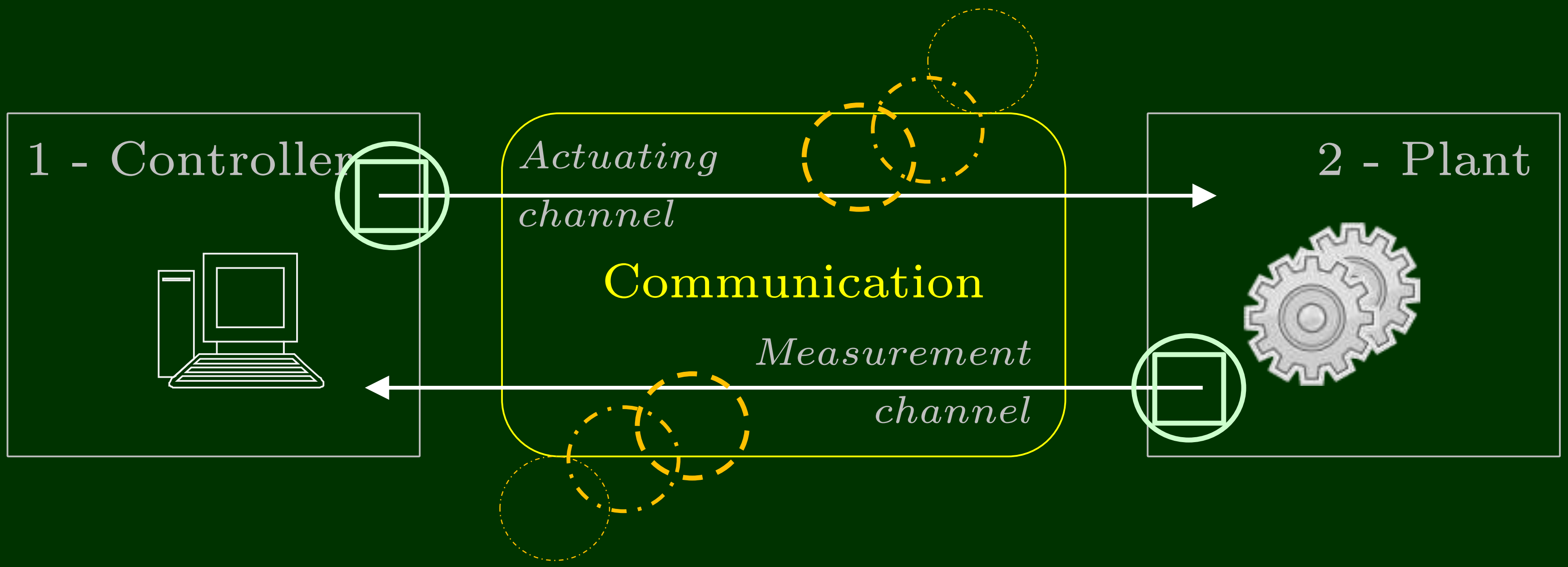
Some idea about comm. delay values

Other RTT approximated values

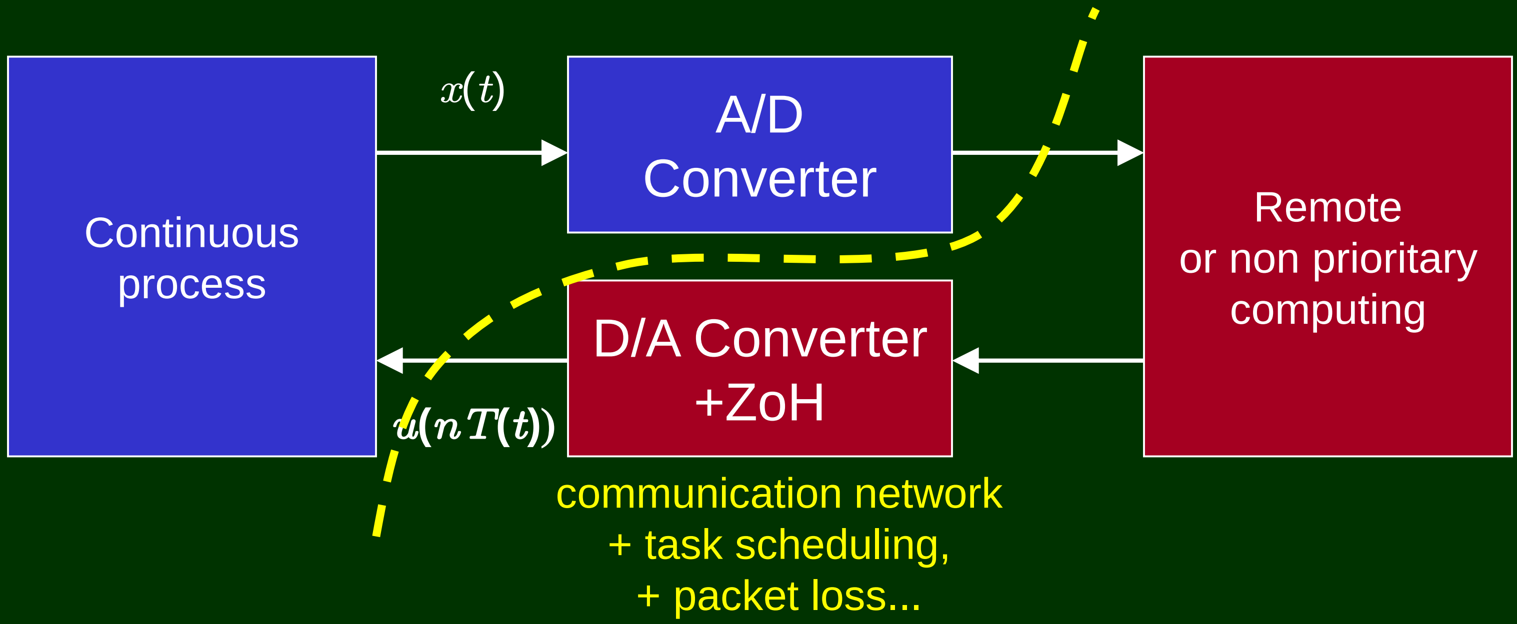
unshared CAN 2m:	*200 µsec*
bluetooth 2m:	*40 msec*
Internet:	*100-400 msec*
orbital stations:	*0.4-7 sec*
underwater 1.7km:	*>2 sec*

Situation 4: Wireless control loops

transmission + sampling + packet loss



Situation 5: Asynchronous sampling



Integration, z-transform, everything's ok, etc.

