



Smart grid architectures for dynamic wireless EV charging

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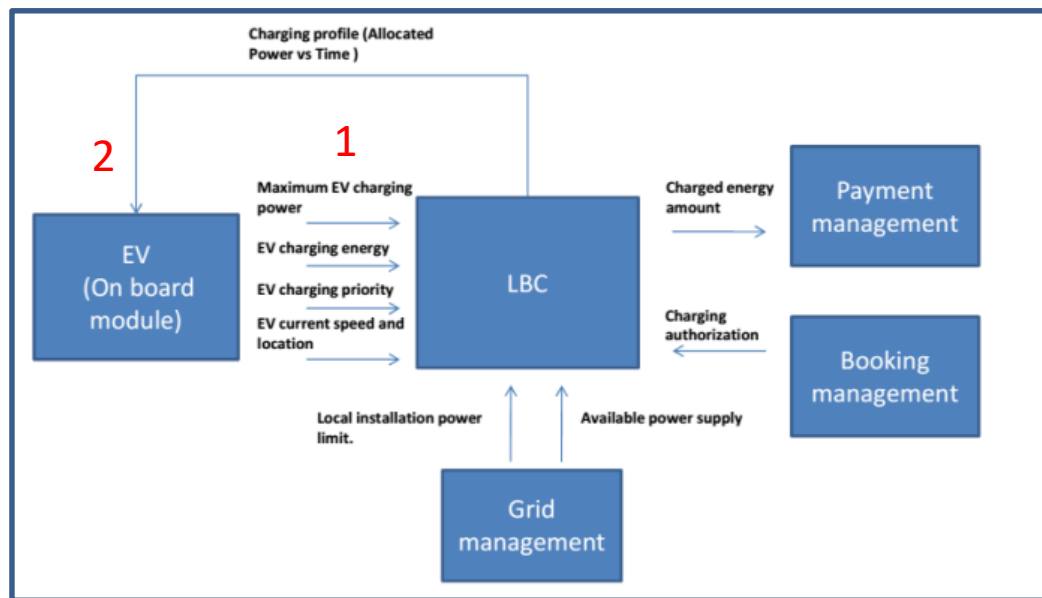


- Objectives of the Smart Grid Architecture for WPT
- DSM System Architecture for WPT
- Evaluation of DSRC
- Conclusions



- **Perform Demand Side Management (DSM-smart charging), avoid peak loads and keep stakeholders satisfied**
 - **Customers:** reduced energy costs and ecological value
 - **Power systems:** optimize generation and grid capacity, cost efficiency by minimizing network reinforcement, facilitation of renewable integration
 - **Society:** reduce CO2 emissions, increase efficiency and social welfare



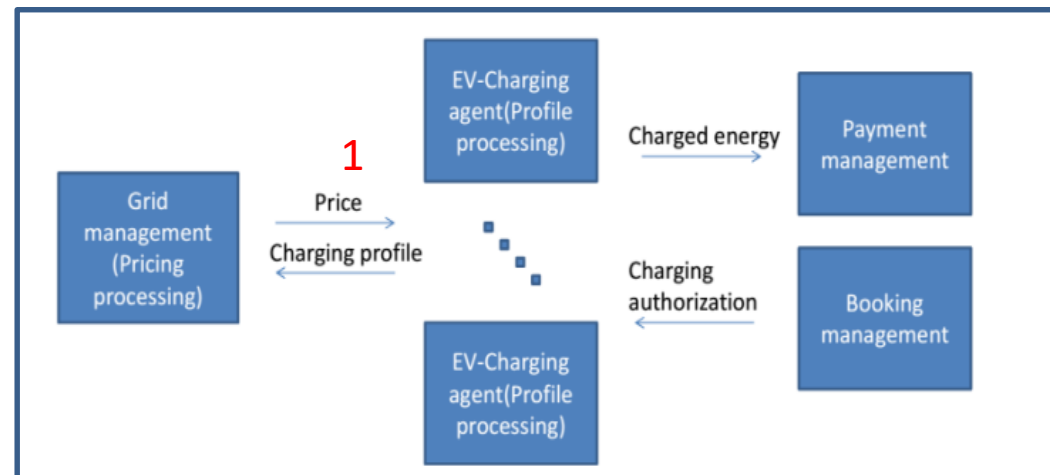


Centralized architecture

- Smart charging negotiation between EVs and the infrastructure (1-2)
- Significant communication and processing overhead and latencies!

