# NeMo – A cloud based electricity network monitoring

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# Introduction NeMo

## Cloud-based Energy-Data Platform

▸ Business focus

  – Real-time measurement of relative energetic quantities in (low)-voltage nets with non-regulated measurement technology

  – Monitoring of local networks and stations including condition monitoring & alerting

  – Analysis, calculation and forecast of live and historical time series data

  – Needs-based mapping of utilities-relevant master data objects and geolocation data

▸ Technical focus

  – Streaming data platform with potential to process (near) realtime data

  – High scalability in terms of data volume and performance

  – Modern architecture with extensive use of Azure PaaS services

  – Frontend as attractive single-page application based on Node.js and React

internal use

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# Platform Overview

Local stations    Edge-Devices

**MV**    **LV**

Azure Data Explorer (ADX)

IoT Hub      Stream Analytics

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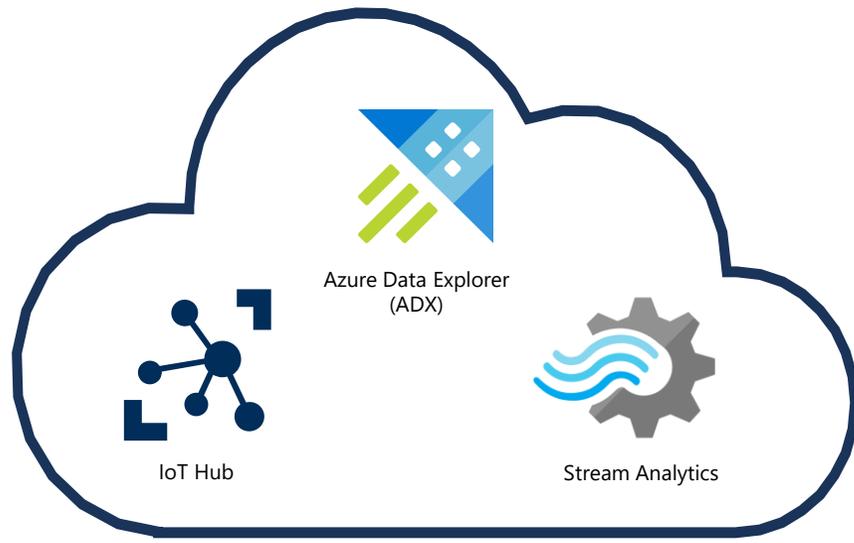
# Condition monitoring of distribution grid station

▸ Problem:

    – Rapidly growing expansion of volatile renewable energies increasingly leads to grid bottlenecks in the transmission and distribution grid

    – Especially in networks of the lower voltage levels

▸ Implication

    – Surplus or shortage of energy today can only be detected in the higher network levels due to poorly monitored lower network levels

    – Increasing requirements regarding the tasks of a network operator

        • Maintaining the voltage band at the grid connection point

        • Avoidance of cable and transformer overloads

        • Equipment monitoring

▸ Solution: Improved monitoring of the low voltage feeders and the local network station

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# Maintenance of distribution grad station

▸ Further benefits of continuous monitoring

- Early detection of short circuits already in the initiation phase

- Precise recognition of triggered fuses in the Service Center

  • Targeted use without prior start-up at the end user

  • Correctly allocated deployment of the service technician

- Detection of permanently heavily loaded stations or stations that are about to be overloaded

- Supervision of the main fuse

- Connection of the short-circuit indicators at medium voltage level

▸ Integration of monitoring into existing processes

- Automatic notification of anomalies due to fixed or learned limits

- Visualization in the network control center and at the service technician via app

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# Forecasting and simulation

▸ Goal:

   – Improvement of the forecast quality at low voltage level in day-to-day business

   – Early identification of critical connection points

   – Extraction of information for network development planning

   – Information for maintenance planning

   – Update and sharpening of standard load profiles

▸ To do:

   – Generalization of measured data to larger network segment

   – What happens on the network segment when...

