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- (71) Applicant: **HEWLETT PACKARD ENTERPRISE DEVELOPMENT LP** [US/US]; 11445 Compaq Center Drive West, Houston, TX 77070 (US).
- (72) Inventors: **LEIGH, Kevin B**; 11445 Compaq Center Drive W, Houston, Texas 77070 (US). **MEGASON, George**; 11445 Compaq Center Drive W, Houston, Texas 77070 (US). **WANNER, Christopher C**; 11445 Compaq Center Drive W, Houston, Texas 77070 (US).
- (74) Agent: **BURROWS, Sarah E**; Hewlett Packard Enterprise, 3404 E. Harmony Road, Mail Stop 79, Fort Collins, CO 80528 (US).
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(54) Title: BLADE SUB-ENCLOSURE INTERMEDIATE CONNECTOR

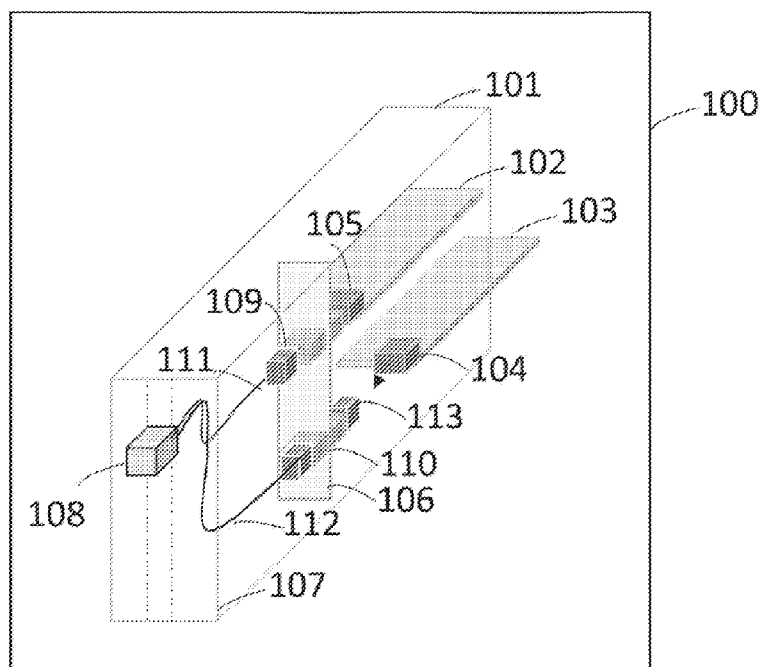


FIG. 1

(57) Abstract: Examples disclosed herein relate to a blade sub-enclosure intermediate connector. For example, a blade sub-enclosure may include a connector housing to removably receive a set of intermediate connectors. Each of the intermediate connectors may be in communication with a line card connector and a system connector. The line card connector is in communication with a line card, and the system connector is in communication with a blade enclosure backplane



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a patent (Rule 4.17(ii))*

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Blade Sub-Enclosure Intermediate Connector

BACKGROUND

[0001] A blade enclosure may include multiple sub-enclosures. The sub-enclosures may enclose multiple line cards while allowing the line cards to communicate with the blade enclosure electrical backplane. The line cards may be, for example, storage or compute mini blades.

BRIEF DESCRIPTION OF THE DRAWINGS

[0002] The drawings describe example embodiments. The following detailed description references the drawings, wherein:

[0003] Figure 1 is a diagram illustrating one example of a blade system including a blade sub-enclosure with an intermediate connector.

[0004] Figures 2A, 2B, 2C, and 2D are diagrams illustrating examples of connecting a system connector to a connector housing using an intermediate connector within a blade sub-enclosure.

[0005] Figure 3 is a diagram illustrating one example of communicating between a system connector and line card connector via intermediate connectors.

DETAILED DESCRIPTION

[0006] In one implementation, a blade enclosure includes a sub-enclosure that allows for flexible modularity such that connections to the blade enclosure may be adjusted by a customer after manufacturing. A connector housing positioned at the sub-enclosure intermediate bulkhead may accept a number of intermediate connectors. The connector housing intermediate connectors may connect to a line card, and the intermediate connectors may communicate with a system connector for communicating with the blade enclosure. The connector housing may accept intermediate connectors of different types, such as where some intermediate connectors are electrical connectors and some intermediate connectors are optical

connectors. The connector housing may include slots or other receptacles for the intermediate connectors such that the number of intermediate connectors is variable. The number or type of connections, such as electrical or optical, between line cards and the blade enclosure backplane may be configured by a customer. A varying number of electrical and optical harnesses may be installed in a modular fashion to connect to the intermediate connectors. The modularity may also allow for better flexibility and easier serviceability.

