NRC · CNRC

Expanded Very Large Array

EVLA Corr Racks/Cables etc.

B. Carlson

NRC · CNRC

Outline

- Rack assembly.
- Meritec cable assembly/installation.
- Rack shipping/installation.
- Control Racks.
- Ethernet cables.
- VLBI recorder rack.

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Rack Assembly

- Currently in progress in Penticton.
- Have all sub-racks, fan assemblies.
- Layout “scoped-out” (baseline plan in A25017N0005), but refinements occurring as we assemble the first 2 racks.
- Waiting for some parts:
  - Common Backplanes.
  - Last minute electro/mechanical parts (switch mounting plate, RPMIB…)
- But, should be in full-swing assembly ~1st week January.
  - Full time contract assembler going since mid Sept.
  - 1 temp worker started, another one shortly…add more EVLA/DRAO techs as needed to meet schedule.

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Rack Assembly

- Plan is to fully assemble racks in Penticton, to minimize site work.
- (I) need to develop QA checklist and test plan.
  - Early rack delivery does not permit fully loaded/powered test.
  - Have tested thermal mock-up to 10 kW successfully.
  - If there is a thermal problem, the only fall-back position is colder air (rack-mount chiller at bottom).
  - …the die is cast!
- 2 shipments: 8 racks each, to mitigate effects of shipping catastrophic failure.
  - Direct shipment in dedicated shipping crates from Penticton to VLA.

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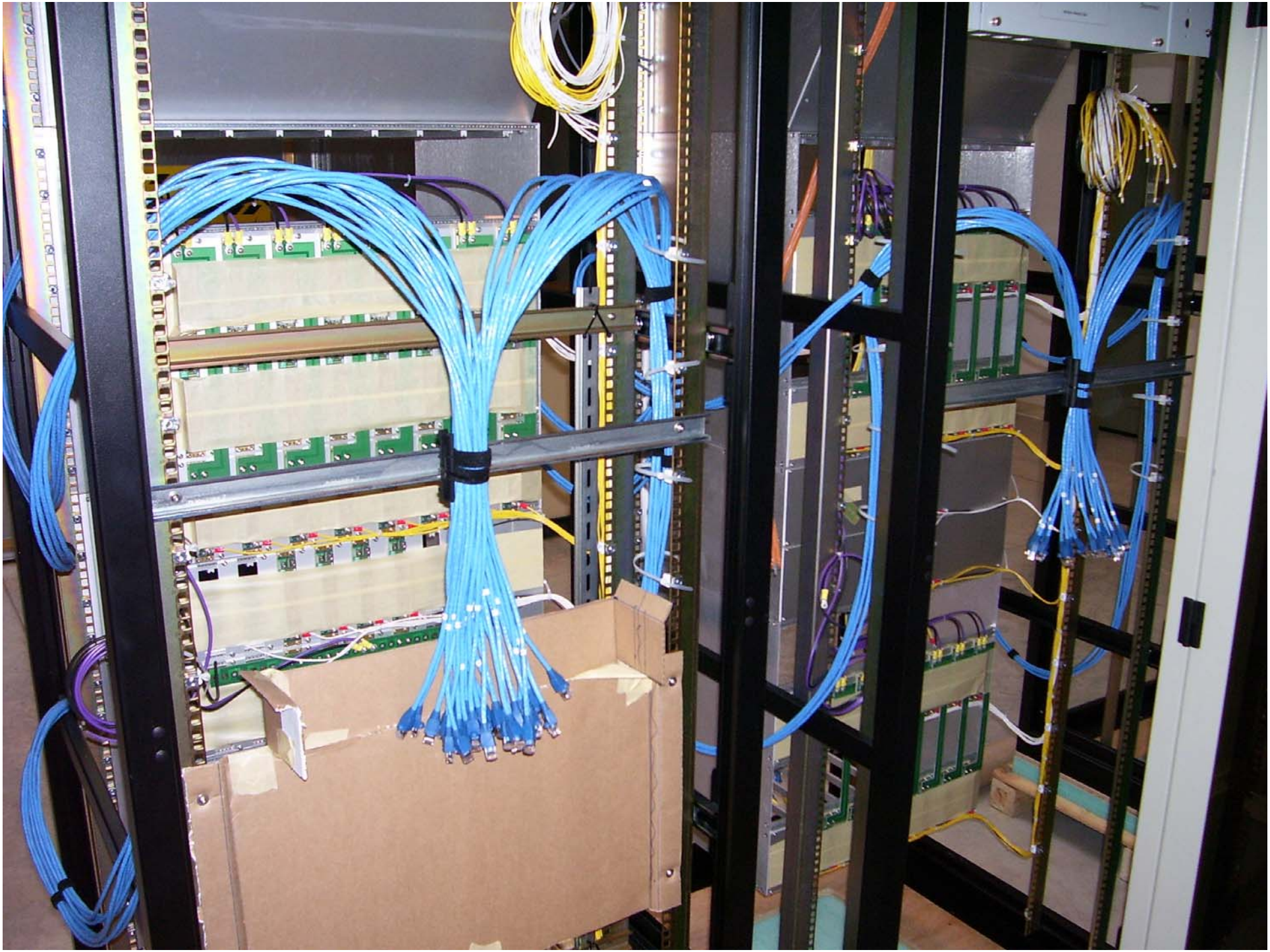
Rack Cables

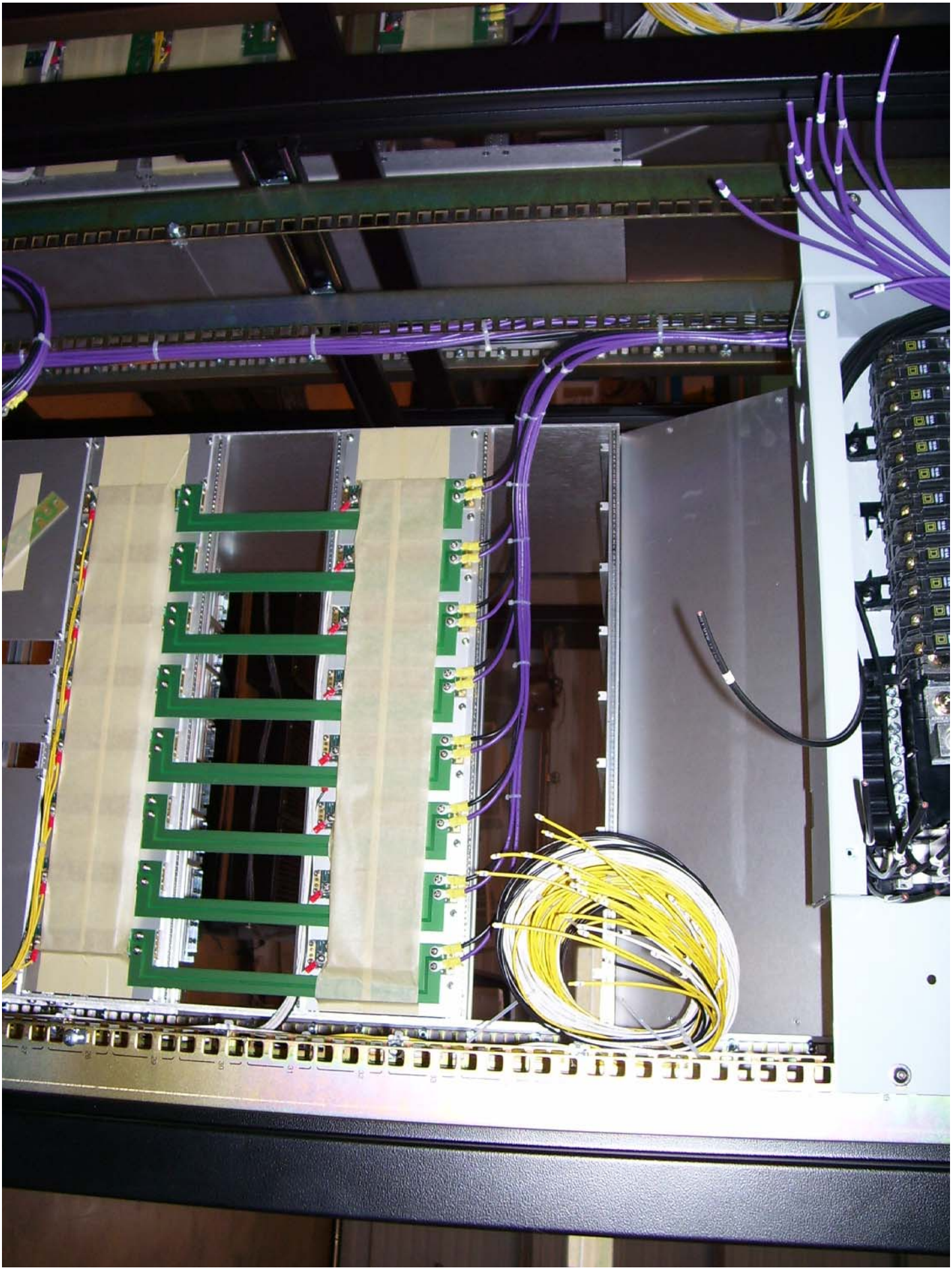
- All cables colour coded:
  - -48 VDC hot: VIOLET; RETURN: BLACK.
  - Board power control: WHITE; monitor: YELLOW.
  - Ethernet M&C BLUE; CBE RED; Phased output: YELLOW.
  - Fan power, M&C.

- All cables labeled (except for –48 VDC power)



Opening door will sound
ALARM

Breaker Panel



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Meritec Cables

- All ordered, Meritec is maintaining Dec. 28/07 delivery date.
- “st-TC”, Station rack, rack-to-rack installation plans ready (A25005N0004, A25005N0003, A25005N0001).
- PVC labels being made…gearing up for labeling and assembly of rack-to-rack cables.

