Future Electric Power Systems

efficient, reliable, secure, resilient, adaptable, and economic

Sharif University of Technology

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IoT-aided Smart Grid

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IoT and Smart Grid

The IoT is defined as a network that can connect any object with the Internet based on a protocol for exchanging information and communication among various smart devices in order to achieve monitoring, tracking, management, and location identification objectives

The IoT focuses on three main concepts

- Things oriented (devices)
- Internet oriented (network)
- Semantic oriented (software)

IoT and Smart Grid

According to the U.S. Department of Energy; a smart grid is considered as an intelligent grid that integrates technologies of advanced sensing, control methodologies and communication capabilities into current electricity grid at the both transmission levels and distribution levels

Smart grid deploys various types of devices for monitoring, analyzing and controlling the grid

One of the main concerns for smart grid is the connectivity, automation and tracking of such large number of devices, which requires distributed monitoring, analysis and control through high speed, ubiquitous and two-way digital communications

Smart grid is considered as one of the largest applications of the IoT

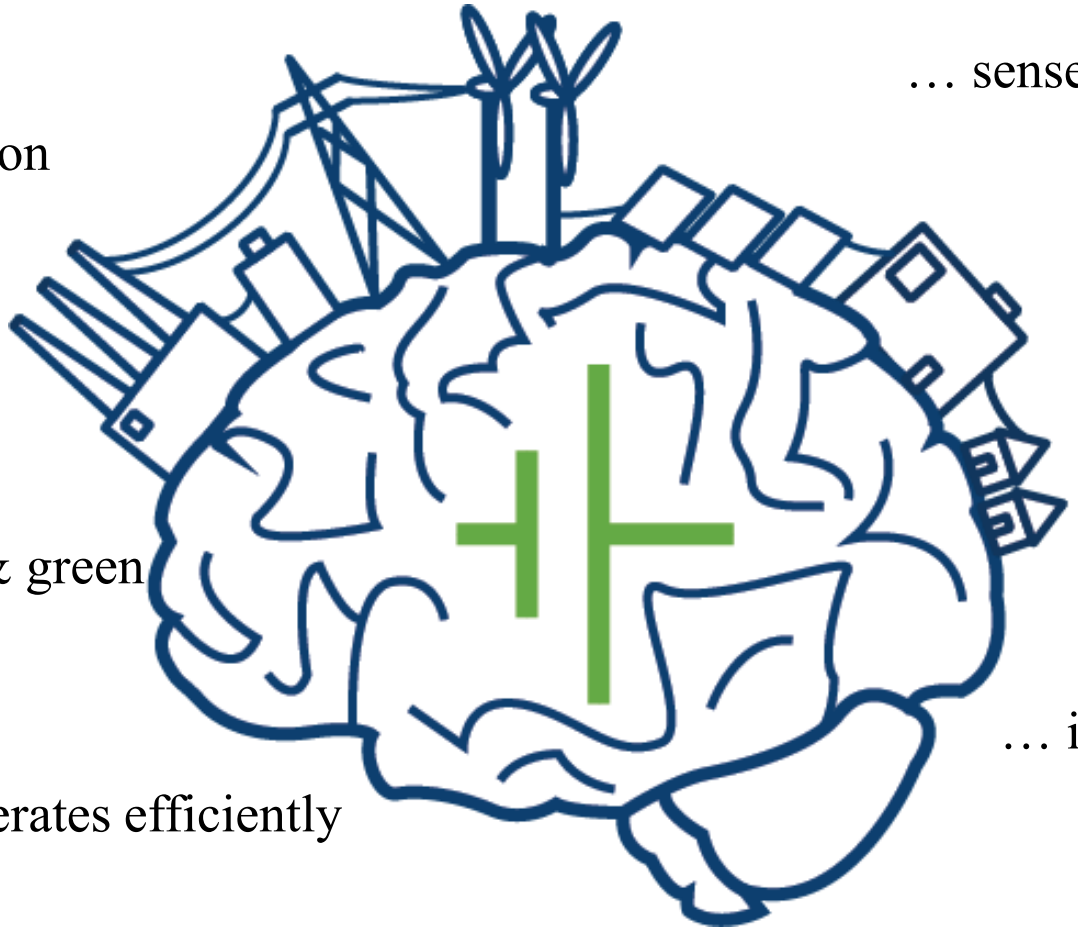
In smart grid, advanced communication systems are required

IoT and Smart Grid

GRID that ….

