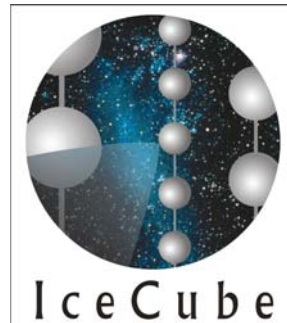# Electrical Wiring in DFL and Related Issues

December 2003
Madison Workshop

Nobuyoshi Kitamura

UW-Madison

Objective

Copper wiring of the **Dark Freezer Laboratory** setup for DOM test and calibration.

➔Data / Power connection between HUB (DOR cards) and DOMs.

➔Local Coincidence (LC) connections between DOMs.

The RAPCAL function will be relied on for the test and calibration.

➔Data / Power connections must be compatible with RAPCAL.
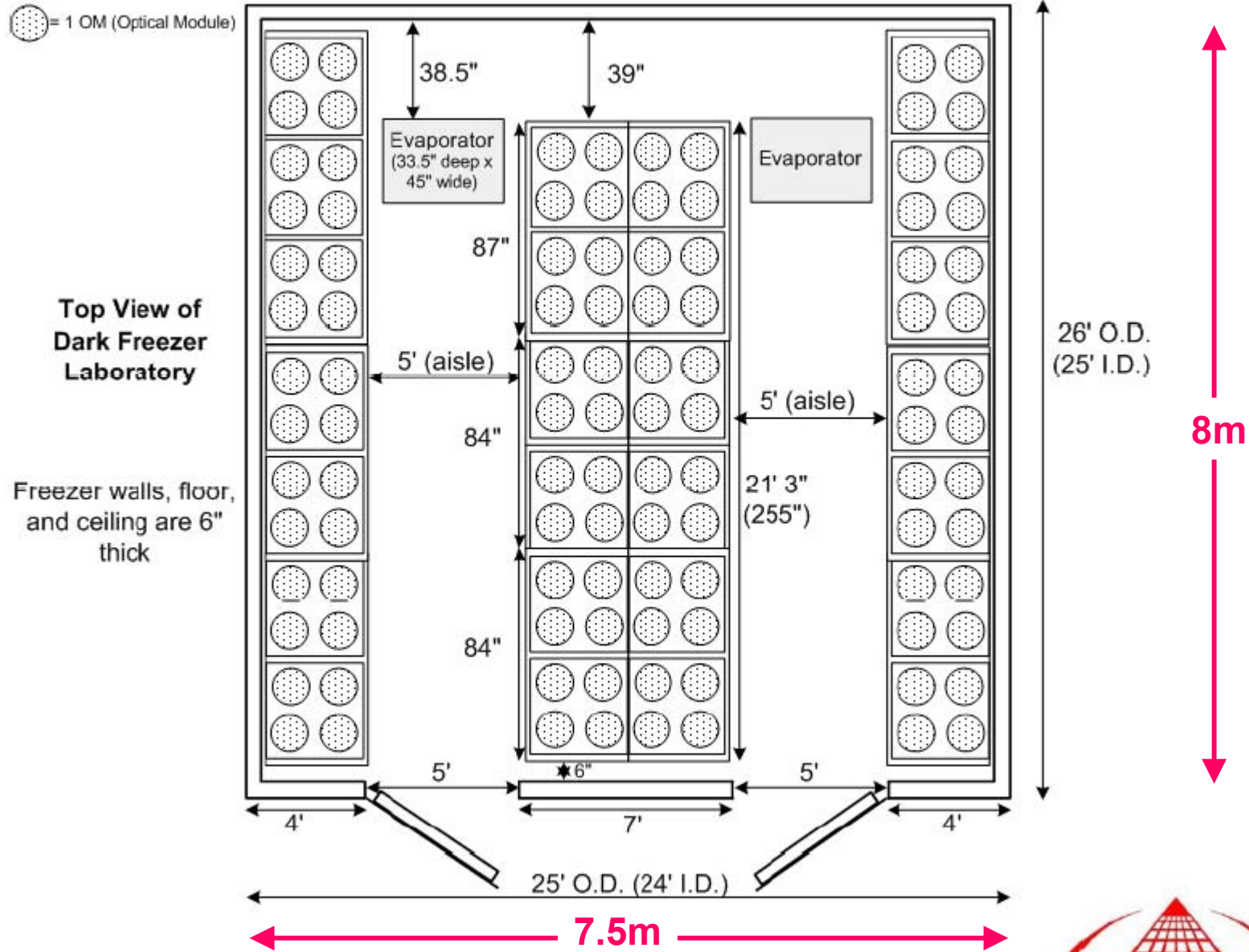
2

