

IBM Intelligent Cluster / 1350 / iDataPlex Cabling Best Practices

This document is best viewed in color to receive the full benefits of the photos.

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Revision History

11/09/10 **10B Updates**

Added IBM J48E, J08E and J16E, Mellanox IS5100 and IS5300, Voltaire 4200

05/05/10 **10A Updates**

Added Mellanox InfiniBand, Force10 E600i / E1200i

10/29/09 **9B Updates**

Added, Hyper Scale CXP Bend radius reference, Voltaire 4700 Hyper Scale cable plug reference, Voltaire 8500, IBM (Brocade) RX08, RX16 cabling reference.

7/29/09 **Fiber InfiniBand / 10 GB Ethernet Guidelines iDataPlex**

Added instructions for running fiber uplink cables from leaf switch to core switch in iDataPlex.

Planning

Understanding the cluster configuration is important in setting up your cable strategy. Please obtain the CPOM Step 3 file and review prior to installation. This Document contains Cluster rack and content image, Complete cabling to and from listing including PDU line cord power connection photos, Cluster BOM and other valuable information in planning the cluster installation.

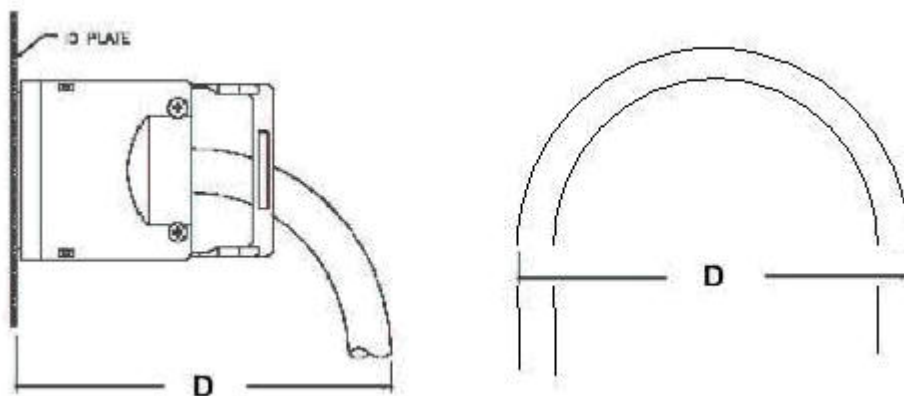
Meet your Customer so that you may clearly understand their expectations and requirements.

Cable handling is important to our customers and the performance of the product being delivered. Below are examples of cable handling and installation expectations that must be observed.

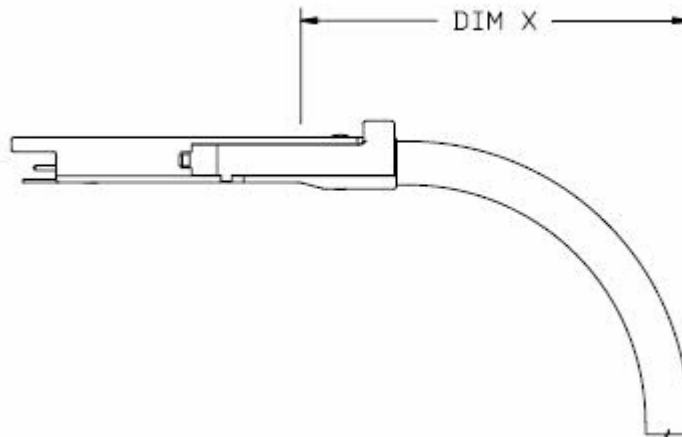
- Cable bend radius chart for quick reference.

Cable Type	Minimum Bend Radius	Should cable management arms be used?
Cat5 Ethernet	1" or 25mm	Yes
LC or Myricom 10Gb Fiber	1" or 25mm	Yes
Infiniband 26 AWG	2.75" or 70MM	No
Infiniband 28 AWG	2.28" or 58MM	No
InfiniBand 30 AWG	1.98" or 50MM	No
10GB SFP+ Ethernet 30AWG	1.98" or 50MM	No
10GB SFP+ Ethernet 28AWG	2.36" or 60MM	No

SDR and DDR Copper InfiniBand with CX4 Connector



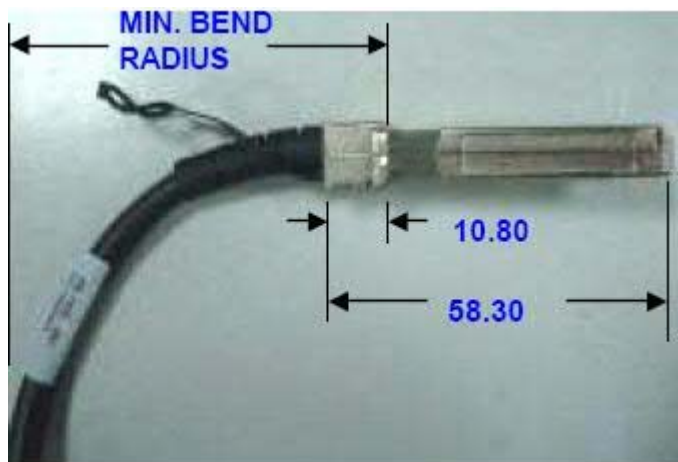
QDR Copper InfiniBand with QSFP Connector



WIRE AWG	DIM X
30 AWG	1.98"
30 AWG EXD	2.13"
28 AWG	2.28"
27 AWG EXD	2.43"
26 AWG	2.43"
26 AWG EXD	2.71"

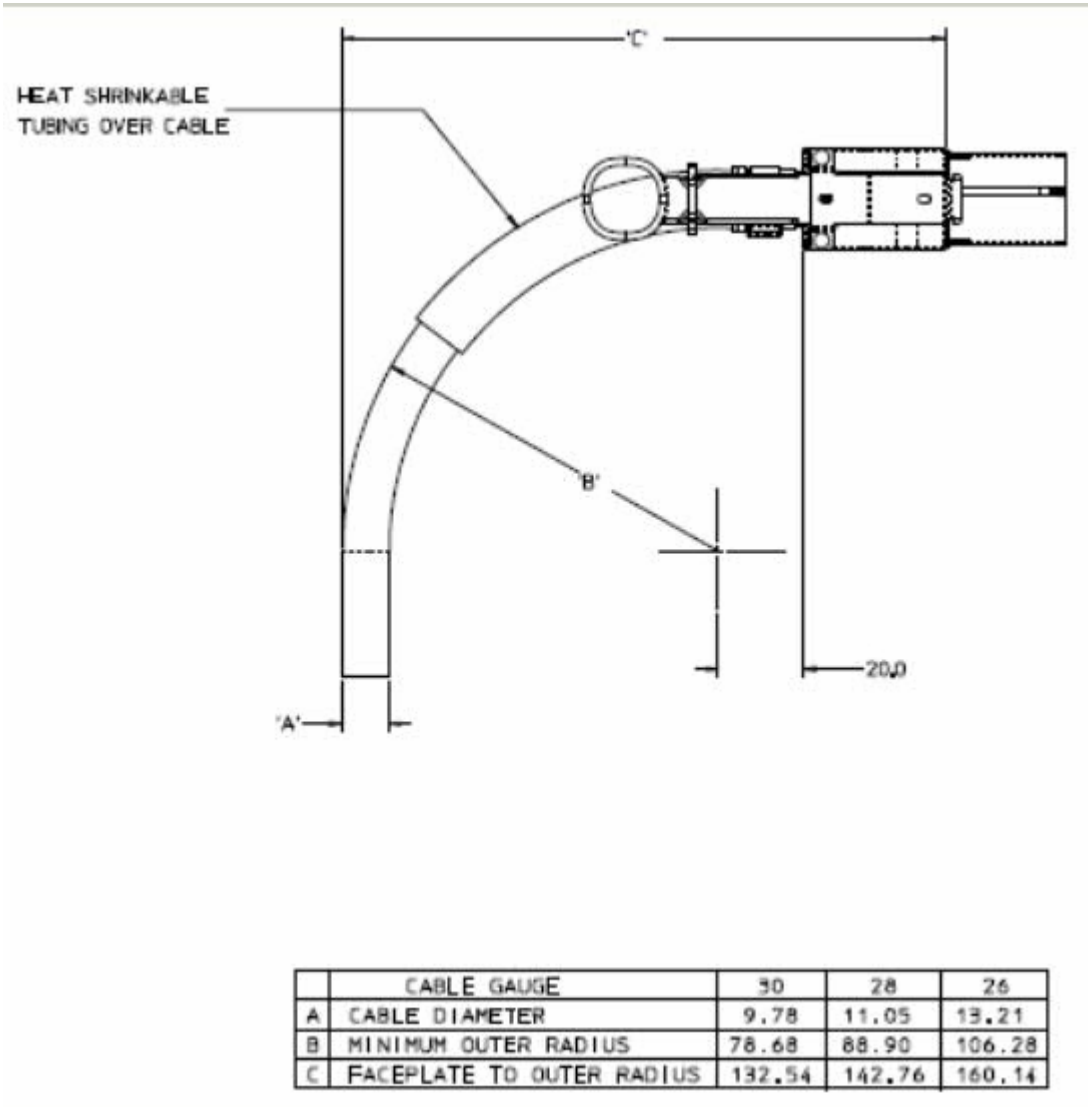
SFP+ Copper 10GB Ethernet

24 AWG	80MM Min Bend Radius (7M, 10M)
26 AWG	70MM Min Bend Radius
28 AWG	60MM Min Bend Radius
30 AWG	50MM Min Bend Radius (0.5m, 1M and 3M)



- Do not kink InfiniBand or 10GB Ethernet cables.
- Do not over bend InfiniBand or 10GB Ethernet cables.
- Do not twist InfiniBand or 10GB Ethernet connectors.