$$u(t) = u_d(t_k) = g(x(t_k)), \quad \boxed{t_k \neq kT}$$

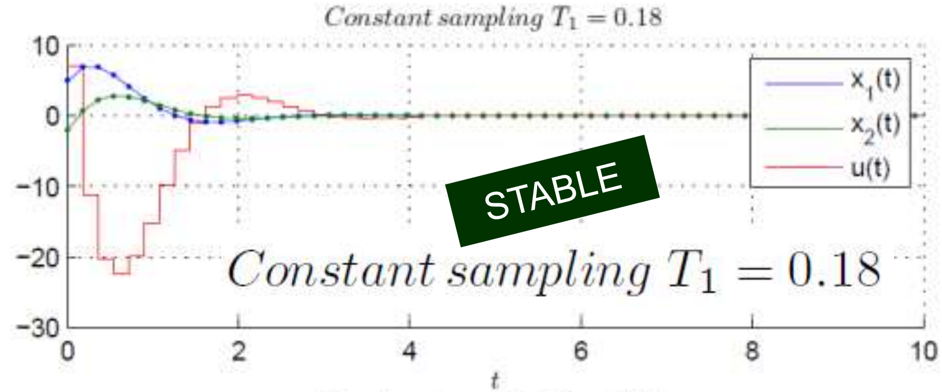
Situation 5: Asynchronous sampling

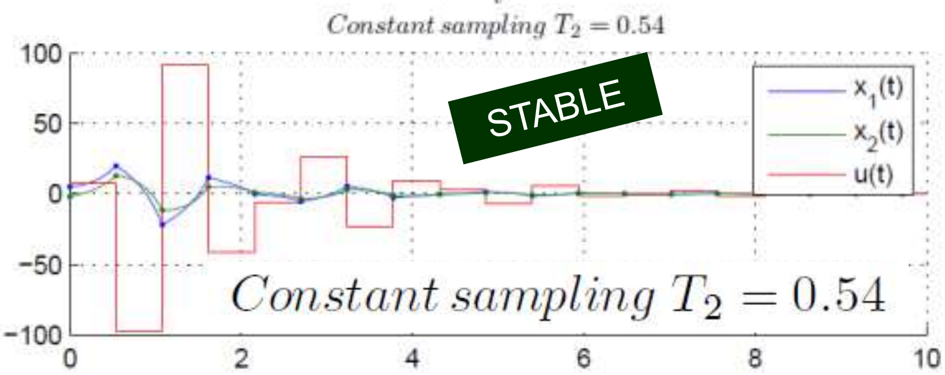
$$\dot{x}(t) = Ax(t) + BKx(t_k),\ \forall t \in [t_k, t_{k+1}),\ \forall k \in \mathbb{N}.$$

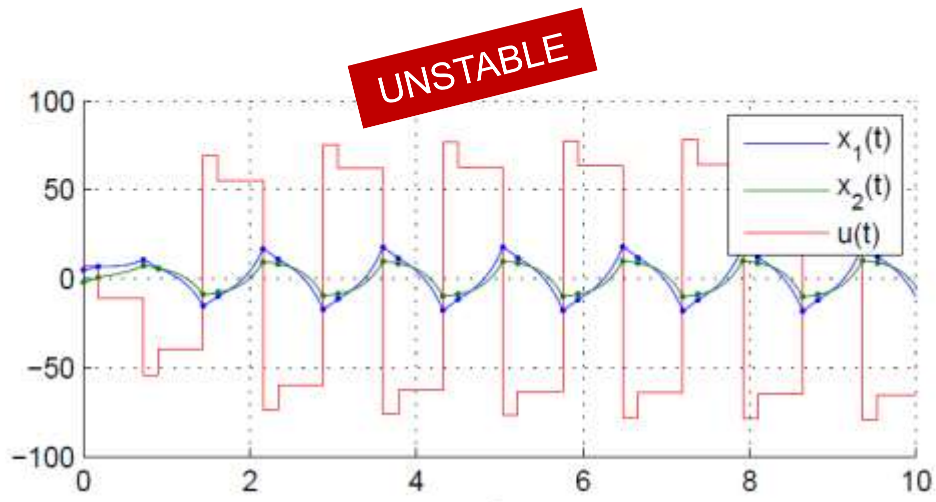
$$A = \begin{bmatrix} 1 & 3 \\ 2 & 1 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 0.6 \end{bmatrix}, \quad K = -\begin{bmatrix} 1 & 6 \end{bmatrix}. \qquad t_{k+1} = t_k + h_k$$

variations of the sampling interval h_k may induce instability.

