MOBILE DATA CENTER

Inventors: Barry Rimler, Rockville, CT (US); Neil Rasmussen, Concord, MA (US)

Correspondence Address:
LOWRIE, LANDO & ANASTASI
RIVERFRONT OFFICE
ONE MAIN STREET, ELEVENTH FLOOR
CAMBRIDGE, MA 02142 (US)

Assignee: American Power Conversion Corporation, West Kingston, RI

Filed: Oct. 14, 2005

Related U.S. Application Data

Provisional application No. 60/619,389, filed on Oct. 15, 2004.

Publication Classification

Int. Cl.
A47B 53/00 (2006.01)

U.S. Cl. ............................................................. 312/201

ABSTRACT

At least one version is directed to a mobile data center that includes a trailer having a length greater than a width and having an interior, the trailer being configured to be transported in a direction generally parallel to the length, and a plurality of equipment enclosures installed in the interior of the trailer to form a row, with the row being parallel to the length of the trailer, wherein the row is positioned in the interior such that a first aisle is on a front side of the row and a second aisle is on a back side of the row. The mobile data center also includes at least one cooling unit constructed and arranged to draw warm air from the second aisle and provide cool air to the first aisle to cool equipment contained in the plurality of equipment enclosures.
Fig. 8

**Diagram:**

- **120** connected to **ATS**
- **ATS** connected to equipment and systems in a data center
- **402** labeled as a generator
- Connections labeled as **184**, **186**, **188**, **190**, and **192**
MOBILE DATA CENTER

RELATED APPLICATION

[0001] This application claims priority under 35 U.S.C. § 119(e) to U.S. Provisional Application Ser. No. 60/619,389, entitled "MOBILE DATA CENTER," by B. Rimler, filed on Oct. 15, 2004, which is hereby incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a system and method for providing data center infrastructure, including power distribution, cooling and equipment mounting facilities for electronic equipment, and more specifically to methods and apparatus for providing a mobile data center solution.

BACKGROUND OF THE INVENTION

[0003] Centralized data centers for computer, communications and other electronic equipment have been in use for a number of years, and more recently, with the increasing use of the Internet, large scale data centers that provide hosting services for Internet Service Providers (ISPs), Application Service Providers (ASPs) and Internet content providers are becoming increasingly popular. Typical centralized data centers contain numerous racks of equipment that require power, cooling and connections to communications facilities. It is common in data centers to use raised flooring, beneath which power cables and communication cables may be run between racks of equipment and to facility distribution panels. In addition, it is common to use the space beneath the raised flooring as an air plenum to provide cooling to the racks of equipment. In some facilities, in place of, or in addition to the use of raised flooring, overhead cable ladders are used to route cables throughout the facility. These cable ladders are typically fastened to support members in the ceiling of the facility.

[0004] It is often desirable to operate equipment within data centers seven days a week, 24 hours per day, with little or no disruption in service. To prevent any disruption in service, it is common practice in data centers to use uninterruptible power supplies (UPSs) to ensure that the equipment within the data centers receives continuous power throughout any black out or brown out periods. Typically, data centers are equipped with a relatively large UPS at the main power distribution panel for the facility. Often, the UPS is a 480 volt 3 phase unit that is selected to have sufficient capacity to meet the power requirements for all of the equipment within the facility.

[0005] In addition to using centralized data centers, it is often desirable to provide Internet access, and other information technology services on a temporary basis at locations that otherwise have no Internet access or only limited access. For example, at major national or international sporting events, political conventions and other large gatherings, it is often critical to provide Internet and other telecommunications access for attendees of such events, and for members of the press covering such events. Further, after natural disasters, rescue workers, and insurance adjusters often have the need for mobile data centers that include their own sources of power and cooling. In addition, there is often the need at a centralized data center to provide additional capacity on a temporary basis to handle, for example, a short-term increase in need. While solutions for mobile communications and control systems have been in use by the military, other government agencies, and news organizations for some time, these systems provide solutions that are far different from typical data centers and often not compatible with standard data center equipment.