Dark Freezer Lab (DFL)
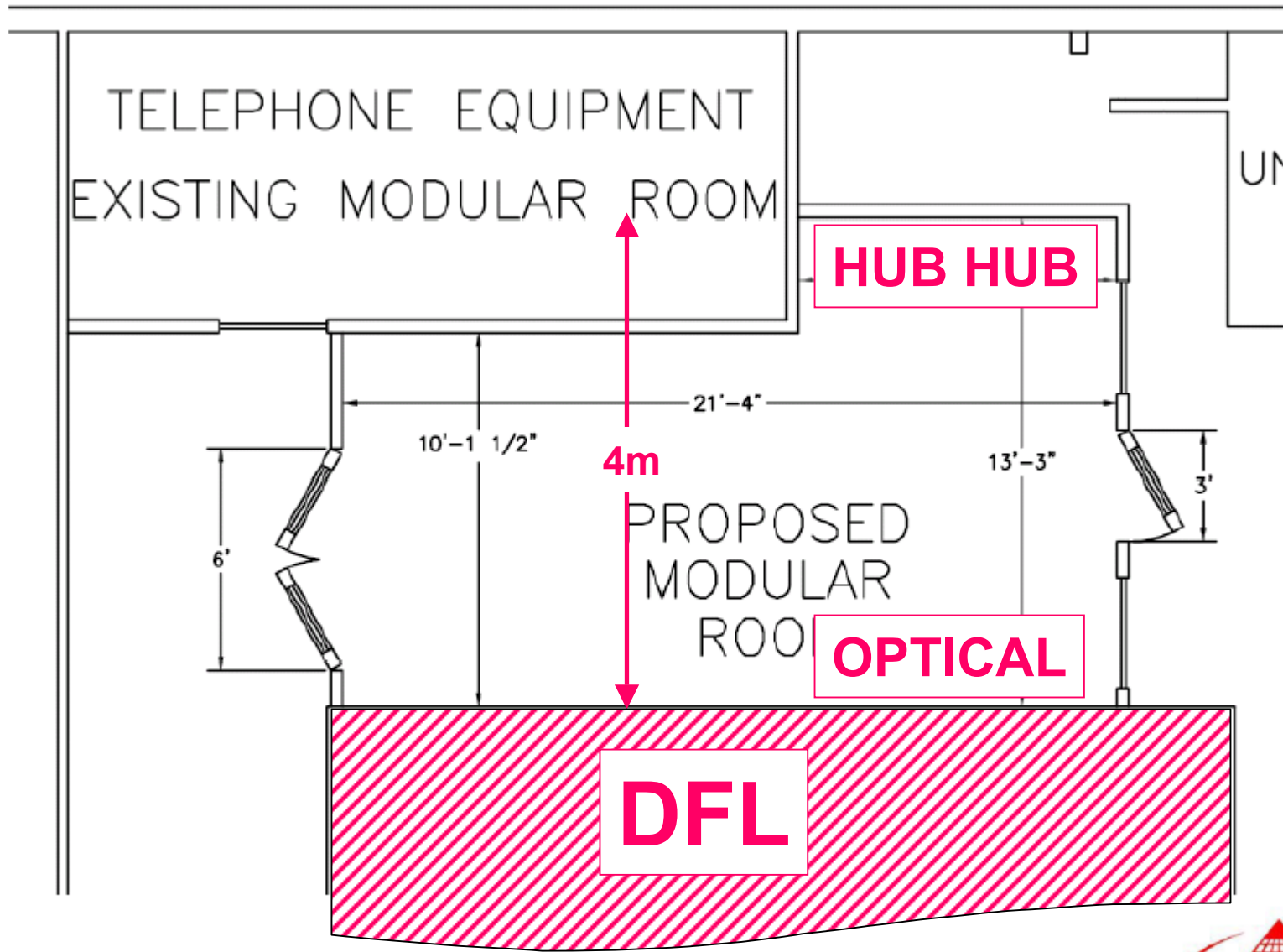
TOTAL
78 boxes x 4 OMs/box
312 OMs

