

**WHAT IS CLAIMED IS:**

1. A server rack sub-assembly, comprising:  
at least one motherboard having a perimeter;  
a plurality of heat-generating electronic devices mounted on the motherboard in an area of the motherboard thermally decoupled from the motherboard perimeter;  
one or more brackets comprising heat transfer surfaces and attached to the motherboard along at least a portion of the motherboard perimeter, the one or more brackets adapted to receive a cooling airflow circulated over the bracket and to convectively transfer heat into the cooling airflow, the one or more brackets adapted to couple the motherboard to a server rack assembly; and  
a heat transfer device thermally coupled to the area of the motherboard that is thermally decoupled from the motherboard perimeter and the one or more brackets, wherein the heat transfer device is arranged to conductively transfer heat from the one or more electronic devices to the brackets.
2. The server rack sub-assembly of claim 1, further comprising a heat sink mounted on the motherboard in the area of the motherboard thermally decoupled from the motherboard perimeter, the heat sink thermally coupled to the area of the motherboard and the heat transfer device.
3. The server rack sub-assembly of claim 1, wherein at least a portion of the heat sink includes the one or more brackets.
4. The server rack sub-assembly of claim 2, wherein the heat sink comprises a thermal interface between at least a portion of the plurality of heat-generating electronic devices and a planar portion of the heat sink, the thermal interface adapted to increase contact between the portion of the plurality of heat-generating electronic devices and the heat sink as a temperature of the heat sink increases.

5. The server rack sub-assembly of claim 4, wherein the thermal interface comprises a phase-change material enclosed against the planar portion of the heat sink by a film, the phase-change material adapted to change from a substantially solid material to a semi-solid or liquid material as the temperature of the heat sink increases.

6. The server rack sub-assembly of claim 5, wherein the changed phase-change material substantially fills an air gap between the portion of the plurality of heat-generating electronic devices and the heat sink.

7. The server rack sub-assembly of claim 5, wherein the changed phase-change material substantially fills an air gap between the motherboard and the heat sink.

8. The server rack sub-assembly of claim 1, wherein the heat transfer device comprises a heat pipe enclosing a working material.

9. The server rack sub-assembly of claim 8, wherein the heat pipe further comprises an evaporator and at least one condenser, the evaporator thermally coupled to the area of the motherboard thermally decoupled from the perimeter, the condenser thermally coupled to one or more of the brackets.

10. The server rack sub-assembly of claim 8, wherein the working material is adapted to receive the heat generated by the electronic devices and transfer the heat to the one or more brackets.

11. The server rack sub-assembly of claim 2, wherein the heat transfer device comprises a mesh thermally coupled to the area of the motherboard that is thermally decoupled from the perimeter and at least one of the brackets.

12. The server rack sub-assembly of claim 11, wherein the heat sink further comprises one or more fins extending from a planar portion of the heat sink, and  
the mesh is coupled to the heat sink over the fins such that the mesh and the heat sink are in thermal contact.

13. The server rack sub-assembly of claim 11, wherein the mesh comprises one or more wings extending from a substantially planar portion of the mesh, the wings adapted to thermally communicate heat from the planar portion of the mesh to at least one of the brackets.

14. The server rack sub-assembly of claim 1, wherein the one or more brackets are adapted to couple at least three motherboards to the server rack assembly.

15. A method for cooling electronic equipment, comprising:  
providing at least one server rack sub-assembly comprising at least one motherboard and one or more brackets coupled to the motherboard along at least a portion of a perimeter of the motherboard, the one or more brackets adapted to couple the motherboard to a server rack assembly, the motherboard comprising a plurality of heat-generating computing devices mounted on the motherboard in an area thermally decoupled from the perimeter;  
circulating a cooling airflow directed over the one or more brackets adjacent the perimeter;  
conductively transferring heat generated by the plurality of computing devices mounted on the thermally decoupled area to the one or more brackets; and  
convectively transferring the generated heat from the one or more brackets to the cooling airflow.

16. The method of claim 15, further comprising:  
conductively transferring heat generated by the plurality of computing devices mounted on the thermally decoupled area to a heat sink mounted on the motherboard in the area thermally decoupled from the perimeter; and  
conductively transferring the heat from the heat sink to the brackets.

17. The method of claim 16, further comprising:

conductively transferring heat generated by the plurality of computing devices mounted on the thermally decoupled area to the heat sink through a thermal interface between the heat sink and the motherboard, the thermal interface comprising a phase-change material.