[0007] Figure 1 is a diagram illustrating one example of a blade system including a blade sub-enclosure intermediate connector. The blade enclosure 100 may house multiple sub-enclosures, such as the blade sub-enclosure 101. The blade sub-enclosure 101 may be any suitable enclosure to house line cards. The blade sub-enclosure 101 may be, for example, a metal or plastic enclosure. The blade sub-enclosure 101 may include a rear bulkhead 107, an intermediate bulkhead 106, and line cards 102 and 103. The line cards 102 and 103 may be any suitable line cards, such as compute or storage line cards. The line cards 102 and 103 constitute line card connectors 105 and 104, respectively. The rear bulkhead 107 and the intermediate bulkhead 106 may be made from sheet metal or plastic forming a portion of the blade sub-enclosure 201.

[0008] The rear bulkhead 107 may include an ability to connect to the blade enclosure 100. For example, a system connector 108 may be a connector for connecting the blade sub-enclosure 101 to the blade enclosure 100. The system connector 108 may be, for example, a blind mate connector. In one implementation, the system connector 108 is a floating cable-terminated receptacle to blind mate with the blade enclosure 100 mid-plane using an alignment feature (not shown). The mounting surface of the system connector 108 may be perpendicular to the PCB plane of the line cards 102 and 103 where the line card connectors 105 and 104 are mounted. In one implementation, the line card connectors 105 and 104 are right-angle PCB-mounted and include an alignment feature for a blind mate application.

[0009] The connector housings 109 and 110 may include intermediate connectors for communicating between the line cards 102 and 103 to the system connector 108. For example, the connector housing 110 may allow for multiple

intermediate connectors. One intermediate connector 113 is shown on both sides of the intermediate bulkhead 106, within the connector housing 110. Likewise, the connector housing 109 may include a set of intermediate connectors, although one intermediate connector is shown. The connector housings 109 and 110 may be configured such that an intermediate connector is used to both connect to a line card connector and a blade sub-enclosure system connector. In one implementation, the intermediate connectors are mounted directly on the intermediate bulkhead 106. The connector housings 109 and 110 may receive multiple intermediate connectors such that the number of intermediate connectors may be selected at install time. In one implementation, the connector housings 109 and 110 are floating cable terminated connectors. The connector housings 109 and 110 may include an alignment feature to allow for blind mate applications. The mounting surface of the connector housings 109 and 110 may be parallel to a PCB plane where the line card connectors 104 and 105 are mounted, such as to create better air flow.

[0010] The intermediate connector 113 may be any suitable connector, such as an optical or electrical connector. For example, the intermediate connector 113 may be an electrical blind mate connector. In one implementation, the connector housings 109 and 110 are configured to accept multiple intermediate connectors such that the intermediate connectors may or may not be inserted into the connector housing 110. For example, the connector housings 109 and 110 may have the ability to accept one, two, or three intermediate connectors such that the connector housing 110 may initially include one intermediate connector and additional intermediate connectors may be added at a later point. As an example, the connector housings 109 and 110 may have slots or receptacles to allow for rows, columns, or arrays of intermediate connectors.

[0011] The connector housings 110 and 109 may be configured such that it may accept an intermediate connector that is either an optical or electrical intermediate connector. In one implementation, different types of intermediate connectors may be used simultaneously. For example, a first intermediate connector connected to the connector housing 110 may be an optical connector, and a second intermediate connector connected to the connector housing may be an electrical connector. As an example, the connector housing 110 may include a first row of electrical intermediate

connector slots and a second row of optical intermediate connector slots.

[0012] Connection mechanisms 111 and 112 may be used to connect the system connector 108 to the intermediate connectors, such as the intermediate connector 115. For example, the connection mechanisms 111 and 112 may be cable wiring harnesses.

[0013] Figures 2A, 2B, 2C, and 2D are diagrams illustrating examples of connecting a system connector to a connector housing using an intermediate connector within a blade sub-enclosure. Figures 2A, 2B, 2C, and 2D illustrate different modular configuration options where an intermediate connector may be used to communicate between a system connector and a line card connector. For example, different intermediate connector configurations may be used depending on the number of system connectors to connect to the line card connectors. The number of intermediate connectors in a connector housing may be determined after the time of manufacture at install time.

