EEVC-2017

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ICT systems for intelligent wireless dynamic EV charging

Overview

- Introduction to wireless charging
- FABRIC -- **Feasibility analysis and development of on-road charging solutions for future electric vehicles**
- Dynamic wireless charging systems ICT
- Intelligent charging
- Conclusion

Introduction to wireless charging

- Allows EV charging while travelling (dynamic) or during short stops ideal for urban environment (stationary)

Increased range → Reduced range anxiety

Smaller batteries → Cheaper EVs

Increased mobility

No visual pollution

More comfort

Safer

- Drivers do not have to deal with dirty and potentially dangerous cables (rain, cable vandalism, cable wear, etc) + Easier charging process

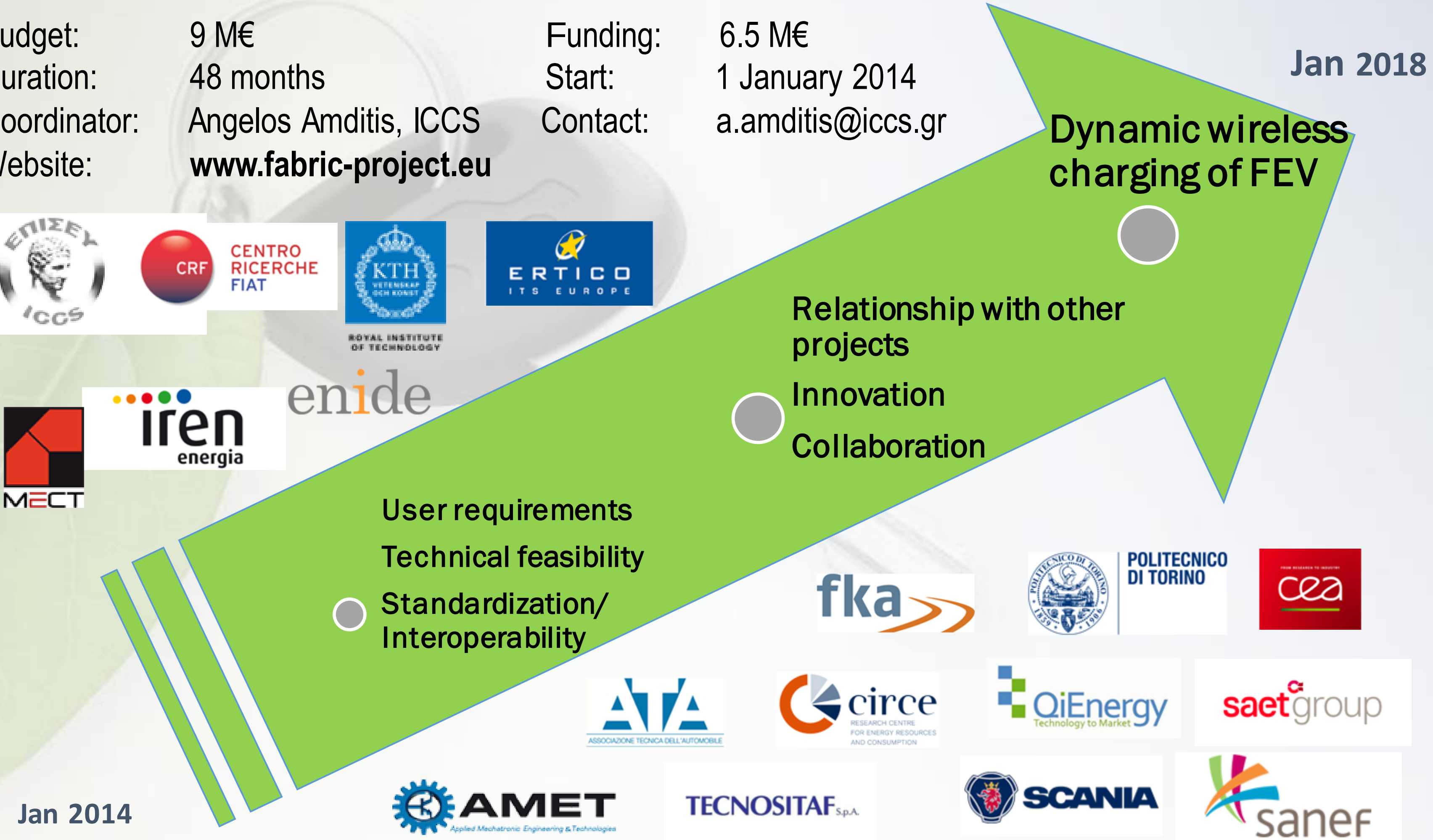
FABRIC

Budget: 9 M€ | Funding: 6.5 M€

Duration: 48 months | Start: 1 January 2014

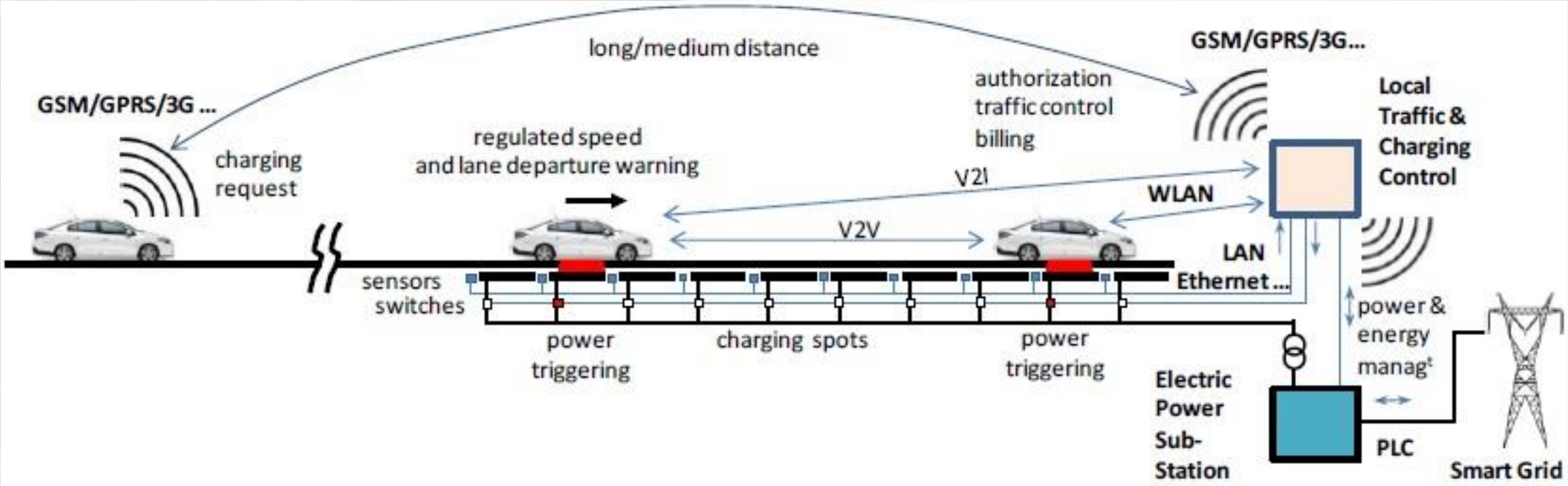
Coordinator: Angelos Amditis, ICCS | Contact: a.amditis@iccs.gr

Website: **www.fabric-project.eu**



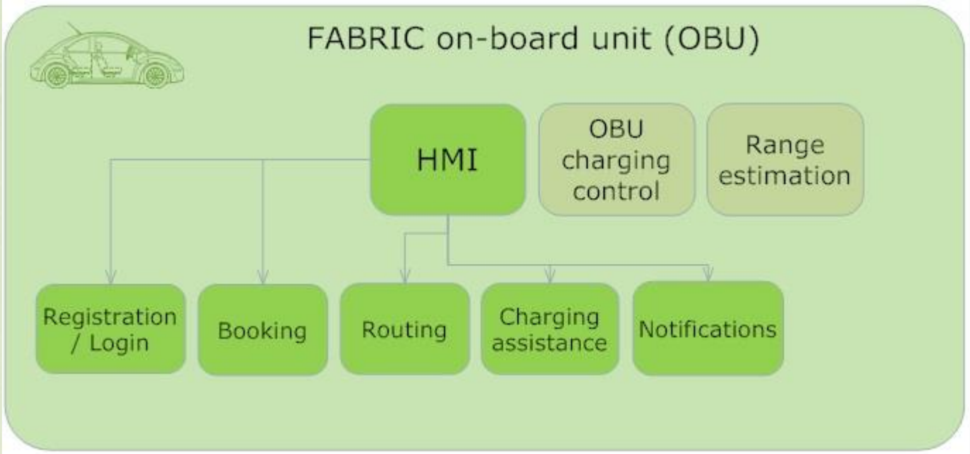
Dynamic wireless charging systems ICT 1/2

