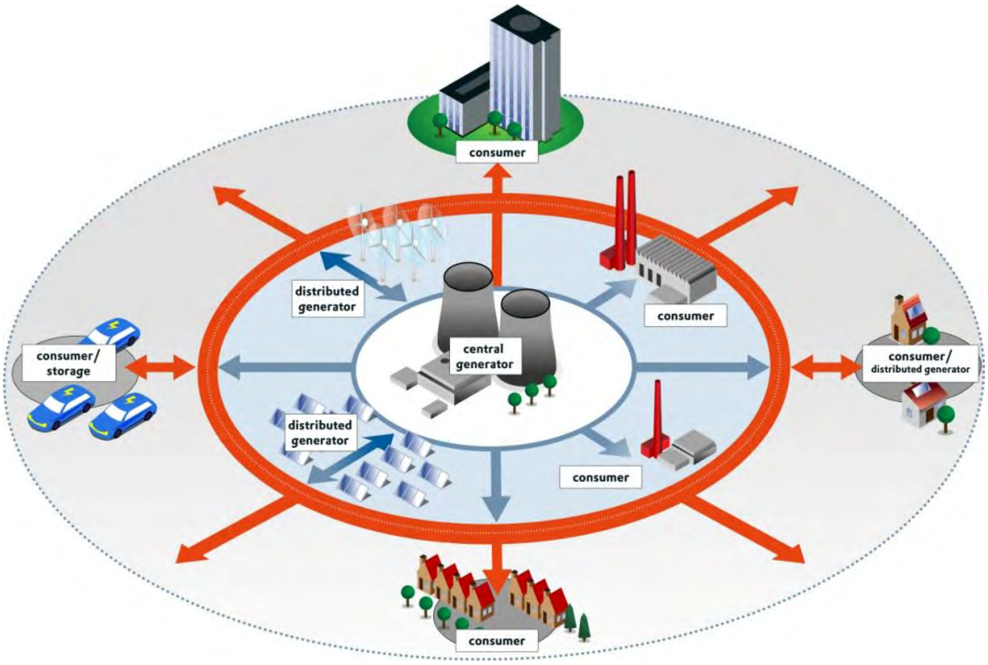
Smart Grids Part 2

The Smart Grid in the medium and low voltage level

zenon®

The Smart Grid from the transformer substation to the end consumer

In the last article, “Smart Grid Part 1”, we looked at the topic of how zenon can be involved with the provision of data to superordinate monitoring bodies.
In this article, we look at the Smart Grid from the substation to the end consumer - the medium and low voltage area.



The medium voltage area of the energy supply network is also known as the distribution grid. This transports the electrical energy from the substations to industrial areas and households. Its voltage ranges between 5 kilovolts to 38 kilovolts. The energy is transferred via cables or overhead lines. The lines start at the substations and end at the transformers, which then transform the voltage, for example, in Europe, to 400/230 Volt. This voltage is then fed directly to the consumers (households or businesses). The medium voltage network is characteristized by very pronounced branching, a high number of elements (masts, transformers, switchgear) and little to no remote monitoring. These characteristics, as described here, are very generalized and will apply to a greater or lesser extent depending on the region under consideration. For example, there is no remote monitoring of the medium voltage grid at all in some parts of the world, whereas in other parts (central Europe) there is complete monitoring through to the consumer (low voltage).

Monitoring of the medium and low voltage areas of the grid

There is, certainly, a greater need to monitor quite complex medium voltage grid systems than was previously the case. The motivations for this are clear: improvement of supply quality (fewer or shorter blackouts), avoiding non-technical losses (energy theft) and improved efficiency for the two-way flows of energy resulting from households" own generation of electricity. This expansion of monitoring will lead to an immense amount of data that must be processed.
Several systems are required for this:

- Distribution Management System (DMS)
- Global Information System (GIS)
- Outage Management System (OMS)
- Customer Information System (CIS) and
- Work Management System (WMS)

And these are only the most important ones!