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# Insights Webapp

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# NeMo – Area Chart

- ‣ Shows configured network area with maintained objects
- ‣ Objects, lines and polygon courses can be imported via standardized GeoJSON

- ‣ Jump to ONS, detailed dashboard and inclusion in comparison list possible
- ‣ colored visualization of KPIs / line states of network segments
- ‣ Tree representation in the left frame serves the same purpose for navigation

internal use

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# NeMo – Area Chart
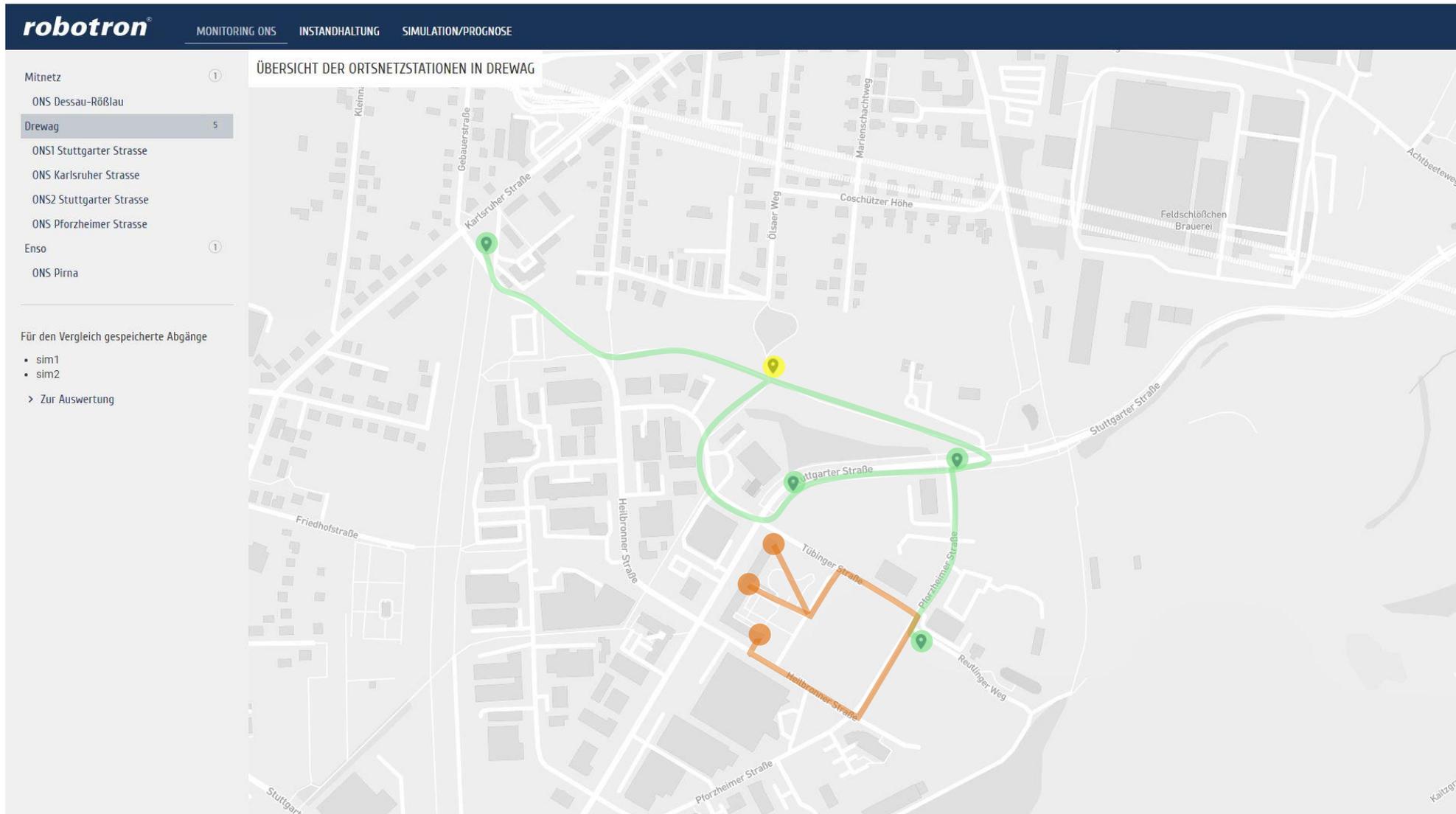
# NeMo – Overview local network station

▸ Shows current, voltage and frequency of an network station (aggregated over all feeders)

