US 20080258909A1

(19) **United States**

(12) **Patent Application Publication**

(10) **Pub. No.: US 2008/0258909 A1**

(43) **Pub. Date: Oct. 23, 2008**

Meyer et al.

(54) **METHODS AND SYSTEMS FOR AUTOMATED DATA MANAGEMENT**

(76) Inventors: **Brian Nedward Meyer**, Fairview, PA (US); **Joel Burlingham**, Erie, PA (US); **Daniel Ballesty**, Wattsburg, PA (US); **David Joseph Schroeck**, Erie, PA (US)

Correspondence Address:
JOHN S. BEULICK (12729)
C/O ARMSTRONG TEASDALE LLP
ONE METROPOLITAN SQUARE, SUITE 2600
ST. LOUIS, MO 63102-2740 (US)

(21) Appl. No.: **11/736,889**

(22) Filed: **Apr. 18, 2007**

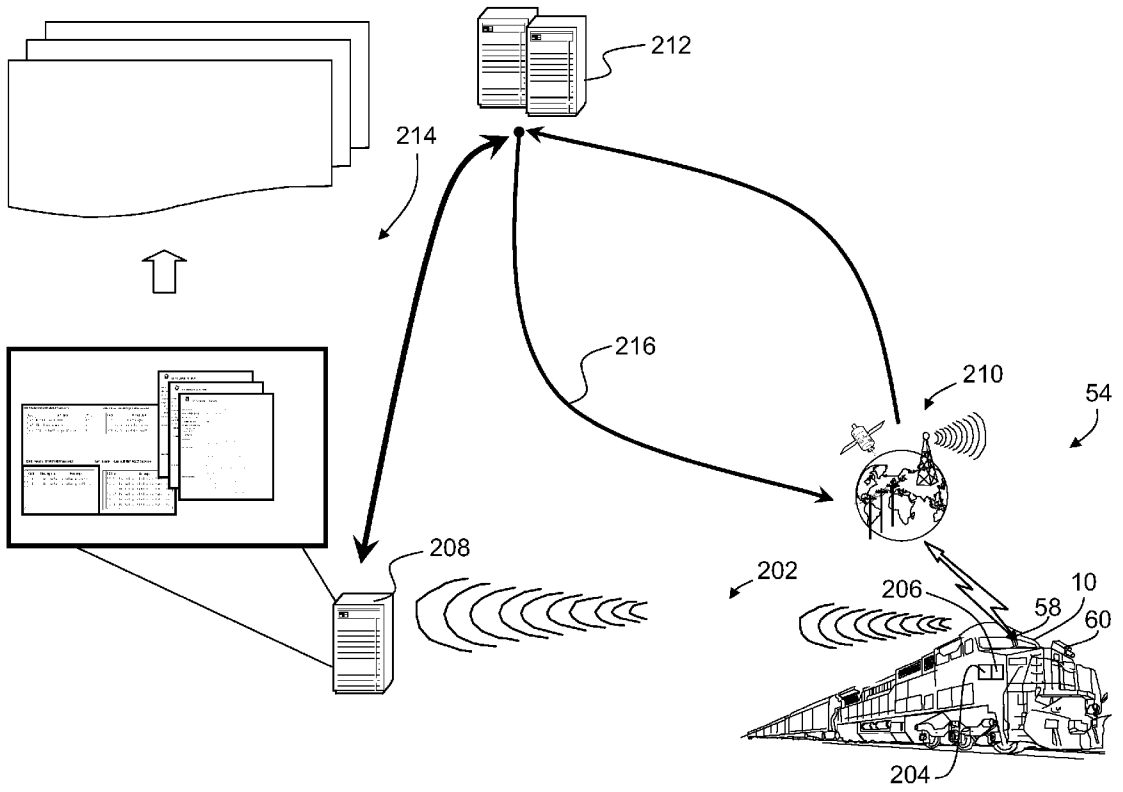
Publication Classification

(51) **Int. Cl.**
B61L 1/00 (2006.01)

(52) **U.S. Cl.** **340/539.25**; 340/901

(57) **ABSTRACT**

Methods and systems for preserving content in a data recorder are provided. The method includes acquiring at least one of image data and audio data relative to an environment in a vicinity of a camera, receiving a data preservation request, and stamping the at least one of image data and audio data for future download using the data preservation request.



