POWER GRID
MONITORING SYSTEM
IoT Implementation

Conductor monitoring
Line loss decrease
Line sag prevention

Data visualization
Data integration
Customized design

Electric tower monitoring
Structure robustness analysis
Seismic risk assessment

Data protection
Data encryption
High security data storage

Dynamic thermal rating calculation
High power transmission efficiency
Current margin control

Energy management mechanism
Self-sustainable
High reliability

7 Monitoring information
8 Transmision protocols
4 Cloud services

Power Grid Monitoring System

Sensor parameters
Conductor temperature
Vibration
3-axis angle
Ambient temperature/humidity
Illumination
Rain
Wind

Wireless communication
Zigbee/ LoRa
Fiber
3G/4G
Satellite
IEC61850
NBIoT/ Cat-M1

Service
- Map information visualization
- Dynamic thermal rating prediction
- Line ampacity dispatch suggestion
- Reconstruction of line temperature distribution

Potential problems with traditional power grids

Increasing electricity demands

With economic development and population growth, global electricity demand increases, resulting in a sharp rise in electricity consumption during peak periods. So, it is necessary to make a good use of current carrying capacity to improve transmission efficiency.

Threats of climate change

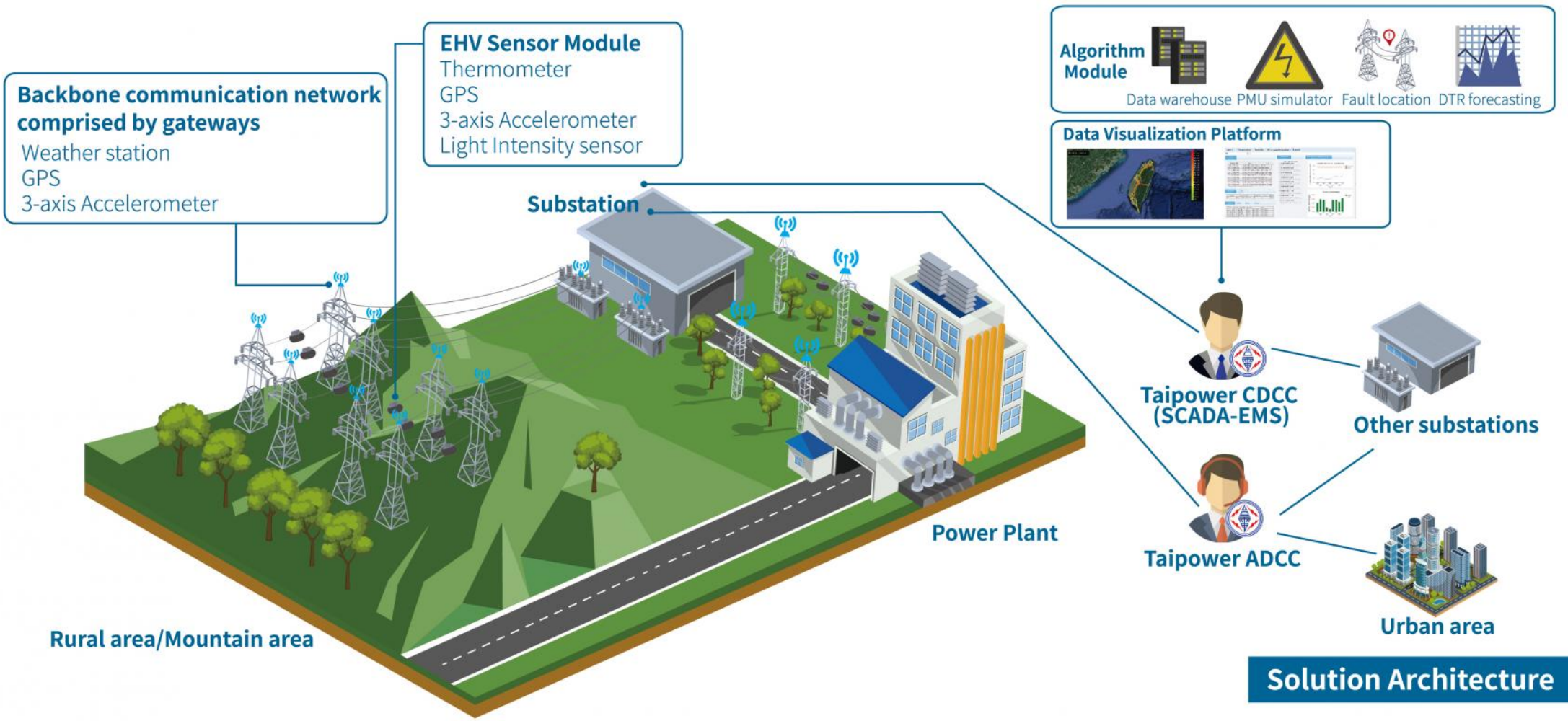
With global climate change, a highly humid and salty environment accelerates transmission line aging, while strong earthquakes and heavy rainfall bring negative impacts to the tower base. Thus, there is an urgent need for a real-time monitoring system capable of measuring these environmental factors and localizing faults.