▸ Preset instantaneous values and time series of the last 8h and 72h

▸ Freely configurable time window

▸ Dynamic display of the physical development of the concrete network station (if stored in master data)

▸ Determination and visualization of system states incl. alarming

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# NeMo – Overview local network station
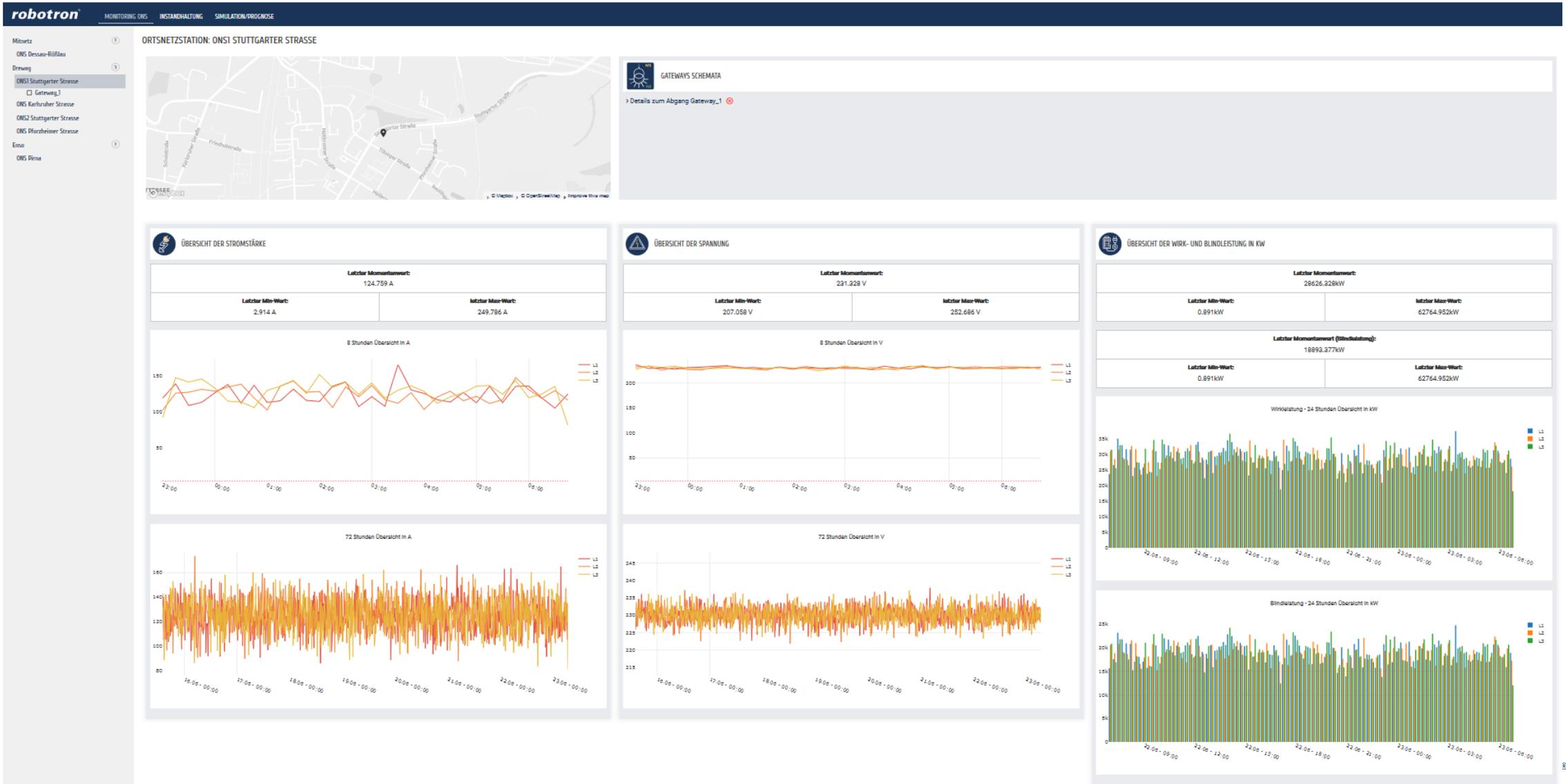
# NeMo – Detailed feeder local network station