[0014] Figure 2A shows line card connectors 200 and 208, system connector 207, connector housings 201 and 204, and intermediate connectors 202 and 205. The intermediate connector 202 may be positioned in the connector housing 201, and the intermediate connector 205 may be positioned in the connector housing 204. The intermediate connector 202 may be used to connect the system connector 207 to the line card connector 200, and intermediate connector 205 may connect the system connector 207 to the line card connector 208. The intermediate connectors 205 and 202 may be electrical connectors. In one implementation, they are electrical blind mate connectors. The line card connectors 200 and 208 may be attached to corresponding line cards. The system connector 207 may be associated with a rear bulkhead of a blade sub-enclosure, and the system connector 207 may connect to a blade enclosure comprising the blade sub-enclosure. The connection mechanisms 203 and 206 may allow the system connector 207 to communicate with the intermediate connectors 202 and 205. The connection mechanisms 203 and 206 may be, for example, wiring harnesses.

[0015] The connector housings 201 and 204 may removably receive a flexible number of intermediate connectors to be used, such as where the connector housings

201 and 204 include multiple receptacles in which intermediate connectors may be inserted. In one implementation, the connector housings may include different numbers of receptacles for intermediate connectors and may include different numbers of intermediate connectors from one another. The line card connectors 200 and 208 may be configured such that they may receive different numbers of intermediate connectors and intermediate connectors of different types. For example, the line card connectors 200 and 208 may include a plurality of receptacles such that it may receive multiple numbers of intermediate connectors. As an example, the line card connector 200 may receive one, two, or three intermediate connectors.

[0016] Figure 2B shows a blade sub-enclosure implementation where the connector housings each include two intermediate connectors. There are two system connectors in communication with two line card connectors. For example, the blade sub-enclosure may be configured such that two receptacles in each of the connector housings include intermediate connectors. The connector housings may include additional receptacles in which intermediate connectors are not attached.

[0017] The system connector 221 communicates with the intermediate connector 212 in the connector housing 211 via the connection mechanism 214, and communicates with the intermediate connector 216 in the connector housing 217 via the connection mechanism 210. For example, the system connector 221 may be disposed apart from the intermediate connectors such that a connection mechanism is used to communicate between the system connector 221 and the intermediate connectors. The system connector 222 communicates with the intermediate connector 213 in the connector housing 211 via the connection mechanism 215 and communicates with the intermediate connector 218 in the connector housing 217 via the connection mechanism 220. The connection mechanisms 214, 210, 215, and 220 may be, for example, cable wiring harnesses. The intermediate connectors 212 and 213 may removably attach to the line card connector 209, and the intermediate connectors 216 and 218 may removably attach to the line card connector 210.

[0018] Figure 2C shows a blade sub-enclosure implementation where the connector housings each include three intermediate connectors such that three system connectors are in communication with two line cards. For example, the system

may be configured such that three receptacles in each of the connector housings include intermediate connectors. The connector housings may include additional receptacles in which intermediate connectors are not attached. The receptacles may form a row or column in which to attach intermediate connectors.

[0019] The system connector 239 communicates with intermediate connector 225 in connector housing 228 via connection mechanism 232, and communicates with intermediate connector 230 in connector housing 229 via connection mechanism 236. The system connector 240 communicates with intermediate connector 226 in connector housing 228 via connection mechanism 234, and communicates with intermediate connector 231 in connector housing 229 via connection mechanism 237. The system connector 241 communicates with intermediate connector 227 in connector housing 228 via connection mechanism 235, and communicates with intermediate connector 232 in connector housing 229 via connection mechanism 238. The intermediate connectors in the connector housing 228 removably attach to line card connector 223, and the intermediate connectors in the connector housing 229 removably attach to the line card connector 224.

[0020] Figure 2D shows a blade sub-enclosure system with a housing connector that includes options for different types of intermediate connectors. For example, the housing connector may include a first row of receptacles for optical connectors and a second row of receptacles for electrical connectors. The connector housing may receive multiple optical and electrical intermediate connectors, and the connector housing may function with some of the receptacles not including an intermediate connector. For example, the connector housing 247 includes optical intermediate connector 249 and electrical intermediate connectors 250, 251, and 252, and the connector housing 248 includes optical intermediate connector 253 and electrical intermediate connectors 254, 255, and 256. Similarly, a line card connector may removably receive both electrical and optical intermediate connectors. For example, line card connector 241 includes optical intermediate connector area 242 and electrical intermediate connector area 243, and line card connector 244 includes optical intermediate connector area 245 and electrical intermediate connector area 246. Line card connector 241 may mate with connector housing 247, and line card connector

244 may mate with connector housing 248.

