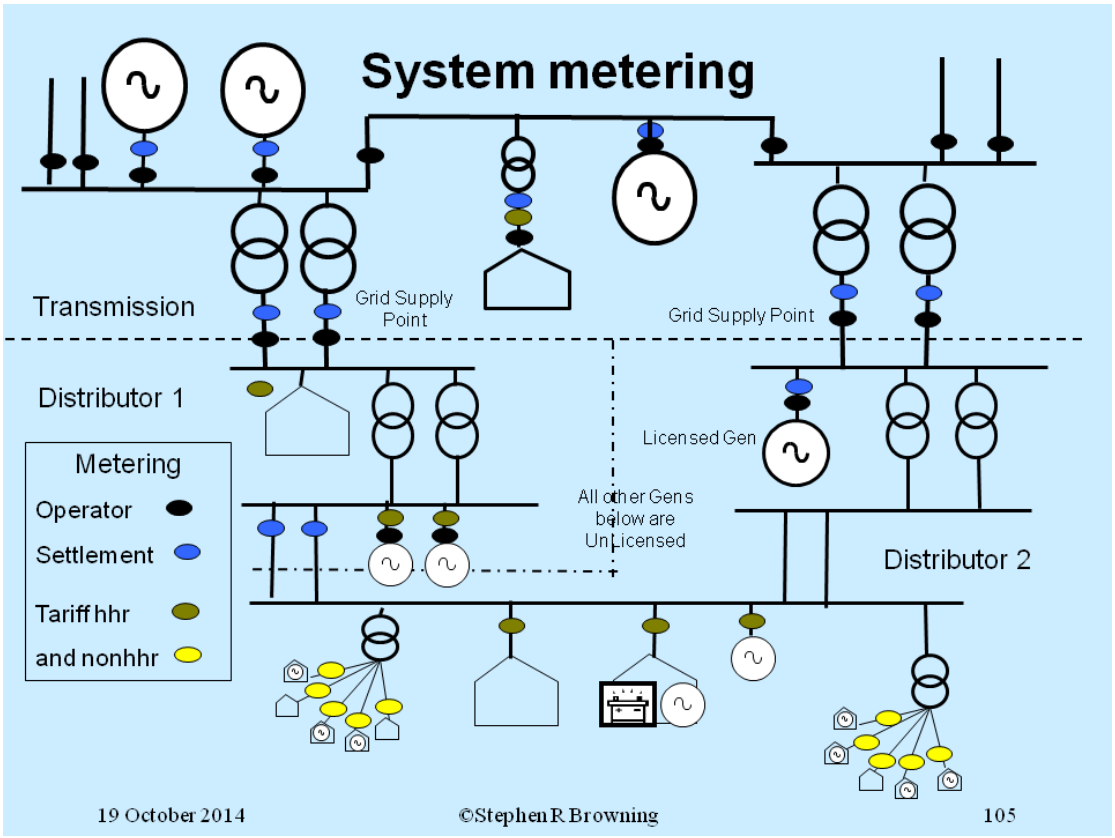
# Future Power Systems 16 - Data Structure, Metering and Settlement

We now need to explore the requirements for the content of different types of messages used between the customer premises and the industry.

We have already said that an IP protocol communications structure is appropriate for the transport of this data. Because of the number of businesses involved in the data chain and the suppliers of equipment to support it, a set of standards for the structure of messages needs to be defined. This not only affects equipment in the electricity management chain, but also those control systems, such as home automation or buildings management, within which energy management is incorporated.

The data structures for the main utility communications between supply and generation and the market and the operator are well defined. These carry data on energy (market timescale) and power/response profiles (operator timescale) with trades (market) and instructions (operator) to adjust same so that demand matches generation to an acceptable tolerance in real time. However, although the same principal data requirements also exist for communication with Distributed Energy Resources (DER), different data structures are appropriate. It will necessary for the aggregation and dissemination tools to handle any translations required.

The first thing to look at is the metering data streams and their uses on the Great Britain (GB) Power System.