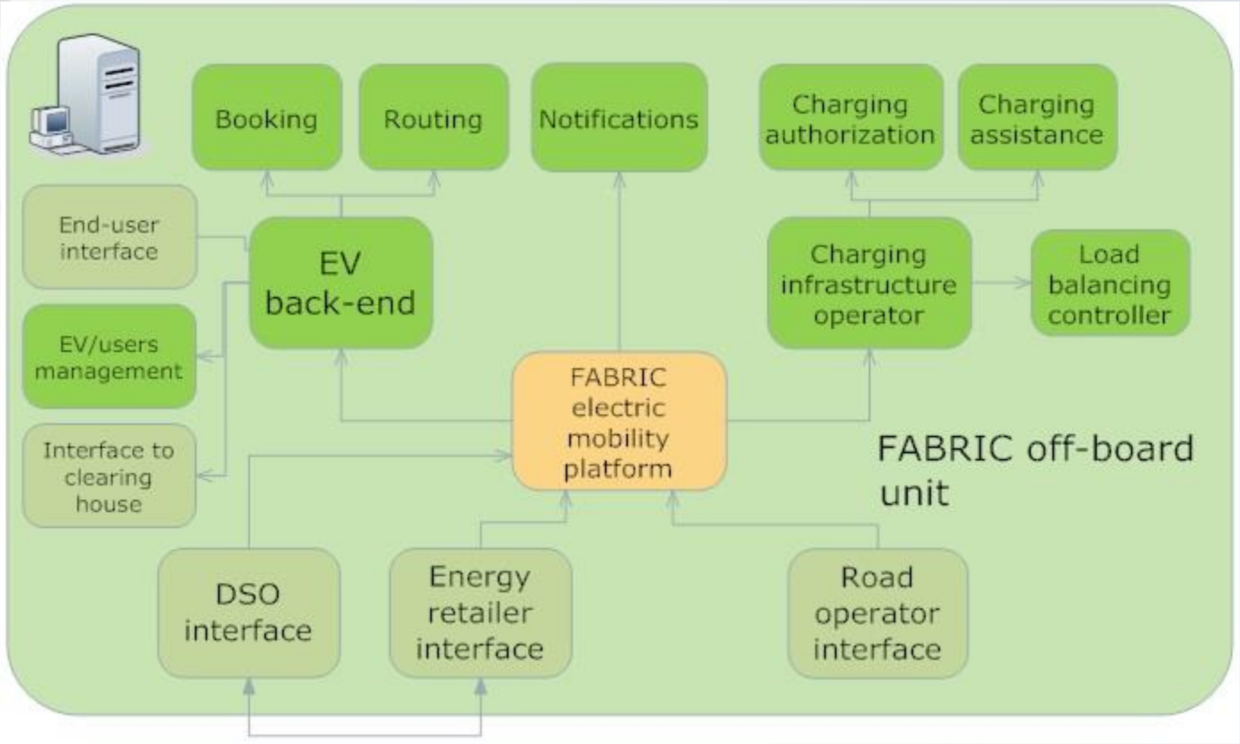
- Increased on-board to off board system connectivity is enabled through a diverse set of communication technologies. (DSRC, Mobile comms 4G-5G)



Dynamic wireless charging systems ICT 2/2

- ICT connectivity between off board enables functions such as
  - Authorization, Billing, Alignment assistance, **Intelligent charging**