21 boxes x 4 OMs/box
84 OMs

36 boxes x 4 OMs/box
144 OMs

21 boxes x 4 OMs/box
84 OMs

= 1 OM (Optical Module)

38.5"

39"

Evaporator
(33.5" deep x
45" wide)

Evaporator

87"

**Top View of
Dark Freezer
Laboratory**

5' (aisle)

84"

5' (aisle)

26' O.D.
(25' I.D.)

8m

Freezer walls, floor,
and ceiling are 6"
thick

21' 3"
(255")

84"

5'

6"

5'

4'

7'

4'

25' O.D. (24' I.D.)

7.5m

J. Hoffman

March 7, 2003

P S L

TELEPHONE EQUIPMENT
EXISTING MODULAR ROOM

HUB HUB

21'-4"

10'-1 1/2"

4m

13'-3"

6'

3'

PROPOSED
MODULAR
ROO
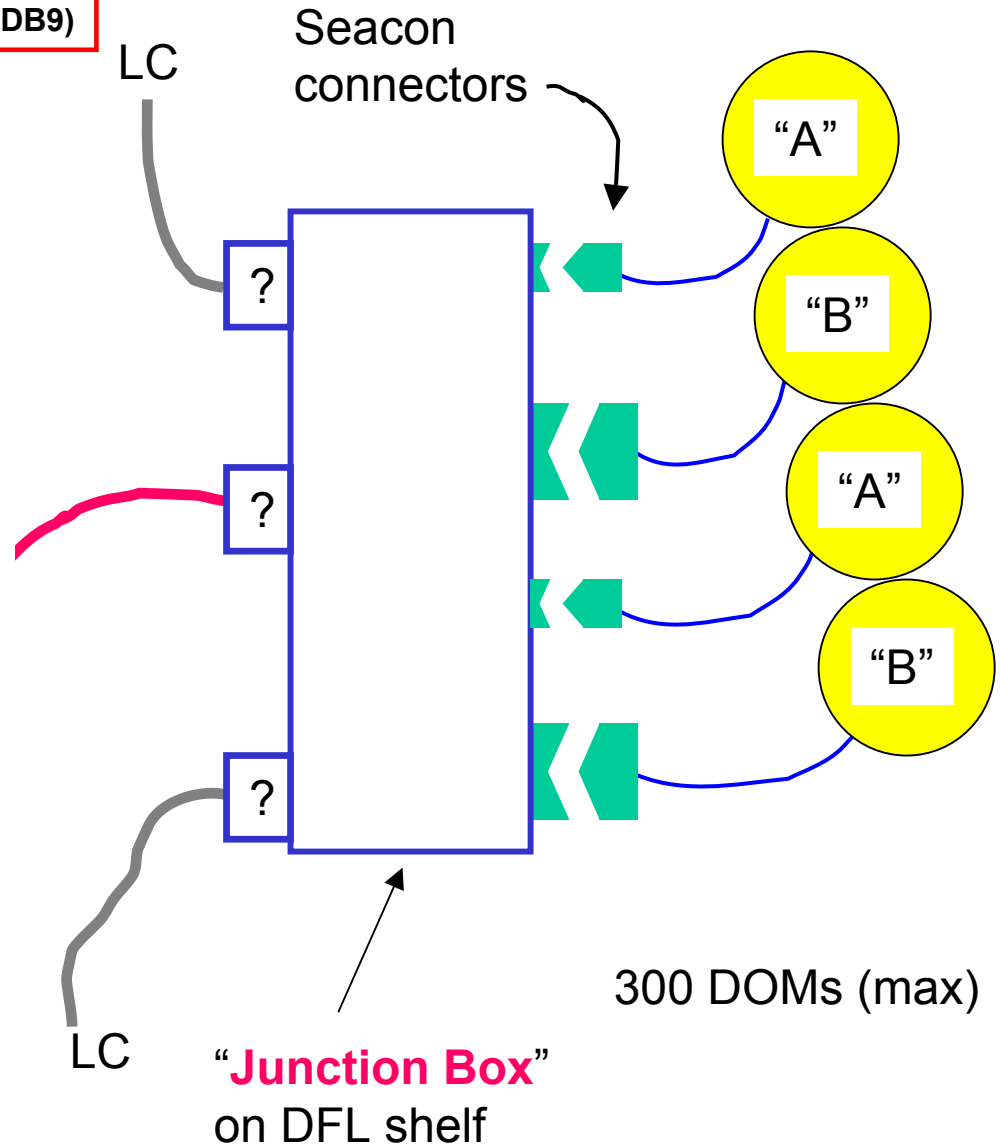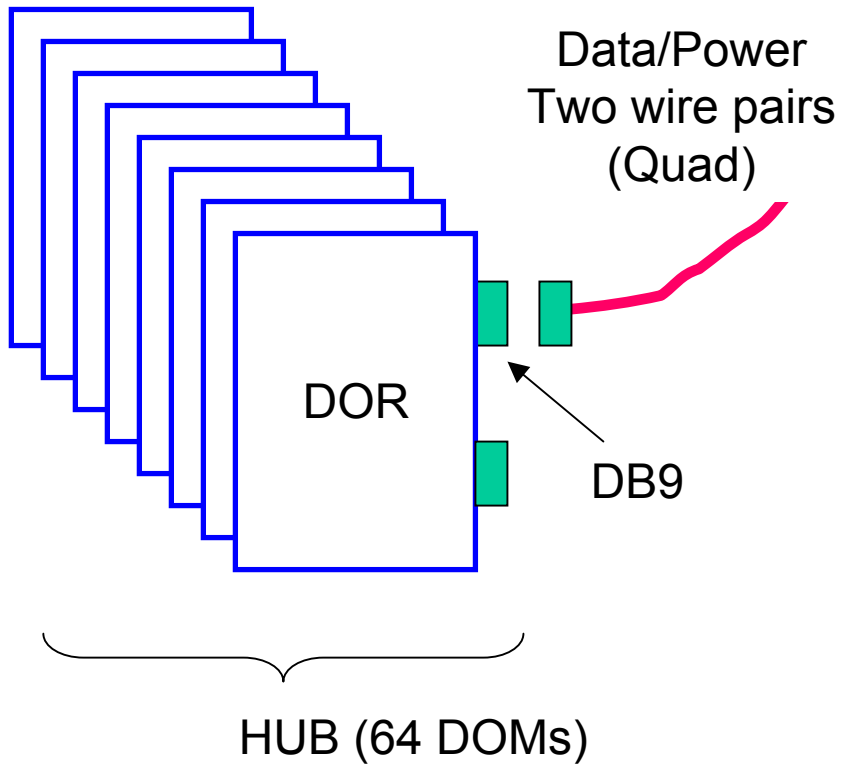
OPTICAL

DFL

J. Hoffman

March 7, 2003

Generic Wiring Scheme

Constraint: One Junction Box per DOR connection (DB9)

Alternatively, "One box per DOR card".
Use the above as a design constraint.