18. The method of claim 15, wherein conductively transferring heat

generated by the plurality of computing devices mounted on the thermally decoupled area to the one or more brackets comprises conductively transferring heat generated by the plurality of computing devices mounted on the thermally decoupled area to the one or more brackets with a heat pipe thermally coupled to the motherboard and the one or more brackets, the heat pipe comprising a working material enclosed in an evaporator in fluid communication with a condenser.

19. The method of claim 18, further comprising:

transferring the generated heat from the plurality of computing devices mounted on the thermally decoupled area to the working material within the evaporator; and

transferring the generated heat from the working material to the one or more brackets.

20. The method of claim 16, wherein conductively transferring heat

generated by the plurality of computing devices mounted on the thermally decoupled area to the perimeter comprises conductively transferring heat generated by the plurality of computing devices mounted on the thermally decoupled area to the perimeter with a mesh thermally coupled to the motherboard and the perimeter, the mesh comprising a plurality of apertures and one or more wings.

21. The method of claim 20, further comprising:

coupling the mesh to the heat sink by sliding the plurality of apertures over corresponding fins mounted on the heat sink; and

coupling each wing to a corresponding bracket adjacent the perimeter.

22. The method of claim 21, further comprising:  
conductively transferring the generated heat from the plurality of computing devices mounted on the thermally decoupled area through the wing and to the corresponding bracket.
23. A system comprising:  
a server rack assembly comprising two or more server rack sub-assemblies, at least one of the server rack sub-assemblies comprising:  
at least one motherboard having a perimeter;  
a plurality of heat-generating electronic devices mounted on the motherboard in an area of the motherboard thermally decoupled from the motherboard perimeter;  
one or more brackets coupling the server rack sub-assembly to the server rack assembly, the one or more brackets comprising heat transfer surfaces and attached to the motherboard along at least a portion of the motherboard perimeter; and  
a heat transfer device coupled to the area of the motherboard that is thermally decoupled from the motherboard perimeter, wherein the heat transfer device is arranged to conductively transfer heat from the one or more electronic devices to the one or more brackets; and  
one or more fans adapted to circulate cooling air over the heat transfer surfaces to convect heat away from the area of the motherboard that is thermally decoupled from the motherboard perimeter and the one or more brackets.
24. The system of claim 23, further comprising a heat sink thermally coupled between the area of the motherboard thermally decoupled from the motherboard perimeter and the heat transfer device.
25. The system of claim 23, wherein at least one of the one or more fans is mounted on the server rack assembly.
26. The system of claim 23, wherein the one or more fans do not circulate air over the area of the motherboard thermally decoupled from the motherboard perimeter.

27. The system of claim 23, wherein the heat transfer device is a heat pipe.

## CLAIMS

1. A server rack sub-assembly, comprising:  
at least one motherboard having a perimeter;  
a plurality of heat-generating electronic devices mounted on the motherboard in an area of the motherboard that is substantially thermally decoupled from the motherboard perimeter;  
one or more brackets comprising heat transfer surfaces and attached to the motherboard along at least a portion of the motherboard perimeter, the one or more brackets receive a cooling airflow circulated, by one or more fans, over the bracket and convectively transfer heat into the cooling airflow while the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter receives substantially none of the cooling airflow, the one or more brackets adapted to couple the motherboard to a server rack assembly; and  
a heat transfer device thermally coupled to the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter and the one or more brackets, wherein the heat transfer device is arranged to conductively transfer heat from the one or more electronic devices to the brackets.
2. The server rack sub-assembly of claim 1, further comprising a heat sink mounted on the motherboard in the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter, the heat sink thermally coupled to the area of the motherboard and the heat transfer device.
3. The server rack sub-assembly of claim 1, wherein at least a portion of the heat transfer device includes the one or more brackets.
4. The server rack sub-assembly of claim 2, wherein the heat sink comprises a thermal interface between at least a portion of the plurality of heat-generating electronic devices and a planar portion of the heat sink, the thermal interface adapted to increase contact between the portion of the plurality of heat-generating electronic devices and the heat sink as a temperature of the heat sink increases.
5. The server rack sub-assembly of claim 4, wherein the thermal interface comprises a phase-change material enclosed against the planar portion of the heat sink by a film, the phase-change material adapted to change from a substantially solid material to a

semi-solid or liquid material as the temperature of the heat sink increases.

6. The server rack sub-assembly of claim 5, wherein the changed phase-change material substantially fills an air gap between the portion of the plurality of heat-generating electronic devices and the heat sink.

7. The server rack sub-assembly of claim 5, wherein the changed phase-change material substantially fills an air gap between the motherboard and the heat sink.

8. The server rack sub-assembly of claim 1, wherein the heat transfer device comprises a heat pipe enclosing a working material.