‣ Shows power, voltage and frequency of an ONS outgoing feeder

‣ Preset instantaneous values and time series of the last 8h and 72h

‣ Display of active and reactive power (current and time series of the last 24h)

‣ Heatmap for power consumption of the last 7 days per hour in comparison to each other

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# NeMo – Detailed feeder local network station
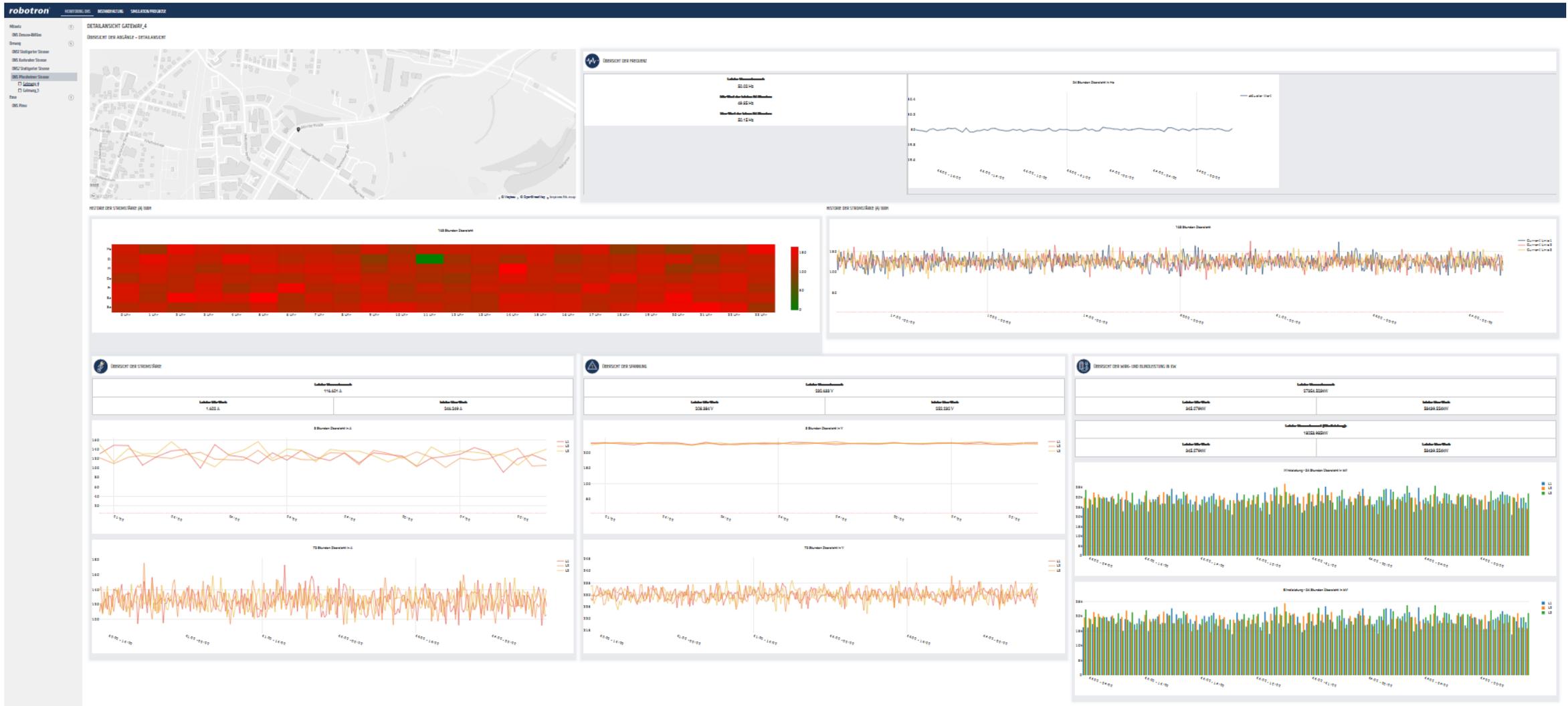
# NeMo – Comparison Dashboard

▸ Selection of the feeders to be compared via map or tree

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# Edge-Components

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# IIoT-Gateway + Power measuring transducer