LC

Seacon connectors

"A"

"B"

Data/Power
Two wire pairs
(Quad)

?

?

"A"

"B"

DOR

DB9

?

LC

300 DOMs (max)

"**Junction Box**"
on DFL shelf

HUB (64 DOMs)

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Junction Box Circuitry

❑ **Power/Data connection to DOMs**

❑ **LC connection between the DOMs**

❑ **LC connection to the neighboring Junction Boxes**

❑ **Adjust signal attenuation**

Emulate a long cable > 250m for RAPCAL

❑ **Adjust signal rise-time**

❑ **Impedance matching (if necessary)**

Signal amplitude at source is fixed: 1.2Vpp
Receiver ADC samples at 20MHz
Receiver ADC dynamic range: 400mVpp
K.H.Sulanke estimates a minimum of 250m cable length for RAP cal.

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Local Coincidence Wiring

If this is a true requirement, accommodating the slack of LC wires becomes an issue.
Can a circuitry inside Junction Box accomplish the same?

LC Up

Terminal Block (or a portion of Junction Box Card)

Same length as the distance between Junction Box neighbors

LC Down

7
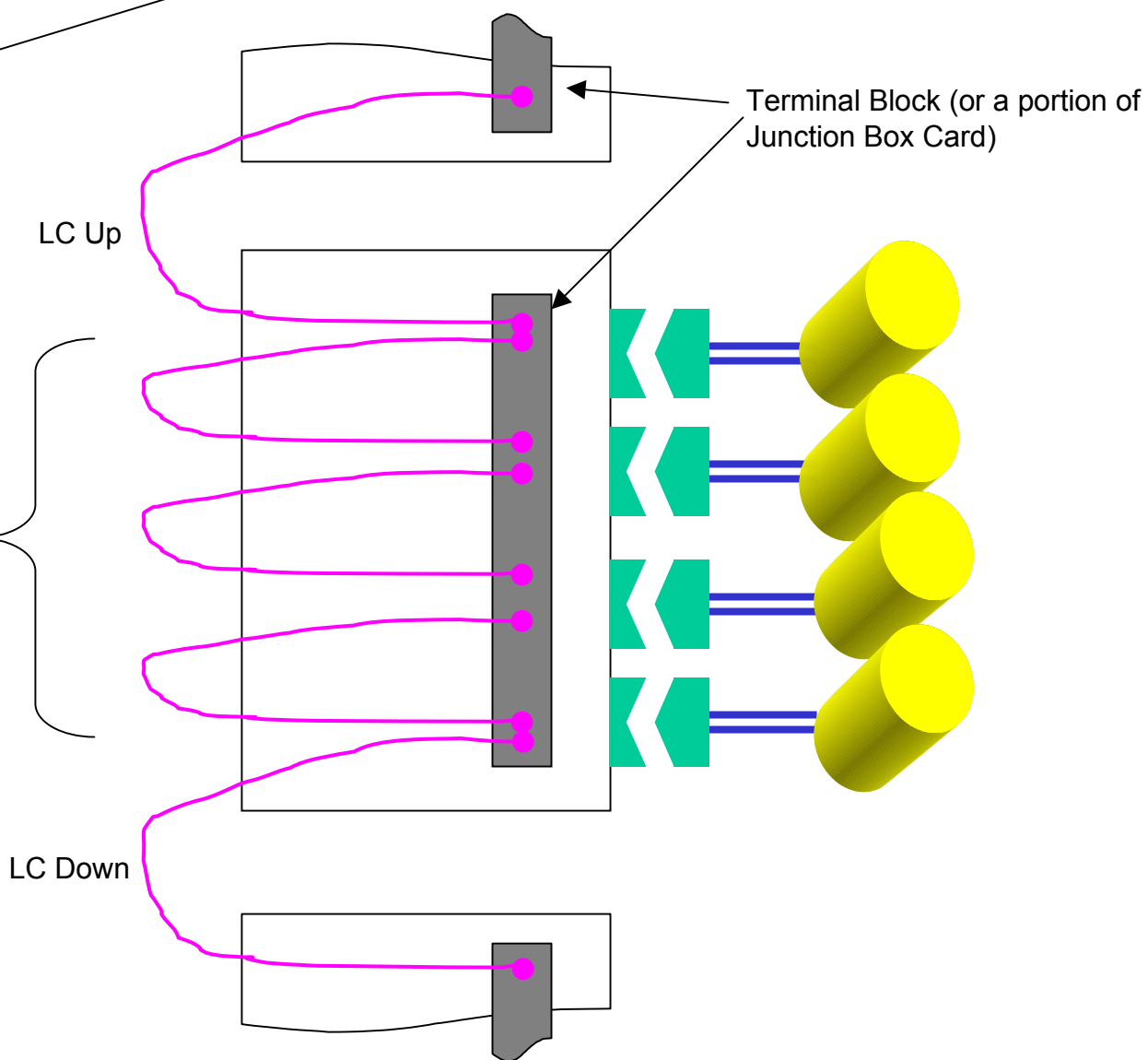
Data/Power Cable (DOR/HUB – DOMMB Cable) Options