Assuming that data from the network is available, there is now the problem of getting these systems to work with each other. Cooperation between these systems is currently harmonized in IEC Standard 61968. This standard concerns the Common Information Model (CIM). CIM is used to unify and simplify the exchange of information. The information to be exchanged is described in UML and then exchanged in XML format.. It should therefore then be possible to receive the data from the medium voltage grid from a SCADA system (such as zenon) and for this to be distributed in a suitable form to all other systems involved. These then prepare the data according to their requirements and exchange it amongst themselves.
For example: a protective device establishes that a transformer in a small transformer substation is defective. The protective device reports this to the SCADA system. The SCADA system forwards the information to the following systems:

- DMS – To recalculate the grid in order to detect any overload of neighboring grid components
- GIS – To show where, precisely, the event took place and which region of it is affected
- OMS – Sounds an alarm that informs the operator of the event
- CIS – Provides the information on the utility"s website, so that customers can find out for themselves why they have no power or how long it will take to rectify the damage
- WMS – Creates a work order with the GIS data detailing where the small transformer substation is for the people who are replacing the transformer

There are, indeed, already regions in which the above-described scenario is a reality. However, due to the extremely high number of elements, the lack of a telecontrol infrastructure and the lack of centralized systems, it is not yet the case that medium voltage networks are monitored in such a way in many parts of the world.

The role of smart meters in monitoring

Further assistance for the monitoring of distribution grids comes from the power customers themselves (such as households). With the smart meters (intelligent electricity meters), not only is the consumption of energy monitored and reported to the electricity supply company, it is also possible to identify an outage via the smart meters and to report this to the electricity supply company. This power outage notification can contribute significantly to the quality of supply from an electricity supply company because power outages are detected immediately and not discovered only once angry customers ring up the electricity supply company to report the incident. In some countries, these smart meters have already been implemented throughout the grid (such as in Italy); smart meters have been introduced in isolated regions in some countries on a trial basis and smart meters do not (yet) exist in some countries. However, the trend is generally moving towards smart meters because electricity supply companies wish to equip themselves for the future.
This is because, in addition to measuring energy consumption and establishing the consumption of energy, smart meters can do more. Because more and more households are generating electricity themselves (by means of solar equipment, for example), smart meters must be able to take this supply of electricity into account. In doing so, the smart meters are able to illustrate whole pricing models in relation to time of day or season in order to calculate not only the costs for consumption but also the yield from the household‟s own electricity generation.
If, for example, there will be electric cars in the garages of the homes of the future, the rechargeable batteries of the car can serve as energy storage. The drawing of energy from the rechargeable batteries of the cars cannot be controlled using the meters that electricity supply companies currently use. It is, therefore, necessary to use smart meters for such purposes.

Smart grid communication

The element of smart meter technology that is absolutely critical is communication. A smart meter must be able to communicate with its central control unit reliably and safely. There are different approaches for this; such as WLAN, UMTS, satellite or PLC (Power Line Communication). There will not be one single suitable solution. A smart meter in a remote region with a bad cable infrastructure will communicate differently to a smart meter in a metropolis with a very well developed infrastructure. Therefore, a mix of different technologies will be required. However, the trend is moving towards TCP/IP based communication.
The path to a fully completed smart grid remains a long one - and may never be fully completed, due to constantly changing requirements in relation to climate change, mobility and technology. This makes it all the more important to focus on „future-proofing" technology as far as possible.

Smart grid and SCADA

We know that the Smart Grid will create an immense amount of data that will have to be received, pre-processed and forwarded by systems such as a SCADA system. COPA-DATA is aware of this requirement and will continue to innovate in the field of protocol implementation and the handling of large amounts of data.
If you would like to know more about intelligent electricity grids, zenon as a distributor of communications or zenon Energy Edition, visit our website at www.copadata.com/energy or write to energy@copadata.com.