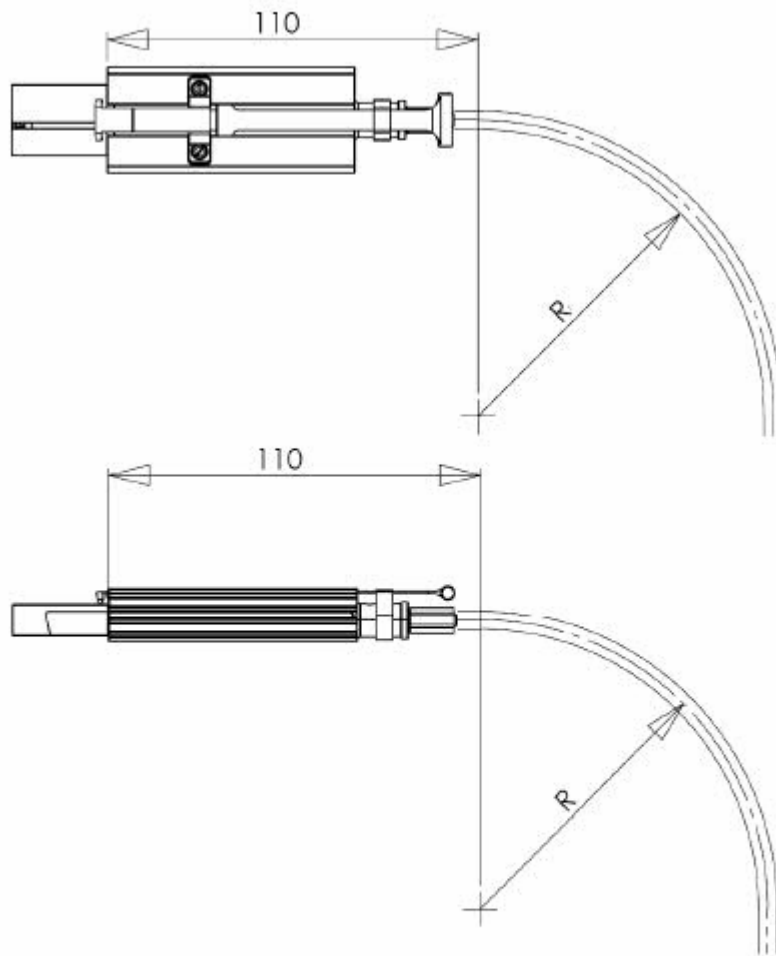
Hyper Scale CXP Copper InfiniBand Cable



- Do not kink InfiniBand or 10GB Ethernet cables.
- Do not over bend InfiniBand or 10GB Ethernet cables.
- Do not twist InfiniBand or 10GB Ethernet connectors.

Hyper Scale CXP to CXP and CXP to QSFP Fiber InfiniBand Cable

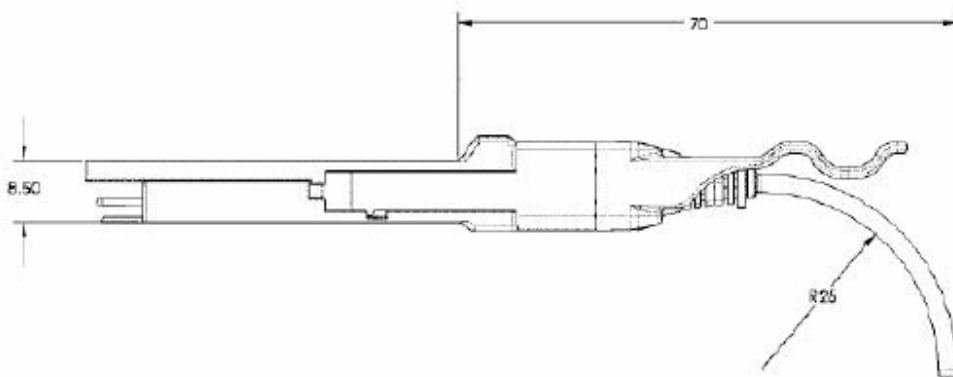
“Bending Radius” guidelines of MergeOptics AOC



Condition	Minimum Bending Radius "R"
Service / Installation	85 mm
Normal Operation	120 mm

IB Fiber Optic Cable Bend Radii	
Cable Type	Bend Radius
Fiber Optic Standard Cable	25 millimeters NOTE: A 50mm diameter is the smallest circle limit

Figure 1-2 Fiber Optic Bend Radius



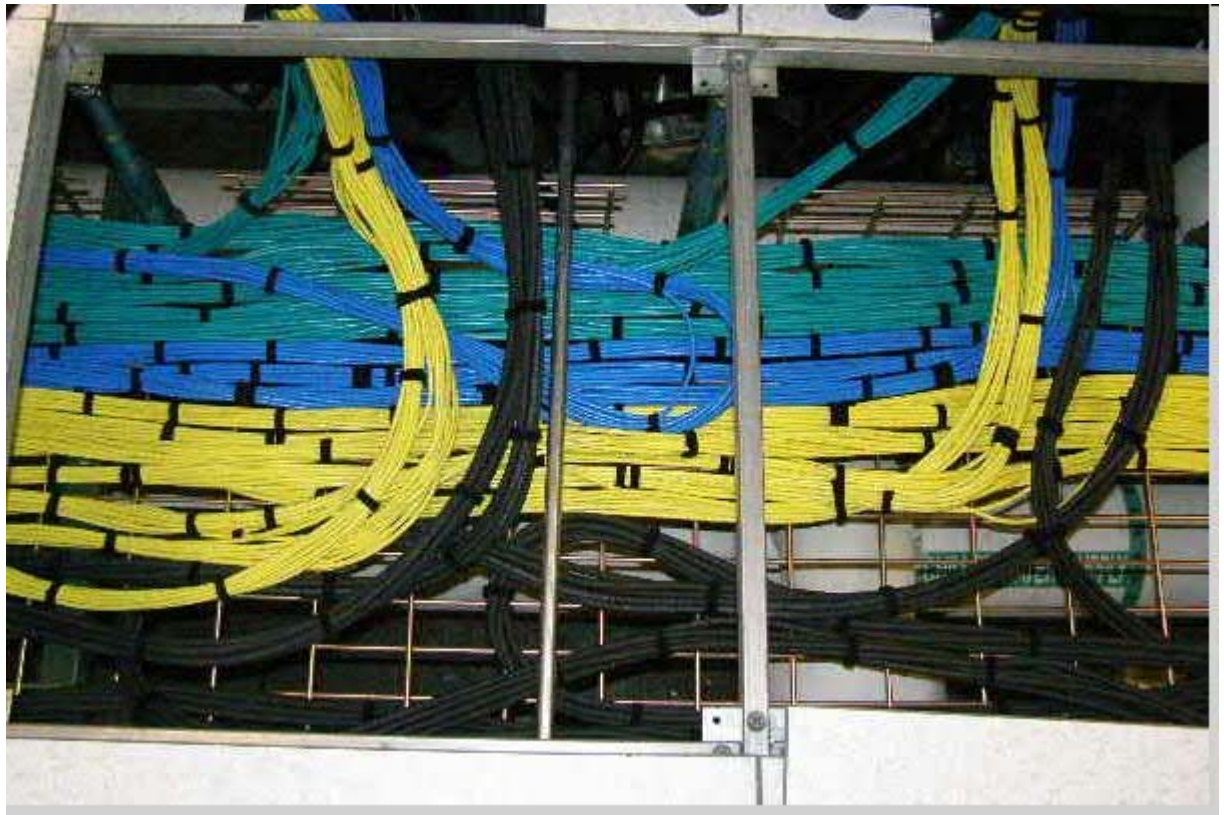
- Surplus Cable management.
Excess cable should be looped in a “U” under floor or in cable trays and not coiled in a circle.

The customer will need to supply the following:

- Floor layout so that you may become familiar with it.
- Rack configuration on raised floor.
- Raised floor and beneath raised floor environment including depth and obstacles that may need to be considered before routing cables. Trays, safety devices (smoke detectors and water sprinklers), plumbing, and existing cables are a few examples.

Examples of proper below floor cable routing and excess cable management can be seen below.





Some installations require above rack cable routing. You need to understand what obstacles are imposed here as well. Establish a specific area for InfiniBand, Cat5, and fiber cables

It is highly recommended that you route InfiniBand cables before the Cat5 and Fiber cables. This ensures the lighter cabling is on top of the heavier InfiniBand cables.

This also makes it easier to install the InfiniBand cables into the racks and will allow for maximum working space within rack cabling areas. It is recommended you loop cables in half and pull them under the floor by the looped end being cautious not to bend beyond cable bend limitations.

InfiniBand and SFP+ Cabling Guidelines

To avoid damage to the InfiniBand cables, follow these guidelines:

- Route cables where they will not be snagged by other devices in the rack or raised floor
- Do not over tighten the cable straps or bend the cables to a diameter smaller than 5.5 inches. (Equal to 2.5" radius). (See figure below. Distance 'D' equals 4 inches).
- Do not put excess weight on the cable at the connection point and be sure that it is well supported
- Do not leave cables on the floor where they can be damaged by carts or foot traffic.
- Provide appropriate strain relief.

Cabling InfiniBand and 10Gb E Switch End

InfiniBand Switch Configuration

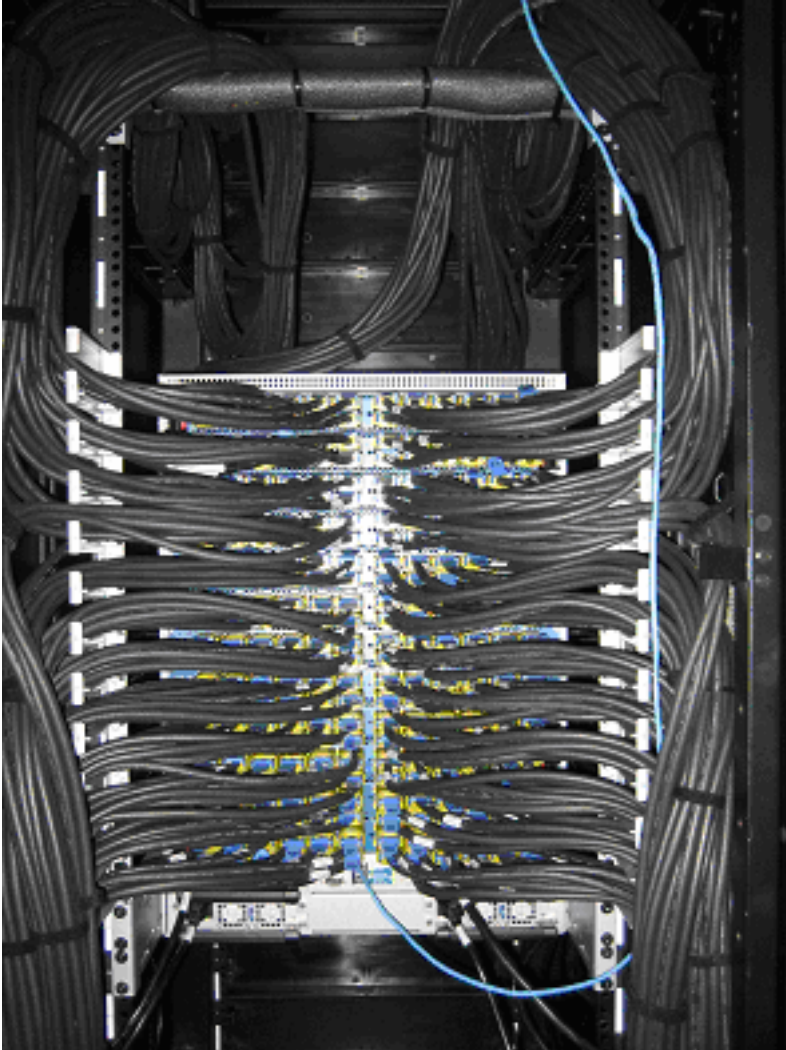
- Split the switch in half vertically down the middle and run cables between the frame and cable management brackets up left and right sides.
- Remove all cable Flag Tags from Switch end of cable. Cable InfiniBand switch from bottom slot 12 through top slot 1. Secure cables to sides of frame using Velcro. The below images demonstrate what the cables should look like when properly routed.
- With cables needing to be run at different lengths to facilitate InfiniBand line card slot port locations, loop excess beneath rack neatly considering cable bend limitations.
- Keep in mind that space will become limited as you begin to fill all pluggable locations on the switch line cards. It is recommended that you position the excess loops under floor or in tray above as far away from the switch rack as possible. Redressing the cable bundle neatly will help with limited space on fully configured switched.