[Zhang, Branicky, Phillips. - IEEE Ctrl.Syst.Mag. 2001]







$$T_1 \rightarrow T_2 \rightarrow T_1 \cdots$$

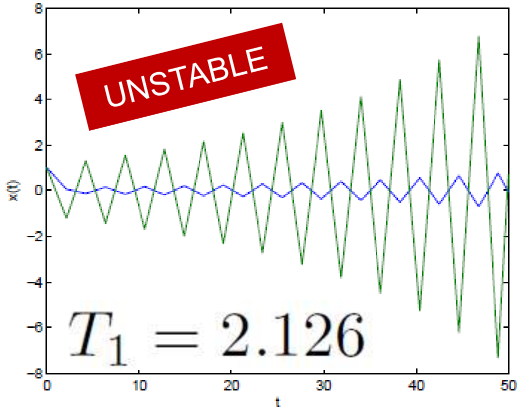
Situation 5: Asynchronous sampling

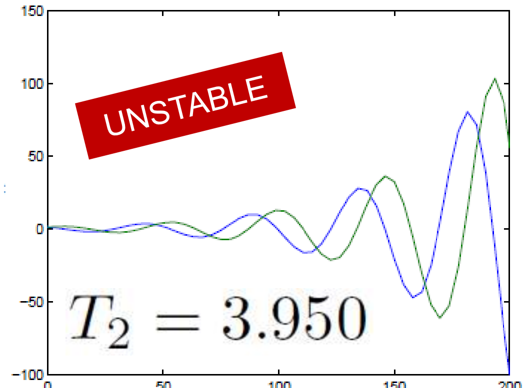
$$\dot{x}(t) = Ax(t) + BKx(t_k), \ \forall t \in [t_k, t_{k+1}), \ \forall k \in \mathbb{N}.$$

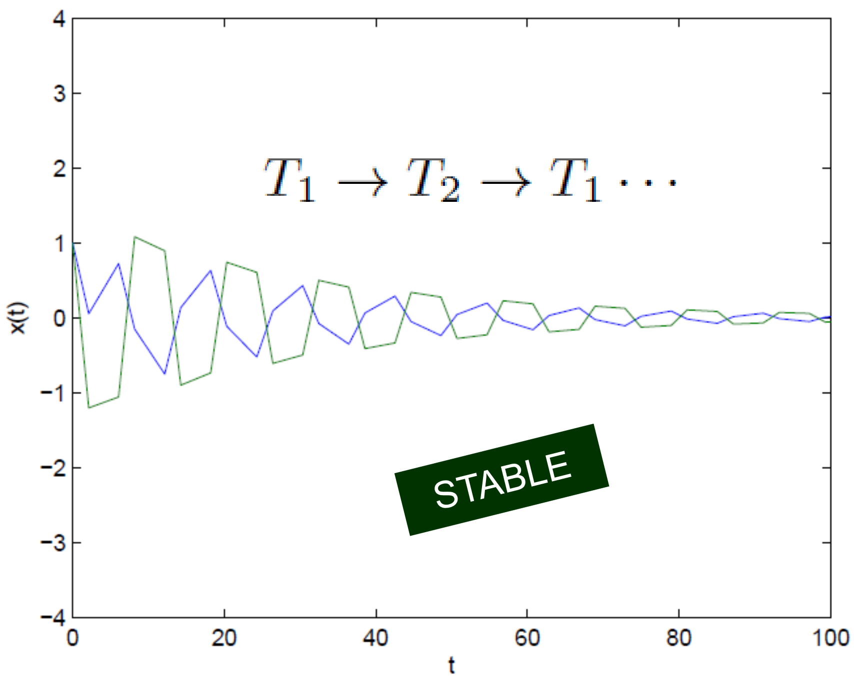
$$A = \begin{bmatrix} 0 & 1 \\ -2 & 0.1 \end{bmatrix}, \ B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \ K = \begin{bmatrix} 1 & 0 \end{bmatrix} \qquad t_{k+1} = t_k + h_k$$