[0021] The system connectors may communicate with different types of intermediate connectors. For example, the system connectors 265 and 267 communicate with optical intermediate connectors, and system connectors 266, 268, and 269 communicate with electrical intermediate connectors. The system connector 265 communicates via connection mechanism 257 with optical intermediate connector 249. The system connector 266 communicates via connection mechanism 258 with electrical intermediate connector 250, and via connection mechanism 261 with electrical intermediate connector 254. The system connector 267 communicates via connection mechanism 262 with optical intermediate connector 254. The system connector 268 communicates via connection mechanism 259 with electrical intermediate connector 251, and via connection mechanism 263 with electrical intermediate connector 255. The system connector 269 communicates via connection mechanism 260 with electrical intermediate connector 252, and via connection mechanism 264 with electrical intermediate connector 256.

[0022] Figure 3 is a diagram illustrating one example of communicating between a system connector and line card connector via intermediate connectors. The system connector 300 communicates with intermediate connectors 303 and 304 via connection mechanisms 301 and 302. The connection mechanisms may be, for example, cable wiring harnesses. The intermediate connectors 303 and 304 may be mated with line card connectors 307 and 308. The line card connector 307 includes alignment feature 309, and line card connector 308 includes alignment feature 310. The alignment features 309 and 310 may be alignment pins or other features that allow the line card connectors 307 and 308 to securely receive intermediate connectors. The intermediate connectors are included in connector housings 305 and 306 that include an alignment feature to align with the alignment features 309 and 310. For example, the alignment features 309 and 310 may be protrusions, and the connector housings 305 and 306 may include slots to receive the protrusions, or vice versa. The alignment feature may facilitate the mating of intermediate connectors in a connector housing to a line card connector. A connector housing allowing for a variable number of intermediate connectors to connect a line card connector a system

connector may provide modularity after the time of manufacture.

CLAIMS

1. A blade sub-enclosure, comprising:
 - a first system connector;
 - a first connector housing disposed apart from the system connector, the first connector housing to removably receive a first set of intermediate connectors, wherein a first line card connector of a first line card removably couples with the first set of intermediate connectors;
 - a second connector housing disposed apart from the first system connector and the first connector housing to removably receive a second set of intermediate connectors, wherein a second line card connector of a second line card removably couples with the second set of intermediate connectors; and
 - wherein a first one of each of the first set of intermediate connectors and the second set of intermediate connectors is in communication with the first system connector.
2. The blade sub-enclosure of claim 1, further comprising:
 - a second system connector; and
 - wherein a second one of each of the first set of intermediate connectors and the second set of intermediate connectors is in communication with the second system connector.
3. The blade sub-enclosure of claim 1, wherein the first set of intermediate connectors and the second set of intermediate connectors are at least one of optical connectors or electrical connectors.
4. The blade sub-enclosure of claim 1, wherein the first system connector includes a blind mate connector.
5. The blade sub-enclosure of claim 1, wherein the first set of intermediate connectors includes an electrical connector and an optical connector.

6. The blade sub-enclosure of claim 1, wherein the first connector housing includes a first housing alignment member to engage a first line card alignment member of the first card connector and the second connector housing includes a second housing alignment member to engage a second card alignment member of the second line card connector.

7. The blade sub-enclosure of claim 6, wherein the first housing alignment member and the second housing alignment member are protrusions and the first card alignment member and the second card alignment member are slots to receive the respective protrusions.

8. The blade sub-enclosure of claim 1, further comprising
a first wiring harness to connect the first system connector to a first one of each of the first set of intermediate connectors and the second set of intermediate connectors.

9. A blade system, comprising:
a blade enclosure including a plurality of blade sub-enclosures to receive a plurality of line cards, each blade sub-enclosure including a rear bulkhead and an intermediate bulkhead disposed across from the rear bulkhead;
a first system connector at the rear bulkhead;
a connector housing at the intermediate bulkhead to removably receive a first set of intermediate connectors, wherein a first line card connector of a first line card removably couples with the first set of intermediate connectors;
a second connector housing at the intermediate bulkhead to removably receive a second set of intermediate connectors, wherein a second line card connector of a second line card removably couples with the second set of intermediate connectors;
and

wherein a first one of each of the first set of intermediate connectors and the second set of intermediate connectors is in communication with the first system connector.