… senses

… makes decision



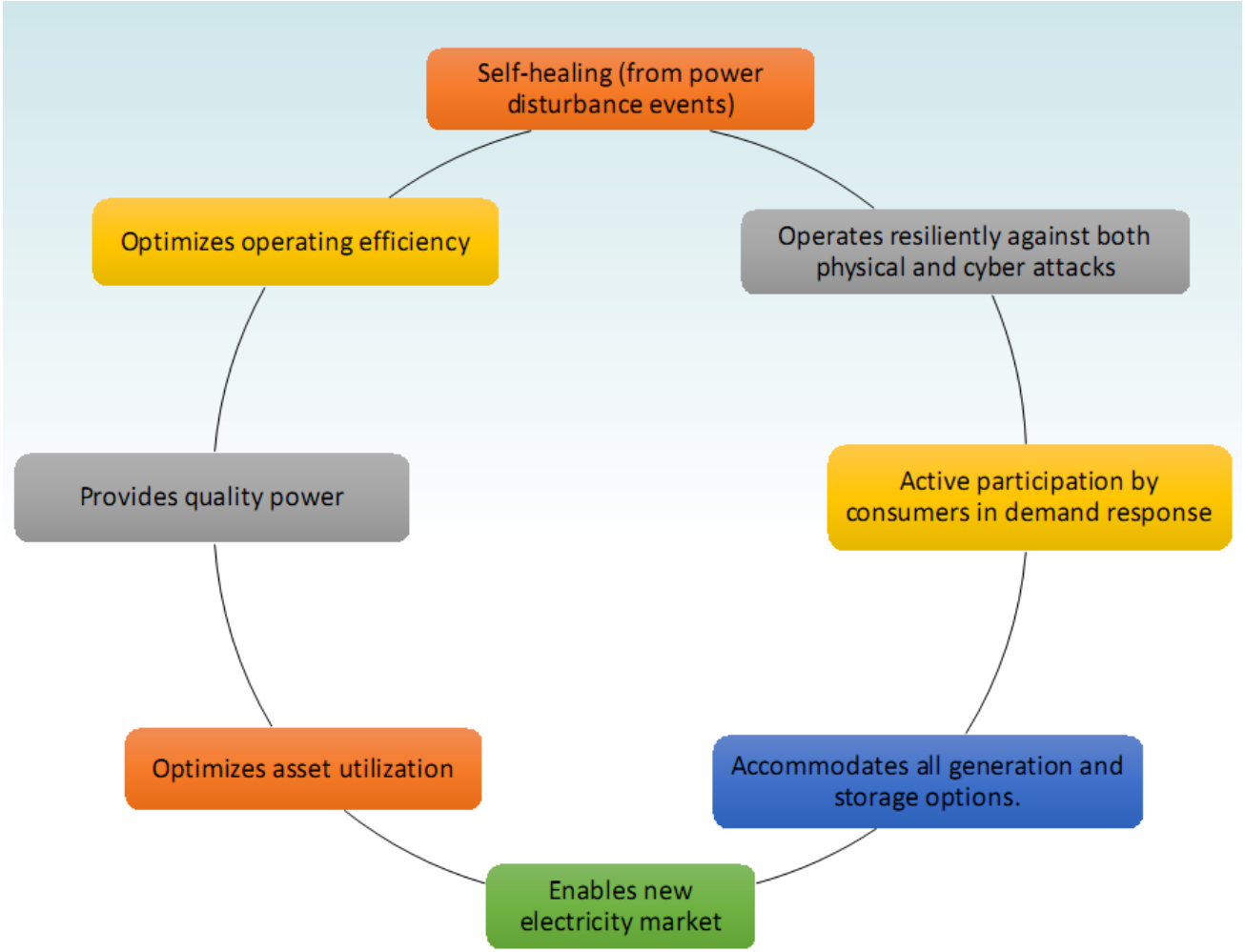
… acts clean & green

… is autonomous

…. operates efficiently

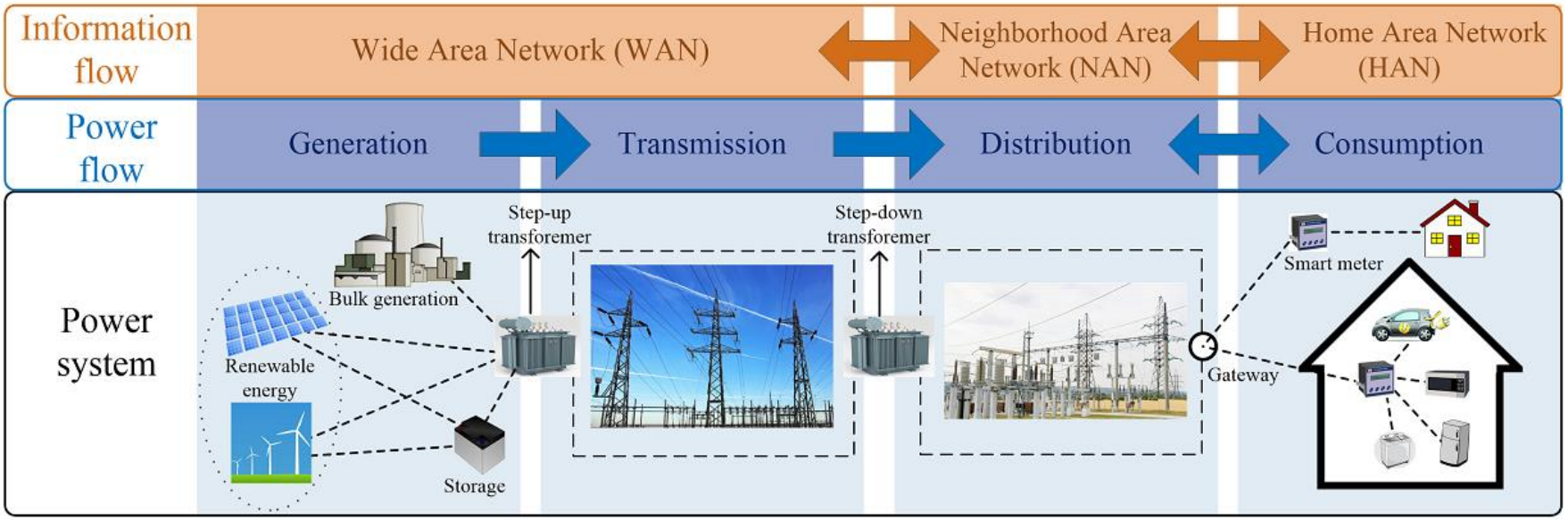
IoT and Smart Grid