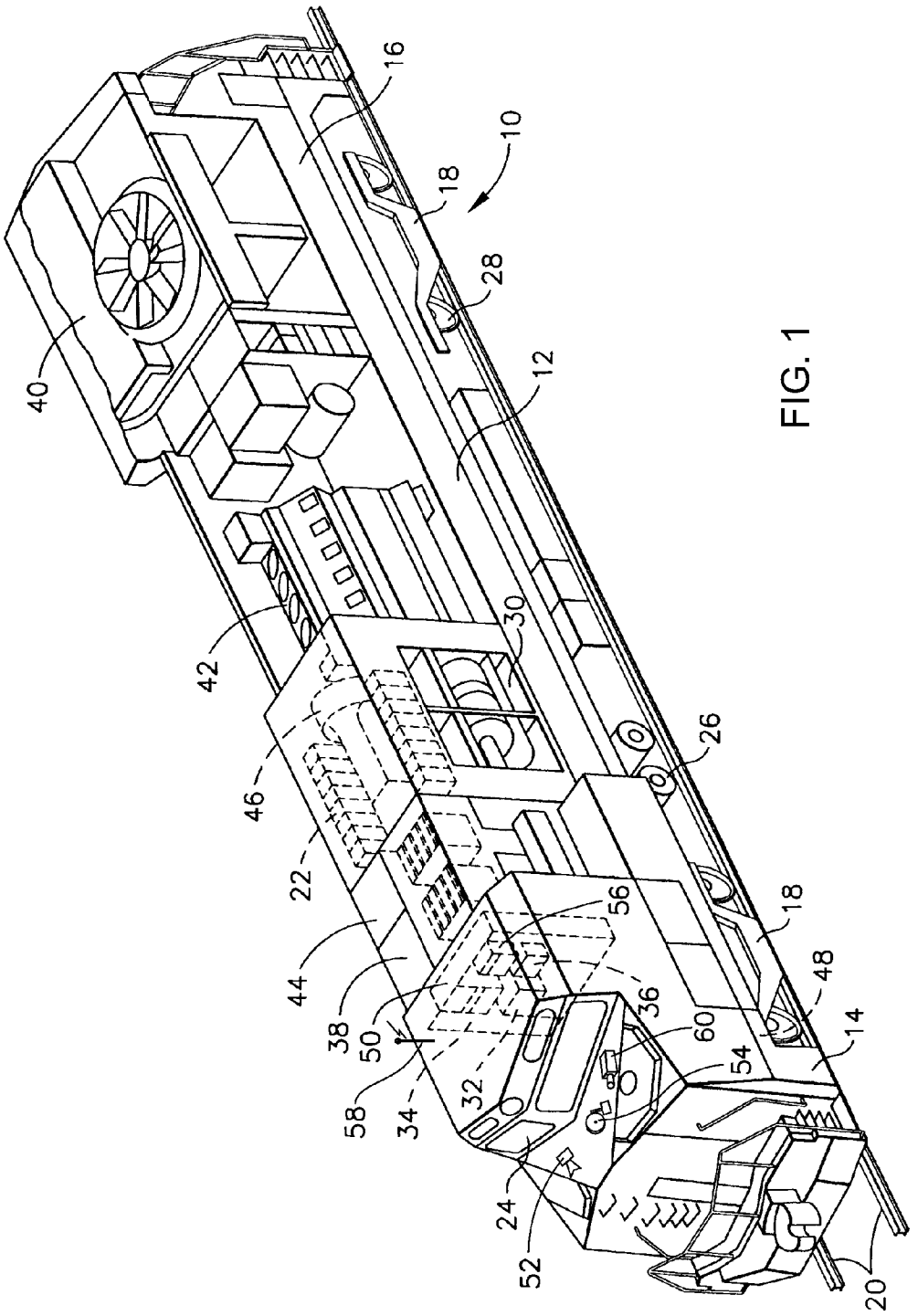

10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
50
52
54
56
58
60

FIG. 1

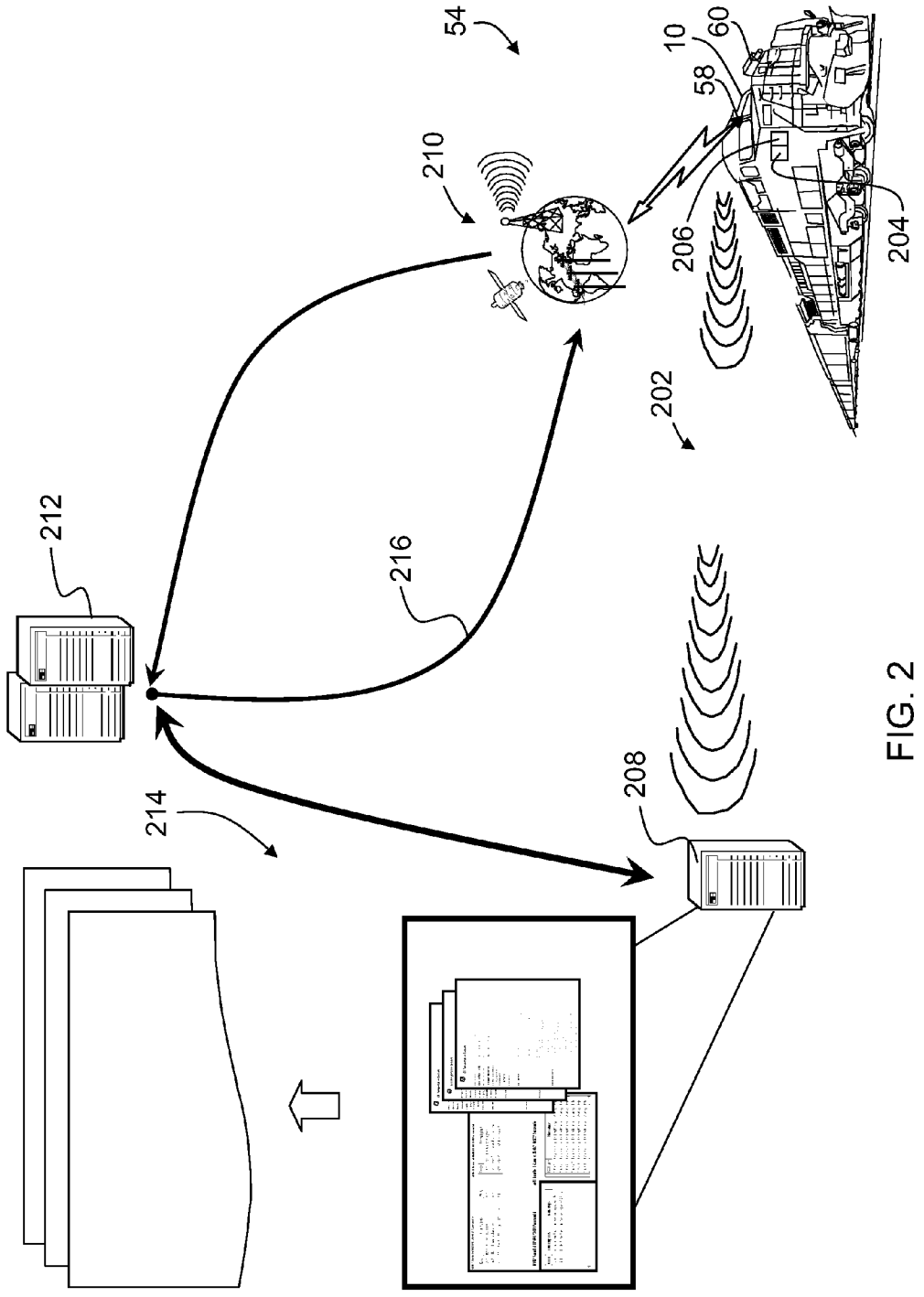


FIG. 2

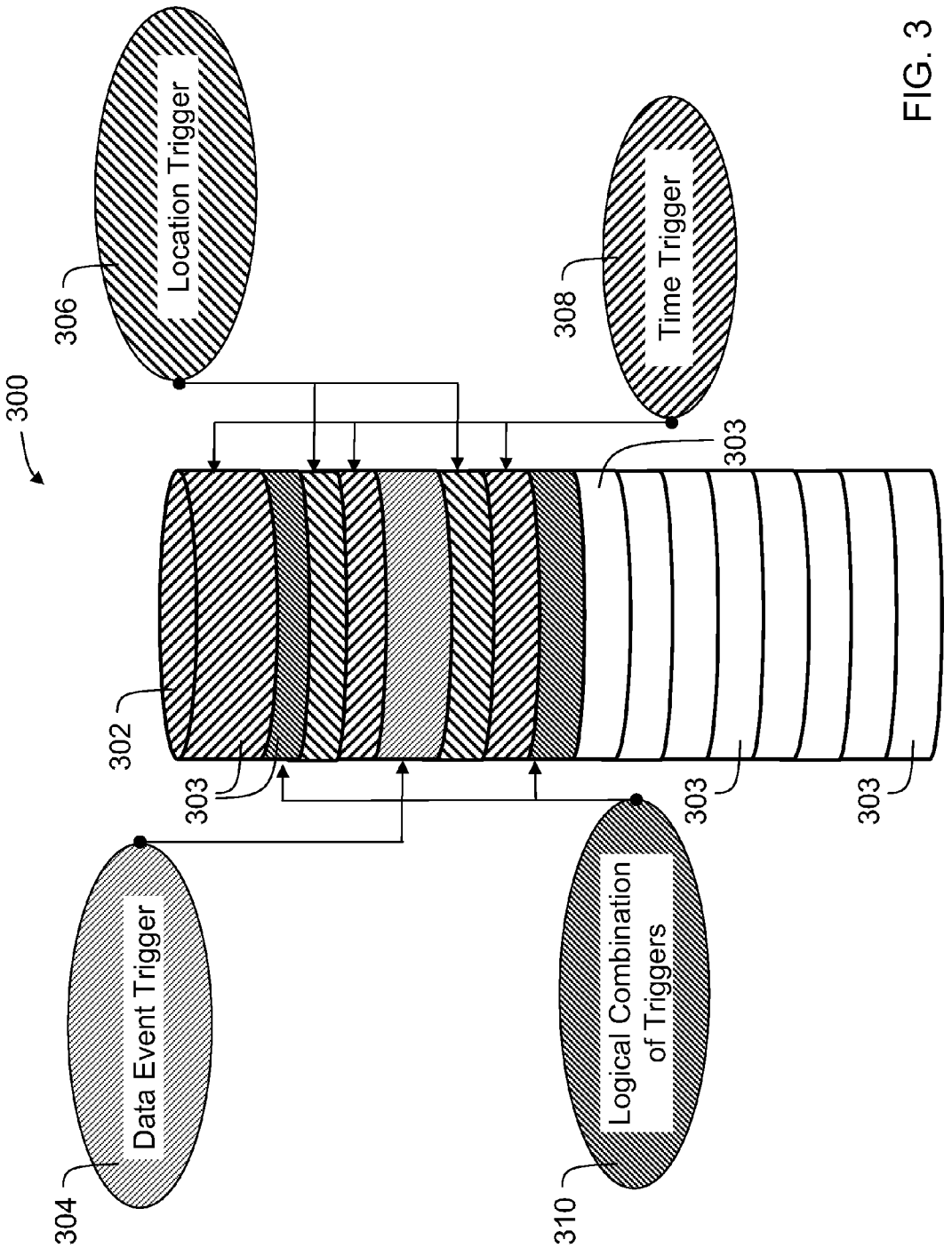

300
306
Location Trigger
308
Time Trigger
303
302
303
303
303
304
Data Event Trigger
310