Requirement: The cables must be shielded.

- **EMI-clean environment inside DFL**
- **Cross-talk management**

Quad vs. Twisted Pair??

➔ Quad cables are difficult to handle (stiffness, bending radius)
➔ Quad cables have matched impedance for DOR and DOMMB (145 Ω)
➔ DOR card assumes Quad per DB9 connector

➔ Twisted pairs are available in many varieties
➔ Matched impedance variety must be custom made.
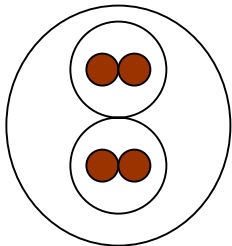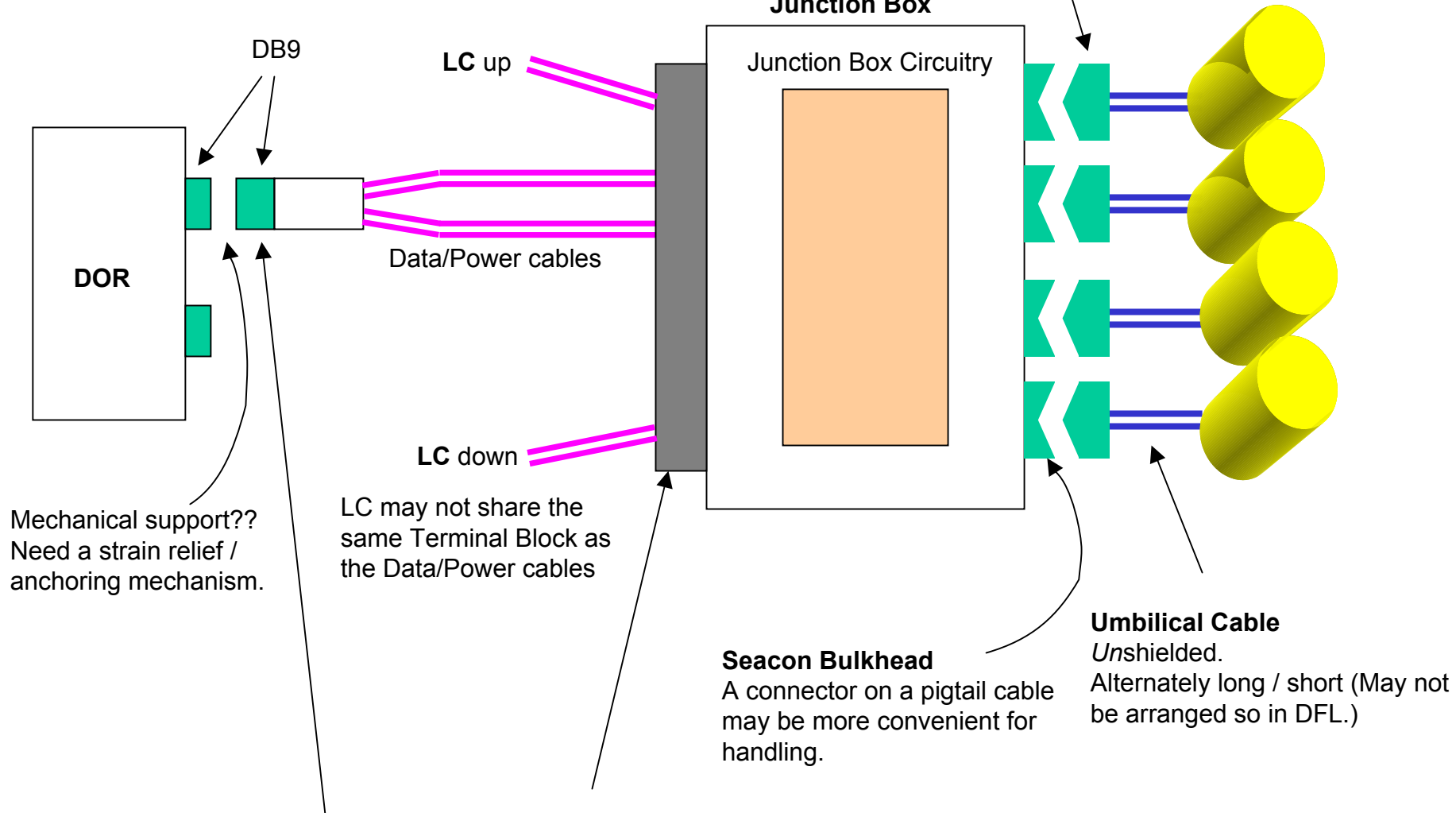
Custom twin twisted-pair (Two shielded, stranded, 145Ω, twisted-pair cables packaged in one) is most convenient.

