

Meinberg Funkuhren GmbH & Co. KG



The Synchronization Experts

Synchronization for
Power Applications

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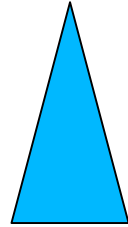
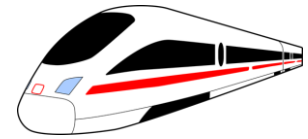
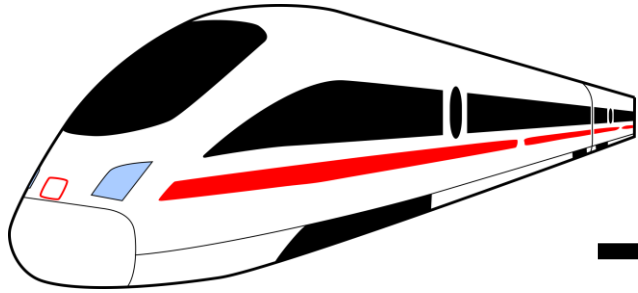


TRAFIKVERKET



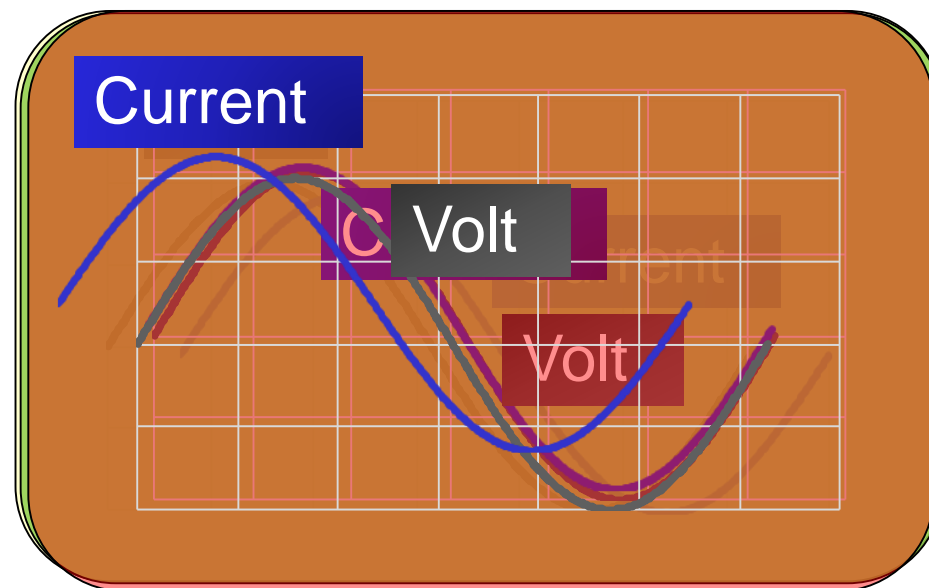
1 Terawatthour / year

(1.000.000.000.000 Watt)



