[0006] One or more power companies may manage the power grid, including managing faults, maintenance, and upgrades related to the power grid. However, the management of the power grid is often inefficient and costly. For example, a power company that manages the local distribution network may manage faults that may occur in the feeder circuits or on circuits, called lateral circuits, which branch from the feeder circuits. The management of the local distribution network often relies on telephone calls from consumers when an outage occurs or relies on field workers analyzing the local distribution network.

[0007] Power companies have attempted to upgrade the power grid using digital technology, sometimes called a "smart grid." For example, more intelligent meters (sometimes called "smart meters") are a type of advanced meter that identifies consumption in more detail than a conventional meter. The smart meter may then communicate that information via some network back to the local utility for monitoring and billing purposes (telemetering). While these recent advances in upgrading the power grid are beneficial, more advances are necessary. It has been reported that in the United States alone, half of generation capacity is unused, half the long distance transmission network capacity is unused, and two thirds of its local distribution is unused. Therefore, a need clearly exists to improve the management of the power grid.

BRIEF SUMMARY

[0008] A smart grid for improving the management of a power utility grid is provided. The smart grid as presently disclosed includes using sensors in various portions of the power utility grid, using communications and computing technology (such as additional bus structures) to upgrade the current electric power grid so that it can operate more efficiently and reliably and support additional services to consumers. The smart grid as presently disclosed may upgrade a traditional electricity transmission and distribution network or "grid," such as by using robust two-way communications, advanced sensors, and distributed computers (including additional intelligence in the electric power transmission and/or electricity distribution). The smart grid may further include additional functionality at a central management facility in order to manage operations, detect and correct faults, manage resources, etc.

[0008a] According to a first aspect of the present invention, there is provided a data management system for a power grid, comprising: a grid device positioned in a section of a power grid, the grid device configured to sense operational data in the section of the power grid, the operational data including at least an electrical parameter associated with the power

grid, a data storage associated with the grid device, the data storage including a plurality of memory locations and configured to store the operational data in the plurality of memory locations, the grid device further configured to communicate a link corresponding to any of the memory locations in the data storage to a central power grid controller that manages the power grid and a plurality of grid devices within the power grid; and the grid device responsive to a request to provide access to the operational data of a memory location in accordance with the corresponding link included in the request.

[0008b] According to a second aspect of the present invention, there is provided a method for data management for a power grid, the method comprising: sensing, using an electrical device positioned in a section of a power grid, operational data, including an electrical parameter in the section of the power grid; storing the operational data in a memory location of a data storage device, the data storage device associated with the electrical device and proximate to the electrical device; sending, to a central power grid controller that manages the power grid, a link to the memory location of the operational data; and responding, with the operational data, to a request that includes the link.

[0009] One example of the management system that may manage a smart grid disclosed below is the Intelligent Network Data Enterprise (hereinafter, termed INDE) Reference Architecture. The INDE Reference Architecture enables integration of intelligent or smart grids into the electric power industry (or other types of industries). Further, management of

Claim

1. An integration framework for facilitating communication with a central power grid that manages a power grid, the integration framework comprising:

a first portion of a bus for communicating operational data to the central power grid authority, the operational data comprising at least one real-time measurement of voltage, current, real power, or reactive power for at least a part of the power grid; and

a second portion of a bus for communicating event data to the central power grid authority, the second portion being separate from the first portion, the event data being distinct from and derived from the real-time measurement and comprising at least one analytical determination as to operation of the power grid based on the at least one real time measurement,

wherein the operational data is communicated via the first portion and not communicated via the second portion, and

wherein the event data is communicated via the second portion and not communicated via the first portion.

2. The integration framework of claim 1 , wherein the first portion of the bus comprises a first segment and the second portion of the bus comprises a second segment, the first and second segments being different segments on the same bus.

3. The integration framework of claim 2, further comprising at least one switch for analyzing at least a part of data received and for routing the data to one of the first segment and the second segment.

4. The integration framework of claim 2, wherein the first portion of the bus comprises a first dedicated segment dedicated exclusively to communicating the operational data; and wherein the second portion of the bus comprises a second dedicated segment dedicated exclusively to communicating the event data

5. The integration framework of claim 1, wherein the first portion of the bus comprises a first bus and the second portion of the bus comprises a second bus, and wherein the first bus is physically separate from the second bus.

6. The integration framework of claim 5, further comprising a router for analyzing at least a part of data received and for routing the data to one of the first bus and the second bus.

7. The integration framework of claim 6, wherein the router analyzes at least one header in the data to determine whether to route the data to the first bus or to the second bus.

8. The integration framework of claim 6, wherein the router is located at the central power grid authority.

9. The integration framework of claim 1, wherein the first portion of the bus further communicates non-operational data, the non-operational data comprising at least one of power quality, power reliability, asset health, and stress data.

10. The integration framework of claim 9, further comprising a third bus for communicating between the central power grid authority and a billing system, the third bus being separate from the first portion of the bus and the second portion of the bus.

11. The integration framework of claim 1, wherein the first portion of the bus is operatively connected to an operational data storage database and to at least one of an outage management system, an energy management system, and a distribution management system.