Note: If more than 240 InfiniBand cables are in the configuration. It is recommended you route the cables through the top of the rack to facilitate ease of serviceability. You may also want to consider less than 240 through the bottom of the switch rack depending on the customer's requirements

- It is recommended that the rack rails that overlap with the 12U of the ISR 9288 IB connectors not be used for PDU or power inlets.
- It is recommended that you install cable management brackets on the rear rail of the rack.

Cabling Core InfiniBand and 10Gb E Switches

The following photo is an example of proper cable routing and how to merge cables into the switch.



Cabling Rack Side InfiniBand

Blade Center Configuration and 1U InfiniBand Switch

- Cables should be bundled in groups of 8 or less and should run up each side of the rack to the Blade Center pass through module. Seven to eight run up left side to pass through module or 1U switch left side ports to and seven to eight up rack right side to pass through module or 1U switch right side ports working from outside towards the center ports. This eliminates excess cable lengths and reduces cable sagging over time. Start at the bottom Blade Center unit and work to the top.
- Cables should be neatly looped into place as to not apply any pressure up down or side to side on module / switch ports.
- Cable bundles should be dressed neatly and fastened to the frame sides using Velcro. When using cable of different lengths, loop excess beneath raised floor or in over head trays neatly considering cable bend limitations.



Cabling Rack Side InfiniBand

Blade Center Configuration and 1U InfiniBand Switch

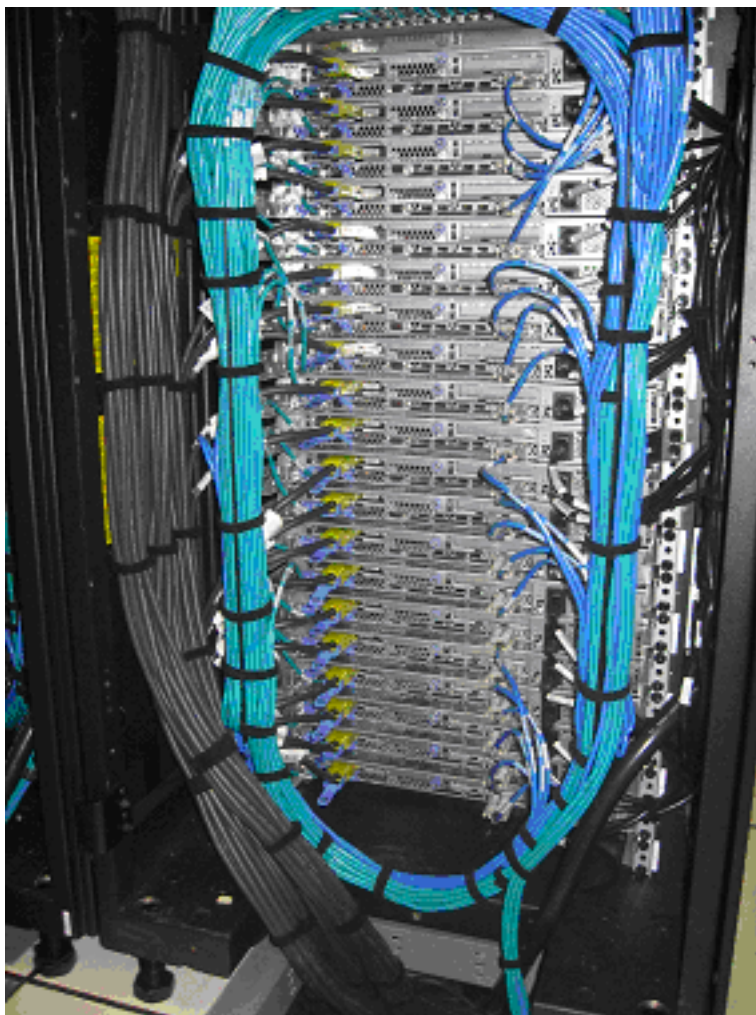


1U, 2U, and 3U Server Configuration

Server Configuration

Cables should be bundled in groups of 10 or less for easily handling. Route cable bundles up the left side of the rack through the cable retention brackets (if installed) and to the server. Plug the InfiniBand cable into the lowest port number or P1 of the server adapter card.

The cable should be routed through the cable management bracket towards the inside of the rack. Use the rack cable retention slots to fasten Velcro to maintain positive retention of cables. (See picture below.)



1U, 2U, and 4U Server Configuration

The following shows a properly cabled server configuration using cables of different lengths to facilitate plugging into each server location.

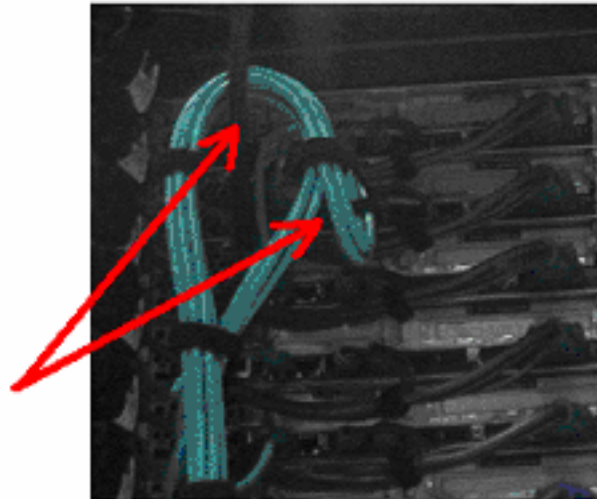


Cat5E Guidelines

To avoid damage to the Ethernet cables, follow these guidelines:

- Route the cable away from places where it can be snagged by other devices in the rack or raised floor.
- Do not over tighten the cable straps or bend the cables to a radius smaller than (1 in.).
- Do not put excess weight on the cable at the connection point and be sure that it is well supported.
- Route Ethernet cables away from power cables.

Maintain minimal 1" radius on any Ethernet cable bending

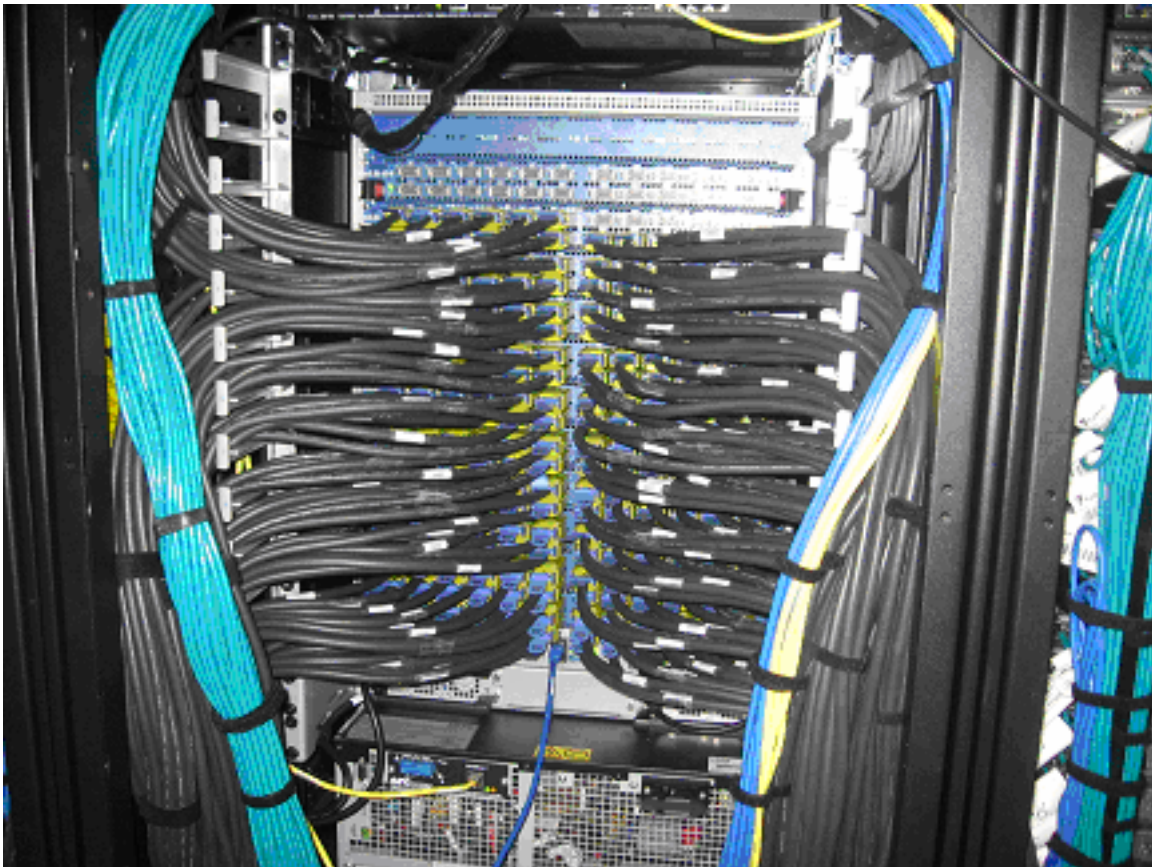


- When attaching to a device on slides, leave enough slack in the cable so that it does not bend to a radius smaller than 50 mm (2 in.) when extended or become pinched when retracted.
- Route the cable away from places where it can be snagged by other devices in the rack or raised floor.
- Do not over tighten the cable straps or bend the cables to a radius smaller than 50 mm (2 in.).
- Do not put excess weight on the cable at the connection point and be sure that it is well supported.