10. The blade system of claim 9, further comprising:

a second system connector; and

wherein a second one of each of the first set of intermediate connectors and the second set of intermediate connectors is in communication with the second system connector.

11. The blade system of claim 9, wherein the first set of intermediate connectors includes an electrical connector and an optical connector.

12. The blade system of claim 9, wherein the first connector housing includes a first housing alignment member to engage a first card alignment member of the first card connector and the second connector housing includes a second housing alignment member to engage a second card alignment member of the second card connector.

13. The blade system of claim 9, further comprising

a first wiring harness to connect the first system connector to a first one of each of the first set of intermediate connectors and the second set of intermediate connectors; and

a second wiring harness to connect the second system connector to a second one of each of the first set of intermediate connectors and the second set of intermediate connectors.

14. A blade sub-enclosure, comprising:

a connector housing to removably receive a set of intermediate connectors,

wherein each of the intermediate connectors is in communication with a line card connector and a system connector,

wherein the line card connector is in communication with a line card and wherein the system connector is in communication with a blade enclosure backplane.

15. The blade sub-enclosure of claim 14, wherein the set of intermediate connectors includes an electrical intermediate connector and an optical intermediate connector.

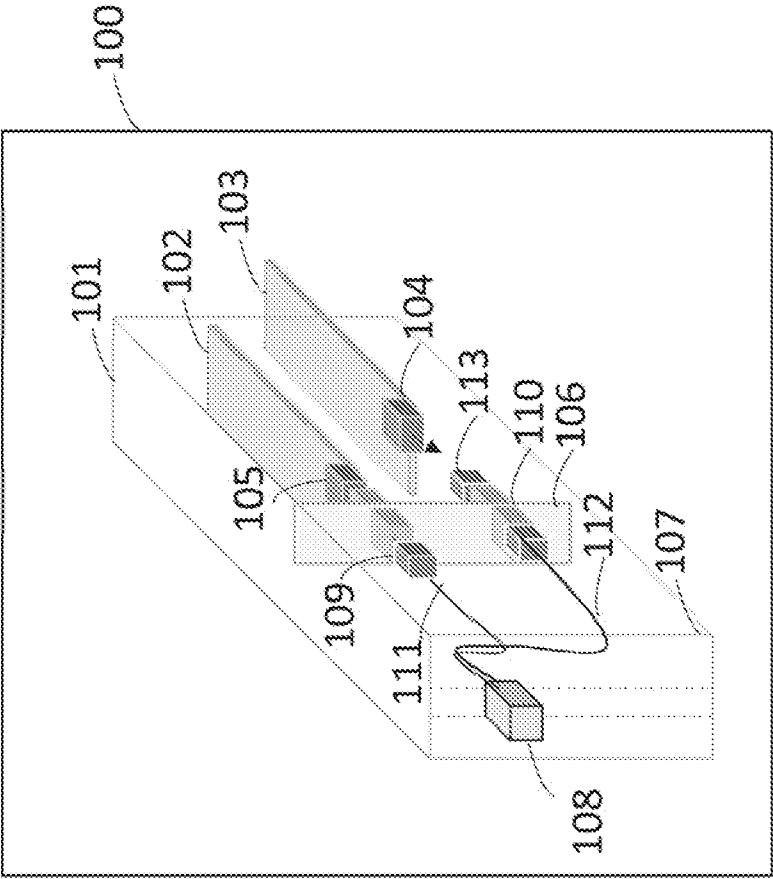


FIG. 1

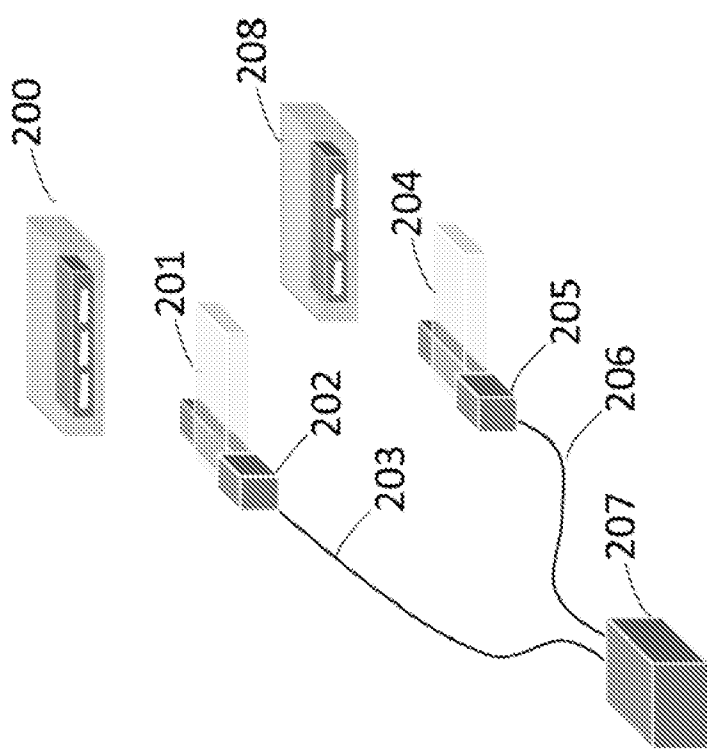
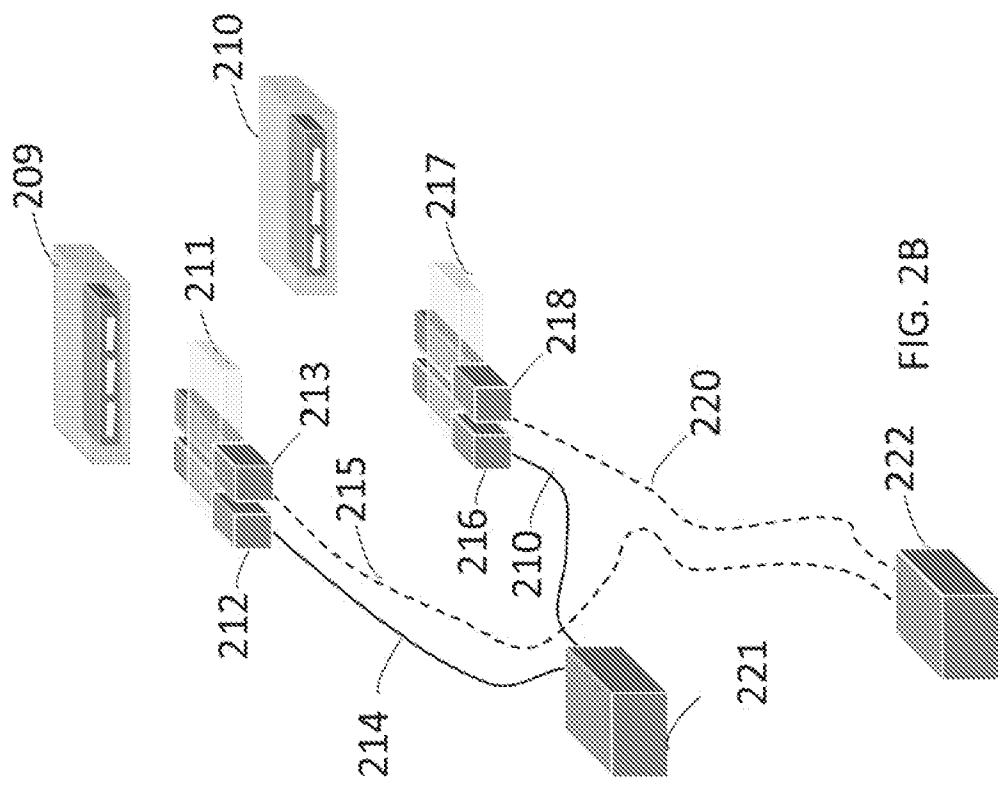