Feature of smart grid



IoT and Smart Grid

Smart grid paradigm



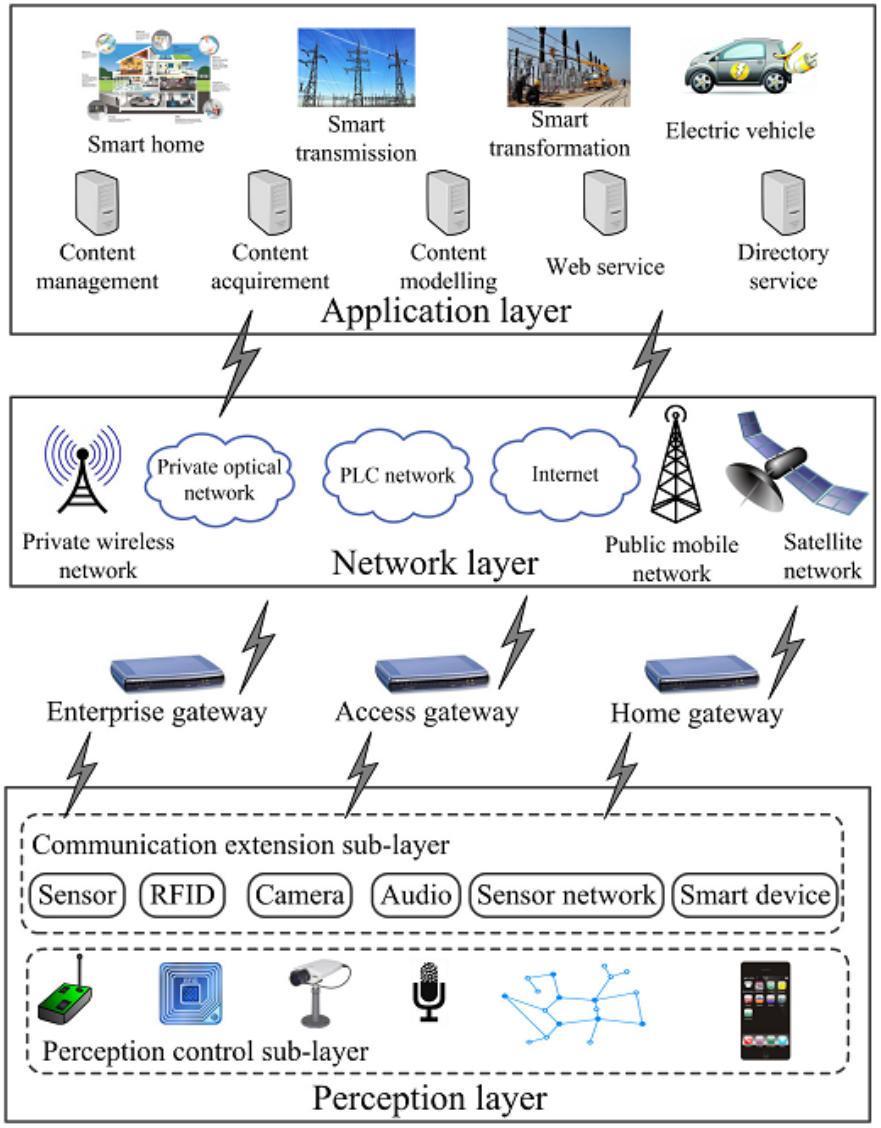
HAN manages consumers appliances, renewable energy resources, and storage systems