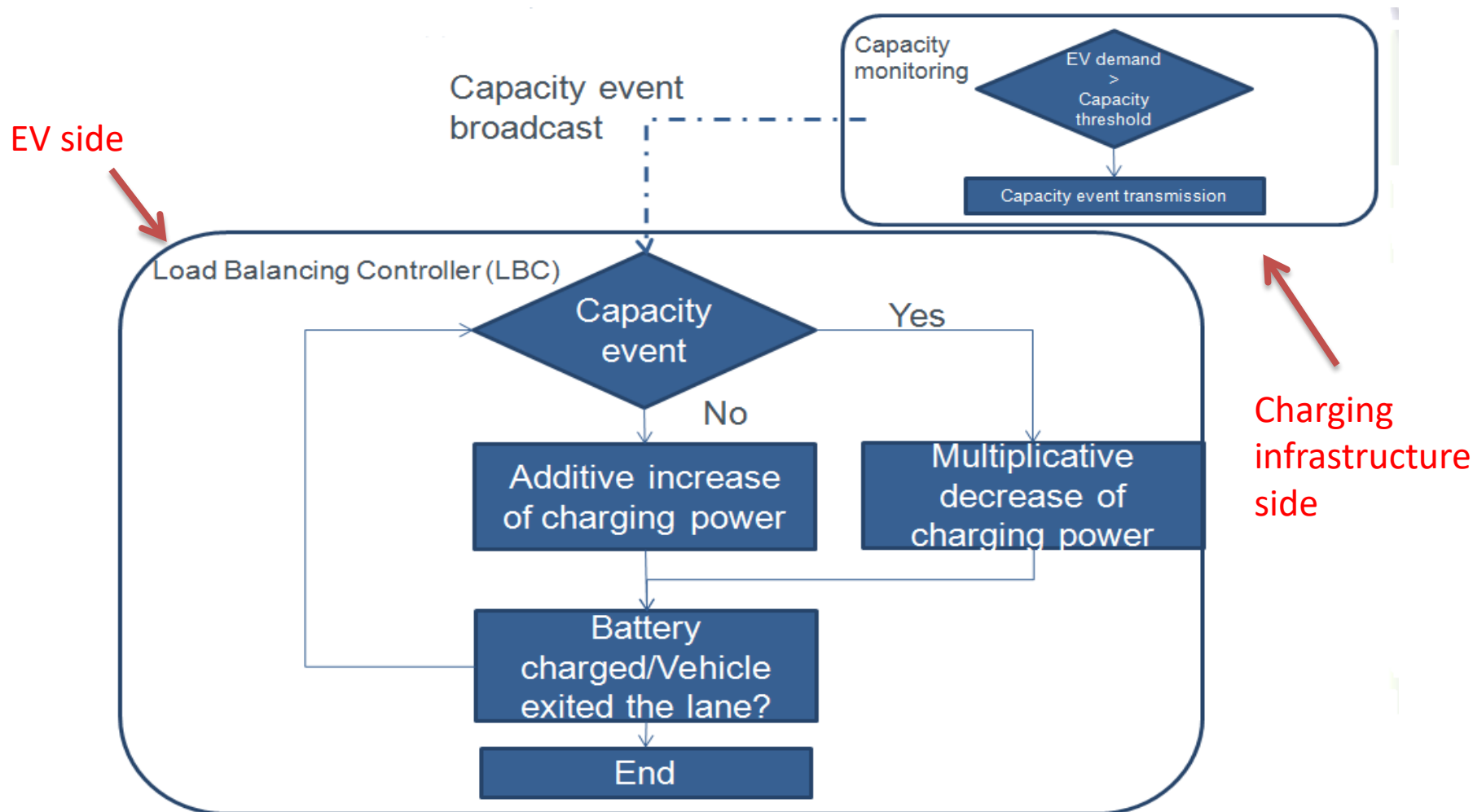
Distributed architecture

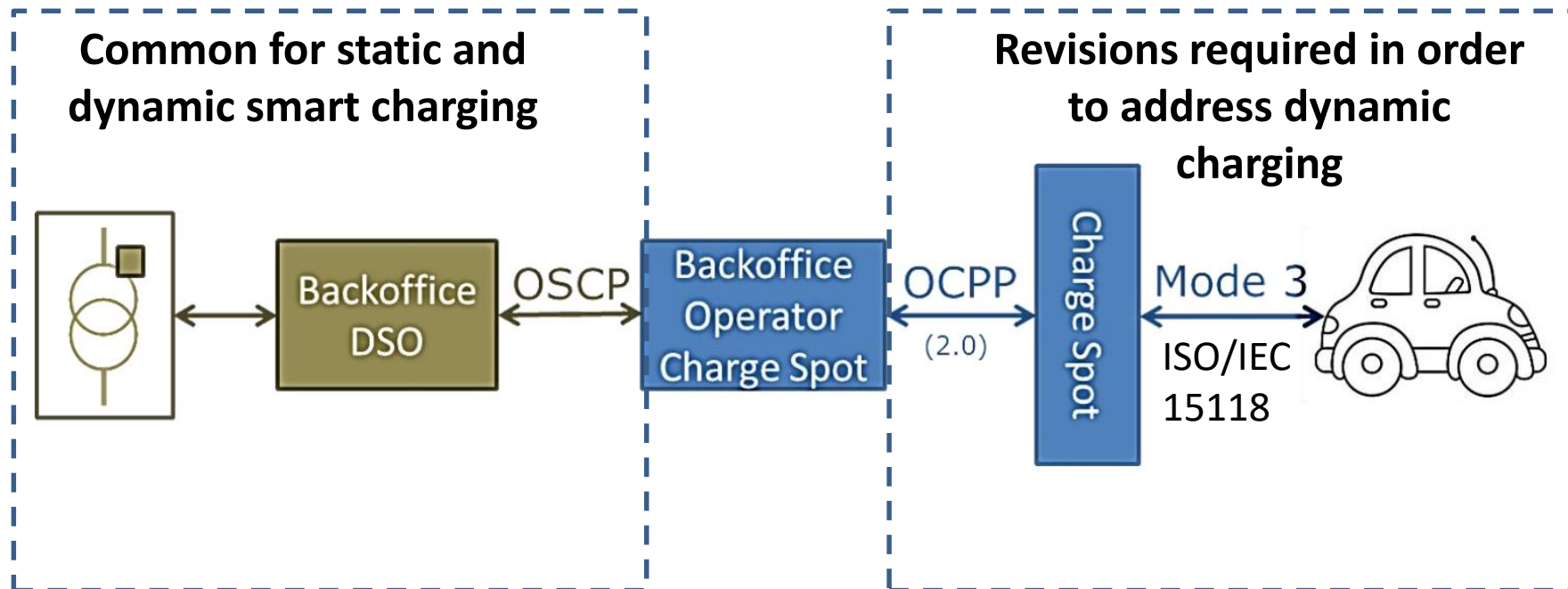
- Smart charging decision made on-board instantly! (Thus a natural candidate for dynamic charging)
- Adaptations towards optimality can follow based on broadcast of low latency smart charging signals. (1)