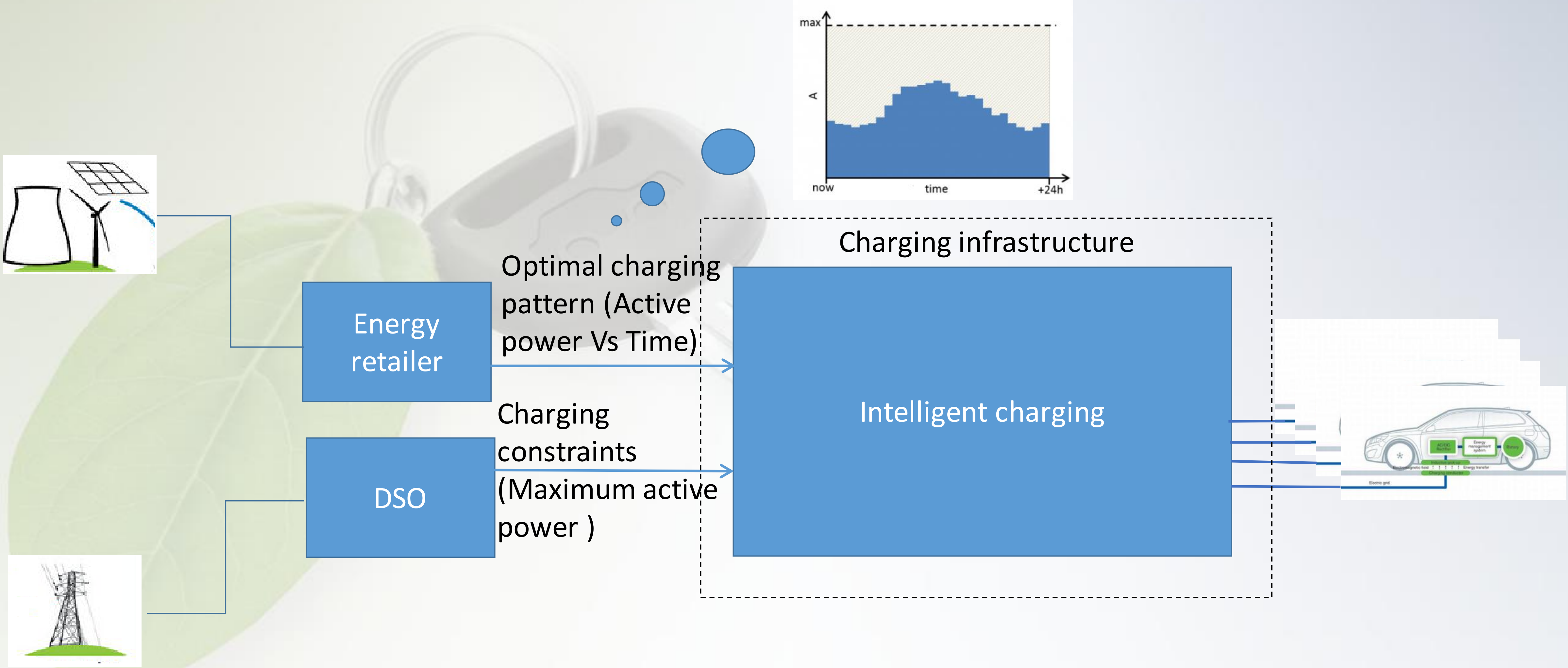




Intelligent charging: Introduction

- Motivation
  - Ensure charging at minimum cost
  - Ensure reliable grid operation
- Manner
  - EVS consult the intelligent charging management module and modify charging power levels accordingly
- Intelligent charging ICT must
  - Host interfaces to both Energy Retailers and DSO (Distribution System Operations) in order to receive associated constraints to the aforementioned objectives
  - Employ a global charging strategy taking constraints into consideration!

Intelligent charging: Architecture



Intelligent charging: Dynamic Wireless Power Transfer (DWPT)

- Dynamic wireless charging perspective
  - No formal charging duration– Vehicles may choose to quit the charging lane randomly
  - Number of vehicles charging concurrently varies heavily
  - Charging over a single pad lasts for some ms!
- Intelligent charging management ICT must be reviewed, taking the above into consideration. The following feasibility example is representative

Intelligent charging: DWPT Feasibility example

- Vehicle moves at U=100km/h
- The length of each charging coil is L=1.5
- The spacing between each coil is DL=0.2ms
- The maximum time for which the intelligent charging problem remains constant is T=min (L/U, DL/U)=7,2ms

Intelligent charging: DWPT Feasibility example

- Therefore only 7.2ms are available to solve the intelligent charging problem.
- According to the flow proposed by ISO/IEC 15118, OCPP the overall latency of defining the intelligent charging power level is Tocpp=2*Tdsrc+Thttp+Tprocessing