NAN establishes interaction between data concentrators and smart meters

WAN serves as a backbone for communication between control centers and bulk power system players

IoT and Smart Grid

Basic Architecture of IoT in Smart Grid



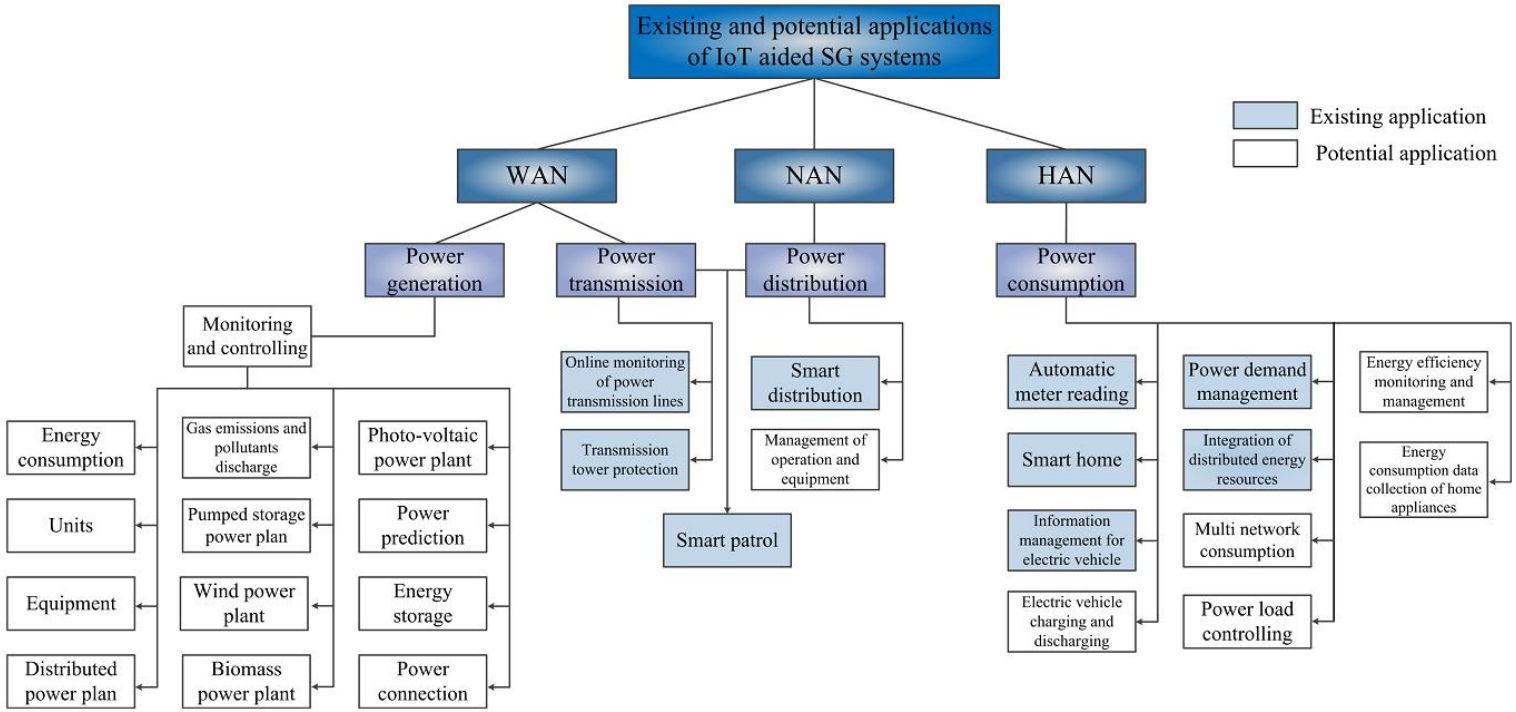
IoT Role in Smart Grid

The application of IoT in smart grids is