SUMMARY OF THE INVENTION

[0006] In at least one embodiment of the invention, a mobile data center solution is provided that can address mobile or short term needs for access to the Internet, telecommunications systems and other data processing and information technology systems.

[0007] A first aspect of the invention is directed to a mobile data center. The mobile data center includes a trailer having a length greater than a width and having an interior, the trailer being configured to be transported in a direction generally parallel to the length, and a plurality of equipment enclosures installed in the interior of the trailer to form a row, with the row being parallel to the length of the trailer, wherein the row is positioned in the interior such that a first aisle is on a front side of the row and a second aisle is on a back side of the row. The mobile data center also includes at least one cooling unit constructed and arranged to draw warm air from the second aisle and provide cool air to the first aisle to cool equipment contained in the plurality of equipment enclosures.

[0008] In the mobile data center, the first aisle may be substantially isolated from the second aisle to prevent air flow between the first aisle and the second aisle other than through the at least one air cooling unit. The plurality of equipment enclosures may include a first group of enclosures and a second group of enclosures with the at least one cooling unit disposed in the row between the first group of enclosures and the second group of enclosures. The mobile data center may further include a plurality of cooling units disposed above the plurality of equipment enclosures and configured to draw warm air from the second aisle and to provide cool air to the first aisle. The mobile data center may further include a first uninterruptible power supply disposed adjacent the first group of enclosures and a second uninterruptible power supply disposed adjacent the second group of enclosures. The mobile data center may further include a raised floor disposed under the plurality of equipment enclosures and having removable tiles disposed in the first aisle. The mobile data center may also include a console area having a user console, wherein the console area is isolated from the first aisle and the second aisle to prevent air flow between the first aisle and the console area and between the second aisle and the console area. The mobile data center may include a generator for generating electrical power, wherein the generator is electrically coupled to the first uninterruptible power supply and the second uninterruptible power supply. The mobile data center may include a transfer switch electrically coupled to the generator, the first uninterruptible power supply and the second uninterruptible power supply and having an input to couple to a utility source of power, and wherein the transfer switch is configured to provide power from one of the generator and the utility source to the first uninterruptible power supply and the second uninterruptible power supply. In the mobile data
center, the row may be substantially centered in the trailer with a width of the first aisle being substantially equal to a width of the second aisle.

[0009] A second aspect of the invention is directed to a method of providing air flow in a mobile data center having at least one row of equipment racks disposed in the data center and arranged to provide a first aisle along a front side of the row of equipment racks and a second aisle along a second side of the row of equipment racks. The method includes drawing warm air from the second aisle into a cooling device, providing cool air from the cooling device to the first aisle, drawing cool air into at least one equipment rack of the row of equipment racks to cool data processing equipment in the at least one equipment rack, and exhausting warm air from the at least one equipment rack into the second aisle.

[0010] In the method, providing cool air may include providing cool air from at least one cooling device, and the method may further include isolating the first aisle from the second aisle to prevent flow of air from the first aisle to the second aisle other than through the at least one cooling device. In the method, providing cool air may include providing cool air from at least one cooling device located in the at least one row of equipment racks. The method may include providing cool air from a plurality of cooling units located above the at least one row of equipment racks. The method may include providing uninterruptible power to equipment in the at least one row of equipment racks. The mobile data center may include a console area, and the method may further include providing a separate cooling device for the console area.

[0011] Another aspect of the invention is directed to a mobile data center that includes a trailer having a length greater than a width and having an interior, the trailer being configured to be transported in a direction generally parallel to the length, a plurality of equipment enclosures installed in the interior of the trailer to form a row, with the row being parallel to the length of the trailer, wherein the row is positioned in the interior such that a first aisle is on a front side of the row and a second aisle is on a back side of the row, and means for drawing warm air from the second aisle and providing cool air to the first aisle to cool equipment contained in the plurality of equipment enclosures.