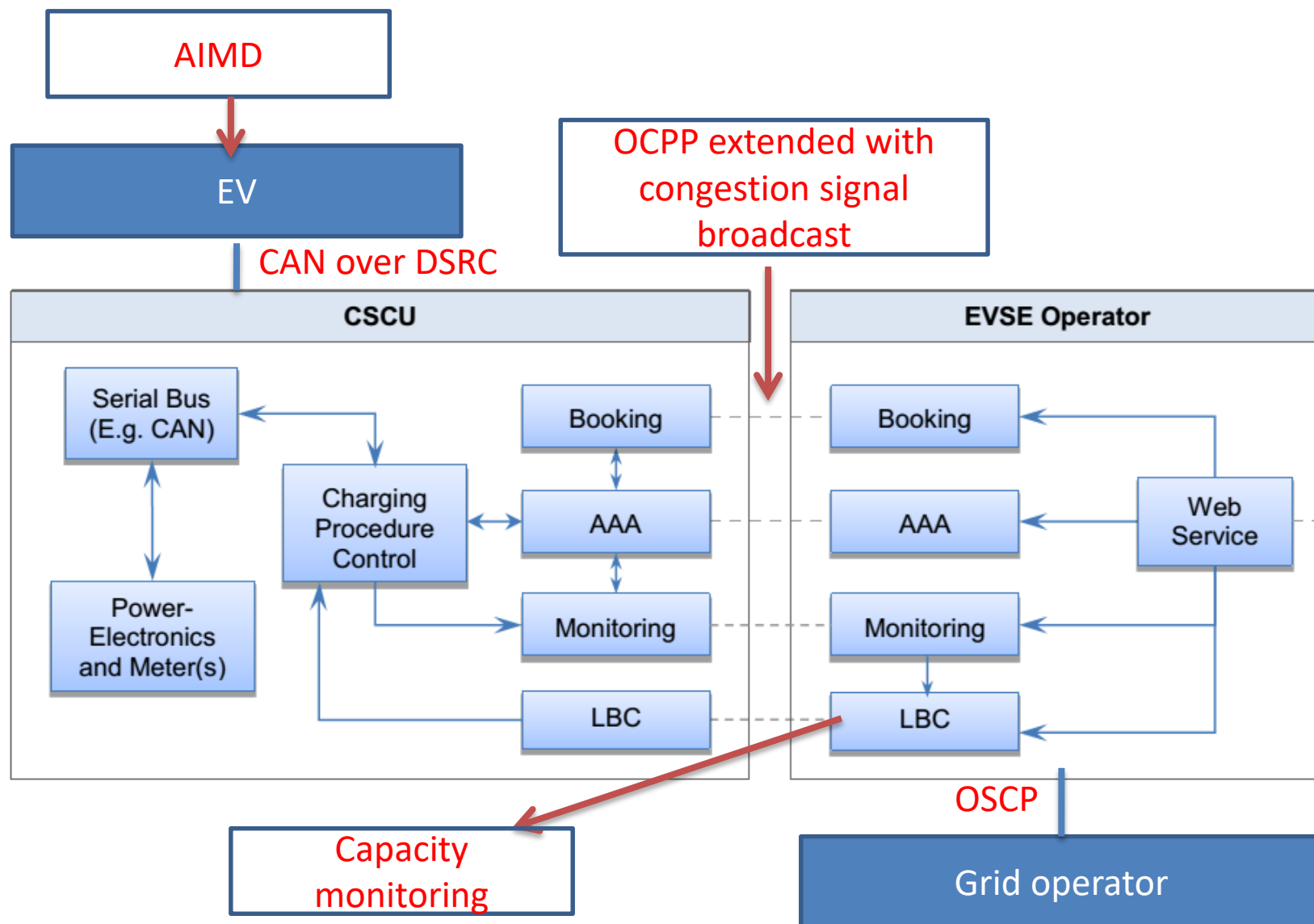




- Based on AIMD (Additive Increase Multiplicative Decrease)