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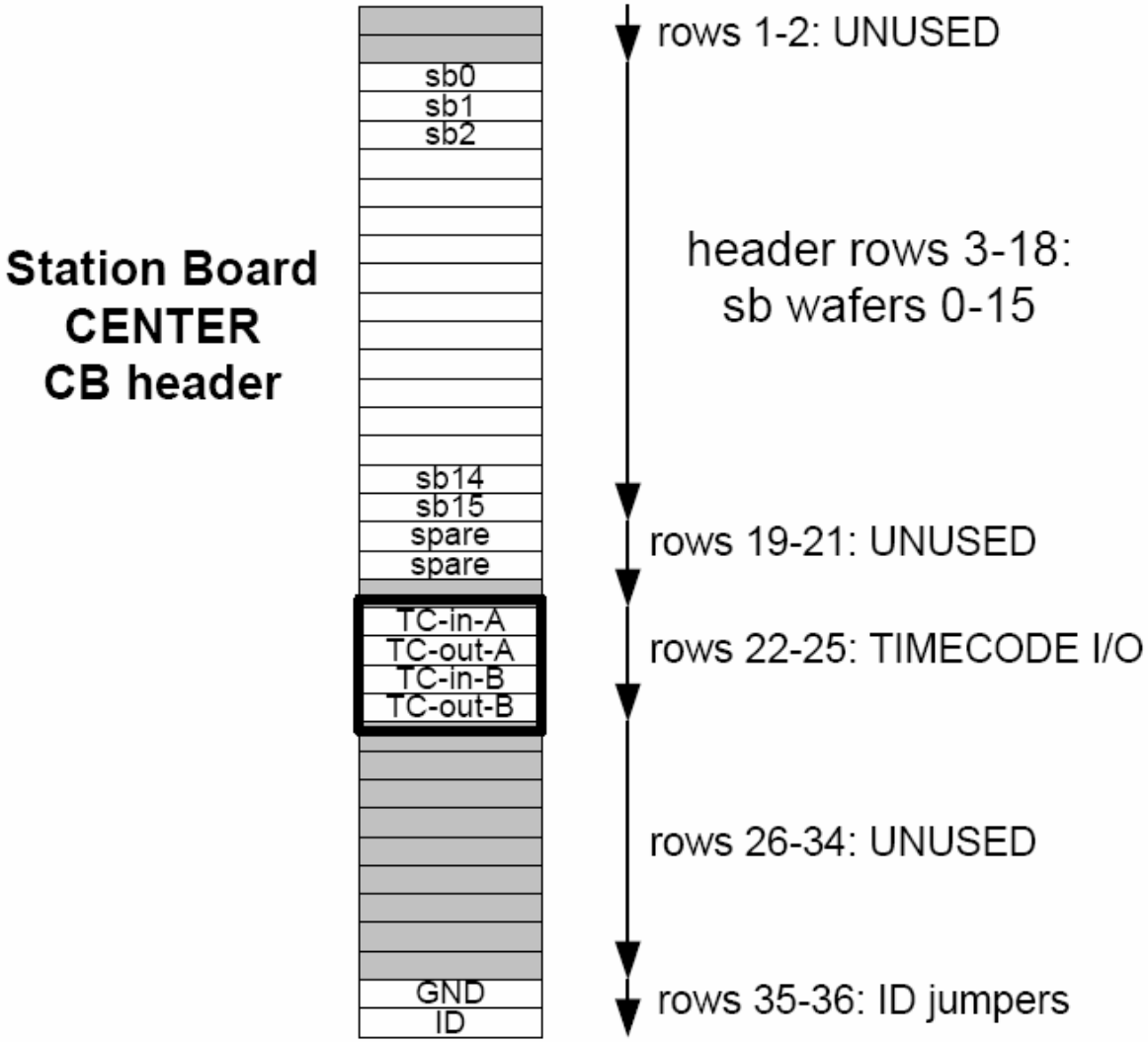
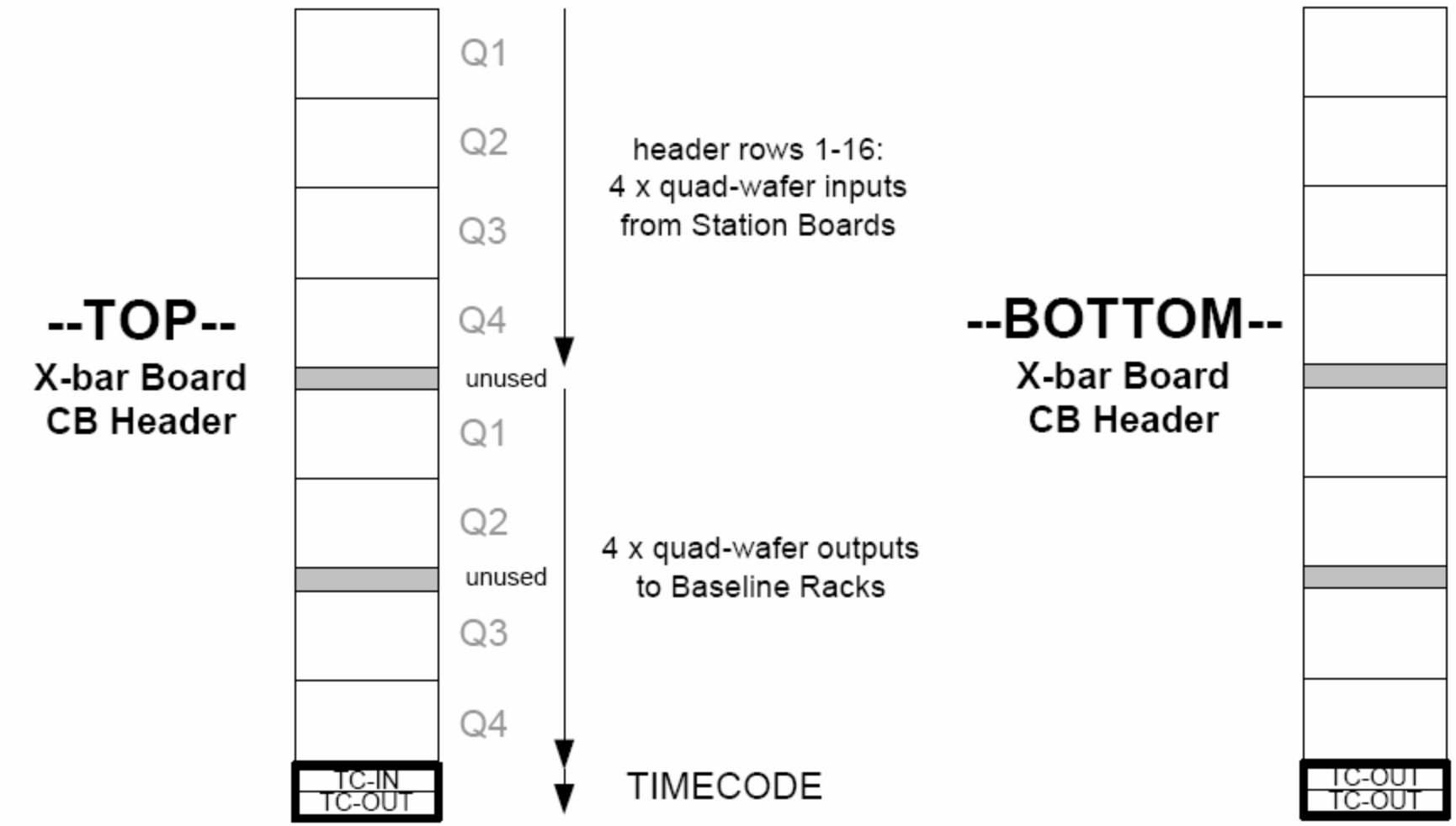
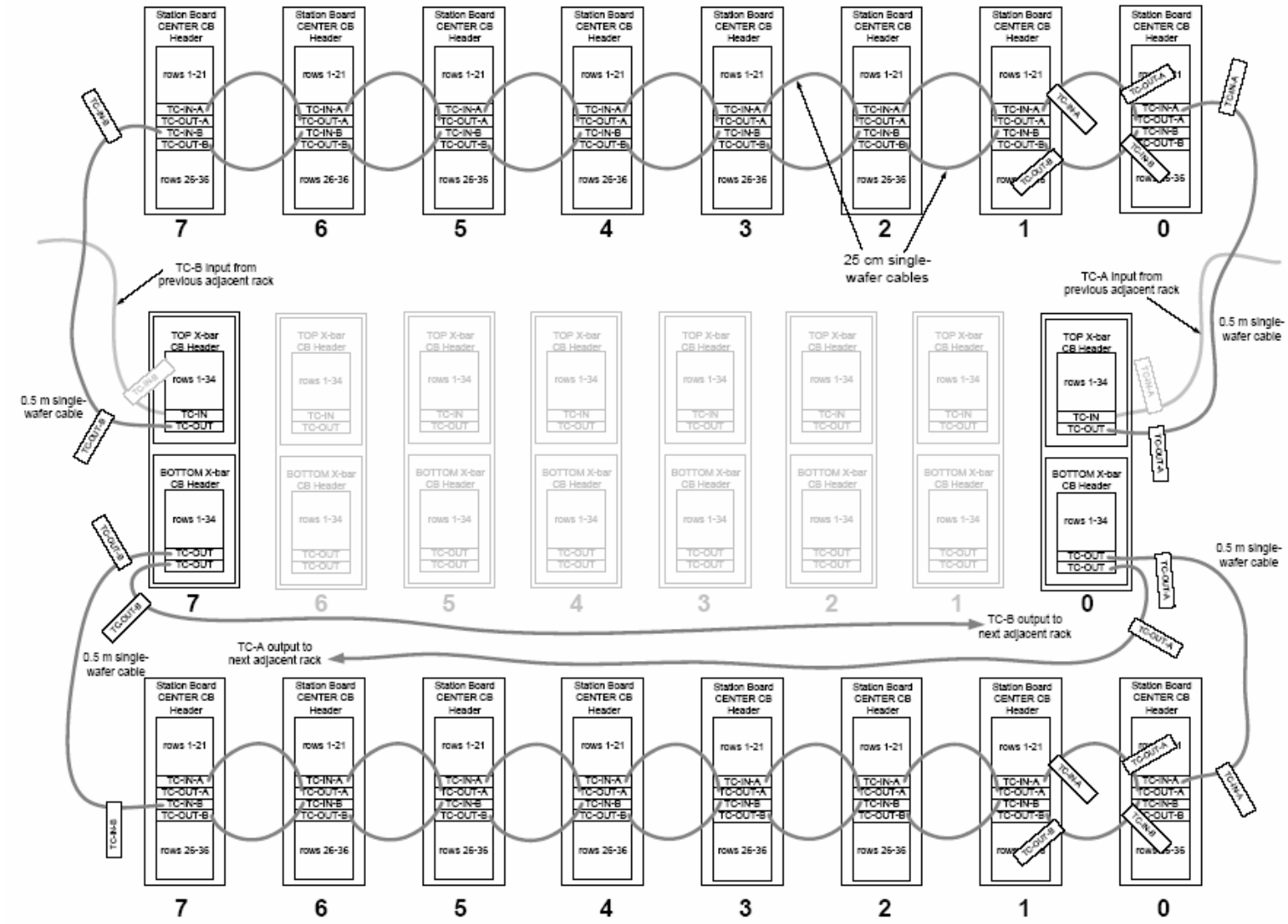
"st-TC" Cable Install