variations of the sampling interval h_k may induce instability. stability

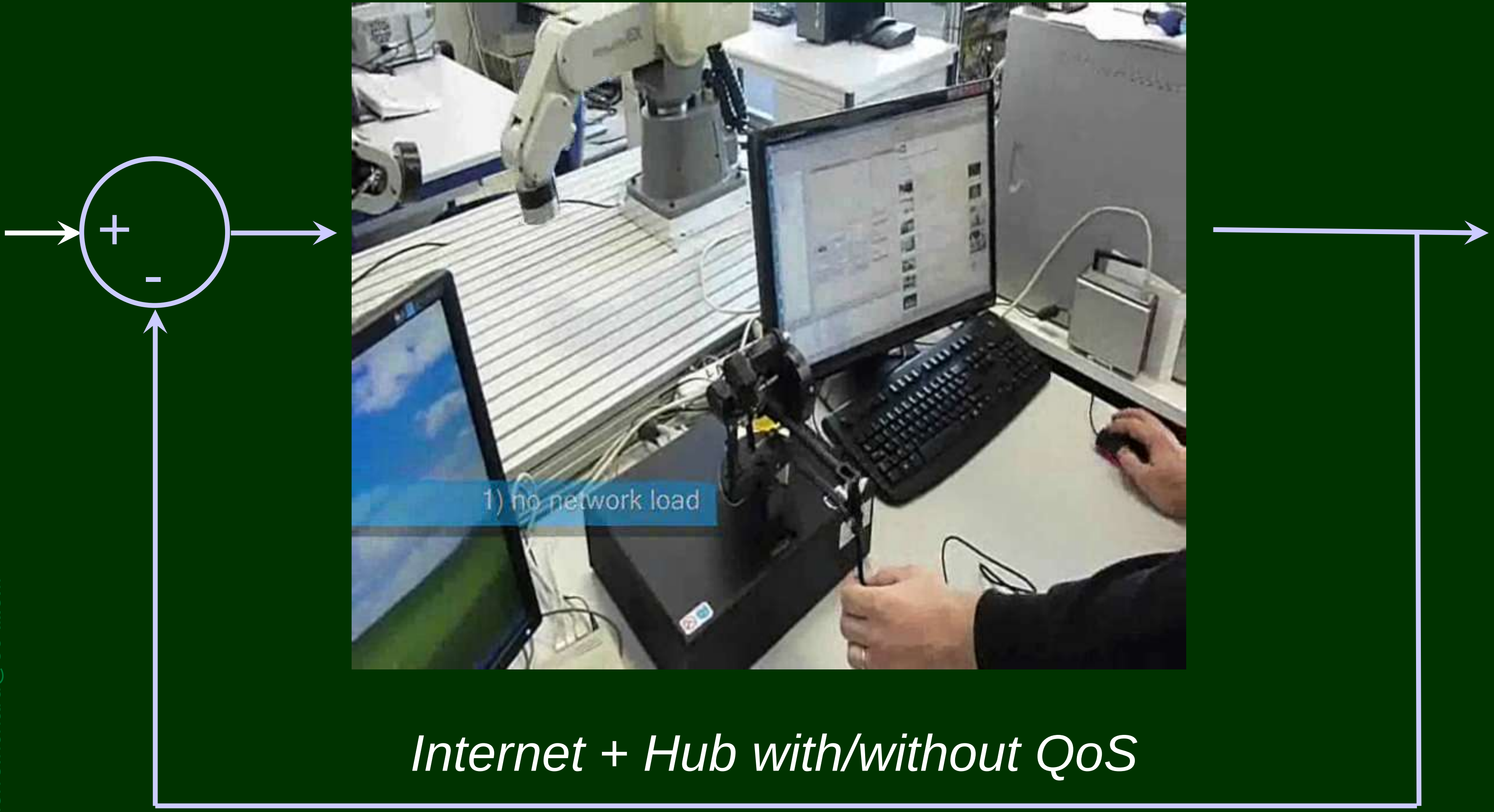
[Gu, Kharitonov, Chen - Birkhauser 2003]