Routing Cat5 E Ethernet Cables

Compute rack configuration:

- Cat5 E cables from the compute rack to the network rack should be coiled in the compute rack and routed under the floor or over the racks in trays.
- It is recommended that you start with the rack furthest from and work towards the network rack.
- Loop excess cables in as large a loop as possible within the tray when routing above rack or in as large a loop as possible when below a raised floor.
- When routing cables into the network rack, it is recommended you follow the same cabling scheme as in the compute racks. Green on left, blue and yellow on right looking at the back of the rack. See photo below.



Example of proper Force10 E300 and E1200 cable routing to facilitate serviceability:

E300

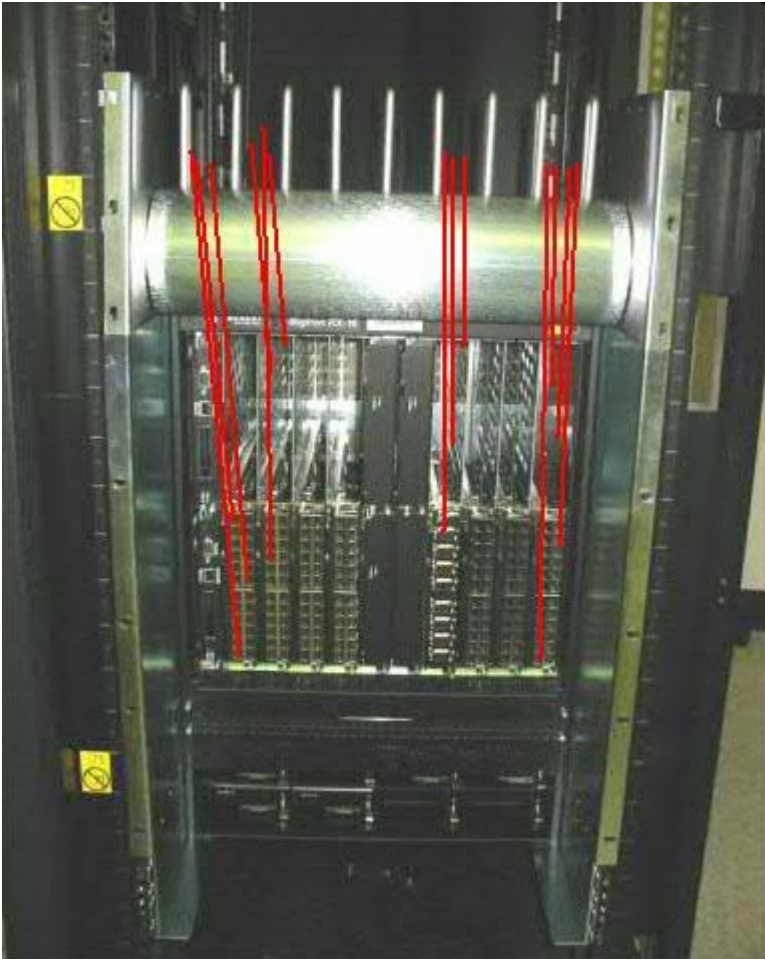


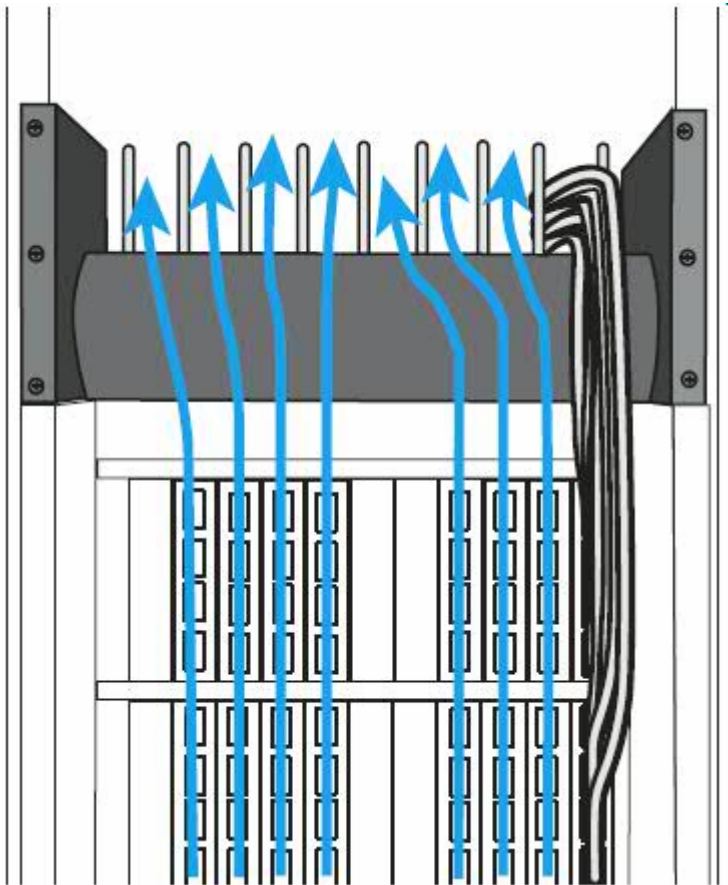
E600, E600i / E1200, E1200i



IBM Ethernet Switch B16R Bundle

Line cards are positioned in a vertical manner with ports facing 1410 rack front (cold aisle) side and IO cables are run vertically up through and secured to cable management comb (bracket) with Velcro, over the switch chassis and then left and right fastening to the rack rear cable management loops on rack left and right sides then down through rack bottom.





IBM Ethernet Switch B08R Bundle

Line cards are positioned in a horizontally manner with ports facing rack rear (hot aisle) side and IO cables are left and right fastening to the rack rear cable management loops on rack left and right sides then down through rack bottom or upward through rack top.



IBM Ethernet Switch J08 and J16 Bundle (Juniper EX8208 and EX8216)

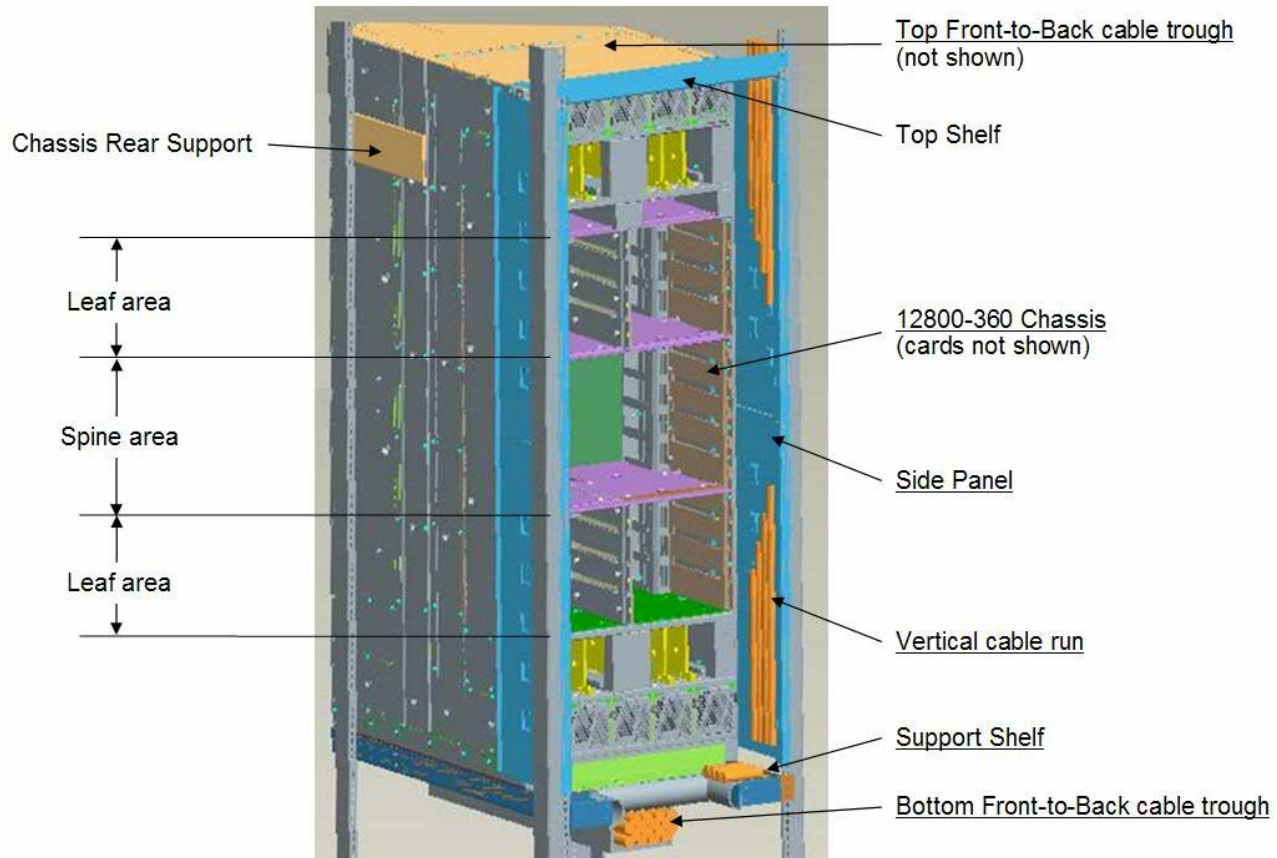
Line cards are positioned in a horizontally manner with ports facing rack rear (hot aisle) side and IO cables are left and right fastening to the rack rear cable management loops on rack left and right sides then down through rack bottom or upward through rack top.



