other, and the system may be upgraded, altered, reworked, or revamped, in a modular fashion, without having to redesign the underlying data acquisition system—either existing legacy systems or a new smart module-based system.

The use of the Smart Module Coordinator allows data from a number of different sensors A, B, C, and D, to be combined into one data payload and uploaded to satellite **480**. Alternatively, each of Smart End Devices **410**, **420**, **430**, and **440** may communicate directly with satellite **480**, without the need for Smart Module Coordinator **450**. However, such a configuration may run the risk of different Smart End Devices **410**, **420**, **430**, and **440** trying to transmit at the same time, and thus interfering with each other's data signals. In such an event, built-in satellite communications protocols may handle retries of data transmission. Note that the embodiment of FIG. **4** is exemplary only and not limiting in the number and arrangement of configurations. For example, one of Smart End Devices **410**, **420**, **430**, and **440** may be designated as a Smart Module Coordinator—logging data from a sensor and also receiving data from its fellow Smart Modules. If the Smart Module Coordinator fails, another of the Smart End Devices may be programmed to take over the Smart Module Coordinator duties, thus enhancing the robustness of the overall system.

Smart End Devices **410**, **420**, **430**, and **440** may be constructed along the lines of FIG. **2**, or may be modified by deleting the 9602 Iridium modem **160** and L-band antenna **110** (a neutered Smart End Device). The Smart End Device may then log data from an attached sensor and then communicate this data in serial form via XBee interface **280** or via wired serial interface through wet plug **145**. Smart Coordinator **450** may be provided, in one embodiment, without sensor interface through wet plug **145**, and receive data from Smart End Devices **410**, **420**, **430**, and **440** via wired or wireless interface. Smart Coordinator **450** may then package this data and upload it via 9602 Iridium Modem **160** and L-band antenna **110**.

However, in the preferred embodiment, all of the smart modules of FIG. **4** may have identical or similar electrical configurations so that they may be programmed and interchanged in the field, thus reducing inventory requirements and reduce costs through economies of scale. Smart modules may be provided with similar or identical hardware, and then programmed in the field to act as Smart End Devices (logging data from sensors) and Smart Coordinators (accumulating data from Smart End Devices) and uploading the data via satellite. In this manner, the inventory of different device types is reduced, and redundant capabilities are provided in the field. If one smart module fails in whole or in part, another module may be configured, even remotely, to take over chores of the failed module, even by remote configuration.

A battery backup in the form of four (4) 9-volt batteries **150** or other battery types (e.g., rechargeable lithium-ion batteries, D-cell batteries, or the like) may be provided within the smart module enclosure **130**. This battery backup may be used to provide Compact Position Reporting. In the event of a power failure on a data buoy or other data acquisition device (or other application) the battery backup **150** may be used to power the device, which may then upload the current GPS position from GPS receiver **270**, via 9602 Iridium modem **160**, so that the device may be tracked. When processor **240** detects a sustained power failure from power conditioning circuit **230**, the device may go into Compact Position Reporting mode. In this mode, sensor data logging may be discontinued, and an error or alarm message may be transmitted, periodically, along with GPS position data. The battery backup **150** may be capable of delivering uninterrupted service of up to two years with two reports per day, allowing more than sufficient time for service personnel to locate and service the device.

The present invention provides a stand-alone smart sensor module, which may be implemented to a data buoy or other data-logging device, without the need to reconfigure the data logging device or buoy to add additional sensor capabilities. The present invention provides a compact and easy-to-install module that stands alone from existing data acquisition systems, and thus requires no interface to existing data acquisition systems. It is compact, lightweight, and inexpensive enough, such that each new sensor may be provided with its own smart module, thus eliminating the need to reprogram existing data logging systems when new sensors are added. A number of other applications are also possible.

The Smart Sensor Module may be reused and modified for other purposes, in addition to its use as interface for an analog sensor. It may be used as a wireless coordinator to other Smart Module interfaced devices or used for higher level processing, like the development underway with the aforementioned AIRMAR PB200 all-in-one sensor. Thus the "sensor" part of the name may be dropped to just "Smart Module", or SM. From a building block standpoint, one can modify the firmware to accomplish a different task or processing need. Modifying the firmware is simplified from two standpoints. One, it uses an RTOS which makes timing matters much easier. Second, the application can be very specific and not as complex as the usual NDBC payload. Thus the required programming and testing is much less complex and time consuming.

Referring to FIG. **4**, on-demand station data retrieval may be provided in one embodiment of the present invention. With code to interface smart end devices **410**, **420**, **430**, and **440** and a wireless smart module coordinator **450** connected to a payload, a data acquisition operator may request missed transmissions from a payload. Such an embodiment may increase availability and allow for retrieving data reports from storms that were missed onshore. The smart module coordinator may routinely acquire a payload message and store it. Then, upon request from the data center, the smart module coordinator may send back whichever message the data center desired through the Iridium modem. The smart module coordinator may also provide the GPS (time & position) and telemetry. The smart module coordinator with wireless capability may collect messages from any smart module end device and report them back to shore and be controlled by shore operators.

The smart module of the present invention may also be used as a standalone basic weather reporting system, known as the Smart Weather Station (SWS). The smart module may be interfaced with an all-in-one weather sensor (providing basic weather data, such as wind speed, wind direction, temperature, dew point, and the like) and a small power system to make a small, inexpensive, portable basic weather station. Such a weather station may be useful where a service visit to a non-reporting station occurs and discovers severe mast damage that cannot be fixed at sea or at a land location. The standalone weather system may be installed to acquire positioning and some basic level of weather data. Such an all-in-one weather system may be less expensive to deploy, as it is based on the standard smart module, thus reducing inventory costs and taking advantage of lower construction costs through large-scale production.

There has been a long desire to be able to quickly install a small basic weather station package in the field when damaged or inoperative weather buoys are encountered. The smart module of the present invention makes this a real possibility. The smart module may be interfaced with an AIR-