Claims

What is claimed is:

1. A system for discovering relationships between meters in an electrical power distribution system, comprising:

a plurality of meters connected to the electrical power distribution system via a substation and deployed at different geographical locations, wherein the plurality of meters are communicatively connected through a communication network, each meter of the plurality of meters is configured for generating and transmitting data samples obtained at the meter;

a correlator which is one of the plurality of meters and configured for:

receiving the data samples from other meters of the plurality of meters;

calculating correlations between the plurality of meters based on the data samples received from the other meters of the plurality of meters; and

transmitting the calculated correlations through the communication network; and

a mapper communicatively connected to the plurality of meters through the communication network and configured for:

receiving the calculated correlations from the correlator through the communication network; and

determining the relationships between at least the plurality of meters based on the calculated correlations, wherein the relationships between two meters comprises one or more of an electrical connectivity relationship between the two meters indicating connections of the two meters to transformers or a phase relationship between the two meters indicating connections of the two meters to phases of the electrical power distribution system, and wherein the relationships are utilized to balance load on different phases, wherein the mapper is a meter.

2. The system of claim 1, wherein

the correlator is further configured for:

determining that a condition for collecting data samples from the plurality of meters has occurred; and

responsive to determining that the condition has been met, sending a request for data samples to the plurality of meters; and

each meter of the plurality of meters is further configured for:

receiving the request for data samples;

processing raw sensor values sensed by the meter to generate the data samples of the meter; and

transmitting the data samples through the communication network.

3. The system of claim 2, wherein processing the raw sensor values to generate the data samples of the meter comprises averaging the raw sensor values sensed by the meter within each predetermined time interval, and wherein the data samples comprises a pre-determined number of averaged sensor values.

4. The system of claim 2, wherein the condition for collecting the data samples from the plurality of meters comprises a pre-determined time point has arrived.

5. The system of claim 2, wherein the condition for collecting the data samples from the plurality of meters comprises a difference between a first data sample obtained by the correlator and a second data sample previously obtained by the correlator is more than a threshold value of sample change.

6. The system of claim 1, wherein the correlator is further configured to calculate correlations between the correlator and the plurality of meters.

7. The system of claim 1, wherein the mapper is further configured for:

receiving the data samples of the plurality of meters and data samples of a second plurality of meters;

calculating correlations between the plurality of meters and the second plurality of meters based on the data samples of the plurality of meters and the data samples of the second plurality of meters; and

determining relationships between meters in the plurality of meters and the second plurality of meters based on the calculated correlations.

8. The system of claim 1, wherein the correlator is further configured for transmitting, through the communication network, a message identifying the correlator as a correlator, and wherein the mapper is further configured for transmitting, through the communication network, a message indicating that the mapper is a mapper.

9. The system of claim 1, wherein the data samples comprise voltage data samples.

10. A method performed by a meter for discovering relationships between a plurality of meters of an electrical power distribution system including the meter, the method comprising:

transmitting, through a local wireless network communicatively connecting the plurality of meters connected to the electrical power distribution system via a substation, a message identifying the meter as a correlator, wherein the correlator is one of the plurality of the meters;

determining that a condition for generating and transmitting data samples has been met;

transmitting, through the local wireless network, a request for data samples to other meters of the plurality of meters;

receiving the data samples from the other meters of the plurality of meters through the local wireless network;

calculating a sample correlation for each pair of meters among the plurality of meters based on the data samples received from the plurality of meters; and

causing the relationships between the plurality of meters to be determined by transmitting the calculated sample correlation to a mapper through the local wireless network, wherein the mapper is a meter, wherein the relationships between two meters comprises one or more of an electrical connectivity relationship between the two meters indicating connections of the two meters to transformers or a phase relationship between the two meters indicating connections of the two meters to phases of the electrical power distribution system, and wherein the relationships are utilized to balance load on different phases.

11. The method of claim 10, further comprising:

responsive to determining that the condition has been met, processing raw sensor data sensed by the meter to generate data samples of the meter.

12. The method of claim 11, wherein the data samples are generated by averaging the raw sensor data within individual time intervals to generate averaged samples, and wherein the data samples comprises a pre-determined number of the averaged samples.

13. The method of claim 10, wherein the data samples comprise voltage data samples.

14. A method performed by a mapper node for discovering relationships between a plurality of meters connected to an electrical power distribution network, the method comprising:

receiving, through a communication network communicatively connecting the plurality of meters connected to the electrical power distribution system via a substation and the mapper node, data samples from the plurality of meters;

receiving, through the communication network, a first set of correlations between a first group of meters of the plurality of meters and a second set of correlations between a second group of meters, wherein the first set of correlations is calculated by a correlator which is one of the plurality of meters in the first group of meters based on the data samples generated by other meters in the first group of meters and the second set of correlations are calculated by a correlator which is one of the plurality of meters in the second group of meters based on the data samples generated by the other meters in the second group of meters;

calculating a third set of correlations between the first group of meters of the plurality of meters and the second group of meters of the plurality of meters based on the data samples of the plurality of meters; and

determining the relationships between the plurality of meters based on the first set of correlations, the second set of correlations, and the third set of correlations, wherein the relationships between two meters comprises one or more of an electrical connectivity relationship between the two meters indicating connections of the two meters to transformers or a phase relationship between the two meters indicating connections of the

two meters to phases of the electrical power distribution system, and wherein the relationships are utilized to balance load on different phases,

wherein the mapper node is a meter.

15. The method of claim 14, further comprising transmitting, through the communication network, a message advertising the mapper node to the plurality of meters.