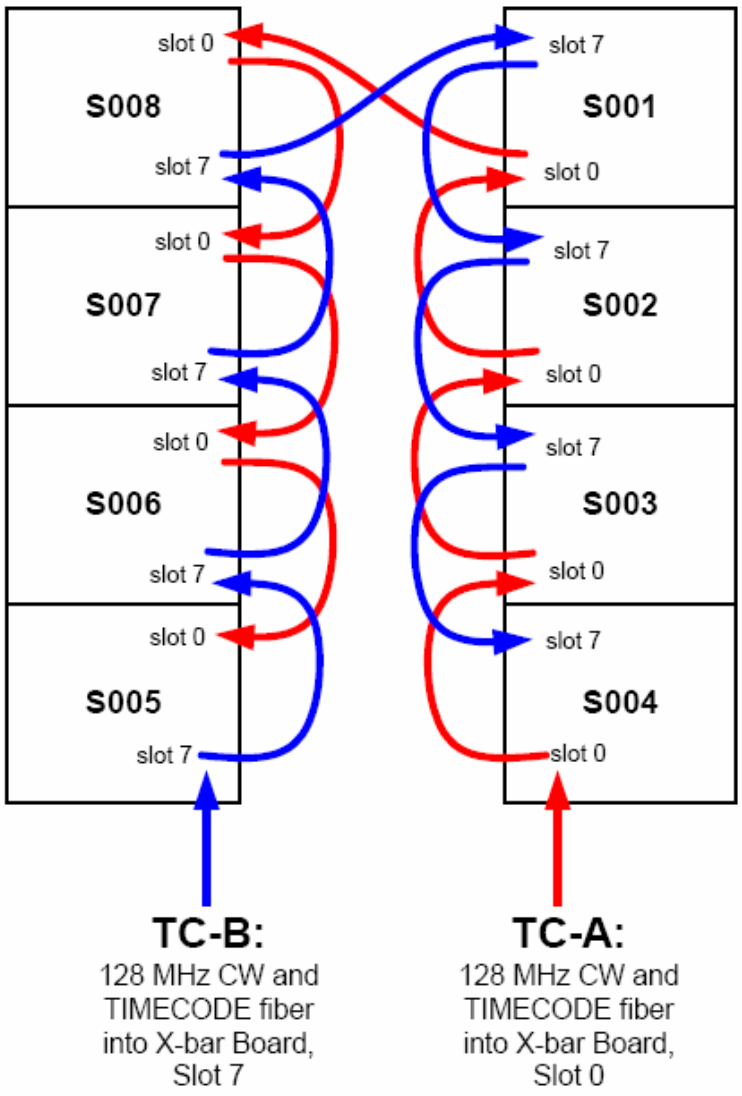
- "st-TC": augmented "NRAO ext-TC" signal with "hop count".

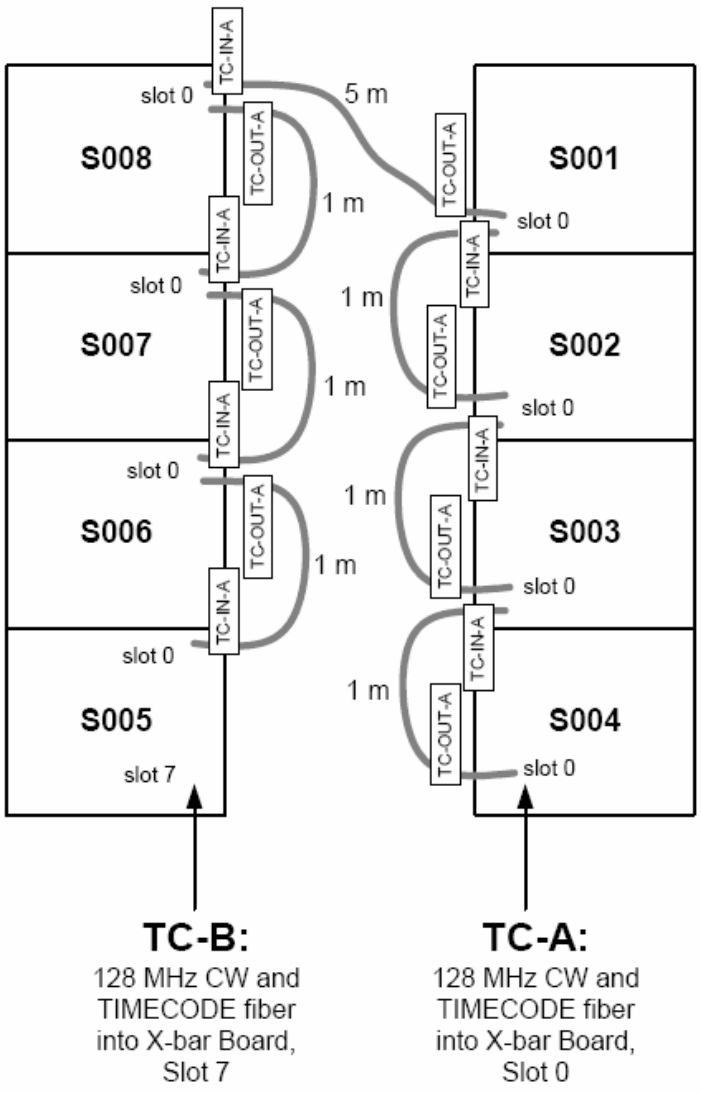
- Distribute to all Station racks and Station Boards in a daisy-chained, bi-directional fashion.
  - Eliminates single board or rack failure from affecting other boards/racks.
  - Hop count incremented with each hop…compensate for delays in Station Board Timing Chip so that signals going to the Baseline Boards are approximately lined-up in time.
  - Station Board develops final absolute TIMECODE.


Station Board
CENTER
CB header
sb0
sb1
sb2
sb14
sb15
spare
spare
TC-in-A
TC-out-A
TC-in-B
TC-out-B
GND
ID
rows 1-2: UNUSED
header rows 3-18:
sb wafers 0-15
rows 19-21: UNUSED
rows 22-25: TIMECODE I/O
rows 26-34: UNUSED
rows 35-36: ID jumpers


--TOP--
X-bar Board
CB Header
Q1
Q2
Q3
Q4
unused
Q1
Q2
unused
Q3
Q4
TC-IN
TC-OUT
header rows 1-16:
4 x quad-wafer inputs
from Station Boards
4 x quad-wafer outputs
to Baseline Racks
TIMECODE
--BOTTOM--
X-bar Board
CB Header
TC-OUT
TC-OUT


Station Board CENTER CB Header
rows 1-21
TC-IN-A
TC-OUT-A
TC-IN-B
TC-OUT-B
rows 26-36
7
6
5
4
3
2
1
0
25 cm single-wafer cables
TC-B input from previous adjacent rack
TC-A input from previous adjacent rack
0.5 m single-wafer cable
TOP X-bar CB Header
rows 1-34
TC-IN
TC-OUT
BOTTOM X-bar CB Header
TC-B output to next adjacent rack
TC-A output to next adjacent rack


slot 0
S008
slot 7
slot 0
S007
slot 7
slot 0
S006
slot 7
slot 0
S005
slot 7
slot 7
S001
slot 0
slot 7
S002
slot 0
slot 7
S003
slot 0
slot 7
S004
slot 0
TC-B:
128 MHz CW and TIMECODE fiber into X-bar Board, Slot 7
TC-A:
128 MHz CW and TIMECODE fiber into X-bar Board, Slot 0


TC-IN-A
TC-OUT-A
slot 0
S008
S007
S006
S005
slot 7
S001
S002
S003
S004
5 m
1 m
1 m
1 m
1 m
1 m
TC-B:
128 MHz CW and TIMECODE fiber into X-bar Board, Slot 7
TC-A:
128 MHz CW and TIMECODE fiber into X-bar Board, Slot 0