12. The integration framework of claim 11, wherein the first portion of the bus is operatively connected to the operational data storage database and to the outage management system, the energy management system, and to the distribution management system.

13. The integration framework of claim 1, wherein the second portion of the bus is operatively connected to an event log storage database and to at least one of an outage management system, an energy management system, and to a distribution management system.

14. The integration framework of claim 10, wherein the second bus is operatively connected to the event log storage database and to the outage management system, the energy management system, and to the distribution management system.

15. A method for communicating data to a central power grid that manages a power grid, the method comprising:

communicating operational data to the central power grid authority on a first portion of a bus, the operational data comprising at least one real-time measurement of voltage, current, real power, or reactive power for at least a part of the power grid, and

communicating event data to the central power grid authority on a second portion of a bus, the second portion being separate from the first portion, the event data being distinct from and derived from the real-time measurement and comprising at least one analytical determination as to operation of the power grid based on the at least one real time measurement,

wherein the operational data is communicated via the first portion and not communicated via the second portion, and

wherein the event data is communicated via the second portion and not communicated via the first portion.

16. The method of claim 15, wherein the first portion of the bus comprises a first segment and the second portion of the bus comprises a second segment, the first and second segments being different segments on the same bus.

17. The method of claim 16, wherein the first portion of the bus comprises a first dedicated segment dedicated exclusively to communicating the operational data; and wherein the second portion of the bus comprises a second dedicated segment dedicated exclusively to communicating the event data

18. The method of claim 15, wherein the first portion of the bus comprises a first bus and the second portion of the bus comprises a second bus, and wherein the first bus is physically separate from the second bus.

19. The method of claim 18, further comprising: analyzing at least a part of data received; and routing the data to one of the first bus and the second bus.

20. The method of claim 15, wherein the first portion of the bus further communicates non-operational data, the non-operational data comprising at least one of power quality, power reliability, asset health, and stress data.

21. A data management system for a power grid, the power grid comprising a central power grid authority for managing the power grid and a plurality of devices within the power grid, the data management system comprising:

data storage associated with a device positioned in a section of the grid, the data storage being proximate to the device, the device sensing an electrical parameter in the section of the grid, the data storage comprising a plurality of memory locations for storing the sensed electrical parameter; and

a central data storage associated with the central power grid authority, wherein the central data storage comprises links to the memory locations in the data storage.

22. The data management system of claim 21 , wherein the device within the power grid comprises a substation.

23. The data management system of claim 22, wherein the data storage associated with the substation comprises a memory that is located in or on the substation.

24. The data management system of claim 22, wherein the substation sends the link to the central power grid authority; and wherein the central power grid authority stores the link in the central data storage.

25. The data management system of claim 24, wherein the central power grid authority accesses the link in the central data storage;

wherein the central power grid authority sends a request to the substation requesting data associated with the link; and wherein the central power grid authority receives a response from the substation comprising the data associated with the link.

26. The data management system of claim 24, wherein the substation further sends at least one header associated with the link; and wherein the central power grid authority comprises:

a first portion of a bus for communicating operational data to the central power grid authority, the operational data comprising at least one real-time measurement of voltage, current, real power, or reactive power for at least a part of the power grid; and

a second portion of a bus for communicating event data to the central power grid authority, the second portion being separate from the first portion, the event data being distinct from and derived from the real-time measurement and comprising at least one analytical determination as to operation of the power grid based on the at least one real time measurement,

wherein the operational data is communicated via the first portion and not communicated via the second portion, and

wherein the event data is communicated via the second portion and not communicated via the first portion.

27. The data management system of claim 21, wherein data is stored in the memory location in the data storage; wherein the central data storage stores the link to the memory location in the data storage and does not store the data stored in the memory location.

28. The data management system of claim 21, wherein the at least one of the plurality of devices within the power grid comprises a meter at a customer premises.

29. A power grid management system for managing a power grid, the power grid comprising a plurality of grid devices, the power grid management system comprising:

a central power grid authority for managing the power grid; a first grid device positioned in a first section of the grid, the first device comprising: a first sensor for sensing an electrical parameter in the first section of the grid;

a first processor for analyzing the sensed electrical parameter in the first section of the grid and determining an event based on the sensed electrical parameter, and a second grid device positioned in a second section of the grid, the second device comprising: a second processor for receiving the event determined by the first grid device, for modifying at least a section of the grid comprising the second section based on the event, and for transmitting to the central power grid authority information indicative of the modification of the at least a section of the grid.

30. The power grid management system of claim 29, wherein the second grid device modifies the section of the power grid without intervention of the central power grid authority.

31. The power grid management system of claim 29, wherein the second grid device comprises a substation.

32. The power grid management system of claim 31 , wherein at least one feeder circuit emanates from the substation; and wherein the first sensor of the first grid device senses the electrical parameter for at least a part of the feeder circuit.

33. The power grid management system of claim 32, wherein the second grid device further comprises a second sensor for sensing an electrical parameter in the second section of the grid; and wherein the second processor analyzes the event determined by the first grid device and the sensed electrical parameter in the second section of the grid in order to modify the at least a section of the grid.