FIG. 2A



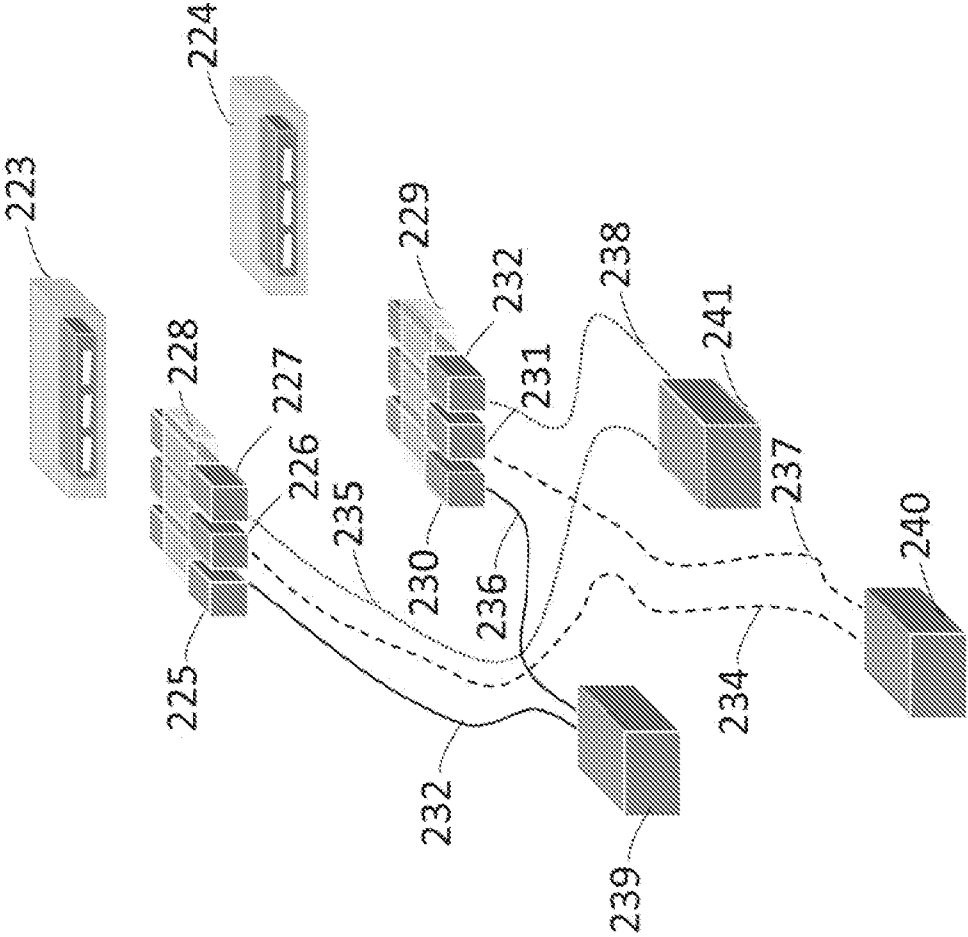
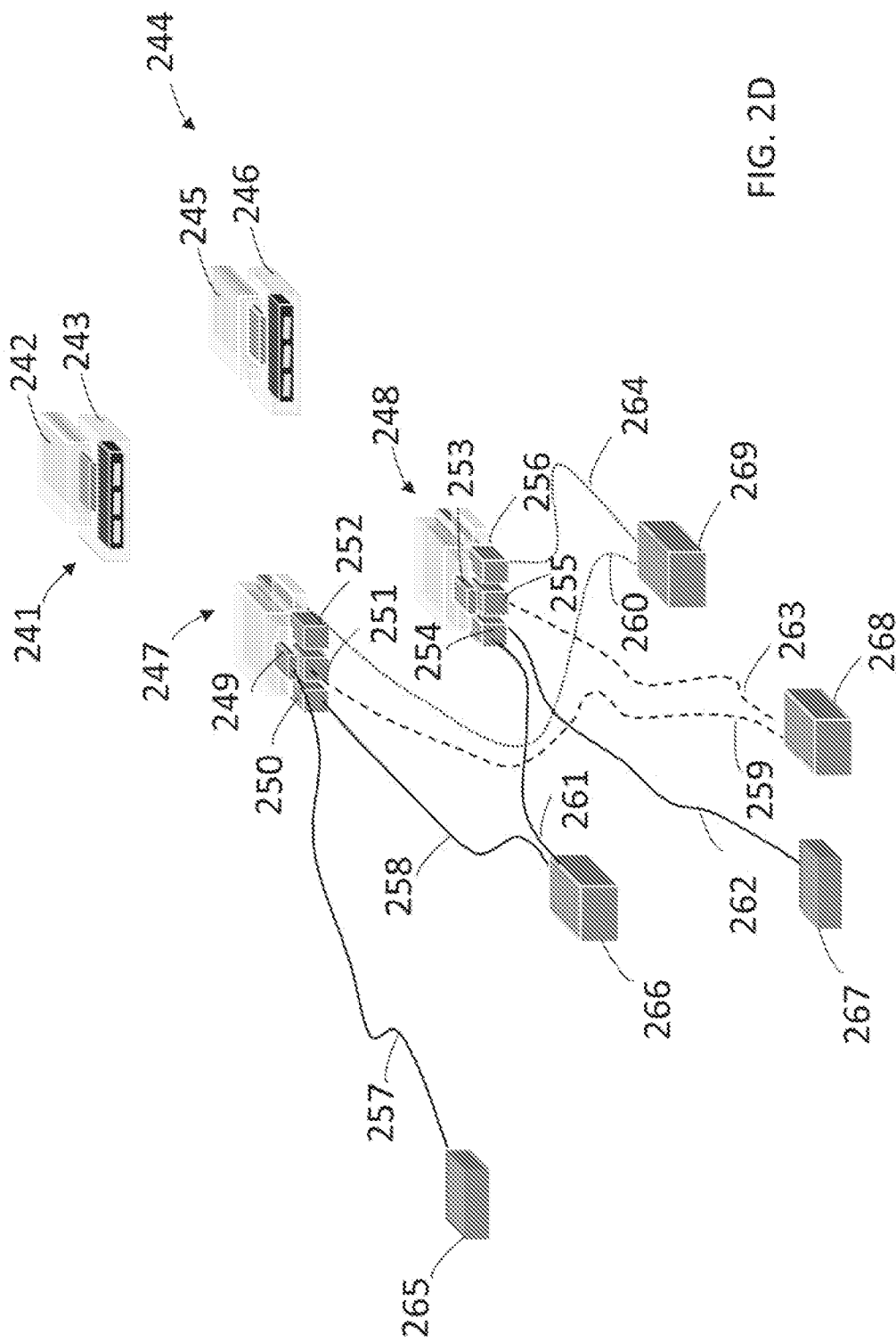