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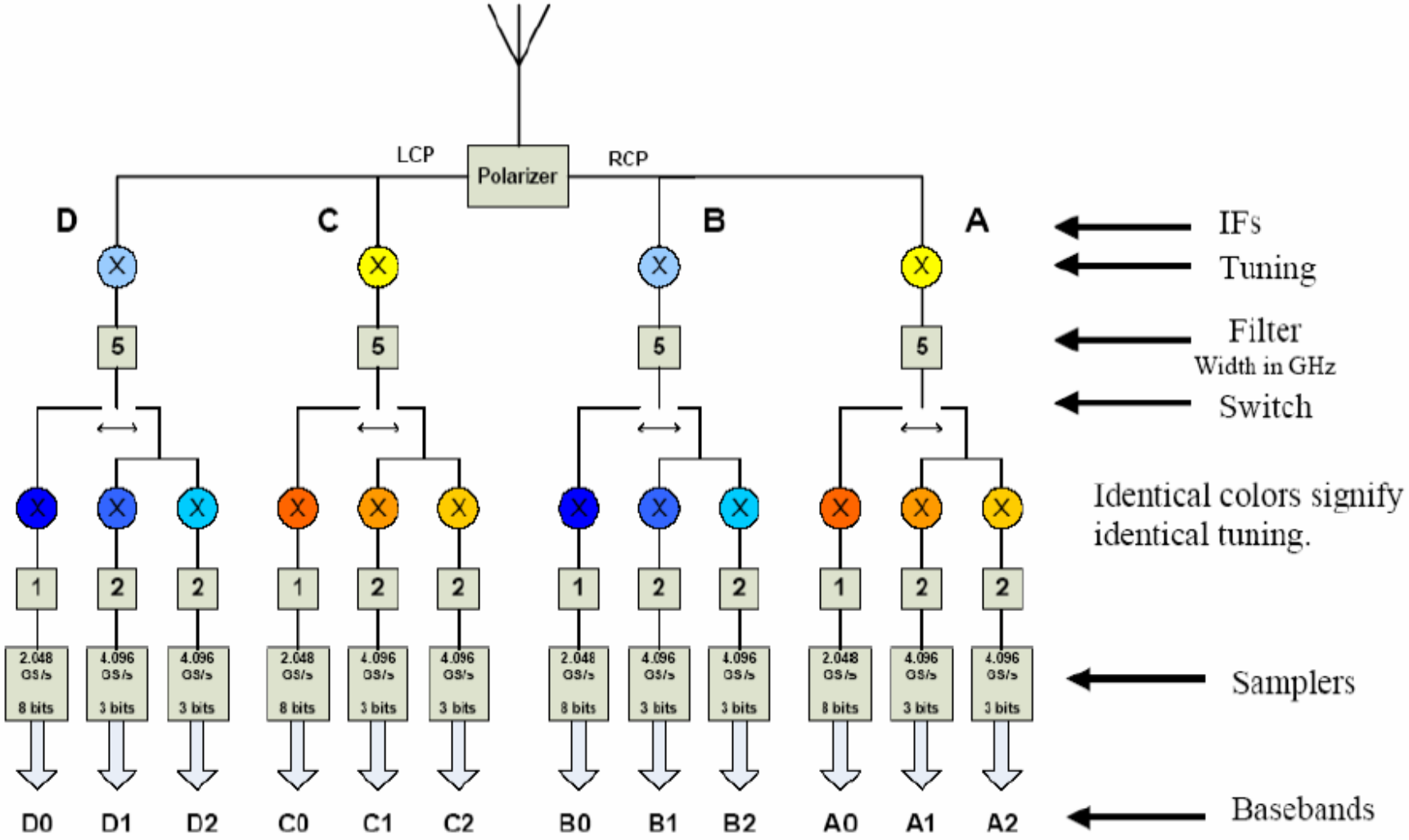
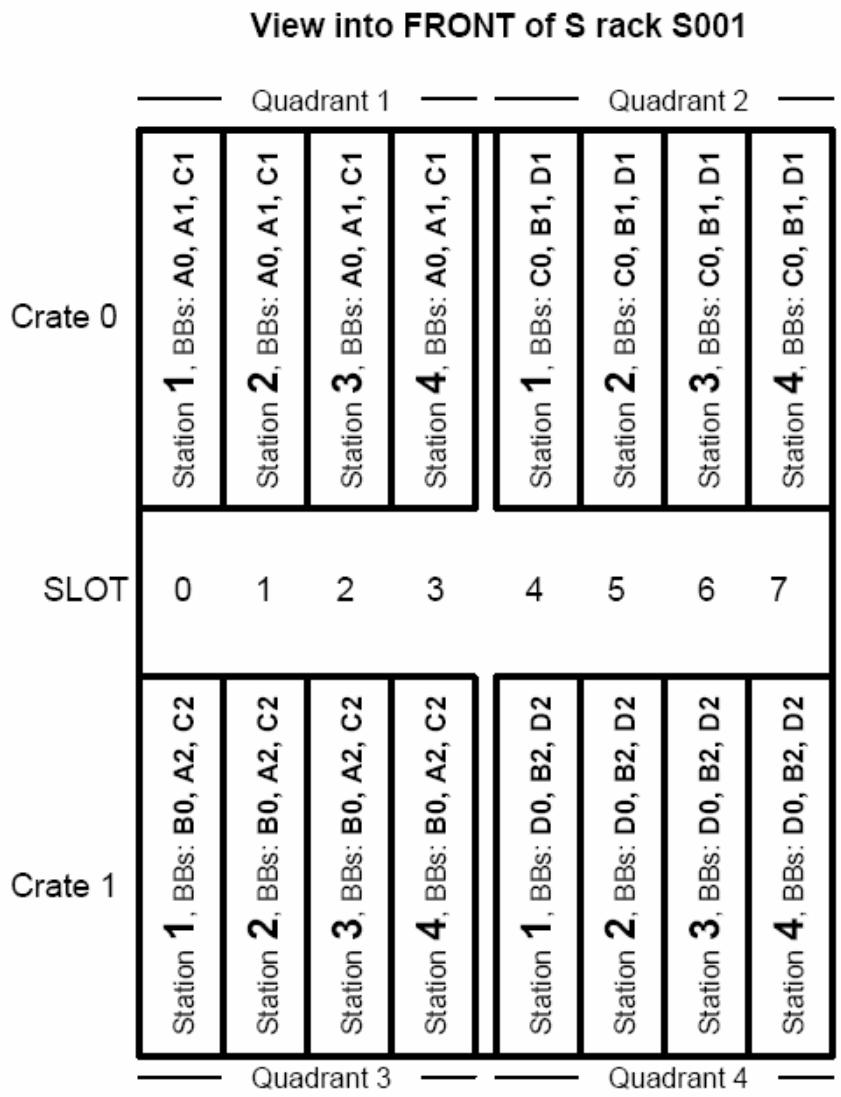
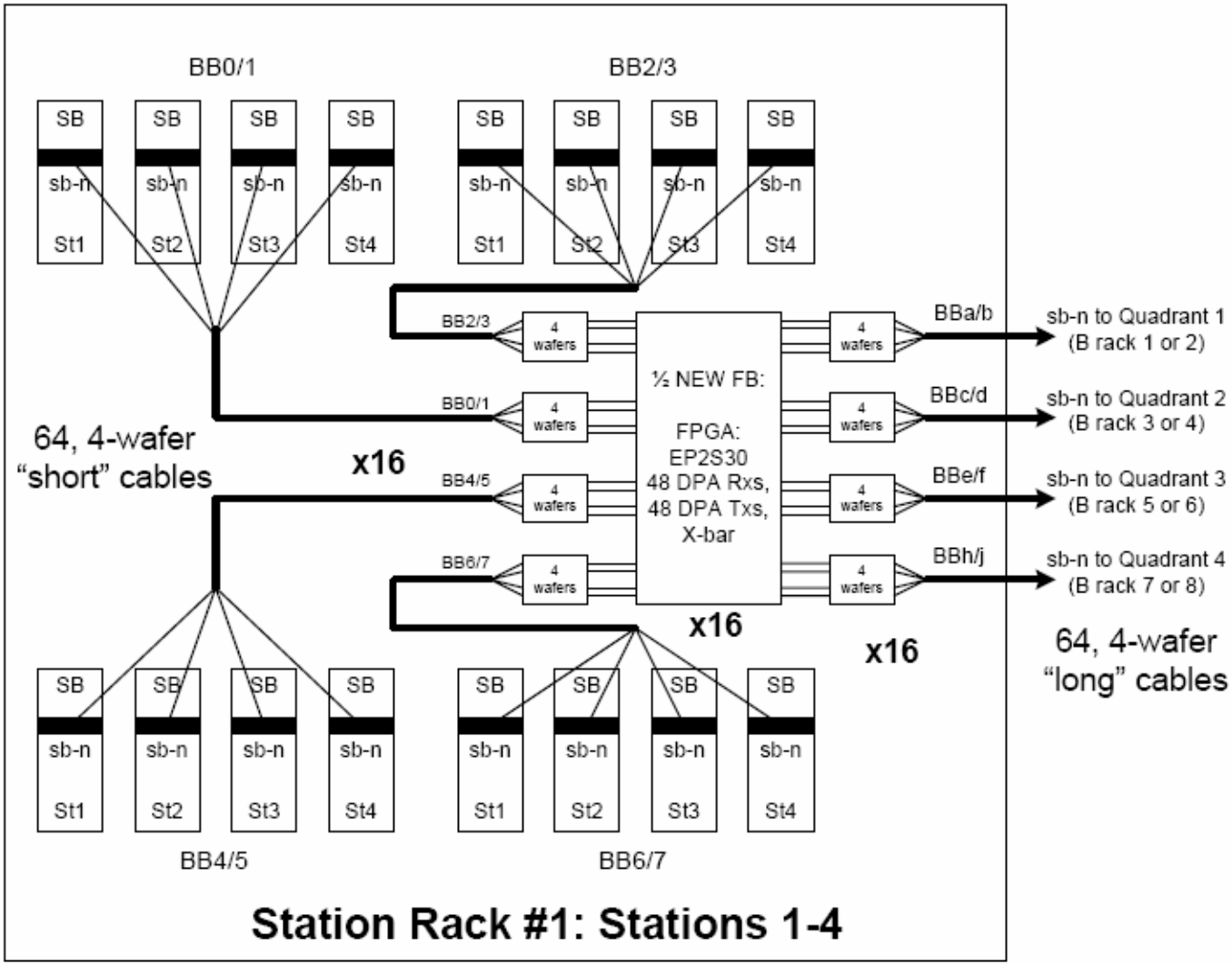
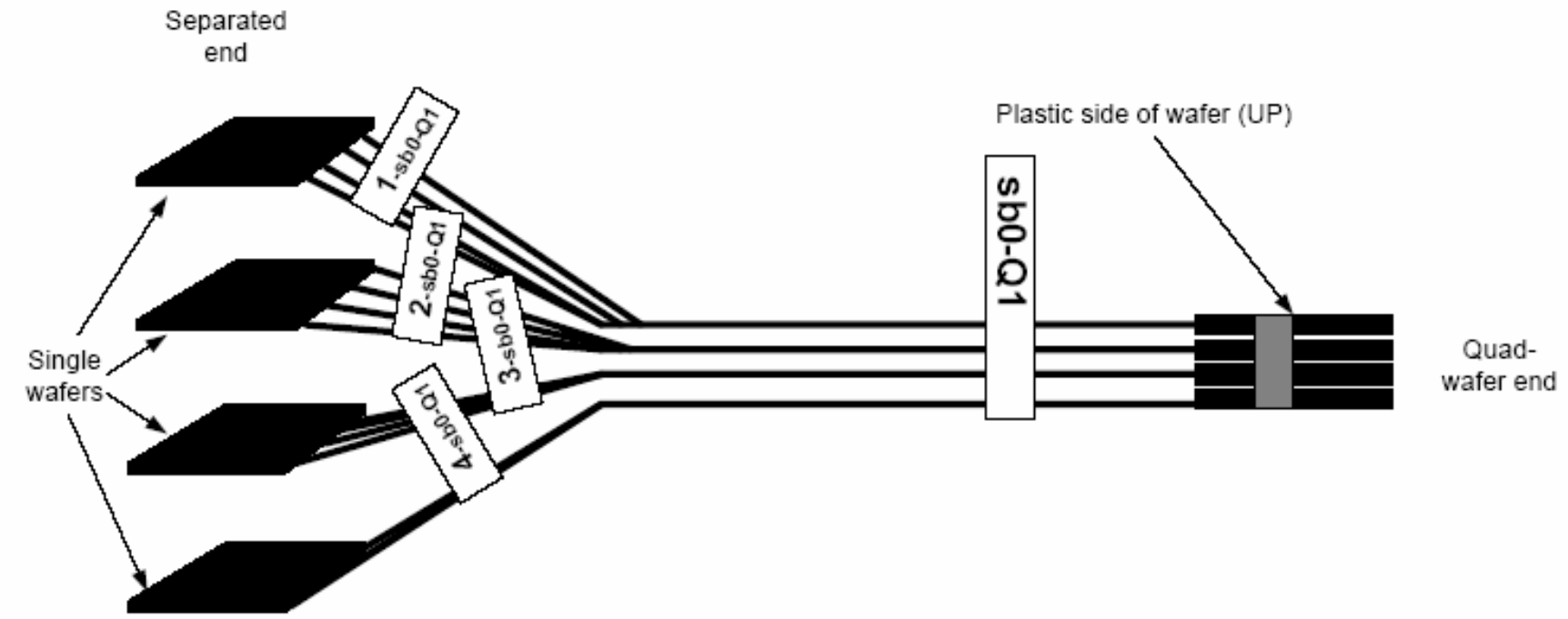
Station rack Meritec Cables