Increased line temperature bringing negative impacts to the safety of transmission lines

An increase in line temperature might increase the risk of line relaxation and sag, eventually affecting current carrying capacity and heat capacity of the lines. Thus, many have paid attention to line temperature and line sag monitoring and early warning services.

Inefficient Troubleshooting

Traditional manual inspection requires a lot of time and money, and poses a threat to personal safety of the maintenance crew. A fault detection device can reduce manpower and maintenance costs afforded by the power company.



Solution Architecture

Products—Transmission Conductor Guardian (TCG)

Features:

High communication security, high durability, high stability, easy installation, and a self-powered device

TCG provides accurate line temperature and conductor information, and uses the magnetic field on the transmission line to generate the required power. Also, there are some energy storage devices inside the TCG, so even if the power of a transmission line is insufficient or the power supply in interrupted, TCG can still operate stably.

Products—
Transmission Conductor Network Gateway (TCNG)

Features:

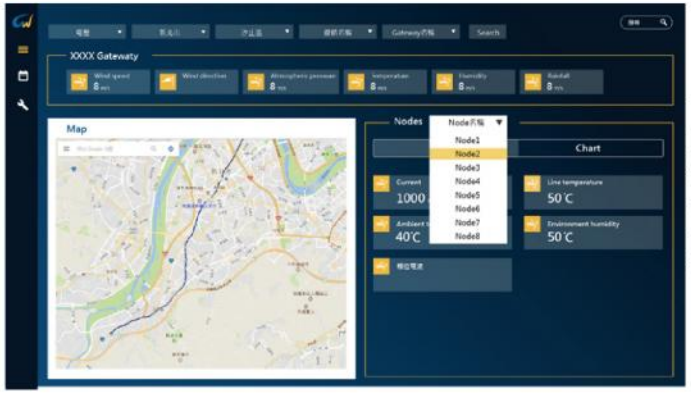
Information security, centralized management, low maintenance and updating costs, automatic re-transmission of information, regular remote updates

TCNG transmits the information of TCGs and weather data to a Grid-well Service Cloud (GSC) through wireless communication, and the information/data can be integrated and managed. For example, each TCG can perform assigned tasks in real time; the system network routing mechanism can be simplified and power consumption can be efficiently managed. EHV transmission lines can be easily monitored and controlled.

Visual interfaces that display power grid statuses in real time

Features:

Providing geographic distribution, sensing information data, environmental parameters and weather information for the grid



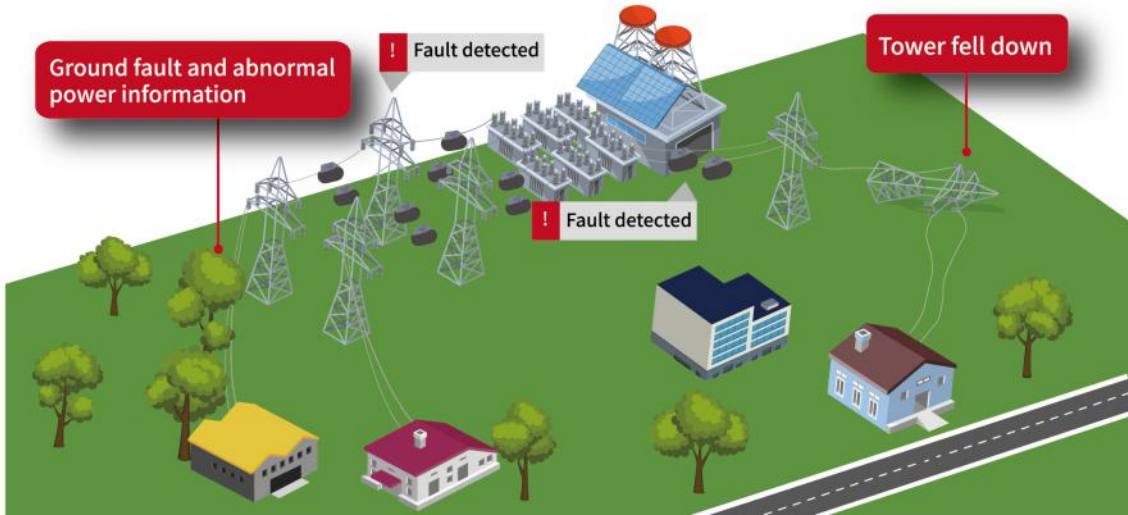
TCGs on the transmission lines transmit the information to a cloud and uses visual interfaces to display power grid statuses in real time.