Logical Combination of Triggers

FIG. 3

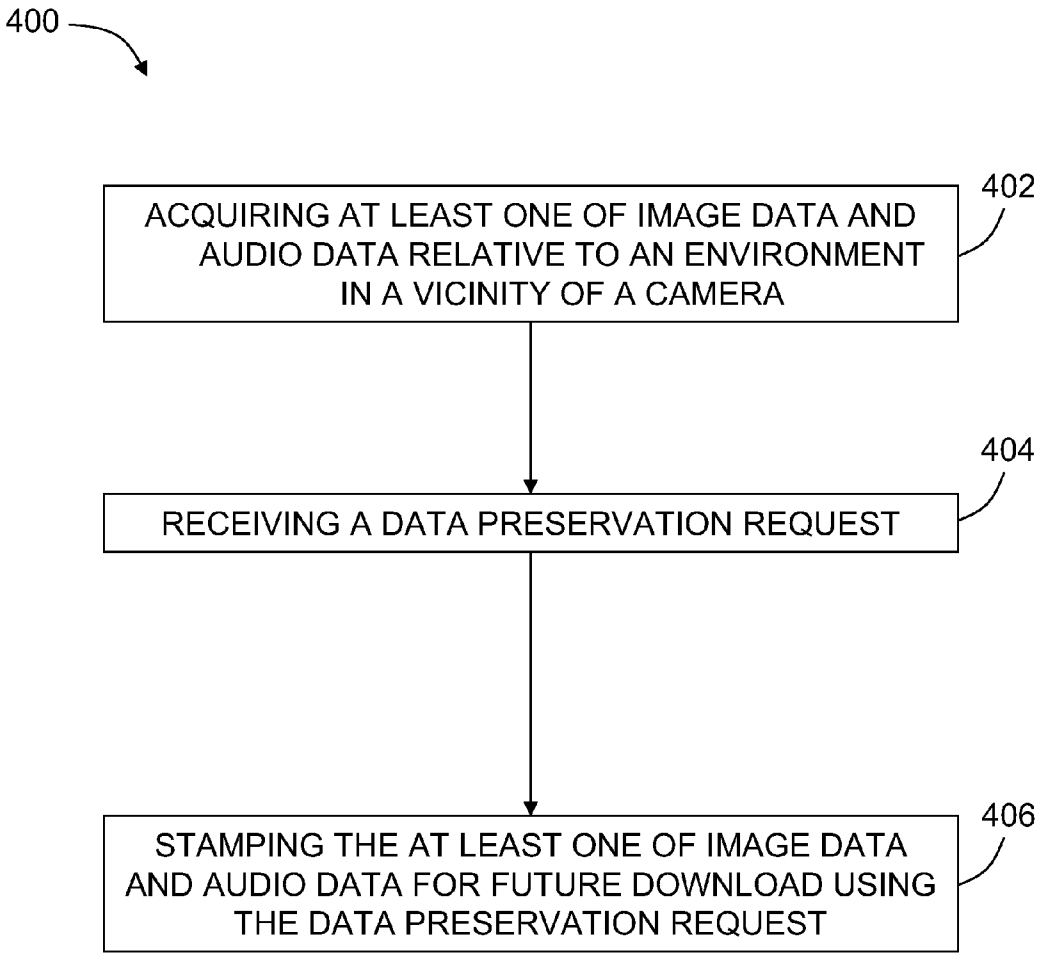

400
ACQUIRING AT LEAST ONE OF IMAGE DATA AND AUDIO DATA RELATIVE TO AN ENVIRONMENT IN A VICINITY OF A CAMERA
402
RECEIVING A DATA PRESERVATION REQUEST
404
STAMPING THE AT LEAST ONE OF IMAGE DATA AND AUDIO DATA FOR FUTURE DOWNLOAD USING THE DATA PRESERVATION REQUEST
406

FIG. 4

METHODS AND SYSTEMS FOR AUTOMATED DATA MANAGEMENT

BACKGROUND OF THE INVENTION

[0001] This invention relates generally to automated data management systems, and more particularly, to systems and methods for recording image, audio, and sensor data and managing the data for future use.