Tdsrc= wireles short range comm latency

Thttp/2= http latency

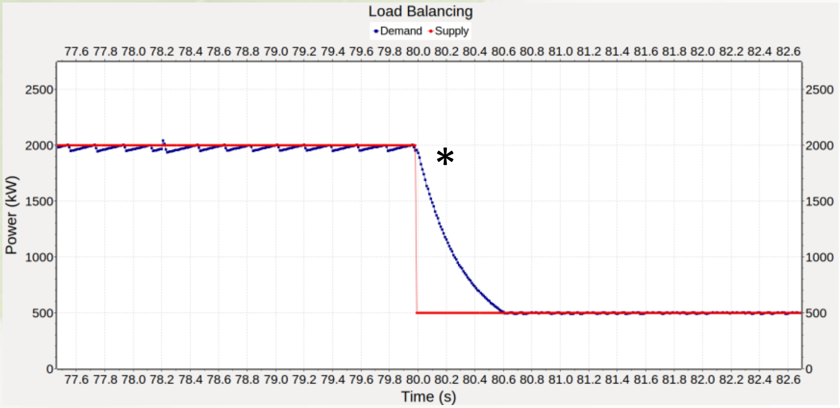
Tprocessing= inteligent charging optimisation latency

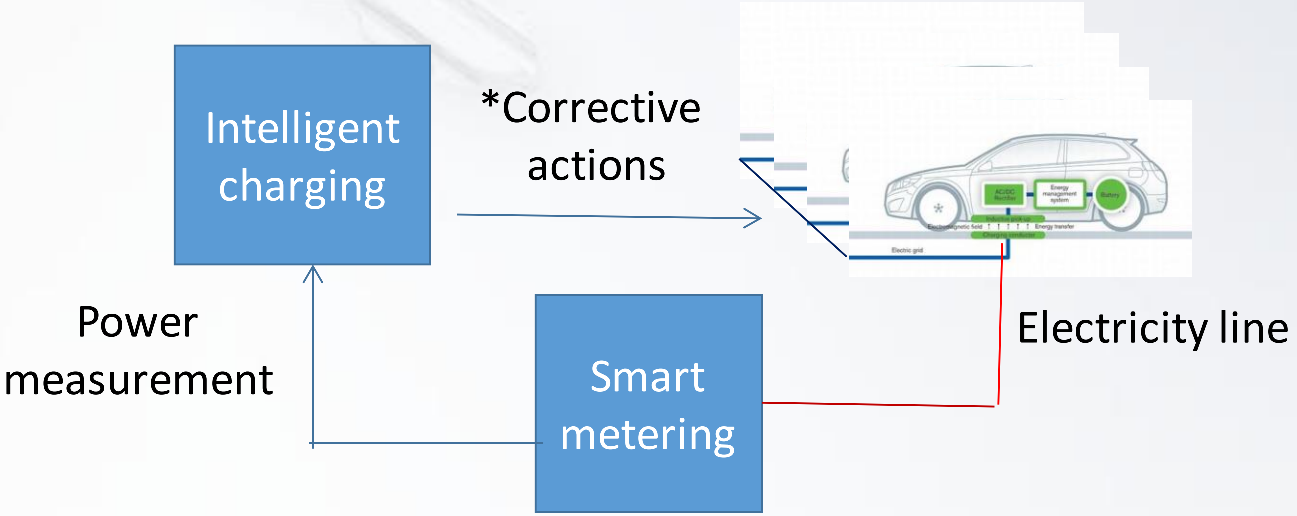
For Tdsrc=3.5ms, THttp=1ms,

Tocpp>8ms>7.2ms!!!

Intelligent charging: DWPT Feasibility example

- Typical intelligent charging protocols introduce lattencies which are tolerable in the case of static or stationary charging but not dynamic.
- Adopt adaptive control techniques for intelligent charging:
  - Set charging power rates at the EV level immediately without consulting the infrastructure and let the infrastructure make corrective actions if required!
  - Example: Additive Increase Multiplicative Decrease (AIMD)





Intelligent charging: Dynamic wireless power transfer

- In Additive Increase Multiplicative Decrease (AIMD)
  - EV charging controllers increase their charging rates linearly without consulting the infrastructure.
  - The infrastructure interferes correctively only if a reduction in charging rates is required.

Conclusion

- Dynamic wireless charging requires special handling w.r.t to intelligent charging (Smart charging)
- Associated standardisation must revise communication protocols in order to address novel requirements
- Adaptive control algorithms are required to address the requirements of the problem.

Thank you!
Questions?

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