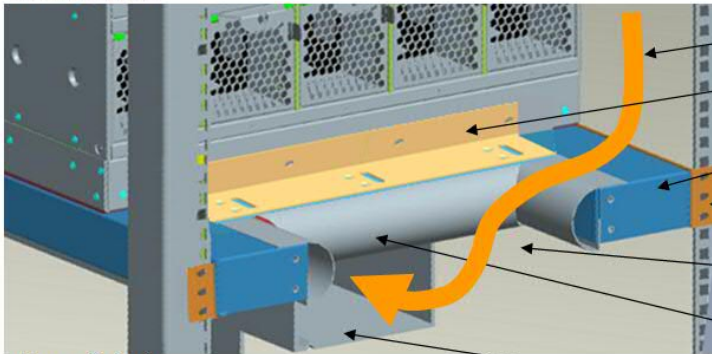
Qlogic 12800 360 864 Port InfiniBand Switch

- Cables should be routed from rack / switch front side ports starting with leaf card slot L201, L203, L205, L207 down left front side , through switch bottom cable trough then to designated rack exit (Top or Bottom). Proceed to leaf slot L202, L204, L206, L208 down right front side, through switch bottom cable trough then to designated rack exit (Top or Bottom)
- Cables should be routed from rack / switch upper front side leaf card slot L219, L221 L223, L225 up left front side, over top through cable trough then up or down rack back left side to designated rack exit (Top or Bottom). Proceed to leaf slot L220, L222, L224, L226 up right front side over top through cable trough then rack back right side to designated rack exit (Top or Bottom).
- Cables should be routed from rack / switch lower rear starting with ports L102, L104, L106, L108, L110 on rack rear right side then up or down to designated rack exit (Top or Bottom). Proceed with ports L101, L103, L105, L107, L109 on rack rear left side up or down to designated rack exit (Top or Bottom).
- Cables should be routed from rack / switch upper rear starting with ports L120, L122, L124, L126, L128 to rack back right side then up or down to designated rack exit (Top or Bottom). Proceed with ports L119, L121, L123, L125, L127 on rack rear left up or down to designated rack exit (Top or Bottom).

Top front



Front of Rack



Cable route

Front Support Bracket

Support Shelf

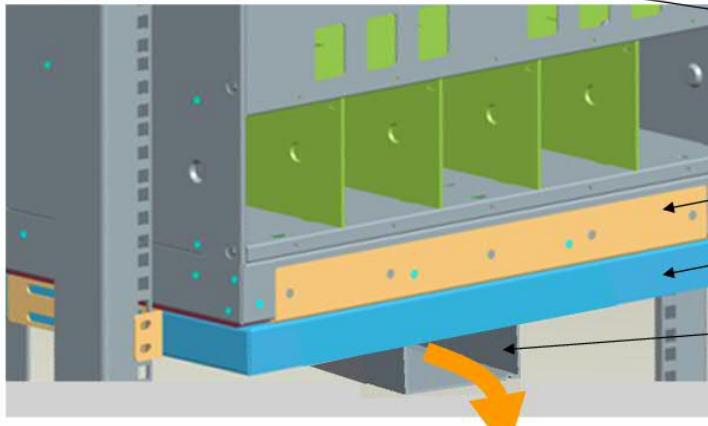
Mounting Bracket

Cable Entry in Support Shelf

Bend Radius Protector

Front-to-Back Cable Trough with Cover

Rear of Rack



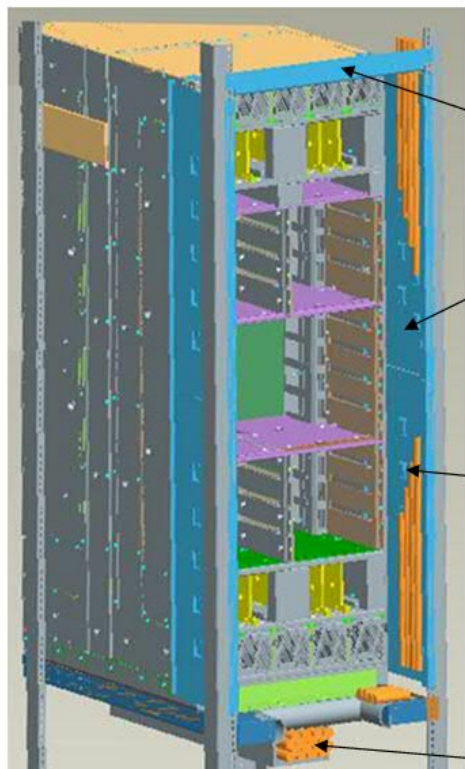
Rear Support Bracket

Support Shelf

Front-to-Back cable Trough
(Bend Radius Protector not shown)

Front of Rack

Front-to-Back cable Trough
(Bend Radius Protector not shown)

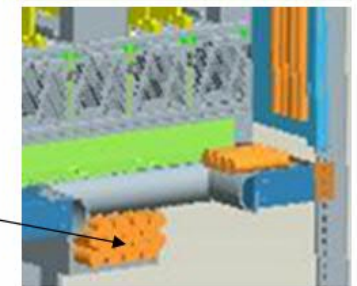
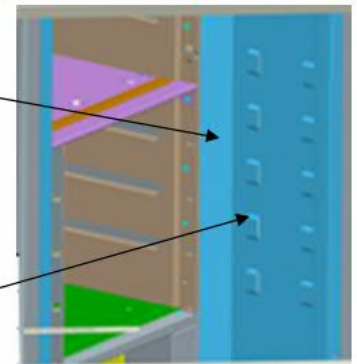
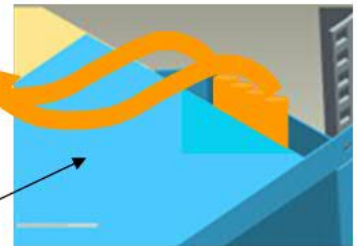


Top Shelf
Fastened to EIA Rails
and top of Chassis

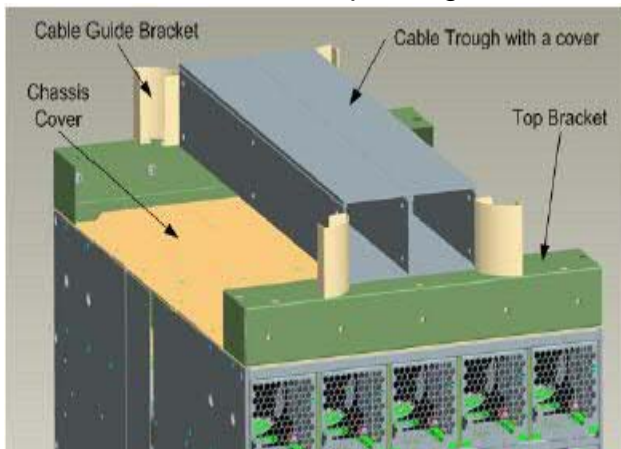
Side Panel
Fastened to front EIA Rails

Bridge forms in Side Panel
for cable tie down

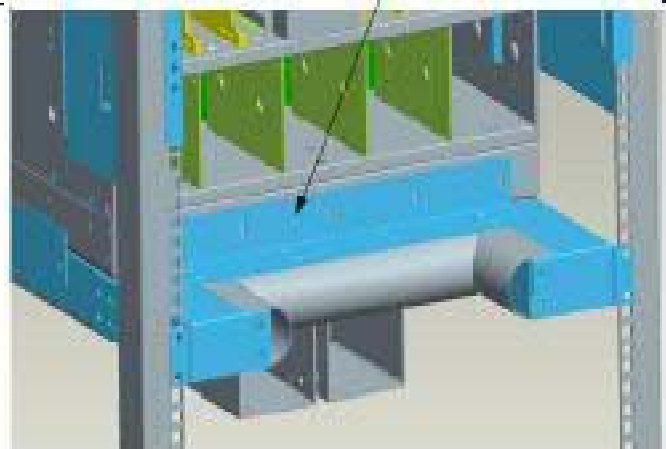
Front-to-Back cable Trough
Fastened to Bottom of
Support Shelf
(Rear Bend Radius
Protector not shown)