[0002] At least some known video recorders acquire image data for extended periods of time and cyclically recycle the image data storage media for reuse in a loop configuration. More recently video recorders rely on digital storage to store images and compressed video files. Such data may be time stamped and retrieved at a later time using the timestamps as an indication of the location of the data of interest on the storage media. Some known video recorders operate in areas where downloading opportunities are limited and with large amounts of data to download, operator intervention to ensure data of interest is not overwritten and subsequently lost is common. Such intervention is time consuming for an operator whose time may be better spent attending to more important tasks. Additionally, large volumes of data and limited bandwidth may prevent complete downloading of data of interest at each download opportunity. Simply pushing data in for example, a first in-first out scheme may not allow for the download of the data of interest in a time sufficient to prevent overrunning the memory buffer. Furthermore, for mobile platforms, adequate download capability may not be available at sufficient frequency to download data efficiently. As memory continues to become less expensive some of the above problems may be remedied. However, additional data transfer requirements also will obviate the gains made in memory technology.

BRIEF DESCRIPTION OF THE INVENTION

[0003] In one embodiment, a method of preserving content in a data recorder includes acquiring at least one of image data and audio data relative to an environment in a vicinity of a camera, receiving a data preservation request, and stamping the at least one of image data and audio data for future download using the data preservation request.

[0004] In another embodiment, a method recording data from a railroad locomotive includes receiving at least one of image data and audio data from at least one camera, storing the data in a first memory, stamping at least some of the image data and the audio data for preservation, and overwriting the at least one of image data and audio data not stamped for preservation with new at least one of image data and audio data received from the at least one camera.

[0005] In yet another embodiment, an automated data management system for a locomotive includes a camera mounted on the vehicle wherein the camera is configured to acquire data relating to an exterior environment of the locomotive. The system also includes at least one sensor configured to generate a signal indicative of an event relating to the operation of the vehicle. The system further includes a processor configured to receive the acquired data, at least one of generate a preservation request based on the generated signal and receive a preservation request from off-board the locomotive, and stamp the acquired data for preservation based on the preservation requests.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a partial cut away view of an exemplary locomotive;

[0007] FIG. **2** is a block diagram of an exemplary embodiment of a wireless data preservation programming and management system in accordance with an exemplary embodiment of the present invention;

[0008] FIG. **3** is a schematic block diagram of a memory subsystem for the trigger based data preservation programming and management system shown in FIG. **1**; and

[0009] FIG. **4** is a flow chart of an exemplary method of preserving content in a data recorder that may be used with system shown in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Many specific details of certain embodiments of the invention are set forth in the following description in order to provide a thorough understanding of such embodiments. One skilled in the art, however, will understand that the present invention may have additional embodiments, or that the present invention may be practiced without several of the details described in the following description.

[0011] FIG. **1** is a partial cut away view of an exemplary locomotive **10**. Locomotive **10** includes a platform **12** having a first end **14** and a second end **16**. A propulsion system **18**, or truck is coupled to platform **12** for supporting, and propelling platform **12** on a pair of rails **20**. An equipment compartment **22** and an operator cab **24** are coupled to platform **12**. An air and air brake system **26** provides compressed air to locomotive **10**, which uses the compressed air to actuate a plurality of air brakes **28** on locomotive **10** and railcars (not shown) behind it. An auxiliary alternator system **30** supplies power to all auxiliary equipment. An intra-consist communications system **32** collects, distributes, and displays consist data across all locomotives in a consist.

[0012] A cab signal system **34** links the wayside (not shown) to a train control system **36**. In particular, system **34** receives coded signals from a pair of rails **20** through track receivers (not shown) located on the front and rear of the locomotive. The information received is used to inform the locomotive operator of the speed limit and operating mode. A distributed power control system **38** enables remote control capability of multiple locomotive consists coupled in the train. System **38** also provides for control of tractive power in motoring and braking, as well as air brake control.

[0013] An engine cooling system **40** enables engine **42** and other components to reject heat to cooling water. In addition, system **40** facilitates minimizing engine thermal cycling by maintaining an optimal engine temperature throughout the load range, and facilitates preventing overheating in tunnels. An equipment ventilation system **44** provides cooling to locomotive **10** equipment.

[0014] A traction alternator system **46** converts mechanical power to electrical power which is then provided to propulsion system **18**. Propulsion system **18** enables locomotive **10** to move and includes at least one traction motor **48** and dynamic braking capability. In particular, propulsion system **18** receives power from traction alternator **46**, and through traction motors **48** moves locomotive **10**. Locomotive **10** systems are monitored by an on-board monitor (OBM) system **50**. OBM system **50** keeps track of incidents occurring in the systems with an incident log.