Fault detection and localization

Features:

Fast finding the location of a fault, sending out an anomaly alarm

When the transmission conductor monitoring system is mounted on a grid, it immediately monitors the status of a currently operating transmission conductor. If any transmission line fault occurs, the location of the fault can be fast detected.

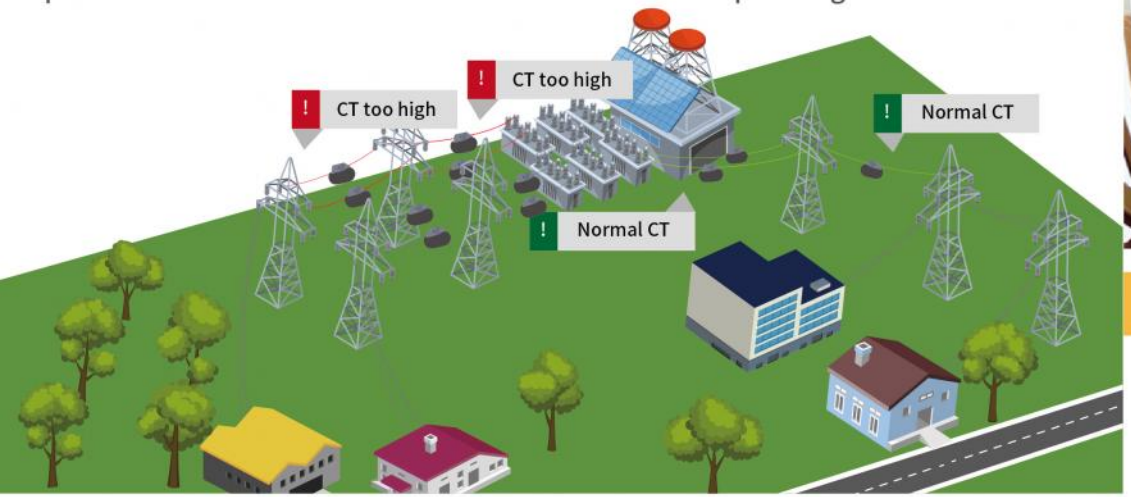


Transmission conductor temperature warning and forecast

Features:

Transmission line temperature calculation and prediction, sending out anomaly alarms

Transmission conductor temperature is measured in real time, according to different upper thresholds for various transmission lines, and an hourly alarm will be sent out if an anomaly occurs. The meteorological data in the past 12 hours is used to predict the transmission line temperature in next 1 to 6 hours, and the predicted data can serve as a reference to establish dispatching schedules.

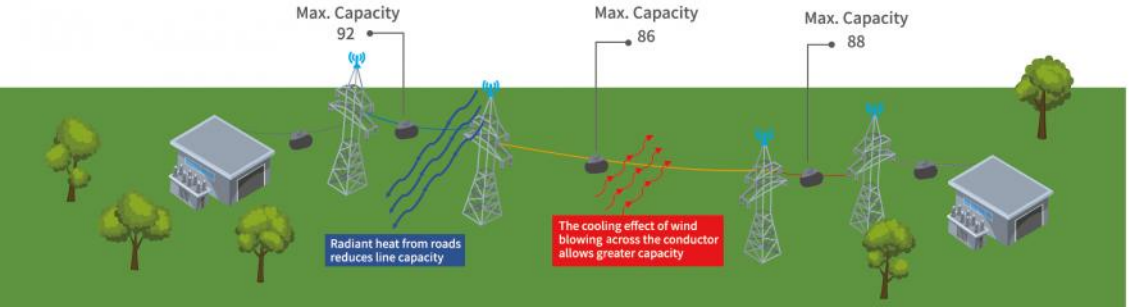


Dynamic heat capacity calculation and transmission efficiency improvement

Features:

Dynamic thermal capacity calculation and prediction, Transmission line management

The IEEE Standard 738-2012 is used to process the real-time meteorological and grid parameters measured by the transmission conductor monitoring system. The data can be inputted to estimate a current carrying margin of the transmission line in real time so as to enhance the transmission efficiency.