**Operator metering**.

The system operator uses continuous spot power metering of all the critical circuits. This covers all transmission circuits, supergrid supply transformers, main generators and interconnections. Because the power system is always in balance, summating the generation output gives the demand less that embedded generation which does not have operational metering. The operator uses the raw and calculated data in real time to monitor generation output versus instruction, also total and supply point demands with the latter used in on line system security analysis. Spot demand history is also used as a basis for demand shape prediction.

**High Level Settlement metering.**

These meters give high accuracy half hour (hhr) energy and average power on the critical tariff circuits, which comprise the supergrid supply transformers, licensed main and transmission connected generators, interconnections, and low voltage circuits connecting each geographical distribution group. The operator uses this metering as a basis for his main demand databanks, by supply point and total, used for forecasting and to support off line security analysis. The tariff and settlement systems use the data to calculate generator energy delivery by generating company

and total supplied energy within each distribution group. All this data is collected daily and held on a half hour basis. The generation company metering is compared with their contracted energy in the market plus or minus energy changes resulting from operator instructions and ancillary service delivery. The resulting difference (imbalance) between contracted+instructed and metered generation is charged or credited using prices derived from the market and system operator power matching actions

**Customer Premises - Low level tariff and settlement metering.**

Half hour Import/Export metering is installed at all premises with maximum demand in excess of 100kw and smaller users who voluntarily request it. There are approximately 100000 such meters in GB from which data is collected approximately once per month.

The remaining 25 million GB meters are simple integrating energy units - mostly Import only although Export registers are included at premises with microgeneration. Readings are collected intermittently for billing purposes.

**Settlement calculation**

A half hour historic demand for every premises is calculated. Each non half hour metered site has a base profile set with a 24 hour curve for each day type (Summer/Winter/Spring/Autumn Weekday/Weekend) assigned, depending on the type of demand (domestic with or without overnight storage heating or commercial by load factor). For each half hour the individual profiled premises demands are summated within each distribution group and then ratioed to meet the total group demand from the high level meter summations less the total demand at all half hourly metered sites in the group. The resultant individual metered demands are then aggregated by supplier, by group and GB total, to give that supplier's total half hourly demand met. That demand is then compared with the supplier's contracted energy purchases for the half hour and the difference (imbalance) charged or credited using prices derived from the market and system operator power matching actions. The supplier metered demands are adjusted as low level non half hour meters are read.

Note that the imbalance charges/credits are the incentive to ensure that the suppliers and generators contract energy accurately on a half hour basis. The market operates down to 1.5 hours ahead in GB with the operator only having sole control from real time up to that boundary.

There is fundamental issue as regards microgeneration in non half hour metered premises. The profiling mechanism assumes that all premises of one type will have an 'average' demand which matches the day type profile. However, microgeneration doe not follow the same driver patterns as demand and it is impossible to produce a profile.

In addition, some incentive schemes for renewable generation, including Renewable Option Certificates in GB, need measurement of gross generated energy, not just net premises import/export.