[0015] A signaling system includes a horn **52** and a bell **54** for signaling to persons outside of operator cab **24**. Horn **52** and bell **54** are used at specific times during transit operations, such as approaching grades or crossings to warn of the locomotives approach. A wireless data preservation programming and management system **54** is carried on-board locomotive **10**. Data preservation programming and management system **56** includes an antenna **58** configured to transmit and receive signals between locomotive **10** and off-board communications devices through for example, but not limited to a 802.11g link, a satellite link, a UHF, and/or a VHF link. Data preservation programming and management system **56** also includes a video camera **60** configured to acquire video and audio data from an external environment of locomotive **10**.

[0016] FIG. **2** is a block diagram of an exemplary embodiment of a wireless data preservation programming and management system **54** in accordance with an exemplary embodiment of the present invention. In the exemplary embodiment, system **54** may be used with locomotive **10** (shown in FIG. **1**). In other embodiments, system **54** may be used with other vehicles, mobile platforms, and/or stationary platforms. Wireless data preservation programming and management system **54** includes a wireless data download communication system **202**. In the exemplary embodiment, wireless communication system **202** includes an onboard receiver **204** and transmitter **206**. Wireless communication system **202** provides an ability to transmit data between a plurality of locomotives **10** and from locomotive **10** to an off-board processing center **208**. In an alternative embodiment, wireless communications system **202** is utilized for communication to system **54** for example, but not limited to, for diagnostics, data downloads, and uploads. Additionally, wireless communication system **202** provides an ability to receive commands and requests from off-board processing center **208**. For example commands pertaining to preservation requests, transmission protocol, channel, transmission format, transmission timer, packet size, and frequency, and combinations thereof. Moreover, data may also be retrieved from the locomotive mounted data preservation programming and management system **54** via manual (wired) interfaces and downloads to another computer or even data preservation programming and management system **54** memory removal.

[0017] Wireless communications system **202** includes multiple communications systems employed as may facilitate a particular communication or environment including, but not limited to wireless satellite communications system, a cellular communications system, radio, private networks, a Wireless Local Area Network WLAN, equivalents thereof, and combinations including the above. In an exemplary embodiment the wireless communication system **202** is used to transmit image data, audio data, environmental and operational parameter data corresponding to a selected event or events to off-board data and monitoring center **208**.

[0018] Off-board data processing center **208** interfaces with wireless communication system **202** and manages the files and commands to and from locomotives **10**. In an alternative embodiment, off-board data processing center **208** uses a multimode wireless communications system **210** to interface with on-board systems through various communications servers **212** accessible in a network hierarchy. The multimode communication system **210** may include but not be limited to a transmitter and receiver for satellite communications, radio, cellular, as well as combinations including at least one of the foregoing.

[0019] Off-board data processing center **208** processes the data received from system **54** including for example, but not limited to inventorying and storing the data. Off-board data processing center **208** also provides access security layers to data subscribers, distributes requested data to client computers **214** over a network topology, and segregates data of legal implication from data of other importance.

[0020] Off-board data processing center **208** also is used to generate preservation requests from off-board locomotive **10**. Preservation request are also generated on-board locomotive **10** based on one or more sensor inputs, combinations of sensor inputs, or combinations of sensor inputs and other signals such as time dependent signals, location dependent signals, and off-board signals. A preservation request is transmitted to system **54**, which then stamps incoming data, data that has already been acquired and stored, and/or data that has yet to be acquired for preservation. Data stamped for preservation will be held in memory until the preservation stamp is released by for example, but not limited to an expiration of a time component of the preservation request, a download of the data, or other indication that the data no long needs to be preserved. Data stamped for preservation may be stored in a first cyclical memory of system **54**, a reserved portion of the first memory, or may be stored in a second memory accessible to system **54**. System **54** is used to select specified data to be stored and/or transmitted to the off-board data processing center **208** under selectable conditions such as when the locomotive approaches or reaches a desired location, wayside signaling device, or at a specified time. Off-board data processing center **208** is also used to remotely modify the configuration of onboard communications system **202** and system **54**. A preservation request may also command system **54** to shutdown recording if, for example, data has not been able to be downloaded and memory has few memory locations available for new data. Conversely, a preservation request may command system **54** to resume recording even if data previously stamped for preservation will be overwritten. The preservation request may include instructions as to which memory locations can be overwritten if different than previously received instructions. The preservation request to stop or resume recording able to be transmitted to a single locomotive, a group including any number of locomotives, or all locomotives accessible to off-board data processing center **208**. The preservation request may include instructions defining a time period that recording is to be stopped or may secure recording until a subsequent preservation request is received.

[0021] In the exemplary embodiment, data preservation programming and management commands are transmitted from off-board data processing center **208** through wireless communication system **202** or through a multimode communications link **216** through communications servers **212** and multimode communication system **210**. Accordingly, system **54** indefinitely preserves stamped data segments from overwriting in a continuous recording system based on a data event, rather than by activating recording based on a data event.