9. The server rack sub-assembly of claim 8, wherein the heat pipe further comprises an evaporator and at least one condenser, the evaporator thermally coupled to the area of the motherboard substantially thermally decoupled from the perimeter, the condenser thermally coupled to one or more of the brackets.

10. The server rack sub-assembly of claim 8, wherein the working material is adapted to receive the heat generated by the electronic devices and transfer the heat to the one or more brackets:

11. The server rack sub-assembly of claim 2, wherein the heat transfer device comprises a mesh thermally coupled to the area of the motherboard that is substantially thermally decoupled from the perimeter and at least one of the brackets.

12. The server rack sub-assembly of claim 11, wherein the heat sink further comprises one or more fins extending from a planar portion of the heat sink, and

wherein the mesh is coupled to the heat sink over the fins such that the mesh and the heat sink are in thermal contact.

13. The server rack sub-assembly of claim 11, wherein the mesh comprises one or more wings extending from a substantially planar portion of the mesh, the wings adapted to thermally communicate heat from the planar portion of the mesh to at least one of the brackets.

14. The server rack sub-assembly of claim 1, wherein the one or more brackets are adapted to couple at least three motherboards to the server rack assembly.

15. A method for cooling electronic equipment, comprising:

providing at least one server rack sub-assembly comprising at least one motherboard and one or more brackets coupled to the motherboard along at least a portion of a perimeter of the motherboard, the one or more brackets adapted to couple the motherboard to a server rack assembly, the motherboard comprising a plurality of heat-generating computing devices mounted on the motherboard in an area that is substantially thermally decoupled from the perimeter;

circulating a cooling airflow directed over the one or more brackets adjacent the perimeter while circulating substantially no cooling airflow over the area of the motherboard that is substantially thermally decoupled from the perimeter;

conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the one or more brackets; and

convectively transferring the generated heat from the one or more brackets to the cooling airflow.

16. The method of claim 15, further comprising:

conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to a heat sink mounted on the motherboard in the area substantially thermally decoupled from the perimeter; and

conductively transferring the heat from the heat sink to the brackets.

17. The method of claim 16, further comprising:

conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the heat sink through a thermal interface between the heat sink and the motherboard, the thermal interface comprising a phase-change material.

18. The method of claim 15, wherein conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the one or more brackets comprises conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the one or more brackets with a heat pipe thermally coupled to the motherboard and the one or more brackets, the heat pipe comprising a working material enclosed in an evaporator in fluid communication with a condenser.

19. The method of claim 18, further comprising:

transferring the generated heat from the plurality of computing devices mounted on the substantially thermally decoupled area to the working material within the evaporator; and

transferring the generated heat from the working material to the one or more brackets.

20. The method of claim 16, wherein conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the perimeter comprises conductively transferring heat generated by the plurality of computing devices mounted on the substantially thermally decoupled area to the perimeter with a mesh thermally coupled to the motherboard and the perimeter, the mesh comprising a plurality of apertures and one or more wings.

21. The method of claim 20, further comprising:

coupling the mesh to the heat sink by sliding the plurality of apertures over corresponding fins mounted on the heat sink; and

coupling each wing to a corresponding bracket adjacent the perimeter.

22. The method of claim 21, further comprising:

conductively transferring the generated heat from the plurality of computing devices mounted on the substantially thermally decoupled area through the wing and to the corresponding bracket.

23. A system comprising:

a server rack assembly comprising two or more server rack sub-assemblies, at least one of the server rack sub-assemblies comprising:

at least one motherboard having a perimeter;

a plurality of heat-generating electronic devices mounted on the motherboard in an area of the motherboard that is substantially thermally decoupled from the motherboard perimeter;

one or more brackets coupling the server rack sub-assembly to the server rack assembly, the one or more brackets comprising heat transfer surfaces and attached to the motherboard along at least a portion of the motherboard perimeter; and

a heat transfer device coupled to the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter, wherein the heat transfer device is arranged to conductively transfer heat from the one or more electronic devices to

the one or more brackets; and

one or more fans adapted to circulate cooling air over the heat transfer surfaces to convect heat away from the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter and the one or more brackets while circulating substantially no cooling airflow over the area of the motherboard that is substantially thermally decoupled from the perimeter.

24. The system of claim 23, further comprising a heat sink thermally coupled between the area of the motherboard that is substantially thermally decoupled from the motherboard perimeter and the heat transfer device.

25. The system of claim 23, wherein at least one of the one or more fans is mounted on the server rack assembly.

26. The system of claim 23, wherein the heat transfer device is a heat pipe.