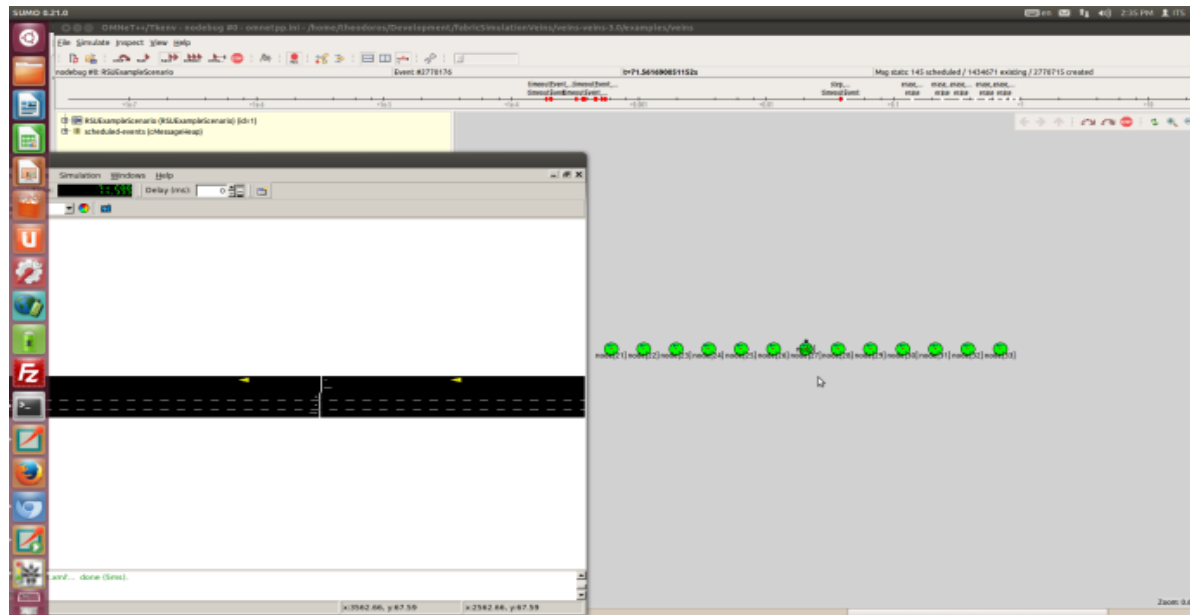






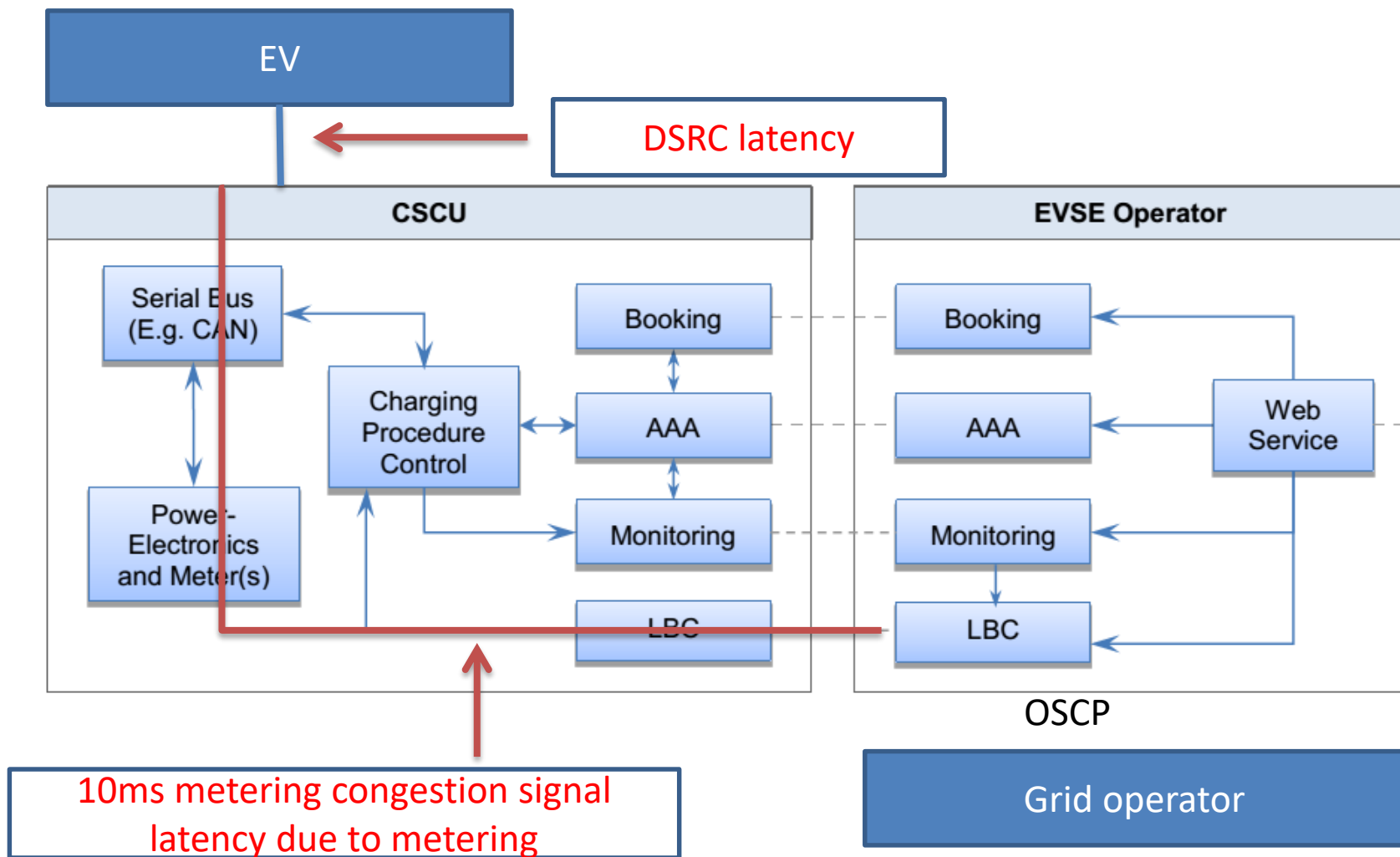
Assess system responsiveness to a change in capacity;