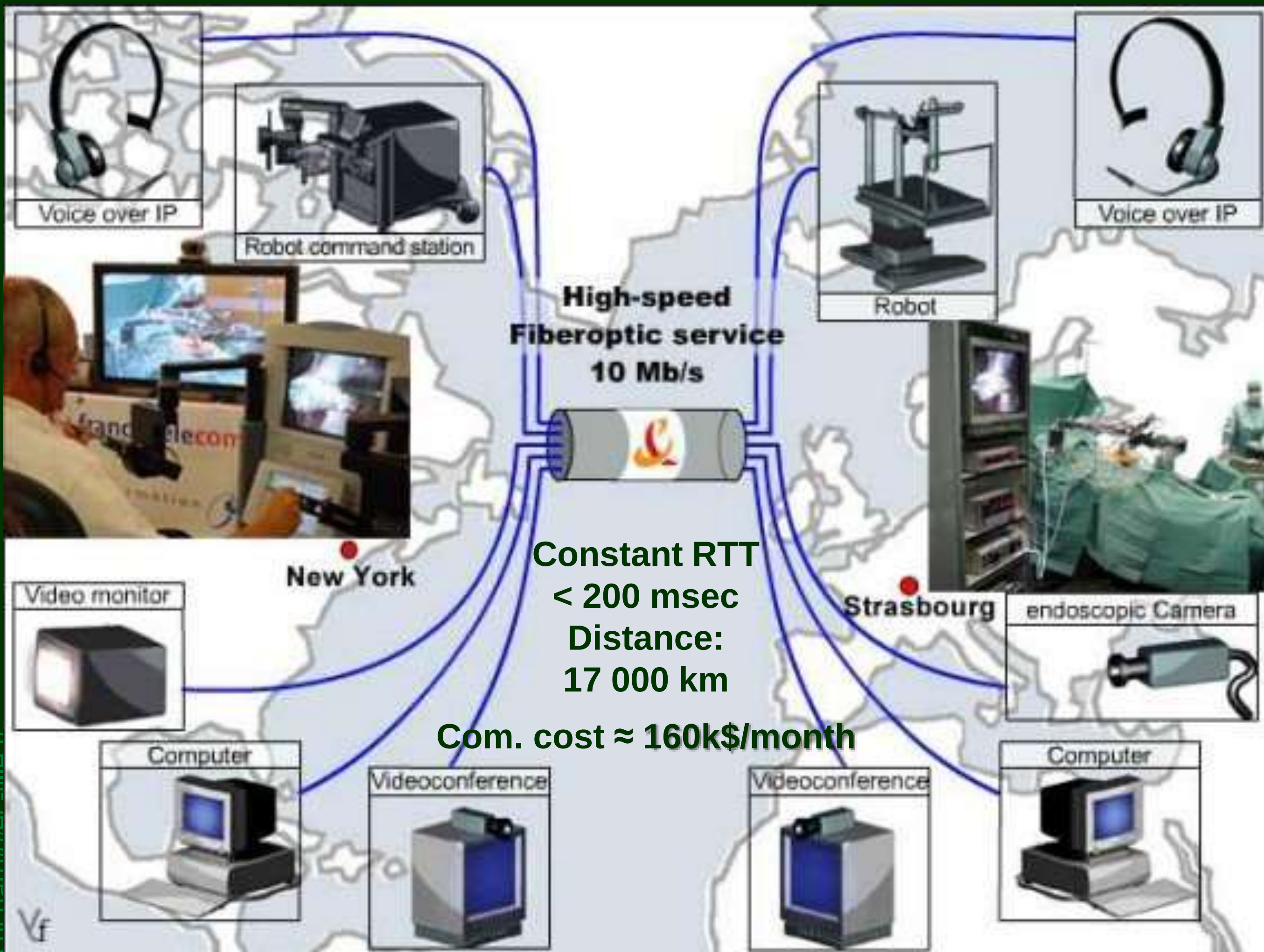


Situation 6: bilateral teleoperation



Internet + Hub with/without QoS

Situation 6: bilateral teleoperation



Business class solution
(Lindbergh operation, 07/09/2001)

« The only restriction to the development of long-distance tele-surgery has to do, still today, with its cost. For tele-surgery, you must use a transcontinental ATM line, that you have to book during 6 monthes, at the price of about 1 million dollars. » Prof. J. Marescaux, Le Monde, January 6, 2010