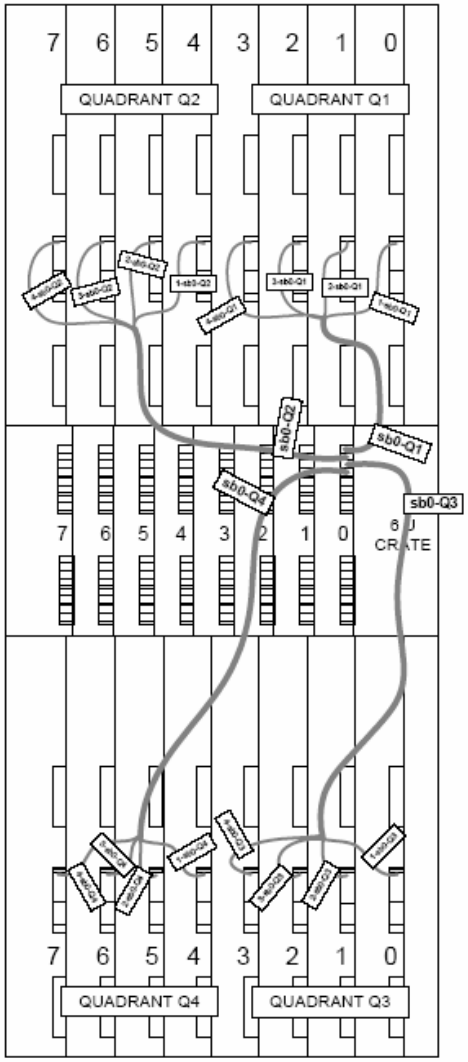
- Route from Station Board center connector to X-bar Boards.
  - All installation is done in Penticton.
- Split quad wafer at Station Board end allows for 4 stations on one quad wafer at X-bar Board end.
- X-bar Board does quadrant switching to allow full resource flexibility.
- Antenna fiber (IFs/BBs)-to-Station Board routing now established (ICD A25010N0002).


LCP
Polarizer
RCP
D
C
B
A
5
1
2
2.048 GS/s
8 bits
4.096 GS/s
3 bits
D0
D1
D2
C0
C1
C2
B0
B1
B2
A0
A1
A2
IFs
Tuning
Filter
Width in GHz
Switch
Identical colors signify identical tuning.
Samplers
Basebands


View into FRONT of S rack S001
Quadrant 1
Quadrant 2
Crate 0
Station 1, BBs: A0, A1, C1
Station 2, BBs: A0, A1, C1
Station 3, BBs: A0, A1, C1
Station 4, BBs: A0, A1, C1
Station 1, BBs: C0, B1, D1
Station 2, BBs: C0, B1, D1
Station 3, BBs: C0, B1, D1
Station 4, BBs: C0, B1, D1
SLOT
0 1 2 3 4 5 6 7
Crate 1
Station 1, BBs: B0, A2, C2
Station 2, BBs: B0, A2, C2
Station 3, BBs: B0, A2, C2
Station 4, BBs: B0, A2, C2
Station 1, BBs: D0, B2, D2
Station 2, BBs: D0, B2, D2
Station 3, BBs: D0, B2, D2
Station 4, BBs: D0, B2, D2
Quadrant 3
Quadrant 4


BB0/1
BB2/3
SB
sb-n
St1
St2
St3
St4
BB2/3
BB0/1
BB4/5
BB6/7
4 wafers
½ NEW FB:
FPGA:
EP2S30
48 DPA Rxs,
48 DPA Txs,
X-bar
BBa/b
BBc/d
BBe/f
BBh/j
sb-n to Quadrant 1
(B rack 1 or 2)
sb-n to Quadrant 2
(B rack 3 or 4)
sb-n to Quadrant 3
(B rack 5 or 6)
sb-n to Quadrant 4
(B rack 7 or 8)
64, 4-wafer
"short" cables
x16
x16
x16
64, 4-wafer
"long" cables
Station Rack #1: Stations 1-4


Separated end
1-sb0-Q1
2-sb0-Q1
3-sb0-Q1
4-sb0-Q1
Plastic side of wafer (UP)
sb0-Q1
Single wafers
Quad-wafer end


7 6 5 4 3 2 1 0
QUADRANT Q2
QUADRANT Q1
sb0-Q2
sb0-Q1
sb0-Q4
sb0-Q3
7 6 5 4 3 2 1 0
6 U
CRATE
7 6 5 4 3 2 1 0
QUADRANT Q4
QUADRANT Q3