[0012] The data center may include means for isolating the first aisle from the second aisle to prevent air flow between the first aisle and the second aisle other than through the means for drawing warm air. In the data center, the means for drawing warm air may include a plurality of cooling units disposed above the plurality of equipment enclosures and configured to draw warm air from the second aisle and to provide cool air to the first aisle. The mobile data center may further include means for providing uninterruptible power to the plurality of equipment enclosures, and may include a raised floor disposed under the plurality of equipment enclosures and having removable tiles disposed in the first aisle. The mobile data center may include a console area having a user console, wherein the console area is isolated from the first aisle and the second aisle to prevent air flow between the first aisle and the console area and between the second aisle and the console area. The data center may include means for generating electrical power for equipment in the plurality of equipment enclosures. In the data center, the row may be substantially centered in the trailer with a width of the first aisle being substantially equal to a width of the second aisle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] For a better understanding of the present invention, reference is made to the drawings which are incorporated herein by reference and in which:

[0014] FIG. 1 shows a perspective view of a data center in accordance with one embodiment of the present invention;

[0015] FIG. 2 shows a top view of the mobile data center of FIG. 1;

[0016] FIG. 3 shows a side view of the mobile data center of FIG. 1;

[0017] FIG. 4 shows a top view of the mobile data center of FIG. 1 with a roof of the trailer removed;

[0018] FIG. 5 shows a side view of the trailer of the mobile data center of FIG. 1 with the side of the trailer removed;

[0019] FIG. 6 shows a top view of the trailer with a soffit section removed;

[0020] FIG. 7 shows a partial view of the driver’s side of the trailer;

[0021] FIG. 8 shows a schematic diagram of power distribution in one embodiment;

[0022] FIG. 9 shows a perspective view of the soffit section of the mobile data center of FIG. 1;

[0023] FIG. 10 shows a layout of carpet on the floor of the data center of FIG. 1;

[0024] FIGS. 11A, 11B, 11C and 11D show views of a raised floor used in the mobile data center of FIG. 1; and

[0025] FIGS. 12A and 12B show a housing containing condensers and a generator in accordance with one embodiment of a mobile data center.

DETAILED DESCRIPTION

[0026] Various embodiments and aspects thereof will now be discussed in detail with reference to the accompanying figures and attachments. It is to be appreciated that this invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings and attachments. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Examples of specific implementations are provided herein for illustrative purposes only. In particular, acts, elements and features discussed in connection with one embodiment are not intended to be excluded from a similar role in other embodiments. Also, the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of "including," "comprising," or "having," "containing," "involving," and variations thereof herein, is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.
[0027] Embodiments of the present invention, which will now be described, provide improved mobile data centers. However, several of the concepts, improvements, systems and methods described herein may also be used in fixed data centers and in other applications. In addition to solutions and methods discussed herein and in the figures and attachments, embodiments of the present invention may use systems and methods described in the following co-pending applications, each of which is incorporated by reference herein in its entirety: U.S. Ser. No. 10/775,551, filed Feb. 10, 2004, titled Adjustable Scalable Rack Power System and Method; U.S. Ser. No. 10/038,106, filed Jan. 2, 2002, titled Adjustable Scalable Rack Power System and Method; U.S. Ser. No. 10/284,835, Toolless Mounting System and Method for an Adjustable Scalable Rack Power System; and U.S. Ser. No. 10/856,741, filed May 28, 2004, titled Methods and Apparatus for Providing Standby Power.

[0028] At least some embodiments described herein, provide a mobile solution having a form, look and feel that is similar to that of standard fixed data centers, providing professionals that utilize the data centers with a comfortable, familiar environment. In addition, at least some embodiments utilize standard equipment in the mobile data centers that is readily available and accepted for use. In one embodiment, equipment enclosures, uninterruptible power supplies, air conditioning systems and other equipment in the mobile data center may be implemented using equipment available from American Power Conversion Corporation, of West Kingston, R.I., under the trade names InfrastruXure™ and Powerstruc™. In at least one embodiment, a mobile data center is implemented using a standard trailer, such as those approved by the U.S. Department of Transportation for travel on U.S. highways. The ability to use standard trailers is particularly desirable as it allows the mobile data centers to be easily transported as necessary.