Switch Top Trough



Switch Bottom Trough

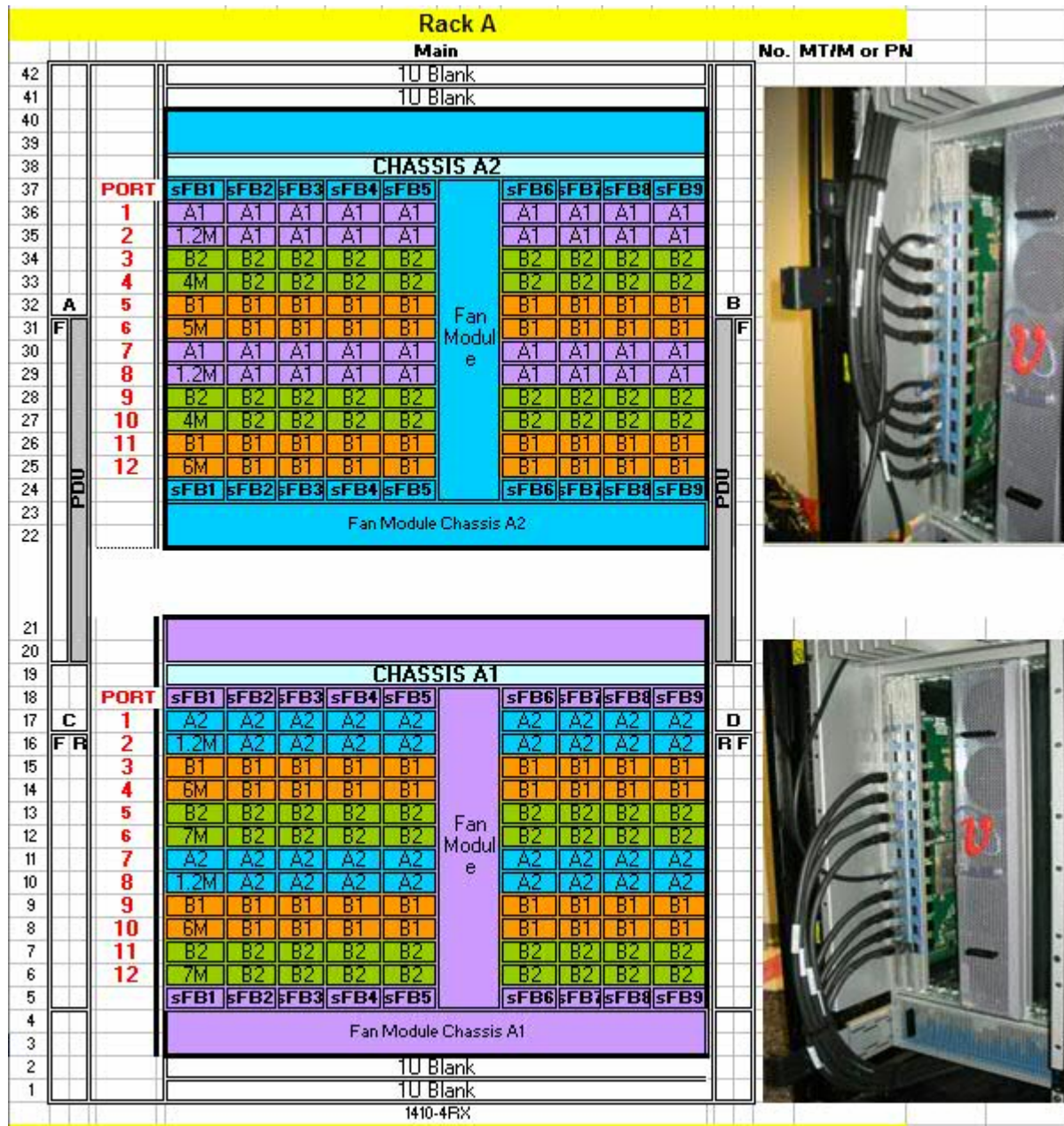


Voltaire 4200

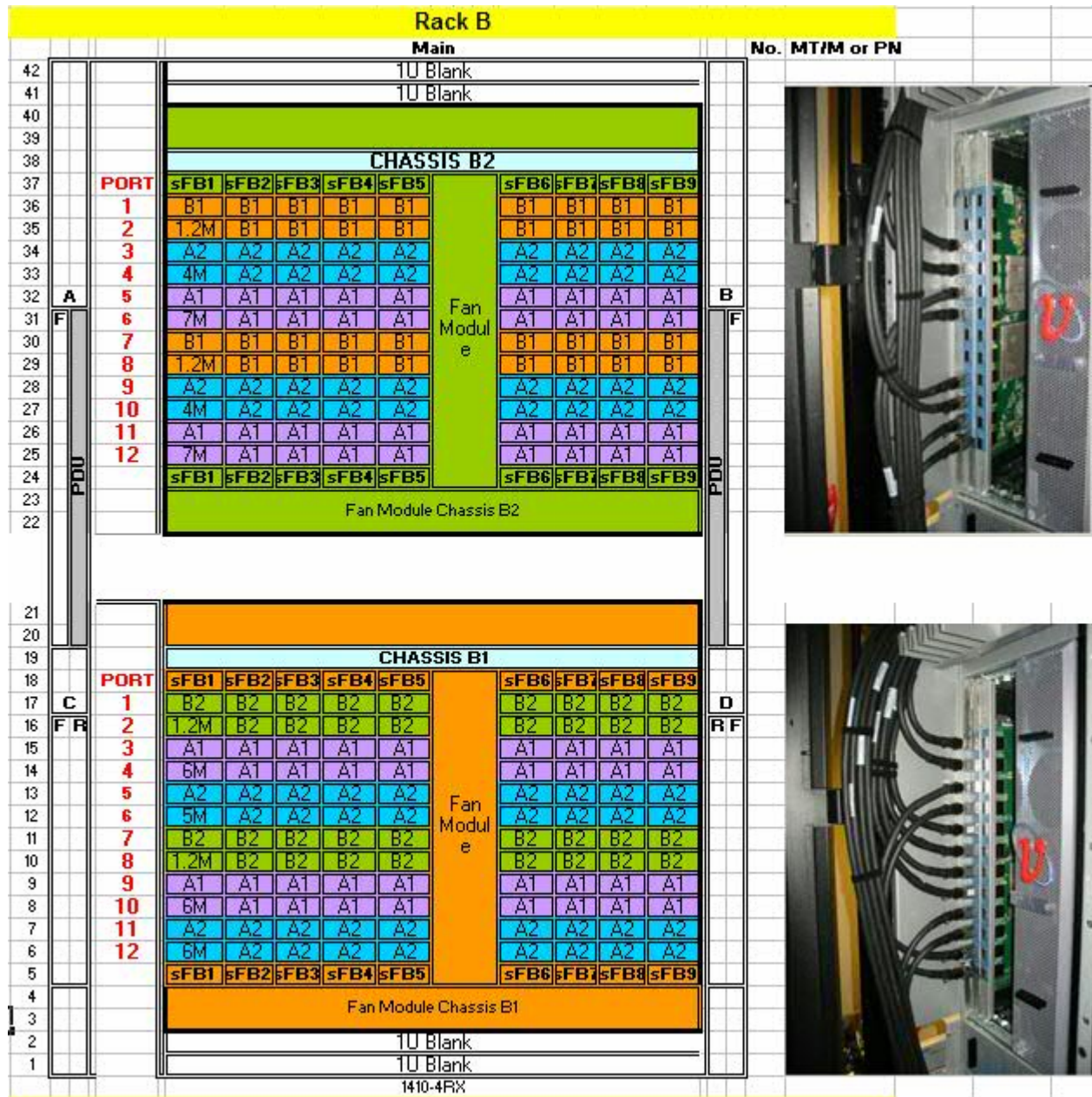
Line cards are positioned in a horizontally manner with ports facing rack rear (hot aisle) side and IO cables are left and right fastening to the rack rear cable management loops on rack left and right sides then down through rack bottom or upward through rack top.



4700 up to 4 in a single 1410 configuration.



Voltaire 4700 up to 4 in a single 1410 configuration.

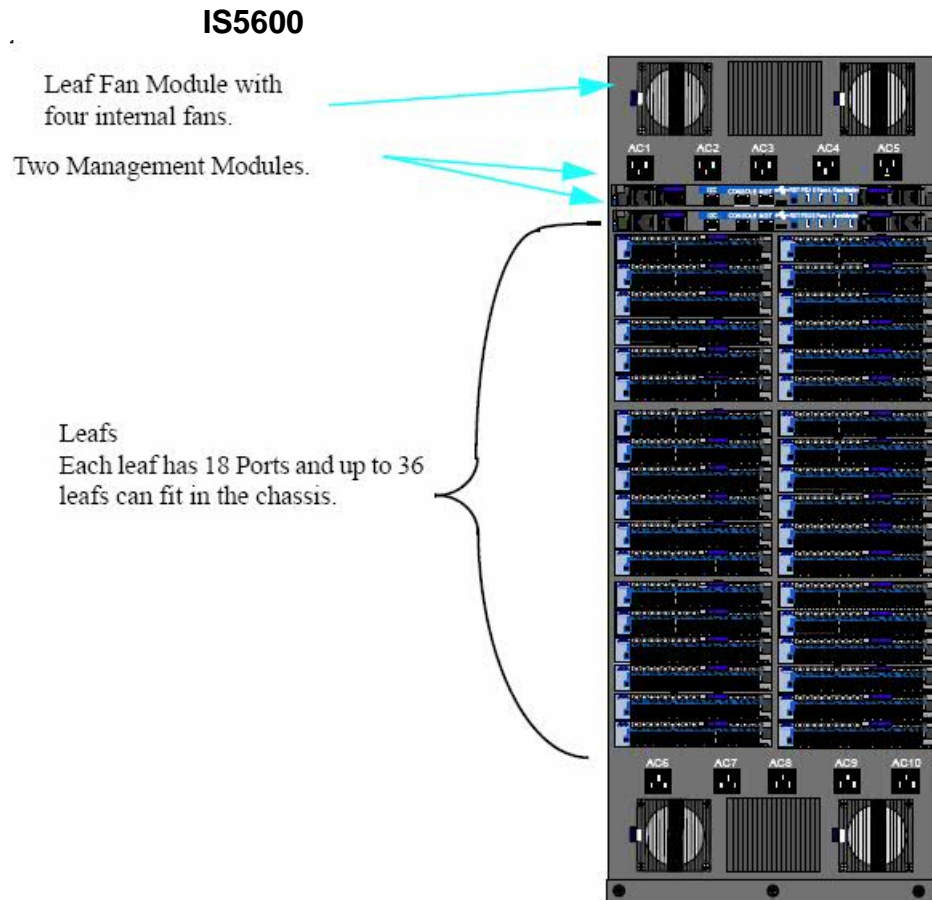


Voltaire 4700 up to 4 in a single 1410 configuration.

- First occurrence within a rack is installed in U3
- Second occurrence within a rack is installed in U22
- PDUs are installed in side pockets AR and BR.
- Rack A Chassis A1 Hyper scale Fabric Board (sFB) CXP cable from Ports 1, 2, 7 and 8 routes to same card and ports in Chassis A2. All other Fabric Board Hyper scale CXP cables from chassis A1 route from rack front under A1 chassis through U1 and U2 and exit rack via rack rear bottom exit port.
- Rack A Chassis A2 Hyper scale Fabric Board CXP cable from Ports 1,2, 7 and 8 route to same card and ports in Chassis A1. All other Hyper scale Fabric Board CXP cables from chassis A2 route from rack front over A2 chassis through U41 and U42 and exit rack via rack rear top exit port.
- Rack B Chassis B1 Hyper scale Fabric Board CXP cable from Ports 1,2, 7 and 8 route to same card and ports in Chassis B2. Hyper scale Fabric Board CXP cable from Ports 3,4,9 and 10 route from rack front under A1 chassis through U1 and U2 and exit rack via rack rear bottom exit port to rack A Chassis A1 same sFB same port. Hyper scale Fabric Board CXP cable from Ports 5,6,11 and 12 route from rack front over A2 chassis through U41 and U42 and exit rack via rack rear top exit port to rack A chassis A2 same sFB same Port on sFB.
- Rack B Chassis B2 Hyper scale Fabric Board CXP cable from Ports 1, 2, 7 and 8 routes to same sFB and ports in Chassis B1. Hyper scale Fabric Board CXP cable from Ports 5,6,11 and 12 route from rack front under A1 chassis through U1 and U2 and exit rack via rack rear bottom exit port to rack A Chassis A1 same sFB same port. Hyper scale Fabric Board CXP cable from Ports 3,4,9 and 10 route from rack front over A2 chassis through U41 and U42 and exit rack via rack rear top exit port to rack A chassis A2 same sFB same Port on sFB.

Mellanox IS5600, IS5300, IS5200, IS5100

- Install cables per section above titled :
Cabling Infiniband and 10Gb E switch end.
- The **IS5300, IS5200, IS5100** are smaller versions of the IS5600 and the same cabling practices will be applied.



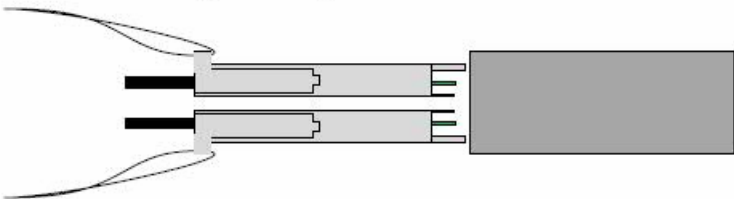
Port Connector Interfaces

The Connector side of the switch has 36leaf boards and each leaf board has 36 QSFP ports. The ports on each leaf board are placed in two rows, 18 ports to a row. The ports are labelled as shown in Figure 8. The bottom row ports are flipped from the top row. See Figure1

Port Numbering

1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35
2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36

Figure1 : Top and Bottom Ports



iDataPlex

Cat5E Guidelines

- Example of how to properly dress Cat5E / Cat 6 Ethernet cables from a Vertical Ethernet Switch location to the node locations. Their should be no strain on the Ethernet plug (cable side) and the cable should intersect the switch port at a 90 degree angle plugging straight into the switch port from the cable rails.