Success case

Taipower company

Achievements

Participating in “The 16th MTE International Invention Exhibition in Malaysia”

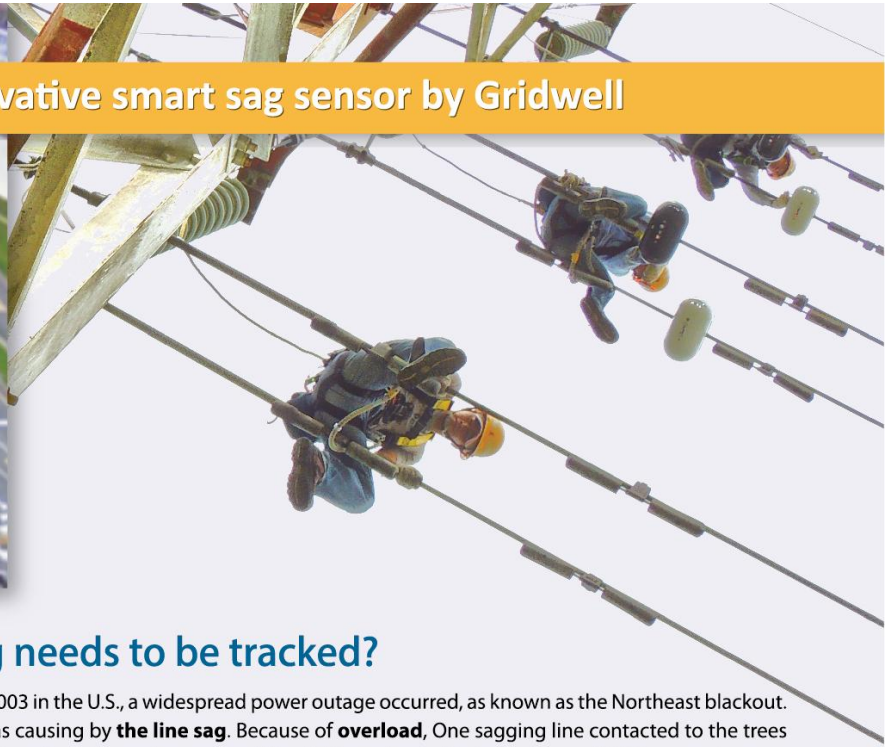
Winning a gold medal with the innovation entitled “An Internet of Things-Based Smart Grid-Wide Safety Monitoring System for EHV Power Grids” ; Being reported by news media agencies.

Participating in “Russia MISIS International Invention Exhibition”

Winning a special award for the best international invention, and a Gold prize honored by the Association of Thai Innovation and Invention Promotion, and the Association of Thai Innovation and Invention Promotion”

Transmission Span Sag Guardian

An innovative smart sag sensor by Gridwell



Direct Monitoring for Sag

Transmission Span Sag Guardian (TSSG) is a wireless, quickly installed, self-powered sag sensing device with communication security, high durability, high stability for transmission lines. **TSSG** provides the real-time conductor sag level investigation, conductor temperature monitoring, line current, and ambient temperature/ humidity.

TSSG High Durability & Stability

TSSG is suitable for transmission line voltages up to 635 kV by passing the high voltage test, can also withstand ± 1500kV lightning surge. **Gridwell TSSG** sag measurement accuracy is within 10 cm, and current measurement range is up to 3000 A.

Features

- **Track the sag level directly** to ensure safety of transmission lines
- **Measure conductor temperature** to enhance transmission capacity
- **Present real-time data with user interface**

Application Specification			
Sag Measurement Accuracy	± 10 cm	Sensor Radio Range	500 Meters Line of Sight
Operating Voltage	0~635 kV	Power Consumption	1 W
Operating Current	0~3000 A	Size / Weight	40 x 21 x 25 cm / 5 kg
Operating Temperature	-40 ~ 85 ℃	Battery Back-Up	3 Week

Why sag needs to be tracked?

On August 14, 2003 in the U.S., a widespread power outage occurred, as known as the Northeast blackout. The accident was causing by **the line sag**. Because of **overload**, One sagging line contacted to the trees underneath and resulted in a serious **ground fault**. The outage affected an area of 24 thousand square kilometers and an estimated 50 million people.

Severe **transmission line sag** may seriously affect the safety of the power grid. It's likely to lead further to **ground faults** and prompt a massive **blackout** with negligence. The caused damage is actually considerable. Power system equipment is damaged directly, and the economic loss is even more significant.

Effect of Sag on Transmission Line