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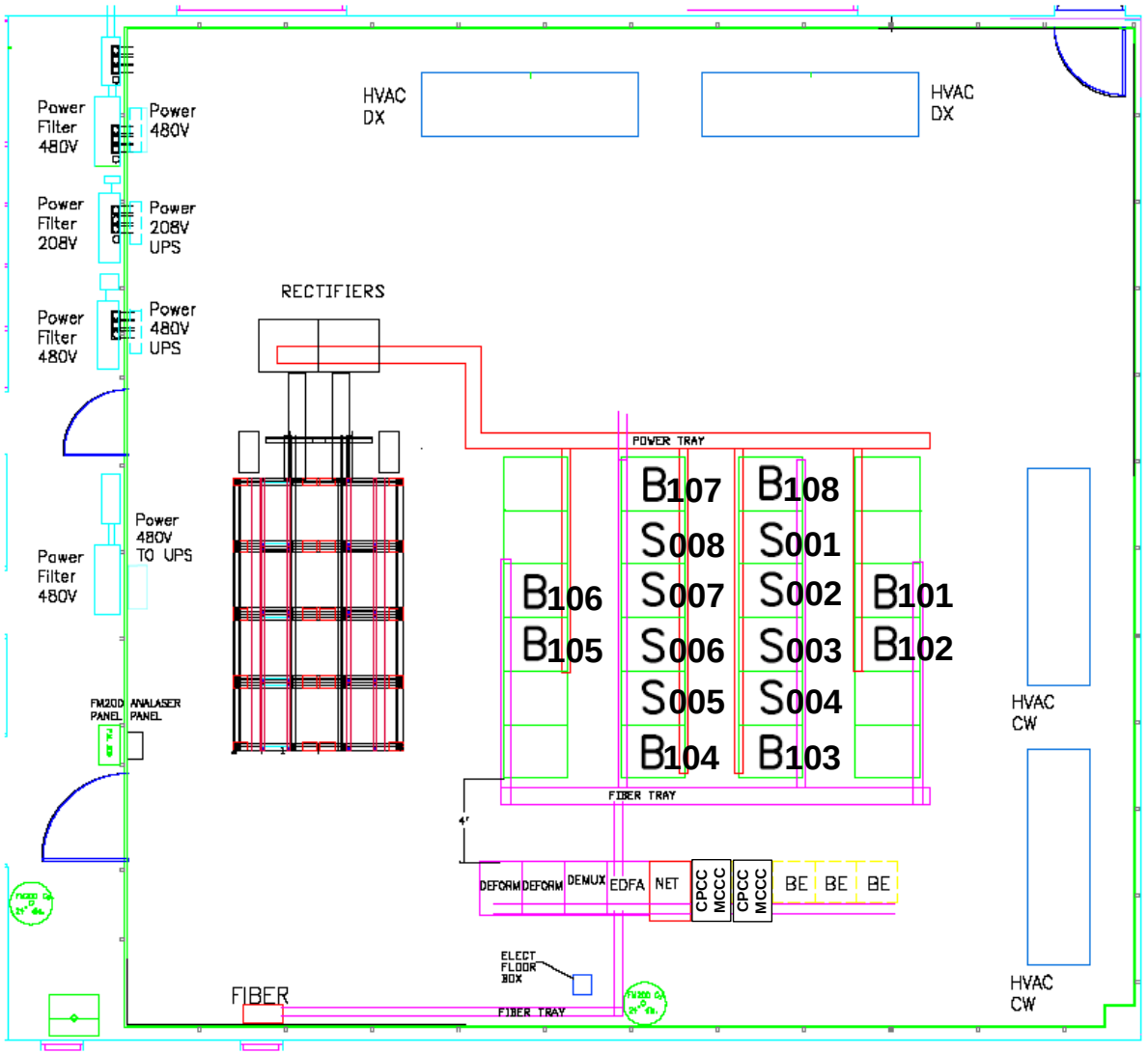
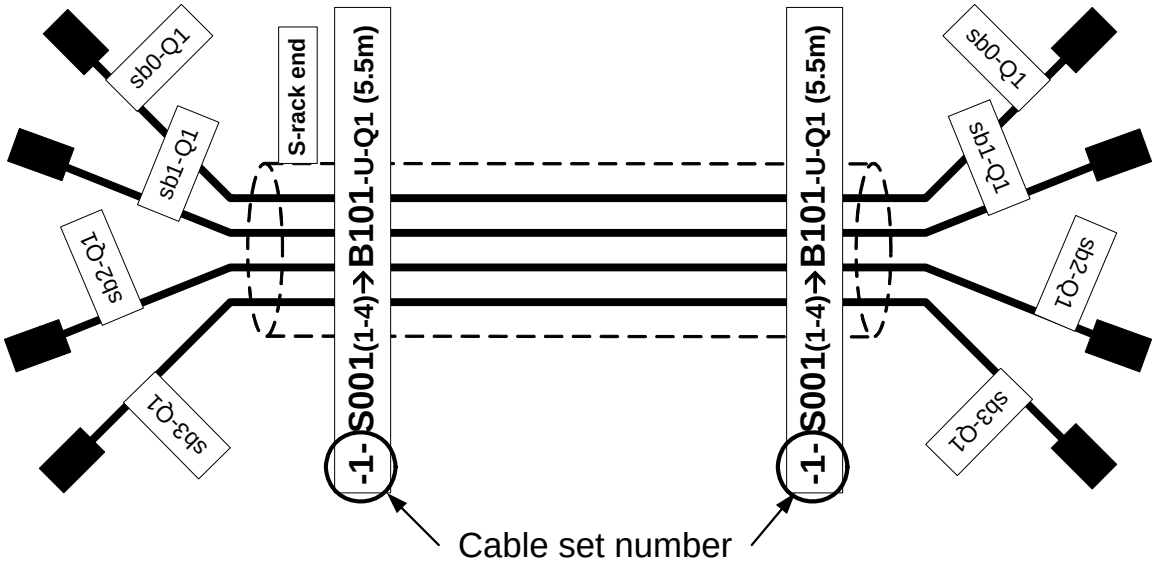
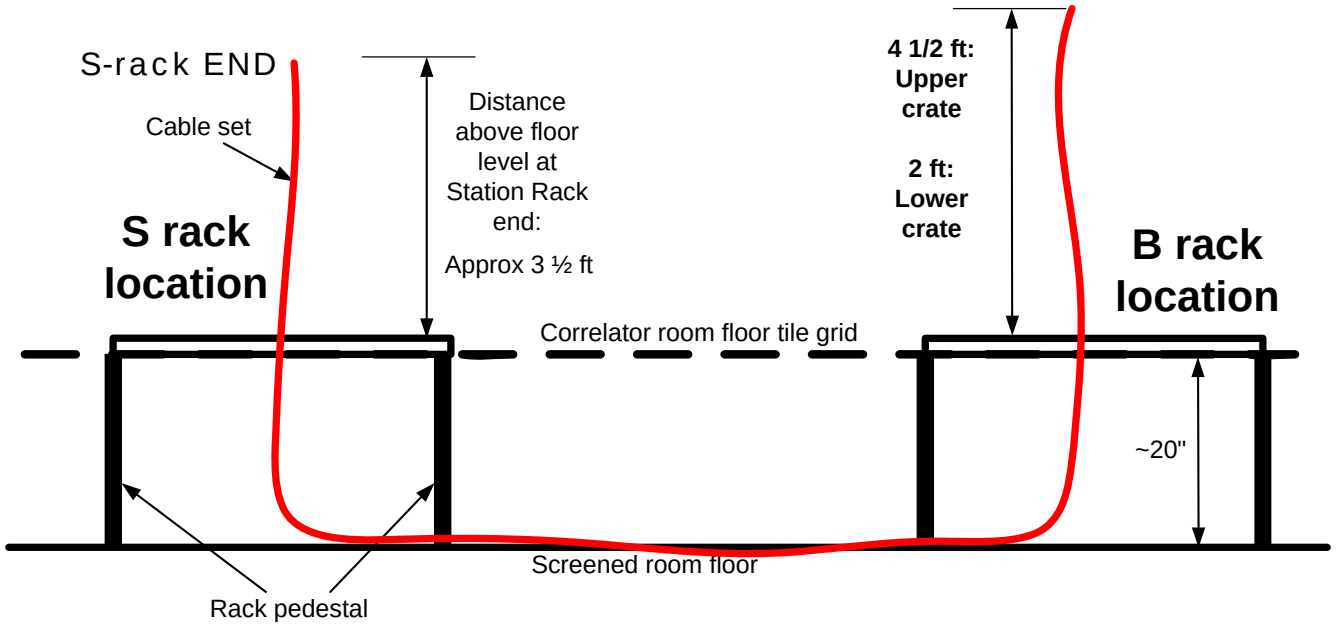
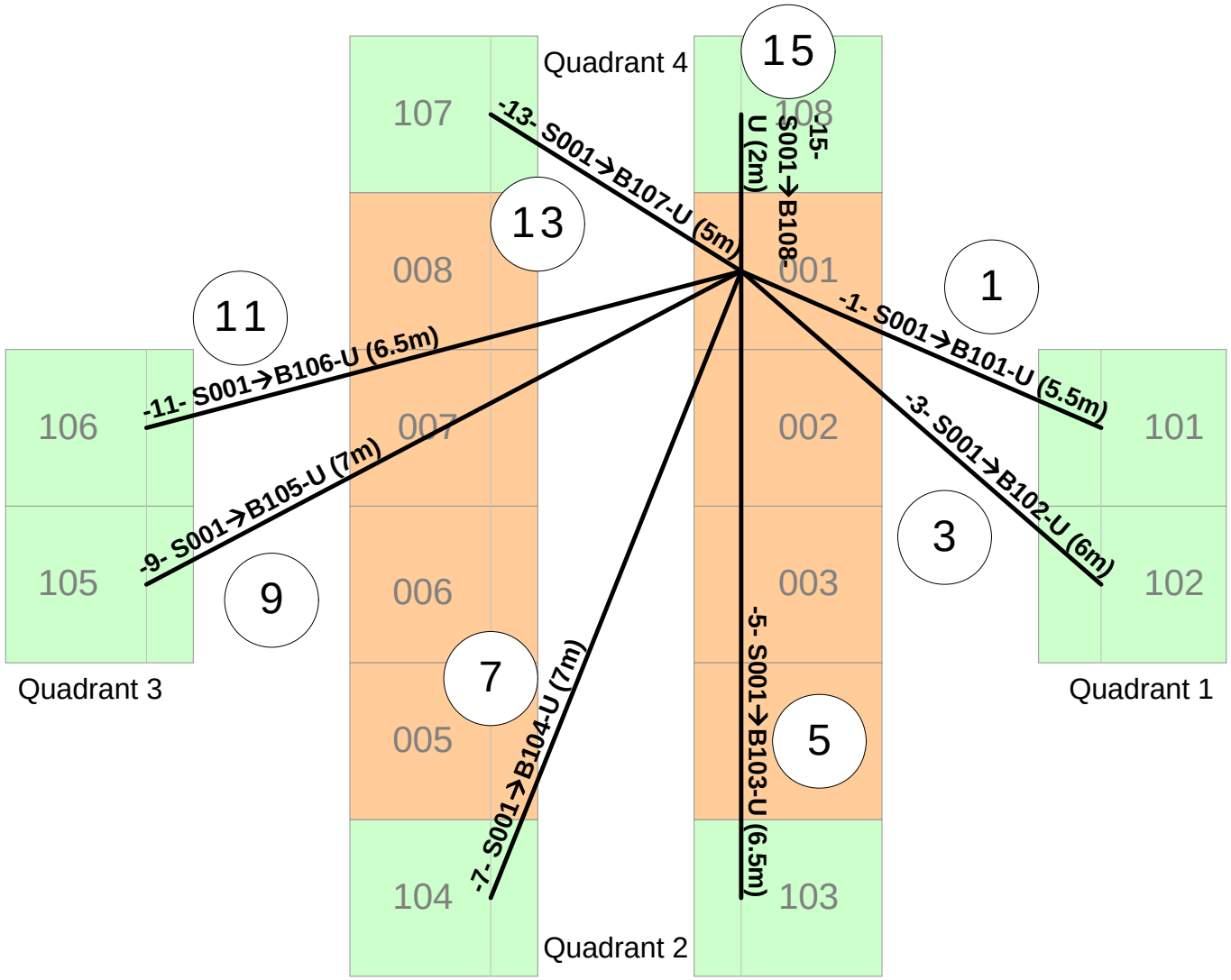
Rack-to-rack Meritec Cables