Situation 6: bilateral teleoperation

+
-

Low cost solution
(Lille, 2012)

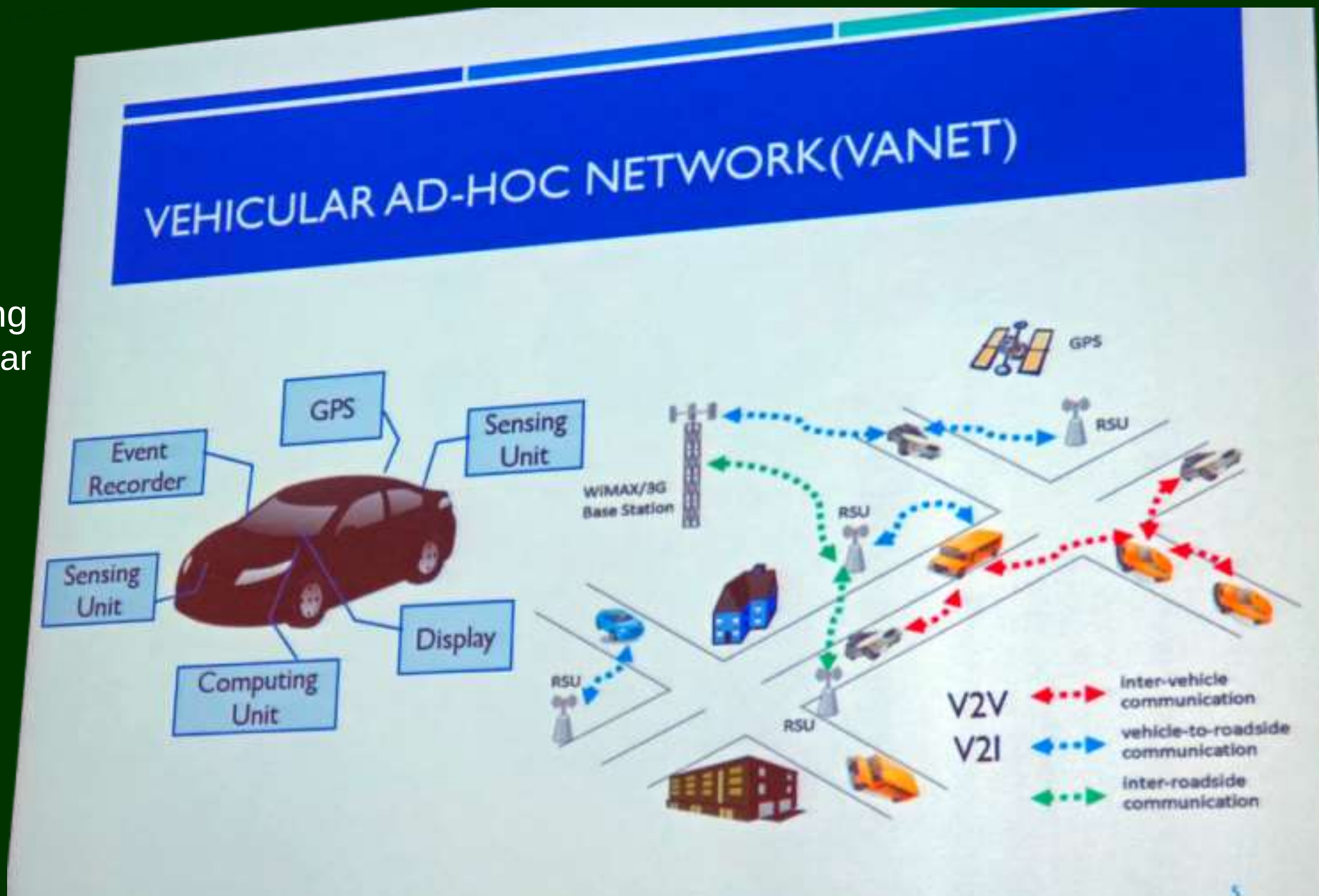
Non-dedicated networks with variable QoS (Internet)