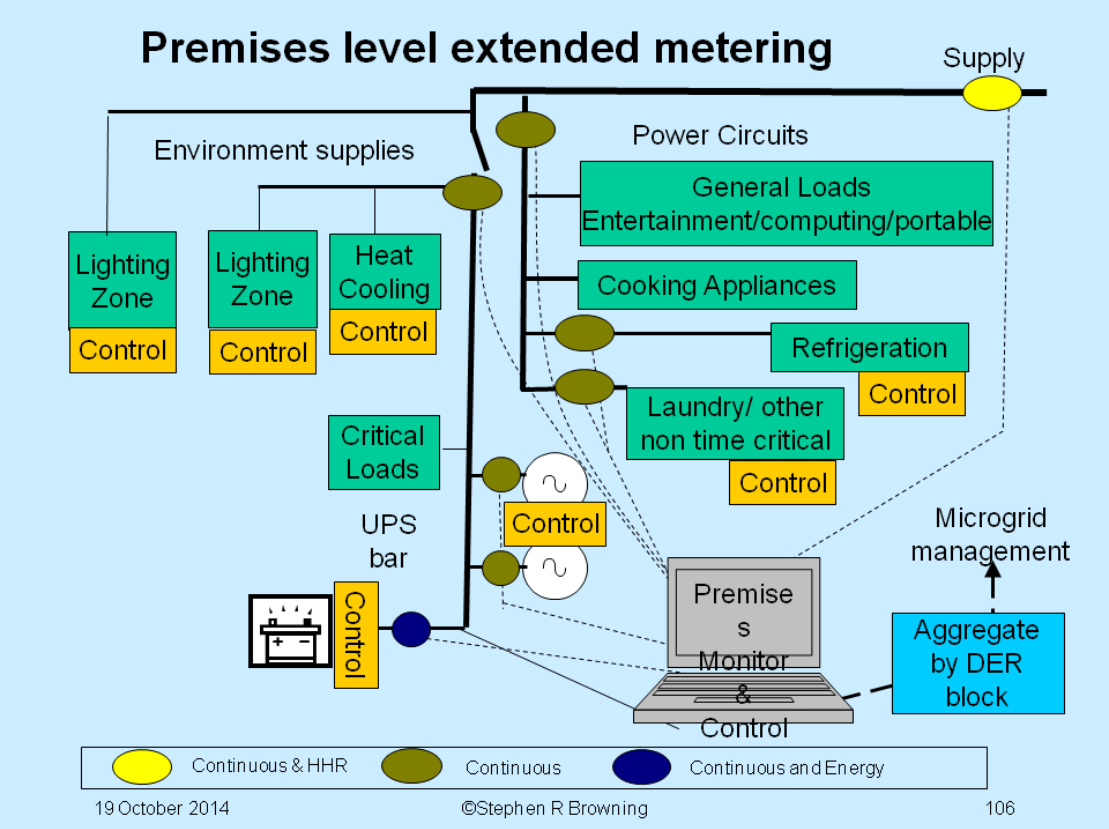
Some Premises are participating in demand management activity, either within market timescales (scheduling of non time critical blocks of demand) or in operator timescales (short notice, short duration interruption of demand). These will also not follow the preset profile for the period of the demand management action.

## Use of System Charging

In the UK, Transmission, Distribution and Balancing services Use of System charges are a fixed annual levy on the Suppliers and Generator Owners. For demand, it is based on supplier (wholesale) take at the three chargeable (Triad) system peaks; each Peak must be at least 10 days away from the others. The retail customer is billed via the supplier; they don't see the UoS element explicitly unless the tariff has a Standing Charge (p/day) separate from the Energy rate (p/kWh). Otherwise the UoS is recovered as a p/kWh figure rolled into the Energy charge. Thus the wires charges are correctly defined as an infrastructure (capacity overhead) charge, not as an energy based component.

## Smart Metering

A prerequisite to enable the execution of premises power management actions, except where triggered solely by frequency, is the establishment of a two way communication mechanism with the industry systems. As part of the intelligent premises control facilities, discrete metering of premises Distributed Energy (DER) elements; generation, demand and storage is required on a time period basis. This is needed to quantify and reward customer action, as instructed or requested by new tariff and trading mechanisms.




Although the number of meter points and the use of continuous metering appear extensive, it is appropriate for real time automatic monitoring of discrete resources and monitoring of control action responses to external signals. Indeed, home automation already makes more extensive use of sensors and controls than this metering system requires.

The enhanced metering, aggregated to allow simple half hour recording of DER elements, can then be signaled to external systems to give a more accurate record of the premises import/export, demand, storage and generation elements. This will assist with system operator, market and settlement processes and also enable the microgrid control systems and the distribution operator to monitor states and capabilities of distributed resources connected to the lower voltage network, as flow patterns become more volatile.

What we can also do with Smart metering is to separate Use Of System charges for infrastructure based on Peak Power use (see FPS5) from Energy charges on a p/kWh basis. This will more correctly signal all apportion the cost of instantaneous Power consumption and influence users to smooth their Power profiles.