- Described in detail in document A25005N0001.
- 512 cables assembled into 128, 4-cable “sets” in Penticton.
  - Nice cable set bundling solution using split-expando with heatshrink termination.
- All cable sets labeled and kitted…ready for install.
  - Each cable is labeled, with source/destination, but also with unique 1-128 number.


Power Filter 480V
Power 480V
Power Filter 208V
Power 208V UPS
Power Filter 480V
Power 480V UPS
Power Filter 480V
Power 480V TO UPS
HVAC DX
HVAC DX
RECTIFIERS
POWER TRAY
B107
B108
S008
S001
S007
S002
S006
S003
S005
S004
B104
B103
B106
B105
B101
B102
FIBER TRAY
DEFORM
DEFORM
DEMUX
EDFA
NET
CPCC MCCC
CPCC MCCC
BE
BE
BE
HVAC CW
HVAC CW
ELECT FLOOR BOX
FIBER
FIBER TRAY


sb0-Q1
sb1-Q1
sb2-Q1
sb3-Q1
S-rack end
-1- S001(1-4)→B101-U-Q1 (5.5m)
-1- S001(1-4)→B101-U-Q1 (5.5m)
sb0-Q1
sb1-Q1
sb2-Q1
sb3-Q1
Cable set number


S-rack END
Cable set
S rack location
Distance above floor level at Station Rack end:
Approx 3 ½ ft
4 1/2 ft: Upper crate
2 ft: Lower crate
B rack location
Correlator room floor tile grid
~20"
Screened room floor
Rack pedestal


Quadrant 4
Quadrant 3
Quadrant 1
Quadrant 2
107
108
008
001
007
002
006
003
005
104
103
106
101
105
102
15
13
11
1
9
3
7
5
-13- S001→B107-U (5m)
-15- S001→B108-U (2m)
-11- S001→B106-U (6.5m)
-1- S001→B101-U (5.5m)
-9- S001→B105-U (7m)
-3- S001→B102-U (6m)
-7- S001→B104-U (7m)
-5- S001→B103-U (6.5m)

NRC · CNRC

Rack Shipping/Installation

- Several possible scenarios…depends on desire to get H/W to the site ASAP.
- Anticipate all racks assembled and ready by end of April, possibly sooner.
- Ship in 2, 8-rack shipments.
  - Doors and side panels ship directly to VLA…not needed in Penticton.
- Each rack labeled with its rack number (e.g. S001). Has specific place in room where it is installed.
- Fan tray assemblies must be attached once in room…due to elevator height limitations.

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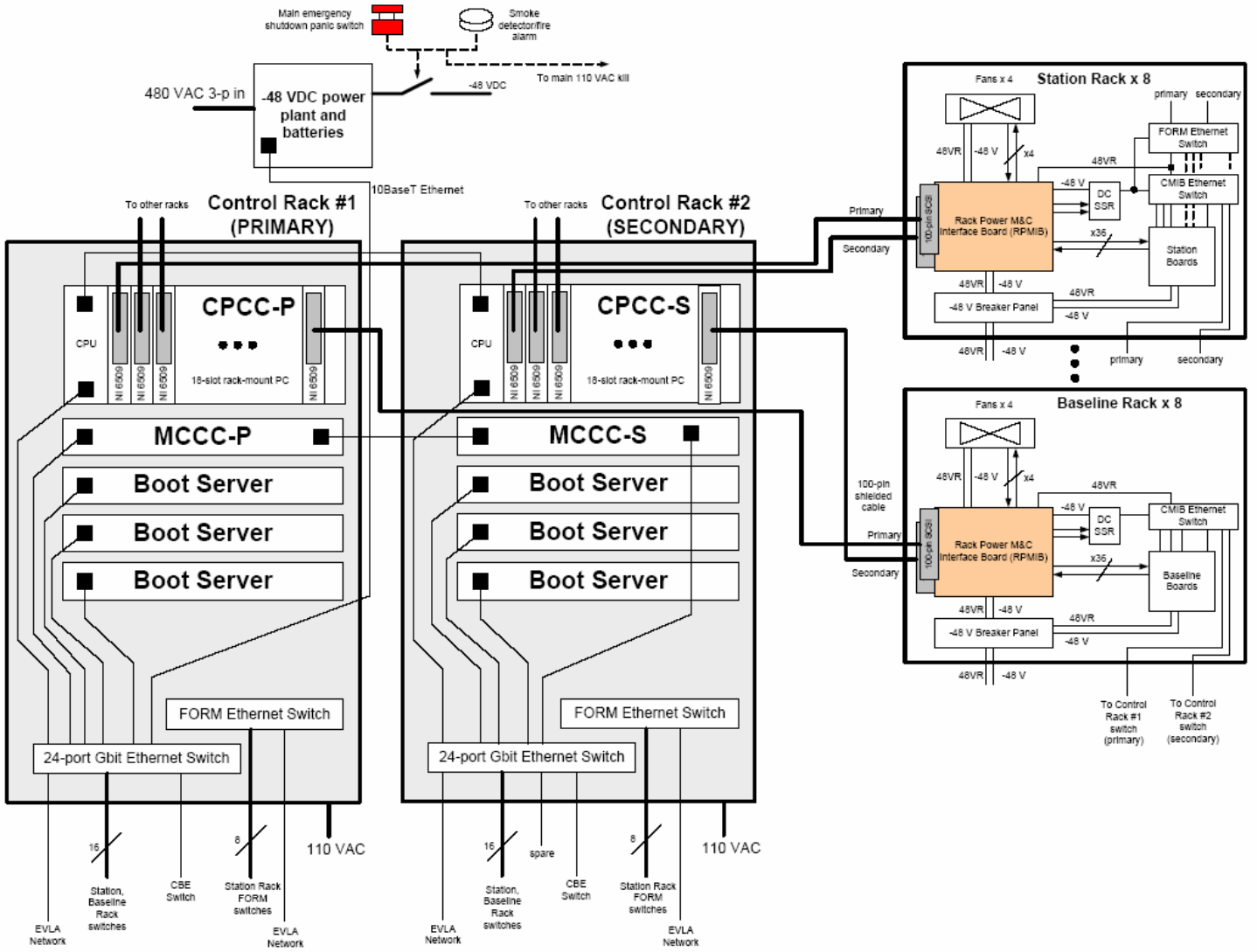
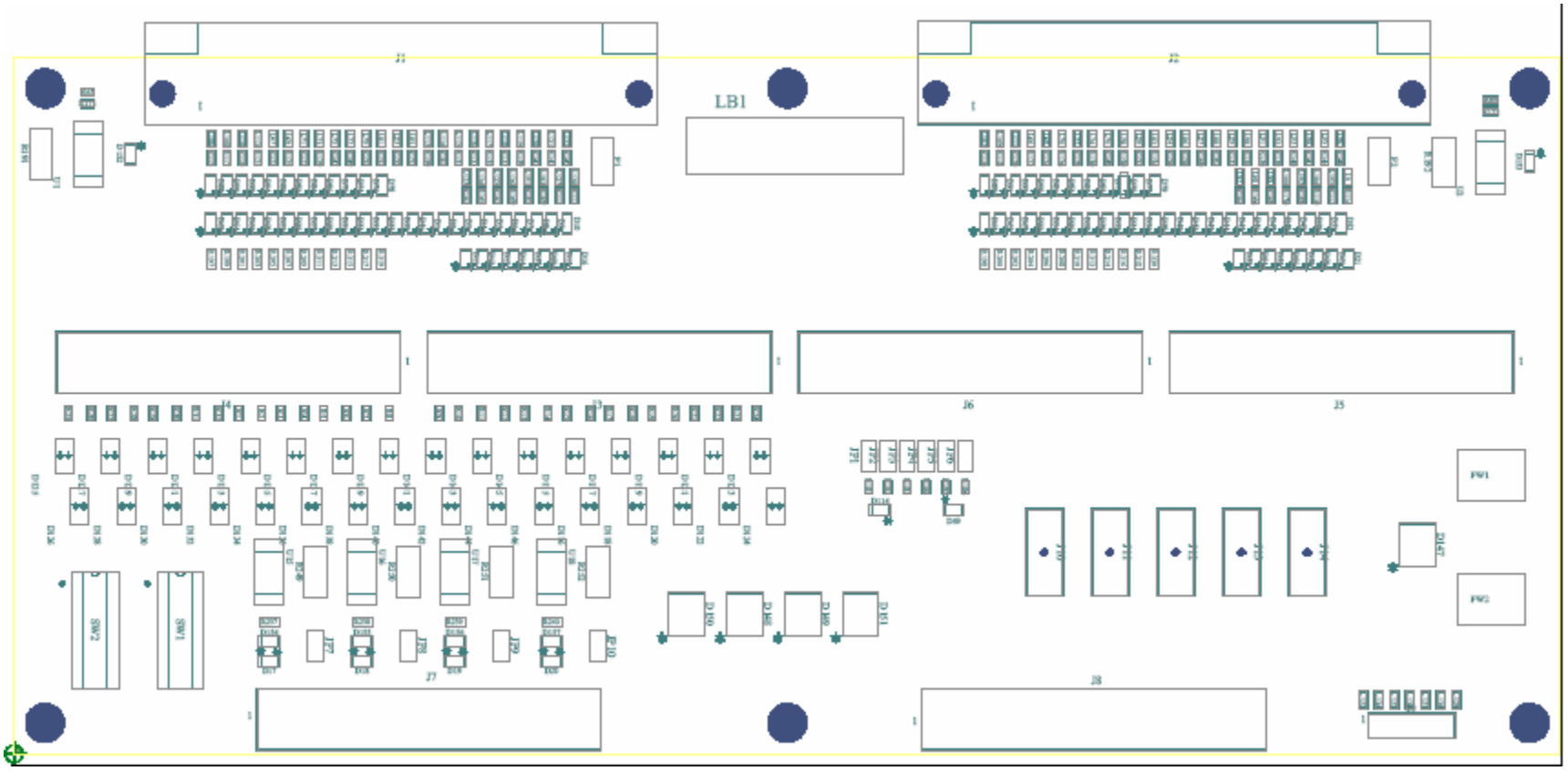
Control Racks