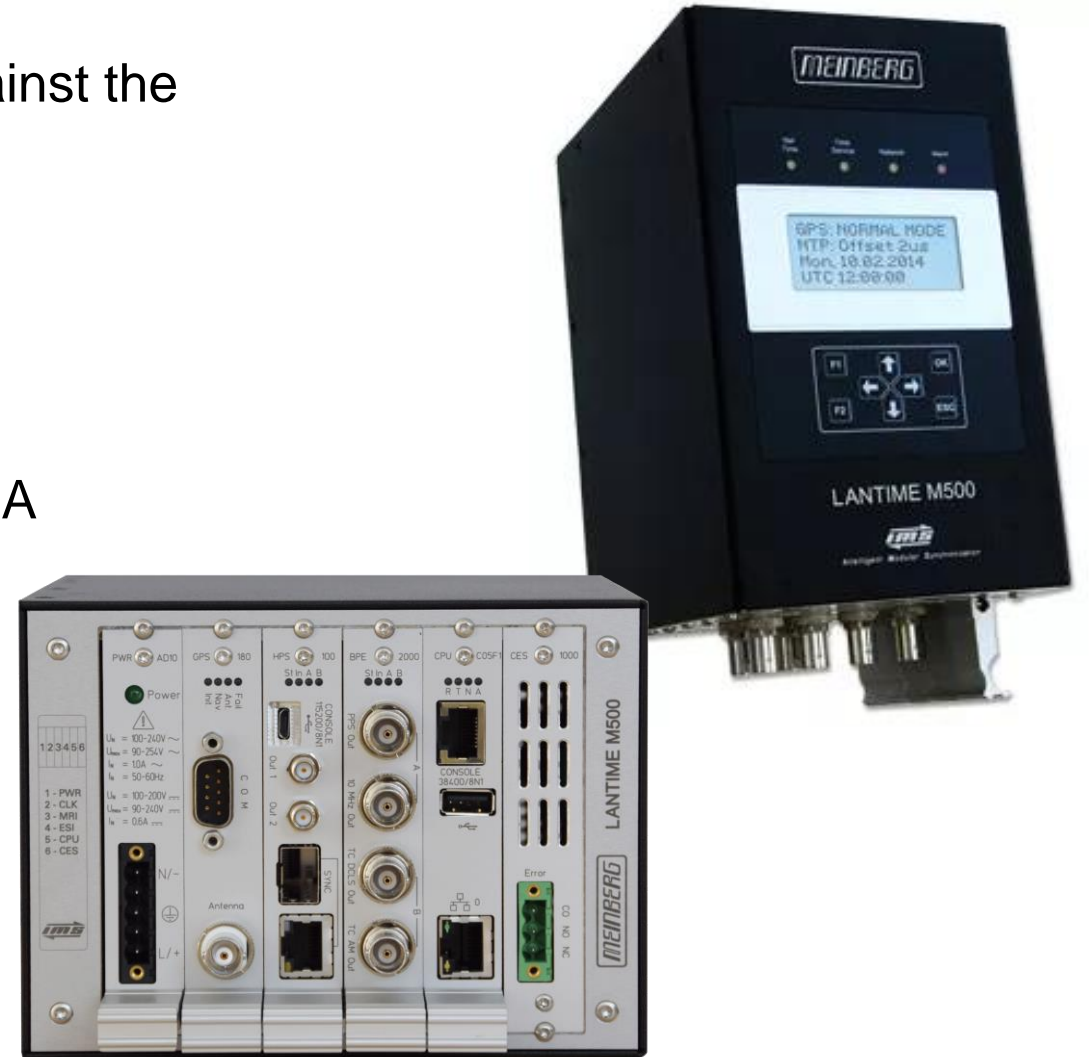
PMU





~~To enhance energy~~
To enhance energy

- Measure the frequency, voltage and current against the 1PPS
- Need UTC time sync when more than one
- Stream more than 10Mbit/hour
- Measure more than 100 times more than SCADA
- For telecom people: PMU = eNodB
- 100nanosec resolution
- Wide Area Measurement Systems - WAMS



PMU – also gives us this:

- Measurable energy and power quality problems
- Voltage fluctuations
- Short-term voltage cuts
- Short-term voltage increases
- Transients
- Flicker
- Harmonics
- Asymmetry
- Frequency
- Efficiency



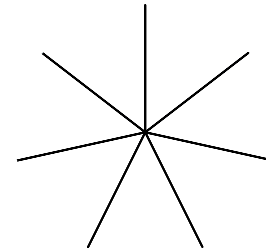


- We started with 4 substations in the south of Sweden.

- ✓ 20 GWh/year decrease
- ✓ €1M per year
- ✓ -7 % of total power consumption

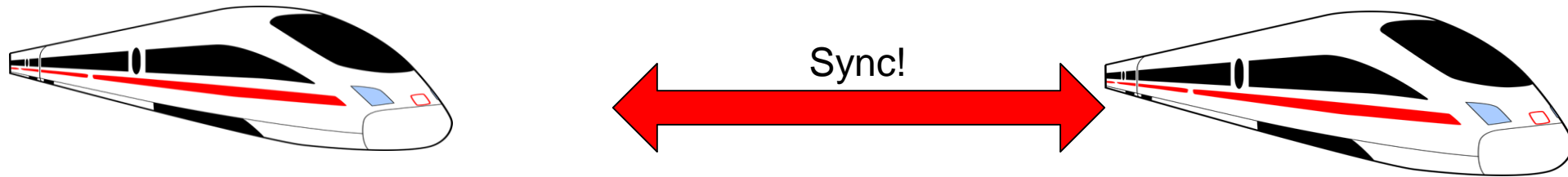


- 100 Converter / Transformer stations, rebuild with PMU
- All PMU communicate to next PMU like a star network