to monitor equipment status

to collect information throughout the network

to control the grid



IoT Role in Smart Grid

HAN applications of IoT

Smart home

optimizes daily power consumption

IoT Role in Smart Grid

HAN applications of IoT

Information management system for EVs

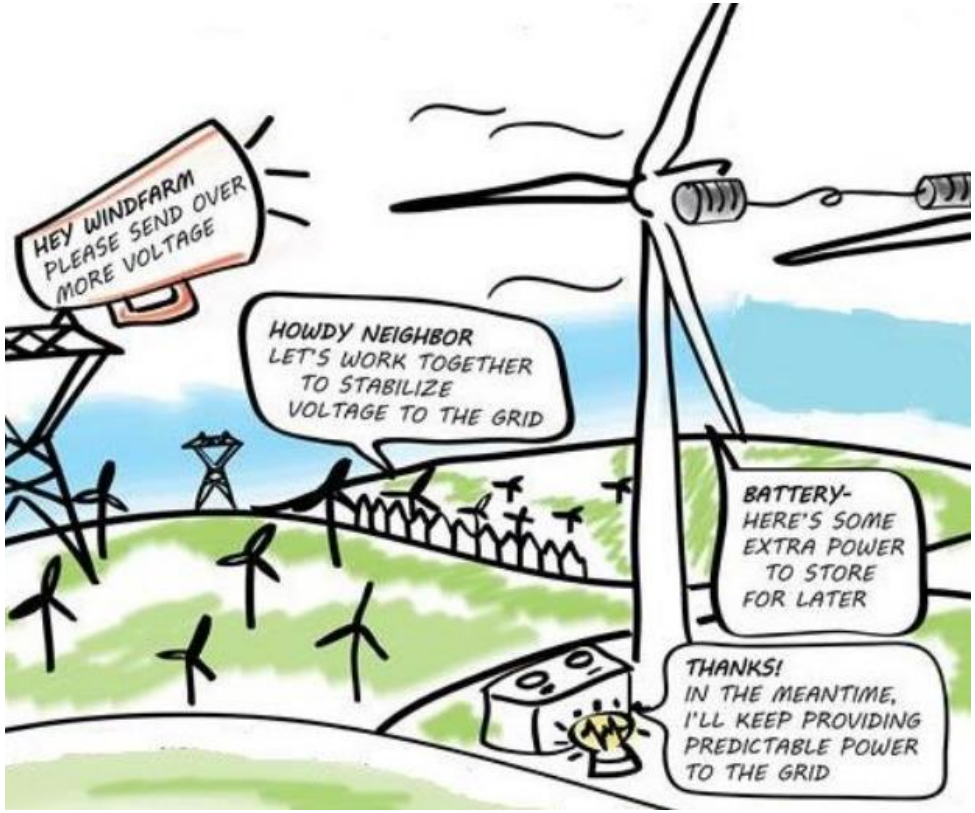
optimizes charging/discharging status of EVs