FIG. 2C



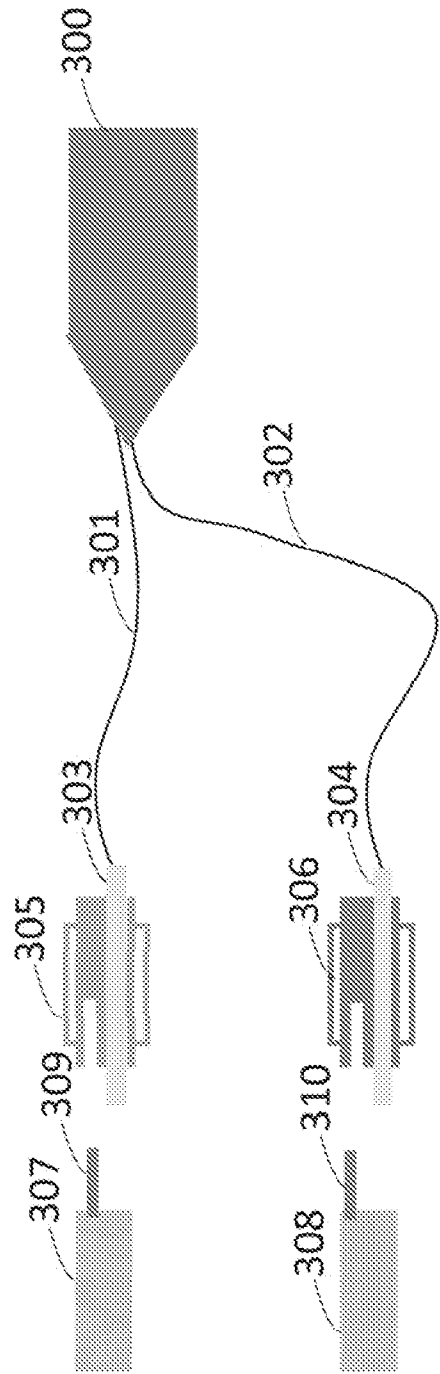


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/016162**A. CLASSIFICATION OF SUBJECT MATTER****G02B 6/36(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G02B 6/36; G06F 11/30; G06F 15/173; H01R 43/00; G02B 6/38; G02B 6/46; G06F 13/00; G01R 31/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: blade, sub-enclosure, intermediate connector, line card

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2005-0050272 A1 (BEHRENS et al.) 03 March 2005 See abstract, paragraphs [0045]-[0082] and figures 2-16.	1-15
Y	WO 2013-137870 A1 (HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P.) 19 September 2013 See abstract, paragraphs [0015]-[0016] and figure 1.	1-15
A	US 2006-0026325 A1 (HUANG et al.) 02 February 2006 See figures 2-4.	1-15
A	US 2014-0002101 A1 (ZIOTA TECHNOLOGY INC.) 02 January 2014 See figures 2-5.	1-15
A	US 2008-0162691 A1 (ZHANG et al.) 03 July 2008 See figures 1-3.	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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"&" document member of the same patent family

Date of the actual completion of the international search

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Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 35208,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

KANG, Sung Chul

Telephone No. +82-42-481-8405



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/016162

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