- Can current communication standards support the methodology as presented in previous slides?
- Simulation based on the VEINS (VEHicular Network Simulation platform)



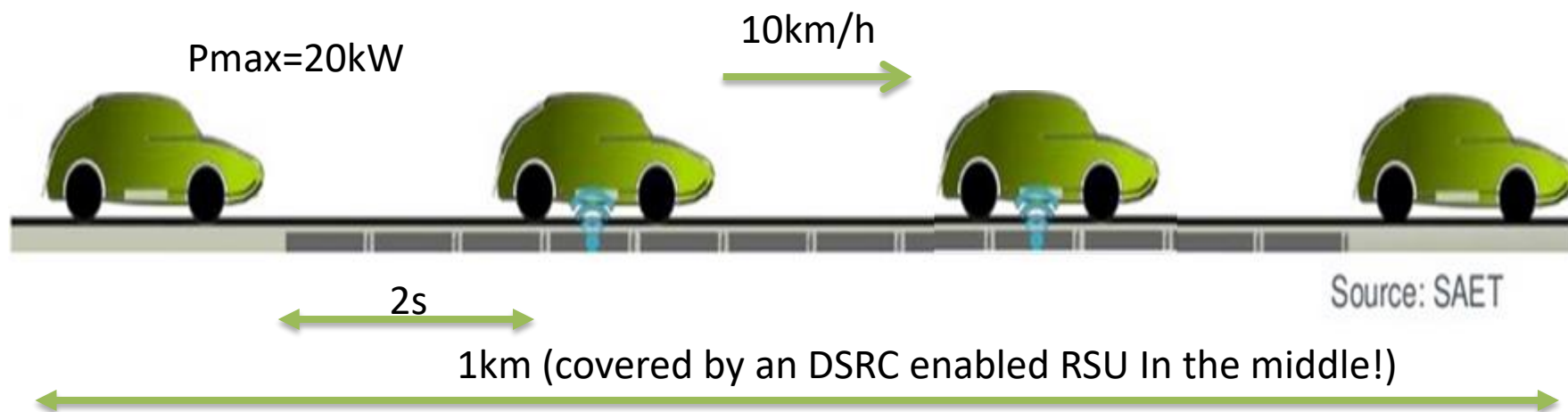


- System comms simulation parameters





- Traffic simulation parameters (Traffic jam over charging lane)