Below is an example of how the Cat5 E cables should be routed from the switch to the nodes within the rack.



Fiber InfiniBand / 10 GB Ethernet Guidelines iDataPlex

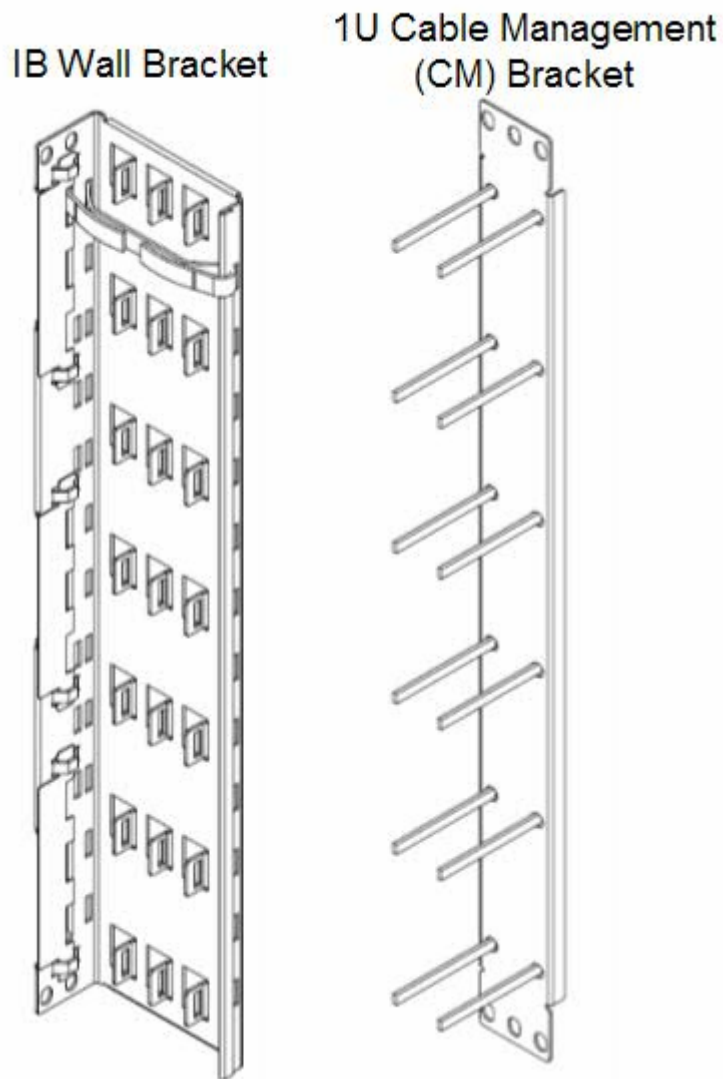
- Fiber down link cables to the servers or nodes from core switch must be run behind the Cat5E / Cat 6 cables that run from the cable management bracket to the nodes. Velcro fiber cables behind cable management bracket.
- Fiber cables to InfiniBand or 10GB Ethernet leaf switches from core switch must be run on the outside of the handle brackets and over top of the Cat 5E / Cat 6 cables and secured to the handle bracket using Velcro.
- If InfiniBand cables are entering the rack from the bottom. Route and secure cables to top nodes first working your way to the lowest node last.
- If InfiniBand cables are entering from the top. Route and secure cables from lowest node and work upward.





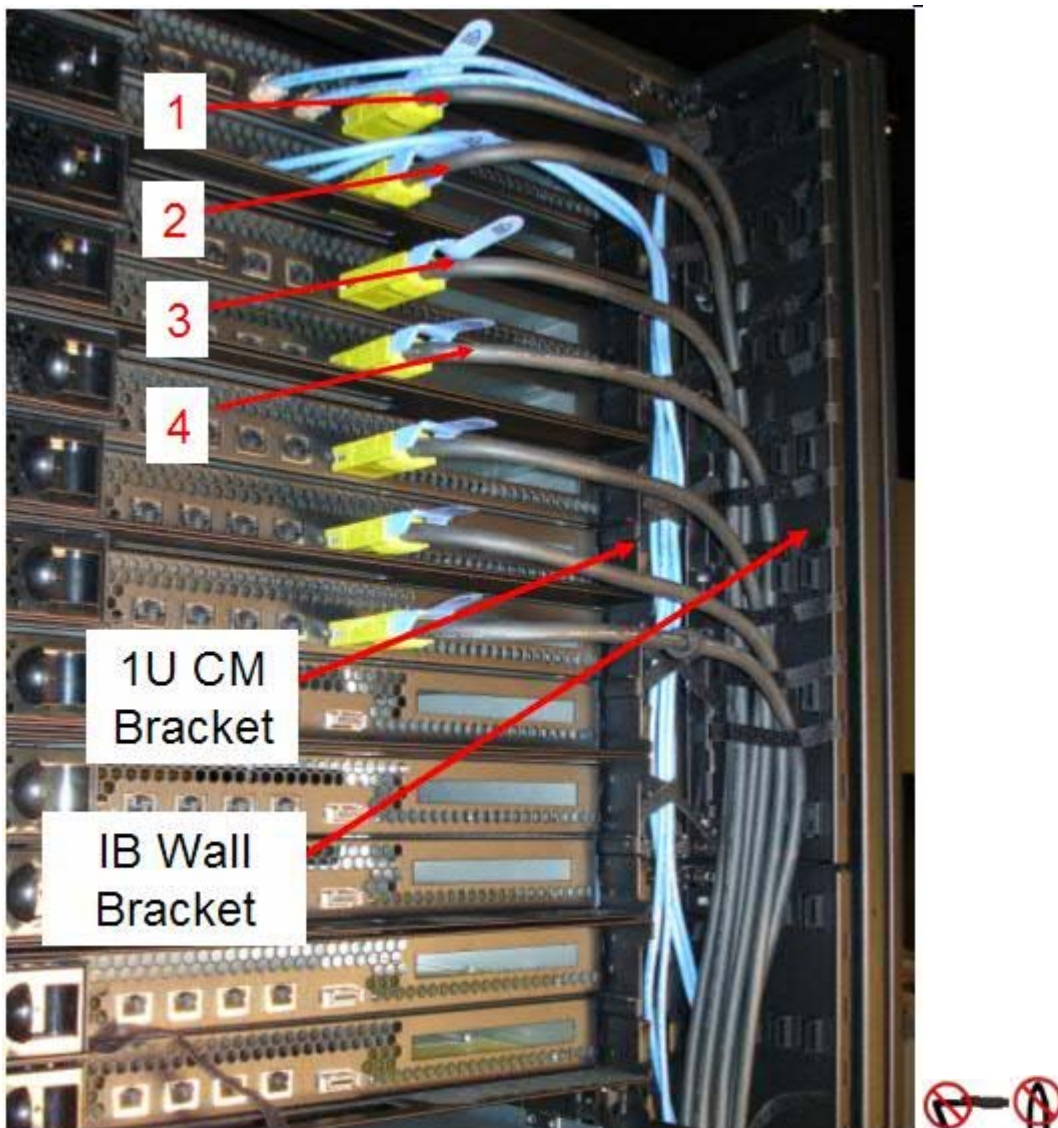
Copper InfiniBand Guidelines

- When 26 AWG copper InfiniBand is installed in the iDataPlex rack a 1U Cable management (belt loop) bracket will be used to secure the Cat5 E / Cat 6 Ethernet cables. This bracket will be installed in all ODD slots in columns B and D.

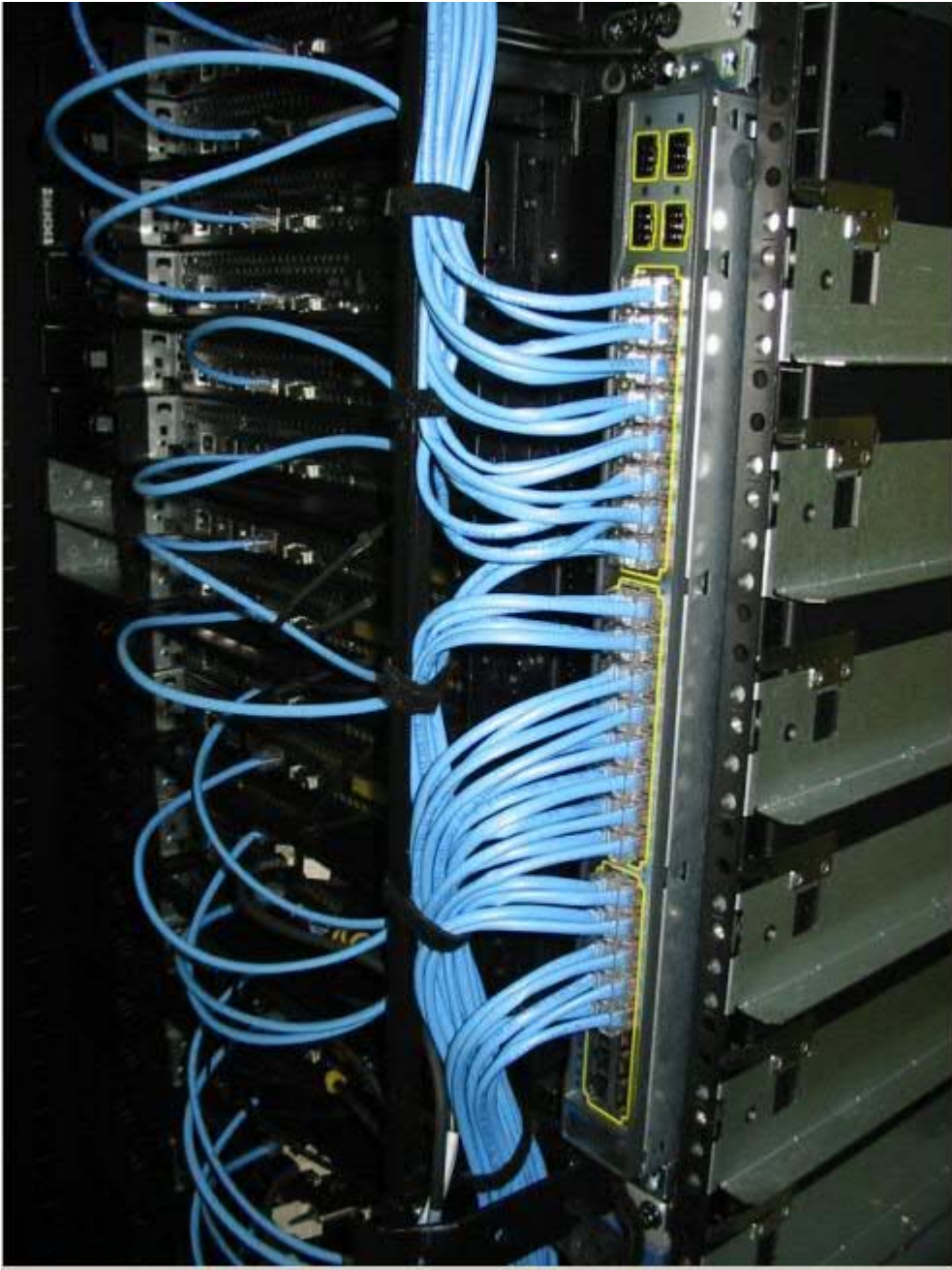


- If DDR 26 AWG Copper InfiniBand cables are to be run in Columns B and or D. IB wall brackets may be installed in all EVEN slots.
- If InfiniBand cables are entering the rack from the bottom run and secure cables to top nodes first working your way to the lowest node last.