- Description in A25026N0000.
- Dual 1+1 redundancy.
- Contains CPCC, MCCC, boot servers, switch.
- 19” COTS racks, all COTS components/computers.
- CPCC: rack-mount PC or CompactPCI.
  - My vote is rack-mount PC…generic, easily replaced.


Main emergency shutdown panic switch
Smoke detector/fire alarm
To main 110 VAC kill
480 VAC 3-p in
-48 VDC power plant and batteries
-48 VDC
10BaseT Ethernet
To other racks
Control Rack #1 (PRIMARY)
To other racks
Control Rack #2 (SECONDARY)
CPCC-P
CPCC-S
CPU
NI 6509
18-slot rack-mount PC
MCCC-P
MCCC-S
Boot Server
Boot Server
Boot Server
Boot Server
FORM Ethernet Switch
FORM Ethernet Switch
24-port Gbit Ethernet Switch
24-port Gbit Ethernet Switch
110 VAC
110 VAC
16
8
16
spare
8
Station, Baseline Rack switches
CBE Switch
Station Rack FORM switches
EVLA Network
Station, Baseline Rack switches
CBE Switch
Station Rack FORM switches
EVLA Network
Primary
Secondary
Fans x 4
Station Rack x 8
primary
secondary
FORM Ethernet Switch
CMIB Ethernet Switch
48VR
-48 V
x4
DC SSR
x36
100-pin SCSI
Rack Power M&C Interface Board (RPMIB)
Station Boards
-48 V Breaker Panel
primary
secondary
100-pin shielded cable
Primary
Secondary
Fans x 4
Baseline Rack x 8
Baseline Boards
To Control Rack #1 switch (primary)
To Control Rack #2 switch (secondary)

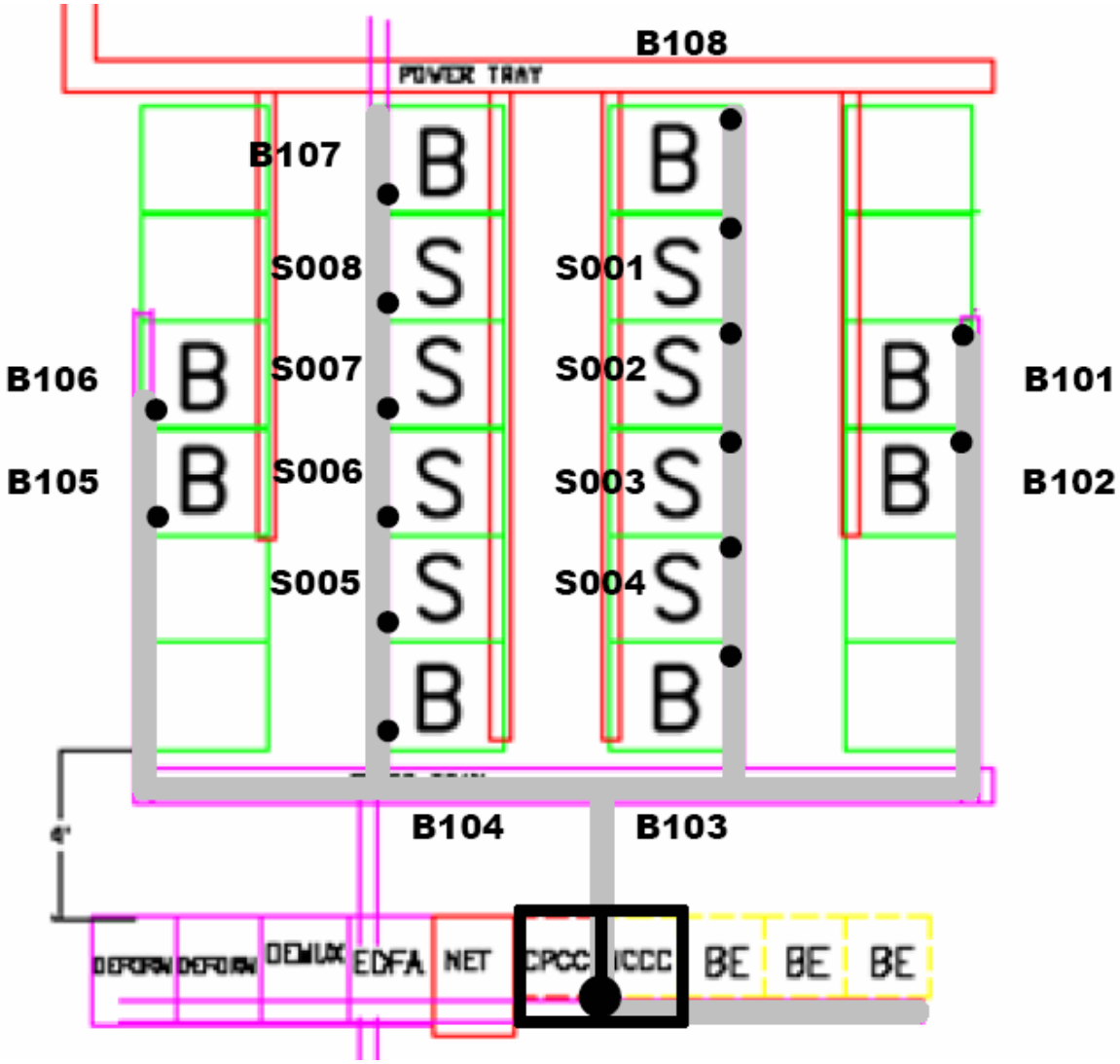

LB1

NRC · CNRC

Control Racks

- 100-pin RPMIB "SCSI" cables are unbroken from CPCC/NI6509 card to RPMIBs in racks.
- Custom cables…custom lengths. 2 cables per rack.
- Need final overhead tray configuration so final lengths can be determined and these cables can be ordered.

- Preliminary spreadsheet ready, based on the following diagram.
  - Qtys/lengths: 8x12.9 m; 8x12 m; 4x11.3 m; 4x10.5 m; 4x9.7 m; 4x9 m
  - 32 in total for EVLA; 2 for eMERLIN (15 ft)


B108
POWER TRAY
B107
S008
S001
B106
S007
S002
B101
B105
S006
S003
B102
S005
S004
B104
B103
EDFA
NET
CPCC
ICCC
BE
BE
BE

NRC · CNRC

Ethernet Cables

- All cables are cat6 solid, UTP.
- All cables broken out at top-front of rack with ~3 ft leader, and cat6 RJ-45 couplers.
  - Station rack: 4 x BLUE M&C cables out the top…all into Control Rack switches.
  - Baseline rack: 2 x M&C BLUE; 16 x CBE RED; 16 x VLBI YELLOW out the top.
    - BLUE into Control Rack switches; RED into CBE switch; YELLOW into VLBI switch.
- Rack-to-Control Rack, CBE, Ethernet cables can be built on-site, or sized and built in Penticton, once all rack and tray locations known.
  - Add another 5 ft of cable for margin, if pre-built.

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VLBI Recorder Rack

- Location in room doesn't matter for rack assembly.
- Each B-rack breaks out a cat6 cable for 1 GigE from each B-board.
- For full phasing/selection flexibility, route all 128 cables into 1 GigE/10 GigE switch…software then turns on BB data sources for those sub-bands that are to be recorded.
  - This allows expansion to full 16 GHz phasing capacity.
- NRC provides access to cat6 signals at top of rack. NRAO provides cabling, switch, VLBI recording equipment.

NRC · CNRC

Summary

- Rack assembly.
- Meritec cable assembly/installation.
- Rack shipping/installation.
- Control Racks.
- Ethernet cables.
- VLBI recorder rack.