‣ IIoT Gateway

– Armv7 Cortex-A8 1000 MHz CPU

– LTE Cat. 1 for US, EU, APAC and AUS regions

– -30°C - 70°C (-22°F - 158°F) operating temperature

‣ Data acquisition/ current measuring transducer

– Power and voltage measurement possible (voltage with galvanic connection)

– 4 connections each with 3-phase measurement possible

‣ Inductive current sensor

– Measuring range depending on sensor max. 600 A (e.g. 100A, 200A, 300A)

– Other combinations with 1250 A are currently being tested

– No external power supply necessary

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# Measured variables of the data logger

## ■ Technical Specification

### Measurement

| | |
|---|---|
| Voltage | Per phase, per line and average voltage |
| Current | Per phase, neutral and average current |
| Active Power | Per phase and total active power |
| Reavtive Power | Per phase and total reactive power |
| Apparent Power | Per phase and total apparent power |
| Power Factor | Per phase and total power factor |
| Frequency | Frequency |
| Active Energy | Import, export, net value and total value |
| Reactive Energy | Import, export, net value and total value |
| Apparent Energy | Total value |
| THD Voltage | Per phase, per line and average voltage |
| THD Current | Per phase, per line and average current |
| Demand | Per phase, average current and power |
| Max Demand | Current and power maximum demand and timestamp |
| Unbalance | Current and voltage |
| Max/Min value | Per phase and 3-phase of parameters values |
| Data Logging | Record interval can be set, 50 out of 254 parameters can be record at the same time. |
| Pulse Output | Test pulse output |
| TOU | 4 seasons and 8 tariff |
| Time | Year, month, day, hour, minute, second |

### Electrical Characteristics

Measurement: True RMS
Sampling: 128 point/Cycle
Update time: 0.5 second
Metering system type: 1P2W, 1P3W, 3P3W, 3P4W
Input Range:
Voltage: PT Primary side ratio: 100V~9999KV
PT Secondary side ratio: 50~600V
Direct Input: ≤ 600V(L-L) or ≤ 400V(L-N)
Current:
Main circuit input: 333mV
CT Primary side ratio: 5~9999A
Frequency: 45~65Hz
Metering over range:
Voltage:1.2X rated voltage continuous(600V max)
Current:1.2X rated current of CT

## Accuracy & Resolutions

| Parameter | Accuracy | Resolution | Measurement Range |
|---|---|---|---|
| Voltage | 0.5% | 0.1V | 40.0~400.0V(L-N) |
| Current | 0.5% | 0.001A | 1%~120% CT rating current |
| Neutral Current | 1.5% | 0.001A | 1%~120% CT rating current |
| Active Power | 1.0% | 1W | -999999999~999999999W |
| Reactive Power | 1.0% | 1Var | -999999999~999999999Var |
| Apparent Power | 1.0% | 1VA | 0~999999999VA |
| Power Factor | 1.0% | 0.001 | -0.020~+1.000~0.020 |
| Frequency | 0.2% | 0.01Hz | 45.00~65.00Hz |
| Active Energy | 1.0% | 0.1kWh | 0~99999999.9kWh |
| Reactive Energy | 1.0% | 0.1kVarh | 0~99999999.9kVarh |
| Apparent Energy | 1.0% | 0.1kVAh | 0~99999999.9kVAh |
| THD | 1.0% | 0.1% | 0~100.0% |
| Unbalance | 1.0% | 0.1% | 0~300.0% |

*Accuracy non-include clamp CT ratio error

### Power Quality
THD: Total harmonic distortion per phase, per line, average of voltage and per circuit, average of current.

### Panel light
Indicator light: Power / Communication / System indicator

### Demand
Calculation method: Slide / Fix
Calculation cycle: 1~60 minutes

### Data Logging
Setting: 50 parameters can be record at the same time.
Time interval can be set from 1~32767,
unit can be set to day, hour, minute, second
Memory: 2MB Flash ROM

### TOU (Time of Use)
4 Seasons: 1~4 seasons per year
8 Tariff setting: 1~8 Tariff/day(For peak, mid peak, off peak per day for billing)
Parameters of TOU: AE-Imp, AE-Total, RE- Imp, RE-Total, SE, SE-Total in every circuit month and previous month.
Yearly setting: Tariff setting for 1 year or set up to 5 years

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DATA WITH IMPACT.

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