[0029] In one embodiment, a mobile data center of the present invention is a stand-alone system that includes rack enclosure space to house 500 "U" of electronics equipment, such as servers, telecommunications equipment or other equipment, includes on-board electrical generation that provides 130 kW of power, fault tolerant uninterruptible power supplies that provide 40 kW of backup power; 50 kW of precision air conditioning (and an additional 17 kW of cooling may be included), a satellite ground station and an eleven screen network control center. The on-board electrical generation system may be designed to operate on either diesel, propane, bio-fuels or from any other type of fuel. In other embodiments, additional rack enclosure space may be included, particularly in embodiments that utilize expandable trailers, double wide trailers and multiple trailers.

[0030] FIGS. 1, 2 and 3 show external views of a mobile data center 100 implemented using a standard trailer 102 and a tractor 104 that have been modified to support functions of the data center. In the embodiment shown in FIGS. 1-3, the trailer is a fifty-three foot trailer and is implemented using a Kentucky AVCC/TS Drop-Frame Trailer and the tractor is a Kenworth T600. However, in other embodiments, other trailers and tractors may be used as readily understood by those skilled in the art given the benefit of this disclosure.

[0031] In the embodiment shown in FIGS. 1-3, the trailer 102 has access doors 122A, 122B and 122C that allow personnel access into the trailer, and the trailer also includes access doors 124A, 124B, 124C and 124D that provide access into the area that contains the electrical generation system. The mobile data center also includes a retractable satellite communications dish 123 that is shown in FIG. 1 mounted to the tractor and in an operational position. In other embodiments, the satellite dish may be mounted to another portion of either the tractor or the trailer. The satellite dish is coupled through at least one communications link to systems within the trailer to provide satellite communication capabilities for the mobile data center. As understood by those skilled in the art, the trailer may have other hard wired or radio communications links to support other communication channels.

[0032] The interior of the trailer 102 will now be further described with reference to FIGS. 4-6 and 9. FIG. 4 provides a top view of the mobile data center with the top of the trailer removed. FIG. 5 provides a side view of the trailer with the side wall of the trailer removed, FIG. 6 provides a top view of the trailer with the top of the trailer and an upper soffit removed, and FIG. 9 shows a partial perspective view of the interior of the trailer with a side wall and interior racks removed. The trailer is functionally divided into three areas, including a mechanical systems section 107, a main equipment section 109 and an operator's console section 111. The mechanical systems section 107 contains electrical generation equipment and a condenser used with the air conditioning systems of the data center. The main equipment section 109 includes racks that can contain data processing and communications equipment to support applications of the mobile data center. The operator's console section 111 includes an operator's console and user interface equipment for operators of the data center. Each of these functional sections is described in further detail below.

[0033] With reference to FIGS. 5 and 6, the data center 100 includes two rows of equipment racks 110A and 110B separated by an air conditioner 112. The data center further includes a user console station 114 with additional racks 113 for equipment that is collocated with the user console station. Electrical controls and a patch panel may be included in a rack 116 located in the operator's console section of the trailer. Three automatic transfer switches 120 are installed on a wall between the generator section and the main equipment section.

[0034] In one embodiment, the air conditioner 112 may be implemented using one or more air conditioners available from APC under the trademark NetworkAir™. In this embodiment, the air conditioner 112 draws air from a hot aisle 126 and returns cool air to a cool aisle 128. The rows of equipment racks include racks that are designed for front to back cooling with the front of the racks facing the cool aisle 128 and the backs of the equipment facing the hot aisle 126. In the embodiment shown in FIGS. 5 and 6, each row of equipment racks 110A and 110B includes five general purpose equipment racks 115 along with two power racks 117. In other embodiments, other quantities and configuration of racks may be used. The equipment racks 115 may be implemented using standard data center nineteen inch racks. The power racks may be implemented using uninterruptible power supplies, and in one embodiment are implemented using a combined uninterruptible power supply and power distribution unit, such as those available from APC under the trade name Symmetry™ Power and signaling cabling between the racks 115, the power supplies 117 and other...
devices in the data center may be run over the tops of the racks in separate data troughs provided for that purpose. In other embodiments, power and data cables may be run below the racks in the raised floor section (described below) instead of, or in addition to, over the tops of the racks. In one embodiment, the racks 115 are substantially centered in the middle of the trailer such that the width of the cold aisle is approximately equal to the width of the warm aisle.