IoT Role in Smart Grid

HAN applications of IoT

Integration of DERs

increases supply forecasting accuracy and controls the state of DERs



IoT Role in Smart Grid

HAN applications of IoT

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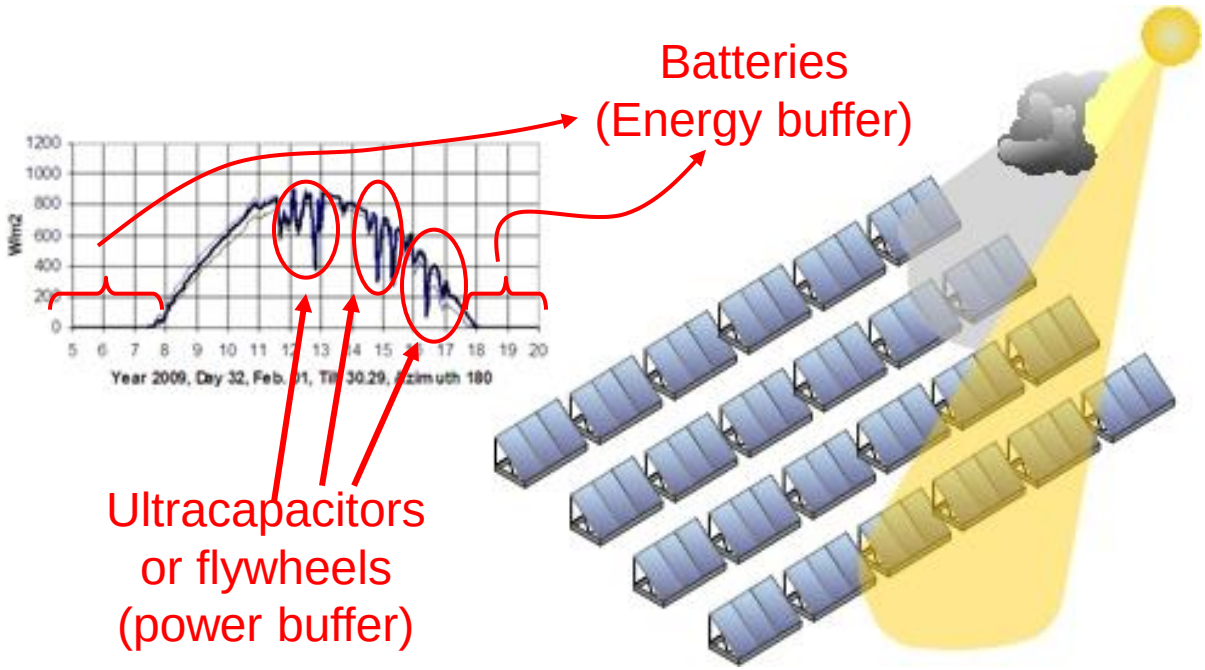


IoT Role in Smart Grid

HAN applications of IoT

Automatic meter reading

collects real-time consumption data and provides users with consumption analysis and statistics

IoT Role in Smart Grid

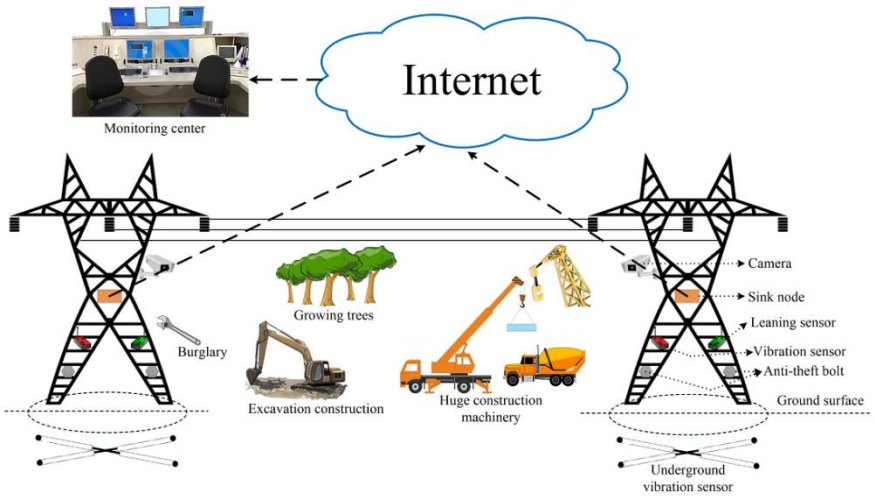
NAN applications of IoT

Smart distribution

any abnormal situation can be predicted or immediately identified

Smart patrol

faults and abnormalities can be located



WAN applications of IoT

Transmission tower protection

enhances safety of towers from physical damages by unsafe construction, growing trees, etc

Online monitoring of transmission lines

measures conductor galloping, temperature, etc

Controlled islanding and network based applications

Benefits

In Iran, 6-8% increment in demand is experienced annually

Generation capacity (MW)	Transmission network length (km)	Distribution network length (km)
73000	121000	397000

Average construction costs: 3000 MT per MW, 500 MT per km, 40 MT per km

Peak reduction monetary value 319 MT per MW

What happen if network losses are reduced by 1%?

What happen if we give up from making a cup of tea?

What happen if we turn off a 100-watt light bulb for an hour every night?

Number of customers: 25 million

Pollution rate: 640 gr CO_2 per kWh

Energy needed to boil 200 ml water: 0.04 kWh

Challenges

Big data challenge (3 Vs: volume, variety, and velocity)

Security against intrusion

Budget limits

Uncontrolled growing demand

Etc

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