- If InfiniBand cables are entering from the top. Run and secure cables from lowest node and work upward.



48Port 1GB Ethernet switch cabling within iDataPlex Vertical position.

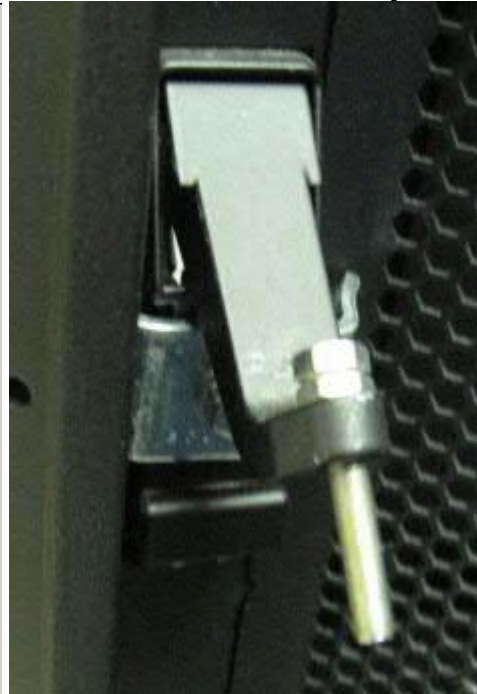


NOTE: SECURE ALL CABLES THAT ROUTE PAST FRONT DOOR LATCHING MECHANISM AS DEEP INTO THE RACK AS POSSIBLE. VERIFY THERE WILL BE NO CONTACT BY CLOSING LEFT FRONT DOOR AND CAREFULLY SECURING LATCHING MECHANISM. DOOR LATCH ADJUSTMENT BOLT WILL DAMAGE CABLES IF NOT PROPERLY ROUTED.

ADJUSTMENT BOLT AND CABLE BRACKET



Door Latch Assembly



Latch bracket and cables recessed into rack making room for latching mechanism.



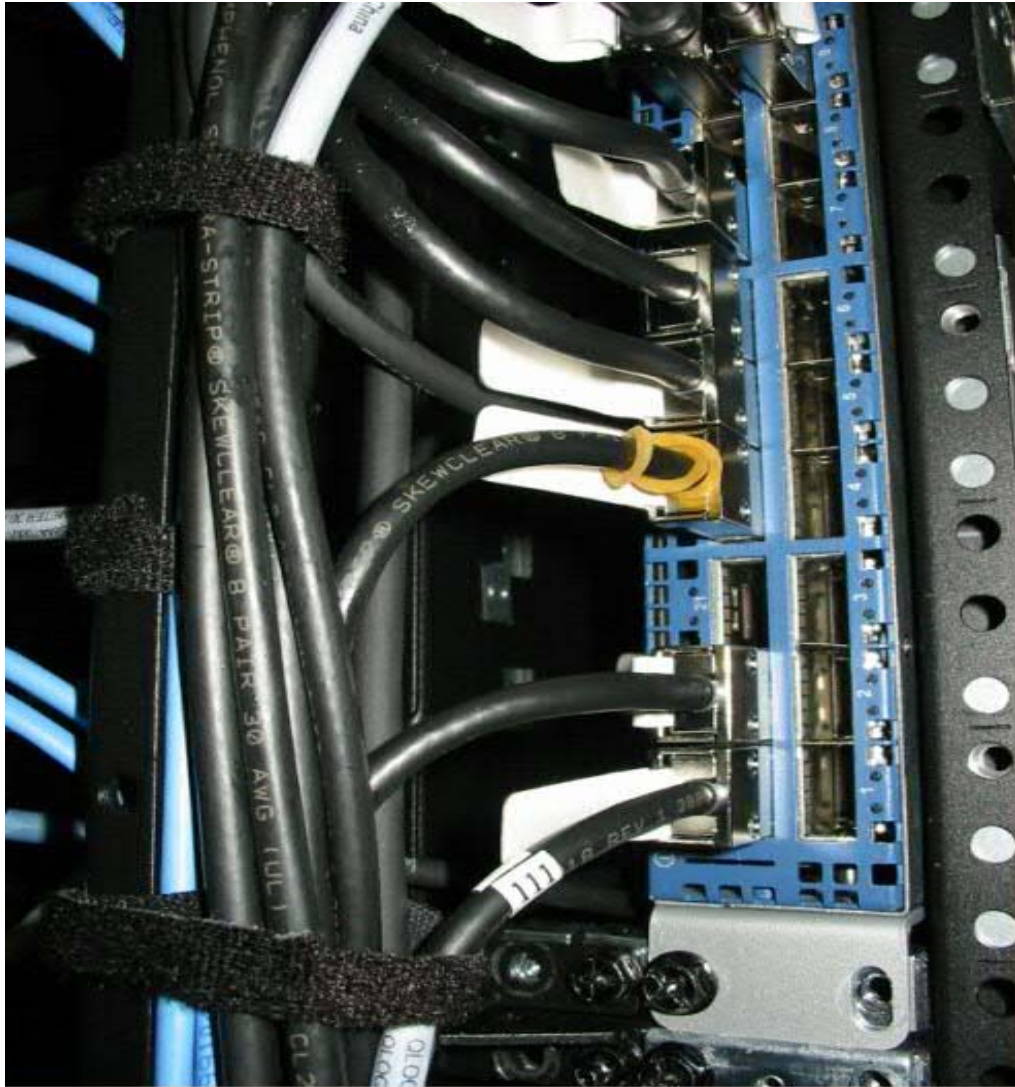
Latch bracket and cables recessed into rack making room for latching mechanism.



36Port QDR InfiniBand switch cabling within iDataPlex vertical position.
30 AWG 0.5M and 1M cables shown.



30 AWG 0.5M and 1M Cables shown.



iDataPlex Nodes in 1410 rack Guidelines

Cabling of iDataPlex Nodes in 1410 Rack

2 U chassis Configuration			
Rack Front View			
U	U Content Description		
42	2U		
41	Chassis		
40	2U		
39	Chassis		
38	2U		
37	Chassis		
36	2U		
35	Chassis		
34	1U Cable Pass-through Bracket		
33	2U		
32	Chassis		
31	2U		
30	Chassis		
29	2U		
28	Chassis		
27	2U		
26	Chassis		
25	2U		
24	Chassis		
23	ENT Switch		
22	ENT Switch or 1U Belt Loop		
21	2U		
20	Chassis		
19	2U		
18	Chassis		
17	2U		
16	Chassis		
15	2U		
14	Chassis		
13	2U		
12	Chassis		
11	1U Cable Pass-through Bracket		
10	2U		
9	Chassis		
8	2U		
7	Chassis		
6	2U		
5	Chassis		
4	2U		
3	Chassis		
2	2U		
1	Chassis		

3 U chassis Configuration			
Rack Front View			
U	U Content Description		
42			
41	3U		
40	Chassis		
39			
38	3U		
37	Chassis		
36			
35	3U		
34	Chassis		
33	1U Cable Pass-through Bracket		
32			
31	3U		
30	Chassis		
29			
28	3U		
27	Chassis		
26			
25	3U		
24	Chassis		
23	ENT Switch		
22	ENT Switch or 1U Belt Loop		
21			
20	2U		
19	Chassis		
18	3U		
17	Chassis		
16	3U		
15	Chassis		
14	3U		
13	1U Cable Pass-through Bracket		
12			
11	3U		
10	Chassis		
9			
8	3U		
7	Chassis		
6			
5	3U		
4	Chassis		
3			
2	3U		
1	Chassis		



Identifies to cable management bracket. **Cables actually route to right side of bracket.**



Arrows identify front of rack view and show cable routing flow Down, Up and left inward to 1U Cable pass-through Bracket. 1U Cable pass-through Bracket. Come in pairs and are installed in same U location in rack front and back.

- Install Rails, Chassis, front and rear 1U Cable pass-through Bracket and Cable management brackets.
- Install chassis as indicated by 2U AND 3U Chassis Configuration.
Other configurations can be supported however the demonstrated racking scheme should be followed. Inspect all fastening hardware to ensure components are secure in rack.
- Route 1GB Ethernet cables first from node port to right side of rack (facing rack front) over cable management bracket and upward or downward depending on location in reference to 1U cable management bracket. Cables should be routed between cable management bracket and right side frame member. Make sure to facilitate room for chassis and FRU serviceability. Route cables through rack front 1U cable pass-through bracket, through rack and out of rear 1U cable management bracket (NOT ILLUSTRATED). Neatly dress to rack rear side right and left cable management area with Velcro then on to final port destination. Neatly attach cables to cable management supports (Rack front and rear) to prevent cables from pulling downward. Bundle and dress all cables with Velcro once all cables have been completely installed.

- Route Fiber cables second from node port to right side of rack (facing rack front) over cable management bracket and upward or downward depending on location in reference to 1U cable management bracket. Cables should be routed between cable management bracket and right side frame member. Make sure to facilitate room for chassis and FRU serviceability. Route cables through rack front 1U cable pass-through bracket, through rack and out of rear 1U cable management bracket (NOT ILLUSTRATED). Neatly dress to rack rear side right and left cable management area with Velcro then on to final port destination. Neatly attach cables to cable management supports (Rack front and rear) to prevent cables from pulling downward. Bundle and dress all cables with Velcro once all cables have been completely installed.
- Inspect cable bundling to ensure neat, clean routing, dressing and serviceability requirements are met.

Rack cabling with 1U cable management bracket.