[0035] Four partitions 131A, 131B, 131C and 131D are used at the ends of the hot aisle and the cold aisle to isolate the cold aisle from the hot aisle to provide efficient air flow within the interior of the data center. The partitions may be implemented using sliding doors, pocket style doors, and other styles of doors and partitions. In FIG. 6, four partitions are used, however, in another embodiment, partition 131B is not used, and cooling air from the cold aisle is used to cool the area in front of the automatic transfer switches 120.

[0036] The electrical generation system for the data center is contained in the mechanical systems area 107. Condensers for the air conditioners may be located in the area near the user console station or in one embodiment, as described further below, may be collocated with the electrical generation system. The condensers may be coupled to the air conditioning units using lines run under the floor of the trailer and/or over the roofs of the racks.

[0037] The automatic transfer switches 120 are used to control power from the electrical generation system. Further, in one embodiment in which the data center 100 may be powered either from available utility power or from the electrical generation system, the automatic transfer switches are used to coordinate the transfer and control of power between the utility and generator. The automatic transfer switches may be implemented using one or more systems described in U.S. patent application Ser. No. 10/856,741 discussed above. Further, in one embodiment, the automatic transfer switches are adaptable to operate with standard industrial control systems and electrical generation systems from various manufacturers. In operation, power from a generator and/or a utility power source are provided to the transfer switches 120, and the transfer switches provide power from one of the generator and the utility power source to equipment in the trailer. In one embodiment, racks in the rows 110A and 110B receive power from the transfer switches and if a power outage occurs, power is provided to the racks from uninterruptible power supplies contained in the power racks 117.

[0038] In one embodiment of the mobile data center, the data center can be powered from two separate utility sources (or other external sources) to provide greater flexibility and redundancy. In this embodiment, as will now be described with reference to FIGS. 7 and 8, a connection bay 183 is contained in a recessed cavity behind a lockable access door 182 located between the rear wheels on the driver’s side of the trailer. The connection bay includes an electrical power connection panel 184 (FIG. 8) that has connectors 188 and 190 for connecting to two external sources of power and also includes connectors 186 and 192 for providing power from the data center to external power loads. In other embodiments, the electrical connection panel may include more or less connectors to provide power to additional loads and receive power from additional sources. In one embodiment, the connectors 186, 188, 190 and 192 are standard power connectors, while in other embodiments, electrical terminals or other devices may be used to make electrical connections to the power panel.

[0039] FIG. 8 provides a diagram of power distribution between the generator 402, the automatic transfer switches 120 and the electrical power connection panel 184. In the diagram of FIG. 8, only one automatic transfer switch is shown, however, in other embodiments, multiple transfer switches may be used. In the embodiment shown, output power from the generator is available at connector 186, and output power from the automatic transfer switch is available at connector 192, while input power from external sources is received at connectors 188 and 190. In one embodiment, over-current protection devices may be coupled between the automatic transfer switch and the electrical power connection panel. The automatic transfer switches 120 may be configured to provide power to the data center from only one source of power at a time or from multiple sources simultaneously. In one embodiment, the access door 182 has holes through which cables pass to the electrical power connection panel. The use of a lockable access door having these holes provides security and safety.