[0022] FIG. **3** is a schematic block diagram of a memory subsystem **300** for the trigger based data preservation programming and management system **54** (shown in FIG. **1**). Memory subsystem **300** is used to facilitate downloading wireless video, audio, and other data that may be used with wireless data preservation programming and management system **54** (shown in FIG. **1**). Sub-system **300** includes a memory **302** that may include a plurality of contiguous memory locations or may include a plurality of separate memory devices that each include contiguous memory locations. Data of interest, for example, but not limited to video,

image, audio, sensor, and externally generated data, or combinations that include at least one of the above are read into memory **302** for storage. Typically the various data are read into memory as files **303** of variable length. Memory **302** is managed such that a stamp associated with the data is stored with the data or is stored separately for example, in an index or look-up table in memory **302** or in another memory. Data files that are stamped for preservation may be stored sequentially in memory **302** with other data that is not stamped, may be stored in a separate reserved area of memory **302**, or may be stored in a separate memory from memory **302**. Additionally, data that has not been received, but is anticipated to be received may also be stamped.

[0023] System **302** includes a data event trigger **304** that may be generated by an event that occurs on locomotive **10** or may be generated off-board such that data recorded from a predetermined amount of time before the event to a predetermined amount of time after the event is stamped for preservation. An event may include for example, an overspeed, a sounding of a horn, sounding of a bell, an emergency brake application, exceeding a speed threshold, a predetermined geographical location, crossing a predefined geographical perimeter, entering or leaving a predefined geographic route, a predetermined time range, a periodic scheduled time, a time of day, or a combination thereof.

[0024] System **302** also includes a location trigger **306** that is generated based on a location of for example, locomotive **10** along a track. Location trigger generates a preservation request to preserve data segments using track coordinates, global positioning system coordinates, geo-fencing, or using landmarks such as specific crossings, waypoints, and/or routes. A time trigger **308** is used to generate a preservation request based on for example, but not limited to a selectable time range, a scheduled time, and a time since a last preservation request was generated. A combination trigger **308** is a logical combination of triggers that permits more exact preservation of data based on a combination of attributes. Such stamping for very specific situations permits a potential reduction in the amount of data that eventually needs to be downloaded. The stamped data may be sorted according to a priority assigned based on attributes associated with the data or the trigger that initiated the stamping. Sorting the stamped data permits the downloading the most important data first. Sorting also permits matching an estimated time associated with downloading a stamped data segment or file to a time length of the next download availability. For example, a download rate typically is known or can be calculated for each file. Also download locations or time-based download opportunities are typically known. Accordingly, using the length of the data files and the download rate a download time can be calculated. The calculated download time can then be used to select a data file that will be completely downloaded in the available time.

[0025] FIG. **4** is a flow chart of an exemplary method **400** of preserving content in a data recorder that may be used with system **54** (shown in FIG. **1**). Method **400** includes acquiring **402** at least one of image data and audio data relative to an environment in a vicinity of a camera, **404** receiving a data preservation request, and stamping **408** the at least one of image data and audio data for future download using the data preservation request. In the exemplary embodiment, a data preservation request is generated based on an occurrence of a predetermined event. For example, a plurality of sensors is located throughout locomotive **10** to monitor the various locomotive subsystems. Actuation of a sensor or a sensor value exceeding a predetermined range may initiate a sensor signal that is used to generate a preservation request. Such sensors may monitor a sounding of a horn, a sounding of a bell, an emergency brake application, exceeding a speed threshold, a predetermined geographical location, crossing a predefined geographical perimeter, entering or leaving a predefined geographic fence, a predetermined time range, a periodic scheduled time, a time of day, or a combination that includes any of the above.

[0026] During data acquisition, receiving a preservation request may modify the operation of system **54** while data acquisition progresses without requiring a suspension of data acquisition during implementation of the instructions included in the preservation request. In the exemplary embodiment, the data preservation request is received using a wireless communication link while acquiring at least one of image data, sensor data, and audio data. Preservation requests may be broadcast to a plurality of systems **54** located over a wide area using the wireless communication link. Each preservation request may be identical or different preservation requests may be sent simultaneously to groups of systems **54** or to individual systems **54**. The wireless communication link may comprise a multi-mode capability and include a plurality of channels. In addition to a preservation request, a download request may be received. System **54** stores the acquired at least one of image data, sensor data, and/or audio data in a memory, receives a download request, and downloads the stored data in an order based on the download request. The memory may comprise a single memory, a plurality of memory devices, or a reserved area of a memory device. The data may be sorted based on a priority from the download request and downloaded in the order specified or determined based on the download request.

[0027] The foregoing description of the exemplary embodiments of the invention are described for the purposes of illustration and are not intended to be exhaustive or limiting to the precise embodiments disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not with this detailed description, but rather by the claims appended hereto.