34. The power grid management system of claim 33, wherein the substation further comprises data storage associated with and proximate to the substation, the data storage

comprising a plurality of memory locations for storing the sensed electrical parameter in the second section of the grid.

35. A method for data management system for a power grid, the power grid comprising a central power grid authority for managing the power grid and a plurality of devices within the power grid, the method comprising:

sensing, using an electrical device positioned in a section of the grid, an electrical parameter in the section of the grid;

storing the sensed electrical parameter in a memory location of a data storage device, the data storage device associated with the electrical device and proximate to the device;

sending to a central data storage associated with the central power grid authority the memory location of the data storage device.

36. The method of claim 35, wherein the device within the power grid comprises a substation.

37. The method of claim 36, wherein the data storage associated with the substation comprises a memory that is located in or on the substation.

38. The method of claim 36, wherein the substation sends the link to the central power grid authority; and wherein the central power grid authority stores the link in the central data storage.

39. The method of claim 38, wherein the central power grid authority accesses the link in the central data storage;

wherein the central power grid authority sends a request to the substation requesting data associated with the link; and

wherein the central power grid authority receives a response from the substation comprising the data associated with the link.

Claims:

1. A data management system for a power grid, comprising:

a grid device positioned in a section of a power grid, the grid device configured to sense operational data in the section of the power grid, the operational data including at least an electrical parameter associated with the power grid,

a data storage associated with the grid device, the data storage including a plurality of memory locations and configured to store the operational data in the plurality of memory locations,

the grid device further configured to communicate a link corresponding to any of the memory locations in the data storage to a central power grid controller that manages the power grid and a plurality of grid devices within the power grid; and

the grid device responsive to a request to provide access to the operational data of a memory location in accordance with the corresponding link included in the request.

2. The data management system according to claim 1, wherein the grid device is configured to receive the request from the central power grid controller for data stored in the memory locations associated with the link; and the grid device further configured to respond to the request by transmission to the central power grid controller of the data stored in the memory locations associated with the link.

3. The data management system according to claim 1, wherein the grid device is a first grid device, the first grid device configured to query the central power grid controller for a link associated with a second grid device included within the power grid.

4. The data management system according to claim 3, wherein the first grid device is further configured to use the link received from the central power grid controller in response to the query to access operational data sensed by the second grid device.

5. The data management system according to claim 1, wherein the grid device further comprises a processor configured to communicate with the data storage associated with the grid

device, the processor further configured to analyze the operational data to determine at least one analytical determination of the operation of the power grid.

6. The data management system according to claim 5, wherein the data storage is further configured to store the at least one analytical determination in a memory location included among the plurality of memory locations and the link corresponding to any of the memory locations includes the memory location of the at least one analytical determination.

7. The data management system according to one of claim 5 or claim 6, wherein the at least one analytical determination by the grid device comprises a prediction of a potential fault.

8. The data management system according to one of claim 5 or claim 6, wherein the at least one analytical determination by the grid device comprises a determination of a past fault or a present fault.

9. The data management system according to claim 1, wherein the central power grid controller is configured to store the link in a central data storage associated with the central power grid controller.

10. The data management system according to claim 9, wherein the central data store is configured to store the link and does not store data stored in the memory location.

11. The data management system according to any one of the preceding claims, wherein the grid device within the power grid includes a substation, and the data storage associated with the grid device includes a memory located in or on the substation.

12. The data management system according to any one of the preceding claims, wherein the grid device within the power grid includes a feeder circuit.

13. The data management system according to any one of the preceding claims, wherein the section of the power grid is operable at a voltage less than 23K Volts.

14. The data management system according to any one of the preceding claims, wherein the grid devices within the power grid comprises a meter at a customer premises.

15. A method for data management for a power grid, the method comprising:

sensing, using an electrical device positioned in a section of a power grid, operational data, including an electrical parameter in the section of the power grid;

storing the operational data in a memory location of a data storage device, the data storage device associated with the electrical device and proximate to the electrical device;

sending, to a central power grid controller that manages the power grid, a link to the memory location of the operational data; and

responding, with the operational data, to a request that includes the link.

16. The method of claim 15, wherein the request for the operational data associated with the link is received from the central power grid controller.

17. The method of claim 15, wherein the electrical device is a first electrical device, and the request that includes the link is received from a second electrical device included in the power grid.

18. The method of claim 15, wherein the link is a first link and the method further comprising the step of analyzing, using a processor, the operational data to make at least one analytical determination of the operation of the power grid; the storing step further comprises storing the at least one analytical determination in a memory location of the storage device; and the sending step further comprises sending, to the central power grid controller, a second link indicative of the memory location of the at least one analytical determination.

19. The method as in any of claims 15 - 18 wherein the step of sensing, using the electrical device positioned in a section of a power grid comprises sensing operational data of a substation.

20. The method as in any of claims 15 - 18, wherein the step of sensing, using the electrical device positioned in a section of a power grid comprises sensing operational data of a feeder circuit.