[0040] The soffit section 121 (see FIG. 9) is disposed between the racks and the ceiling of the trailer in the main equipment section of the trailer. The soffit section includes a support frame to support four air conditioning units 127A, 127B, 127C and 127D above the racks. Fluid piping and electrical cabling in support of the operation of the air conditioners is run in a rear section of the soffit section. The soffit section also includes panels or other devices that provide isolation over the top of the racks between the hot aisle 126 and the cold aisle 128. In one embodiment, the air conditioning units in the soffit section 127A, 127B, 127C and 127D are implemented using units available from Carrier Corporation of Farmington, Conn. having part no. 42CE-A-10-H-R-C-Y-6, however, in other embodiments, other units may be used. The soffit air conditioning units draw hot air from the hot aisle 126 and provide cool air to the cold aisle 128. In one embodiment, each of the racks may accommodate equipment requiring up to 3.6 kW of power and in this embodiment, the temperature of the hot aisle may be 85 degrees Fahrenheit and the temperature of the cold aisle may be 70 degrees Fahrenheit.

[0041] In one embodiment, the soffit section includes drain pans located under each of the air conditioning units 127A, 127B, 127C and 127D. The drain pans collect condensation from the air conditioning units and a drain pipe is coupled to the drain pans to direct the condensation out of the trailer.

[0042] As shown in FIG. 9, the operator console area also includes an air conditioning unit 139 located above the operator’s console. The air conditioning unit 139 provides cooling for the operator console area and for equipment located within the console area. In one embodiment, the air conditioning unit 139 is implemented using the same model air conditioning unit as in the soffit section.

[0043] FIG. 10 shows a plan view of the interior of the trailer with the equipment removed to show location of a raised floor section 180 on the floor of the data center. In one embodiment, as described below in further detail, the area of the floor that contains the carpet section 180 is a raised floor section that uses standard data center raised floor panels.
shown in FIG. 10, the area of the trailer near the user console may also be carpeted.

[0044] In one embodiment of the data center 100, a raised floor is included in the floor of the trailer to facilitate the running of cables between equipment in the data center. Further, cables may be run across the roofs of enclosures of the rows of equipment 110A and 110B as described in U.S. patent application Ser. No. 10/038,106, discussed above. A raised floor system used in one embodiment will now be described with reference to FIGS. 10A, 10B, 10C and 10D.

FIG. 10A shows a truss system 150 that is used in one embodiment of the present invention to provide additional support for the floor in the trailer. FIG. 11B shows a perspective view of the truss system 150. FIG. 11C shows an end view of the truss system, and FIG. 11D shows a detailed view of one side of the truss system. In different embodiments, the truss system may be implemented using wood, steel, other metals, or a combination of these. As shown in FIG. 11A, the truss system includes numerous support pieces that provide structural strength and mounting flanges for the floor of the trailer.

[0045] In one embodiment, standard raised floor tiles (with carpeting as shown in FIG. 10) are used in the areas designated 152A, 152B, 152C, 152D and 152E, and fiberglass reinforced plywood flooring is generally used over the remainder of the floor. However, in at least one embodiment, the plywood flooring may have one or more standard raised floor tiles or other access devices incorporated within it to allow personnel to gain access to the area below the plywood floor. Further, in other embodiments, the raised floor area may cover more or less of the floor space of the trailer.

[0046] In one embodiment, an improved mounting system for the raised floor is used which eliminates the need for the use of pedestals with the raised floor tiles creating more room beneath the floor to run cables. Each of the areas 152A, 152B, 152C, 152D and 152E has sides 154A and 154B that run along the edges of the areas. As shown in greater detail in FIG. 11D, an 18 gauge steel “J” channel 156 is mounted to the sides 154A and 154B. The “J” channel in one embodiment runs the length of the areas 152A, 152B, 152C, 152D and 152E and is designed to provide support for standard two foot square raised floor panels. To provide further support for the raised floor panels, cross pieces from side 154A to 154B running at two foot intervals may be added. The cross pieces may be made of steel or some other material. The use of the “J” channel eliminates the need for raised floor pedestals. While the particular design of the raised floor described above is for use in a mobile trailer, embodiments of the invention directed to the raised floor may be used in other situations in which it is desirable to use a raised floor, including in fixed data centers.