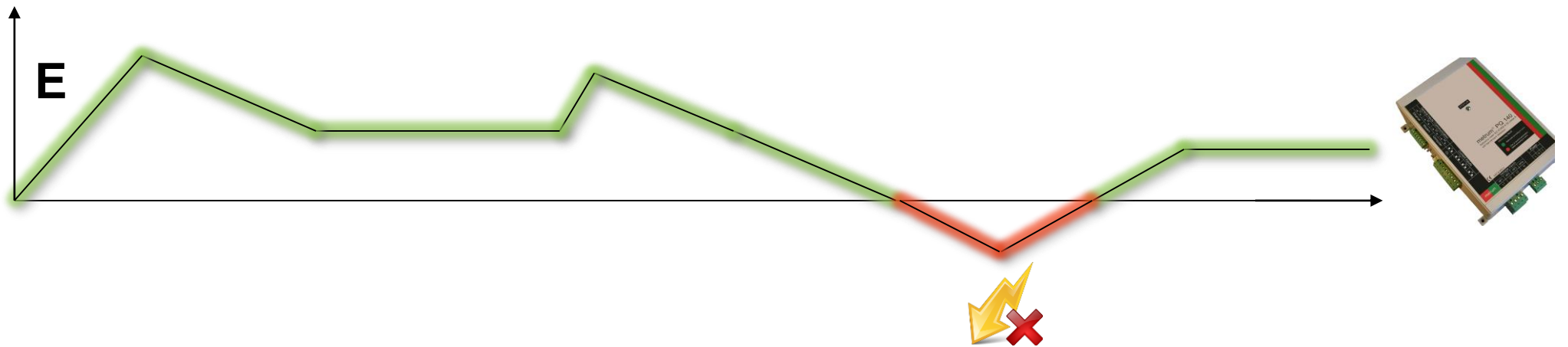
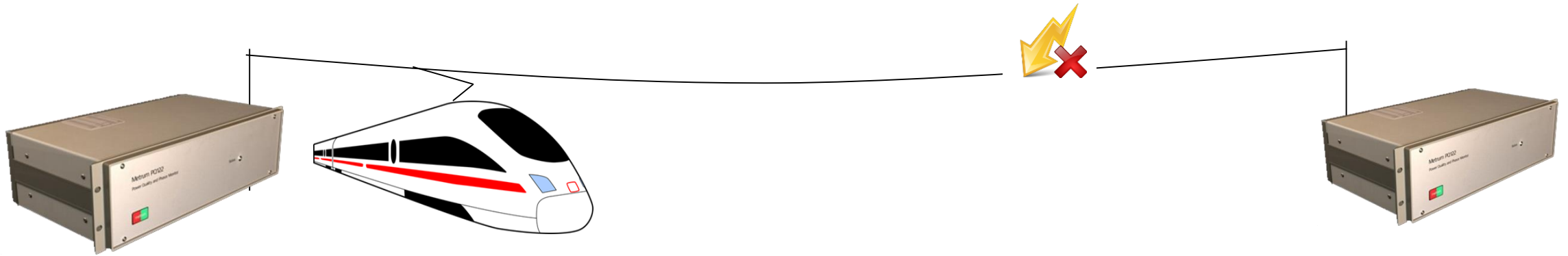


Save **25MEuro** / Year
-10% of total power

- Sync the train departure with arrival
- Rebuilding to PTP, IEEE C.37.238 Power profile



Energy Measurement - Position



NASPI, Time Synchronization in the Electric Power System

https://www.naspi.org/sites/default/files/reference_documents/tstf_electric_power_system_report_pnnl_26331_march_2017_0.pdf

Metrum,

<http://www.metrum.se/pages/swedish-transport-administration.html>



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Thank you for your attention!

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