[0028] The above-described methods and systems for preserving content in a data recorder are cost-effective and highly reliable. The system permits automatically identifying segments of acquired data to be preserved for future download to a processing center. The system permits wireless download of only data of interest that is sorted according to a determined priority. The download occurs without operator intervention and transmits the downloaded data to an off-board library accessible to a plurality of users through a network and is intelligently managed to provide a useful library of data with specific attributes. Accordingly, the methods and systems described herein facilitate operation of data recorders in a cost-effective and reliable manner.

[0029] While the invention has been described in terms of various specific embodiments, those skilled in the art will recognize that the invention can be practiced with modification within the spirit and scope of the claims.

What is claimed is:

1. A method of preserving content in a data recorder comprising:

acquiring at least one of image data and audio data relative to an environment in a vicinity of a camera;

receiving a data preservation request; and

stamping the at least one of image data and audio data for future download using the data preservation request.

2. A method in accordance with claim **1** further comprising generating a data preservation request that is indicative of a predetermined event occurring.

3. A method in accordance with claim 1 further comprising combining a plurality of sensor signals to generate the data preservation request.

4. A method in accordance with claim 1 further comprising programming the data recorder while acquiring at least one of image data and audio data.

5. A method in accordance with claim 1 further comprising receiving a data preservation request using a wireless communication link while acquiring at least one of image data and audio data.

6. A method in accordance with claim 1 further comprising programming a plurality of data recorders at different locations using a multi-mode channel wireless link while at least one of the plurality of data recorders is acquiring at least one of image data and audio data.

7. A method in accordance with claim 1 further comprising programming a plurality of processors at different locations simultaneously while at least one of the plurality of data recorders is acquiring at least one of image data and audio data.

8. A method in accordance with claim 1 further comprising programming a plurality of data recorders at different locations using at least one of an identical program segment transmitted to a plurality of the data recorders and a unique program segment transmitted to at least one of the plurality of data recorders while at least one of the plurality of processors is receiving data.

9. A method in accordance with claim 1 further comprising downloading the stamped data in response to a received download request to a database accessible through a network.

10. A method in accordance with claim 1 wherein receiving a data preservation request comprises generating a data preservation request that is indicative of at least one of sounding of a horn, sounding of a bell, an emergency brake application, exceeding a speed threshold, a predetermined geographical location, crossing a predefined geographical perimeter, entering or leaving a predefined geographic route, a predetermined time range, a periodic scheduled time, a time of day, or a combination thereof.

11. A method in accordance with claim 1 further comprising:
- storing the acquired at least one of image data and audio data in a memory;
- receiving a download request; and
- downloading the stored data in an order based on the download request.

12. A method in accordance with claim 1 further comprising storing the acquired at least one of image data and audio data in a first memory; and
- storing data stamped for preservation in at least one of a reserved area of the first memory and a second memory separate from the first memory.

13. A method in accordance with claim 1 further comprising at least one of suspending data recording based on a preservation request, resuming data recording based on a preservation request.

14. A method in accordance with claim 13 wherein suspending data recording based on a preservation request comprises suspending data recording for at least one of a time period and a trigger event specified in the preservation request.

15. A method recording data on a railroad locomotive comprising:
- receiving at least one of image data and audio data from at least one camera;
- storing the data in a first memory;
- stamping at least some of the image data and the audio data for preservation; and
- overwriting the at least one of image data and audio data not stamped for preservation with new at least one of image data and audio data received from the at least one camera.

16. A method in accordance with claim 15 further comprising:
- receiving sensor data from sensors positioned on-board the locomotive;
- storing the received sensor data in at least one of the first memory and a second memory.

17. A method in accordance with claim 15 wherein stamping at least some of the image data and the audio data for preservation for preservation comprises stamping at least some of the image data and the audio data for preservation that is anticipated to be recorded.

18. A method in accordance with claim 15 wherein stamping at least some of the received image data for preservation comprises stamping the at least one of image data and audio data using a lookup table pointing to the at least one of image data and audio data to be preserved.

19. A method in accordance with claim 15 further comprising wirelessly downloading the data stamped for preservation to an off-board database accessible through a network.

20. A method in accordance with claim 15 further comprising wirelessly downloading the data stamped for preservation to an off-board database comprises:
- receiving data from a plurality of sources through a network accessible to the off-board database;
- inventorying the received data;
- providing access security for the data; and
- segregating data according to a level of importance of the data.

21. A method in accordance with claim 15 further comprising wirelessly downloading the data stamped for preservation in a selectable chronological order.

22. A method in accordance with claim 15 further comprising at least one of suspending data recording based on a preservation request, resuming data recording based on a preservation request.

23. An automated data management system for a locomotive, the system comprising:
- a camera mounted on the vehicle, said camera configured to acquire data relating to an exterior environment of the locomotive;
- at least one sensor configured to generate a signal indicative of an event relating to the operation of the vehicle;
- a processor configured to:
  - receive the acquired data;
  - at least one of generate a preservation request based on the generated signal and receive a preservation request from off-board the locomotive; and
  - stamp the acquired data for preservation based on the preservation requests.

* * * * *