[0047] As discussed above one or more condensers for the air conditioners may be collocated with the electrical generation system. In one particular embodiment, the electrical generation system is implemented using a Cummins diesel generator in combination with a Newage-Stanford alternator and the condenser(s) are implemented using Heatcraft coils. In this embodiment, the generator, the alternator and the condenser(s) are contained within a common sheet metal enclosure along with electrical fans that are powered from a variable speed drive located adjacent to the automatic transfer switches in the data center, which is connected to the electrical system in this embodiment. The electrical fans are used to cool the generator as well as to provide air flow across the condensers. The combination of one or more condensers with the electrical generation system in this embodiment results in a significant space savings in the trailer allowing additional “U” space to be included in the data center.

[0048] One embodiment of a housing 400 used to contain a generator of a mobile data center that is collocated with condensers used with air conditioning units of the data center will now be described with reference to FIGS. 12A and 12B. FIG. 12A shows a side view of the housing 400, and FIG. 12B shows a top view of the housing 400. The enclosure 400 includes a generator 402, fans 404A and 404B, and condensing coils 406A and 406B. In one embodiment, openings are provided in the housing to cause air drawn by the fans to pass over the generator and the condensing coils. In this manner, common fans can be used for the generator and the condenser coils.

[0049] In other embodiments, one or more condensers may be collocated with the electrical generation system, but arranged so that separate air flows are directed across components of the generator and the condensers. The condensers may be coupled to the air conditioning units described above to provide a source of coolant to the air conditioning systems.

[0050] In typical mobile data centers and communication centers, equipment is mounted along the sides of a trailer or shelter with an aisle located in the middle of the equipment to provide access to the equipment. Cooling is typically provided by externally mounted air conditioning units that provide bulk cooling to the trailer or shelter to cool personnel in the trailers and to cool equipment mounted in the trailer. In such a situation, the amount of cooling that must be provided tends to be greater than that actually needed to cool the equipment and the personnel, as the air is not typically circulated in an efficient manner. This can result in the need for additional power for the shelter. In addition, in such typical mobile data centers, the mounting of equipment along the sides of the shelter prevents access to the back of equipment, making it difficult to use standard data center equipment and cabling and/or requiring special blind mating connectors and cooling techniques to cool equipment designed to be cooled from front to back.

[0051] As discussed above, at least one embodiment of the present invention overcomes drawbacks of typical mobile data centers by providing mounting and cooling schemes for data center equipment that allows the equipment to be contained in racks and cooled in an efficient manner. In one embodiment, the row of racks is substantially centered in the trailer to provide a cool aisle and a hot aisle having substantially the same width. In another embodiment, the hot aisle may have a width less than the width of the cool aisle, with the width of the hot aisle being great enough to allow an operator to access equipment in the racks from the hot aisle.

[0052] Having thus described at least one illustrative embodiment of the invention, various alterations, modifications and improvements will readily occur to those skilled in the art. Such alterations, modifications and improvements are intended to be within the scope and spirit of the invention. Accordingly, the foregoing description is by way of example only and is not intended as limiting. The invention’s limit is defined only in the following claims and the equivalents thereto.
What is claimed is:

1. A mobile data center comprising:
   a trailer having a length greater than a width and having an interior, the trailer being configured to be transported in a direction generally parallel to the length;
   a plurality of equipment enclosures installed in the interior of the trailer to form a row, with the row being parallel to the length of the trailer, wherein the row is positioned in the interior such that a first aisle is on a front side of the row and a second aisle is on a back side of the row;
   at least one cooling unit constructed and arranged to draw warm air from the second aisle and provide cool air to the first aisle to cool equipment contained in the plurality of equipment enclosures.

2. The mobile data center of claim 1, wherein the first aisle is substantially isolated from the second aisle to prevent air flow between the first aisle and the second aisle other than through the at least one air cooling unit.

3. The mobile data center of claim 1, wherein the plurality of equipment enclosures includes a first group of enclosures and a second group of enclosures with the at least one cooling unit disposed in the row between the first group of enclosures and the second group of enclosures.

4. The mobile data center of claim 2, further comprising a plurality of cooling units disposed above the plurality of equipment enclosures and configured to draw warm air from the second aisle and to provide cool air to the first aisle.