Our solution: Time-Delay Systems + Lyapunov theory

Situation 7: vehicles

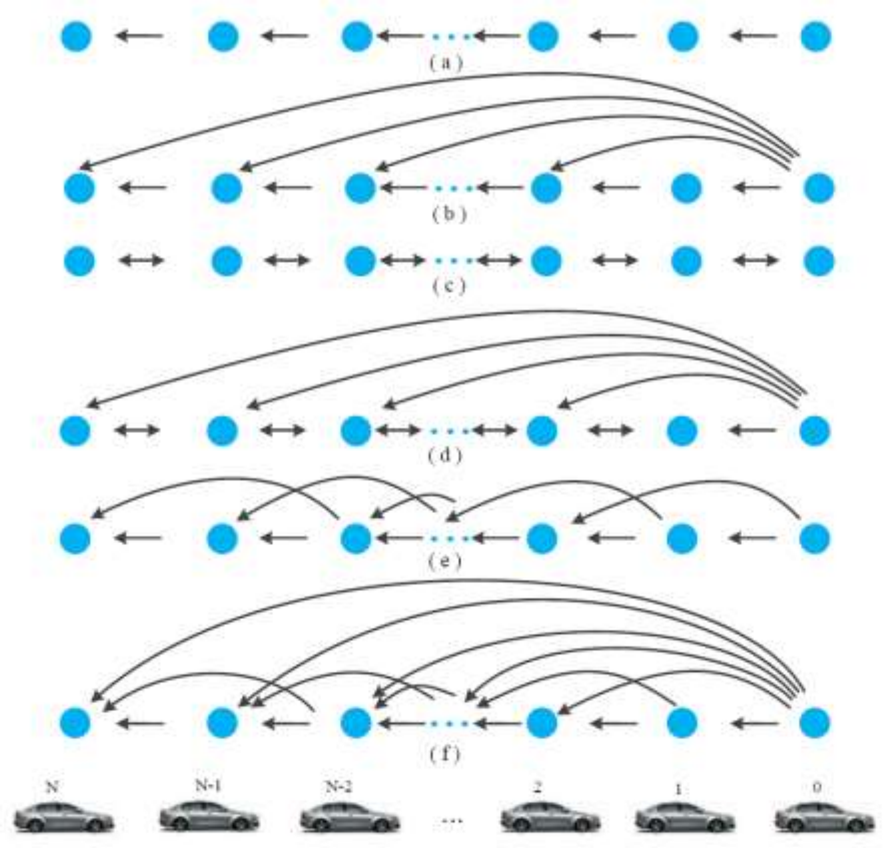
V2I *vs* V2V feedback communications (VANET, etc.)

© Prof. XiaoHong Peng
… yesterday @ Vehicular



Situation 7: vehicles

Platooning



2014 IEEE 17th International Conference on
Intelligent Transportation Systems (ITSC)
October 8-11, 2014. Qingdao, China

Influence of Information Flow Topology on Closed-loop Stability of Vehicle Platoon with Rigid Formation*

Yang Zheng, Shengbo Eben Li, Jianqiang Wang, Le Yi Wang, Fellow, IEEE and Keqiang Li

Your situations?

Your problems?

Your solutions?

Some refs…

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- A switched system approach to exponential stabilization through com. network
  A. Kruszewski, WJ. Jiang, E. Fridman, J.P. Richard, A. Toguyeni, IEEE CST, 20 (4) **2012**
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  B. Zhang, A. Kruszewski, J.P. Richard, Int. J. Control, 87(8) **2014**
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  L.Hetel, C.Fiter, H.Omran, A.Seuret, E.Fridman, J.P.Richard, S.I.Niculescu, Automatica, **2017**

+ in French…