- AIMD simulation parameters

Additive increase

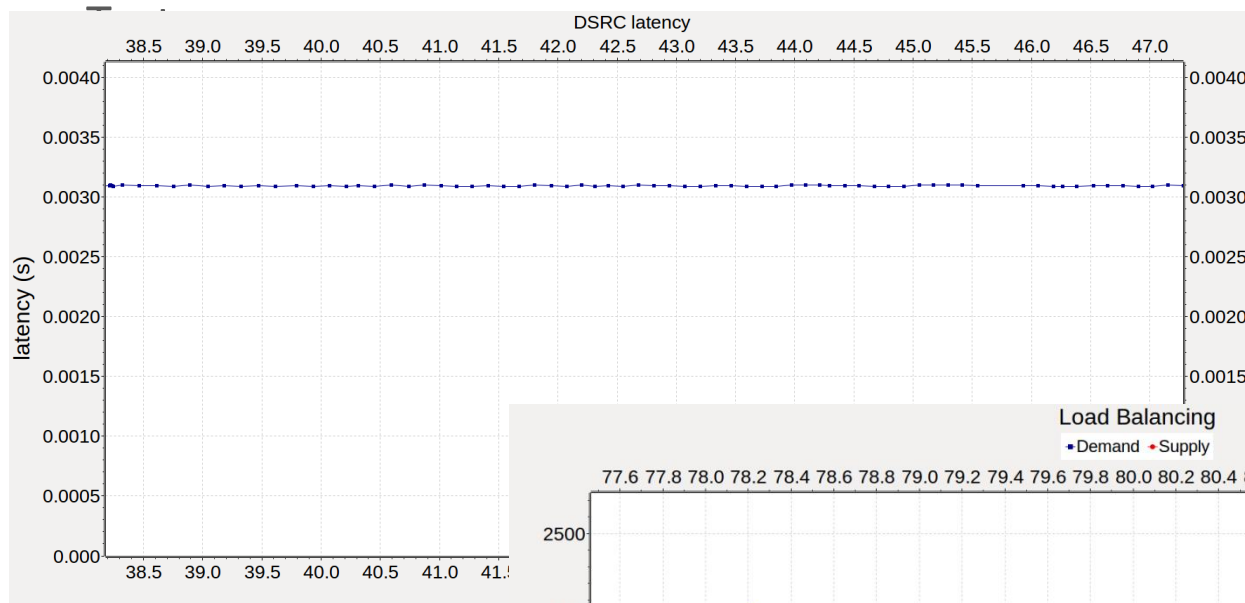
$\alpha=10\text{kW/s}$

$$p(t+1)=p(t)+\alpha\delta t$$

Multiplicative decrease

$B=0.97$

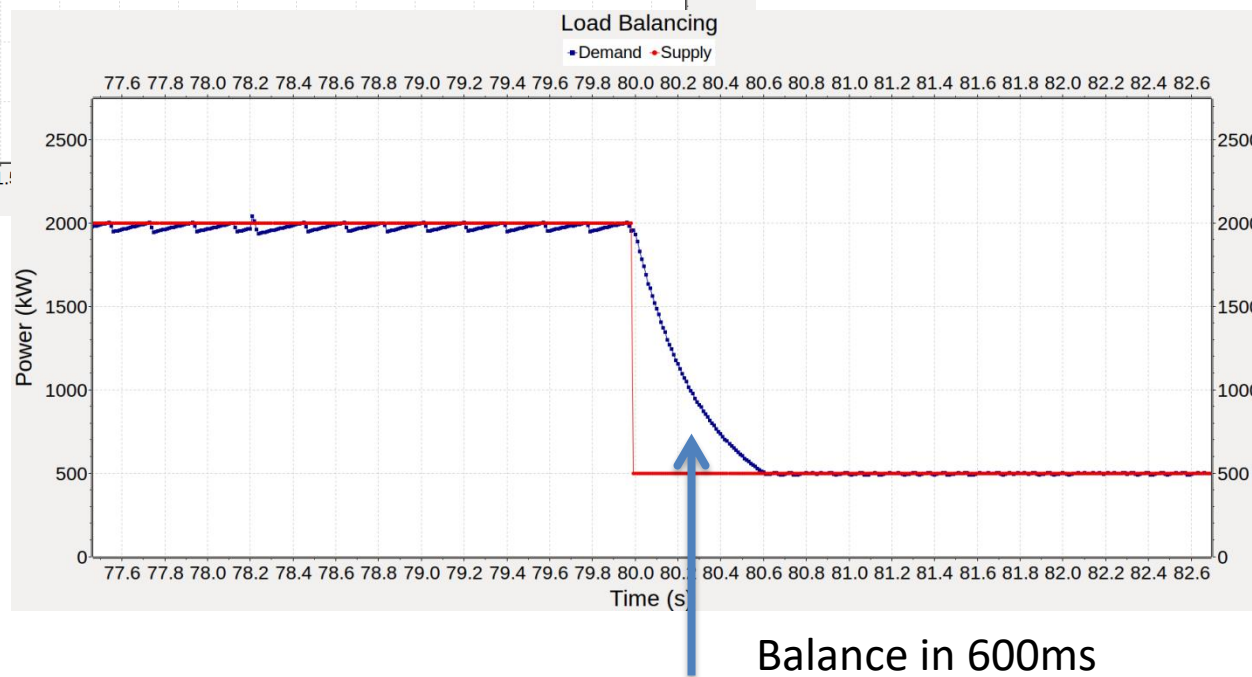
$$p(t+1)=\beta p(t)$$



Latency of congestion
broadcast signal for a
given vehicle

- Steady and predictable

Smart charging
response



Balance in 600ms



- **Reliable automotive communication technologies available to support smart charging in DWPT**
 - 802.11p DSRC can support low latency smart charging operations based on AIMD.
- **High frequency smart metering is essential in supporting smart charging for DWPT**
 - Shift to high frequency metering systems required in the case of E-mobility in order to support AIMD based smart charging
- **The limit of the smart charging communications latency pipeline is currently set by DSRC communications at ~3ms.**
 - Communication, processing and metering latencies can decrease to the 3ms barrier in order to further minimize latency in responsiveness to DSM events.



- **Work done within FABRIC EU FP7 project. For more info please visit**
- **<http://www.fabric-project.eu/>**