5. The mobile data center of claim 3, further comprising a first uninterruptible power supply disposed adjacent the first group of enclosures and a second uninterruptible power supply disposed adjacent the second group of enclosures.

6. The mobile data center of claim 1, further comprising a raised floor disposed under the plurality of equipment enclosures and having removable tiles disposed in the first aisle.

7. The mobile data center of claim 2, further comprising a console area having a user console, wherein the console area is isolated from the first aisle and the second aisle to prevent air flow between the first aisle and the console area and between the second aisle and the console area.

8. The mobile data center of claim 5, further comprising a generator for generating electrical power, wherein the generator is electrically coupled to the first uninterruptible power supply and the second uninterruptible power supply.

9. The mobile data center of claim 8, further comprising a transfer switch electrically coupled to the generator, the first uninterruptible power supply and the second uninterruptible power supply and having an input to couple to a utility source of power, and wherein the transfer switch is configured to provide power from one of the generator and the utility source to the first uninterruptible power supply and the second uninterruptible power supply.

10. The mobile data center of claim 1, wherein the row is substantially centered in the trailer with a width of the first aisle being substantially equal to a width of the second aisle.

11. A method of providing air flow in a mobile data center having at least one row of equipment racks disposed in the data center and arranged to provide a first aisle along a front side of the row of equipment racks and a second aisle along a second side of the row of equipment racks, the method comprising:
   drawing warm air from the second aisle into a cooling device;
   providing cool air from the cooling device to the first aisle;
   drawing cool air into at least one equipment rack of the row of equipment racks to cool data processing equipment in the at least one equipment rack; and
   exhausting warm air from the at least one equipment rack into the second aisle.

12. The method of claim 11, wherein providing cool air includes providing cool air from at least one cooling device, and wherein the method further includes isolating the first aisle from the second aisle to prevent flow of air from the first aisle to the second aisle other than through the at least one cooling device.

13. The method of claim 11, wherein providing cool air includes providing cool air from a plurality of cooling units located above the at least one row of equipment racks.

14. The method of claim 11, wherein drawing cool air includes providing cool air from a plurality of cooling units located above the at least one row of equipment racks.

15. The method of claim 11, further comprising providing uninterruptible power to equipment in the at least one row of equipment racks.

16. The method of claim 12, wherein the data center includes a console area, and wherein the method further includes providing a separate cooling device for the console area.

17. A mobile data center comprising:
   a trailer having a length greater than a width and having an interior, the trailer being configured to be transported in a direction generally parallel to the length;
   a plurality of equipment enclosures installed in the interior of the trailer to form a row, with the row being parallel to the length of the trailer, wherein the row is positioned in the interior such that a first aisle is on a front side of the row and a second aisle is on a back side of the row; and
   means for drawing warm air from the second aisle and providing cool air to the first aisle to cool equipment contained in the plurality of equipment enclosures.

18. The mobile data center of claim 17, further comprising means for isolating the first aisle from the second aisle to prevent air flow between the first aisle and the second aisle other than through the means for drawing warm air.

19. The mobile data center of claim 17, wherein the means for drawing warm air includes a plurality of cooling units disposed above the plurality of equipment enclosures and configured to draw warm air from the second aisle and to provide cool air to the first aisle.

20. The mobile data center of claim 17, further comprising means for providing uninterruptible power to the plurality of equipment enclosures.

21. The mobile data center of claim 17, further comprising a raised floor disposed under the plurality of equipment enclosures and having removable tiles disposed in the first aisle.

22. The mobile data center of claim 21, further comprising a console area having a user console, wherein the console area is isolated from the first aisle and the second aisle to...
prevent air flow between the first aisle and the console area and between the second aisle and the console area.

23. The mobile data center of claim 20, further comprising means for generating electrical power for equipment in the plurality of equipment enclosures.

24. The mobile data center of claim 17, wherein the row is substantially centered in the trailer with a width of the first aisle being substantially equal to a width of the second aisle.

* * * * *