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Wiring with Shielded Twisted Pairs

(The shield connections are not shown.)

Seacon IceCube Connector

DOM in "Can"

Junction Box

Junction Box Circuitry

DB9

LC up

Data/Power cables

DOR

LC down

Mechanical support??
Need a strain relief /
anchoring mechanism.

LC may not share the
same Terminal Block as
the Data/Power cables

Umbilical Cable
*Un*shielded.
Alternately long / short (May not
be arranged so in DFL.)

Seacon Bulkhead
A connector on a pigtail cable
may be more convenient for
handling.

How do we combine the two pairs?
Patch Panel vs. Adapter Box
The Breakout Box could contain
functional components

Terminal Block vs. Connectors
Threading thru the DFL wall would be easier w/o connectors
Attaching connectors after routing the cables may not be easy

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Alternative: *Twin* Shielded Twisted Pairs
(Quad)

(The shield connections are not shown.)
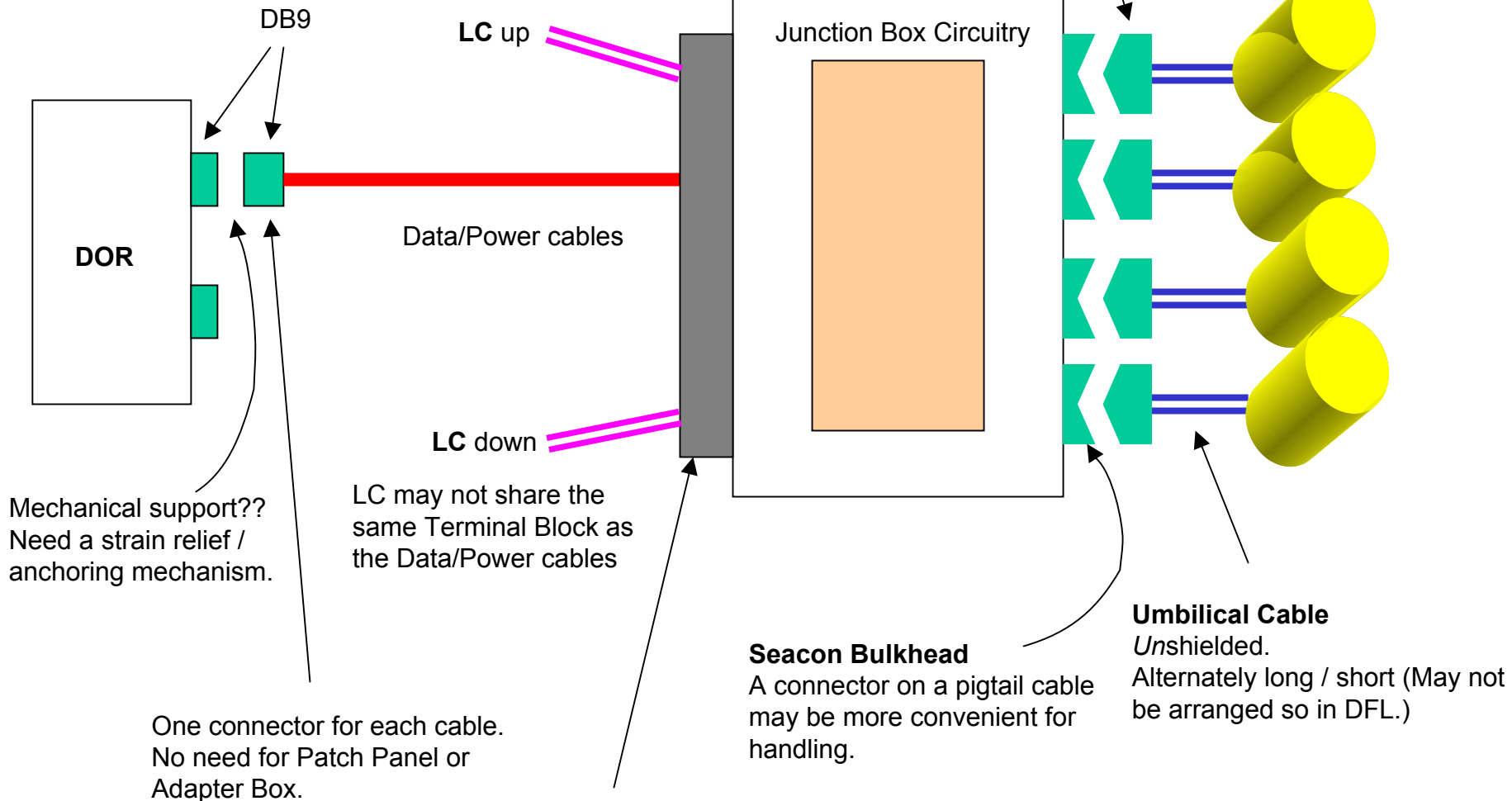
Seacon IceCube Connector

DOM in "Can"

DB9

Junction Box

Junction Box Circuitry

LC up

DOR

Data/Power cables

LC down

LC may not share the
same Terminal Block as
the Data/Power cables

Mechanical support??
Need a strain relief /
anchoring mechanism.

One connector for each cable.
No need for Patch Panel or
Adapter Box.

Seacon Bulkhead
A connector on a pigtail cable
may be more convenient for
handling.

Umbilical Cable
*Un*shielded.
Alternately long / short (May not
be arranged so in DFL.)

Terminal Block vs. Connectors
Threading thru the DFL wall would be easier w/o connectors
Attaching connectors after routing the cables may not be easy

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Alternative: **Shielded Category 5 (CAT5) cable**

"Adapter"

A single CAT5 contains 4 wire pairs.
Use just two pairs.
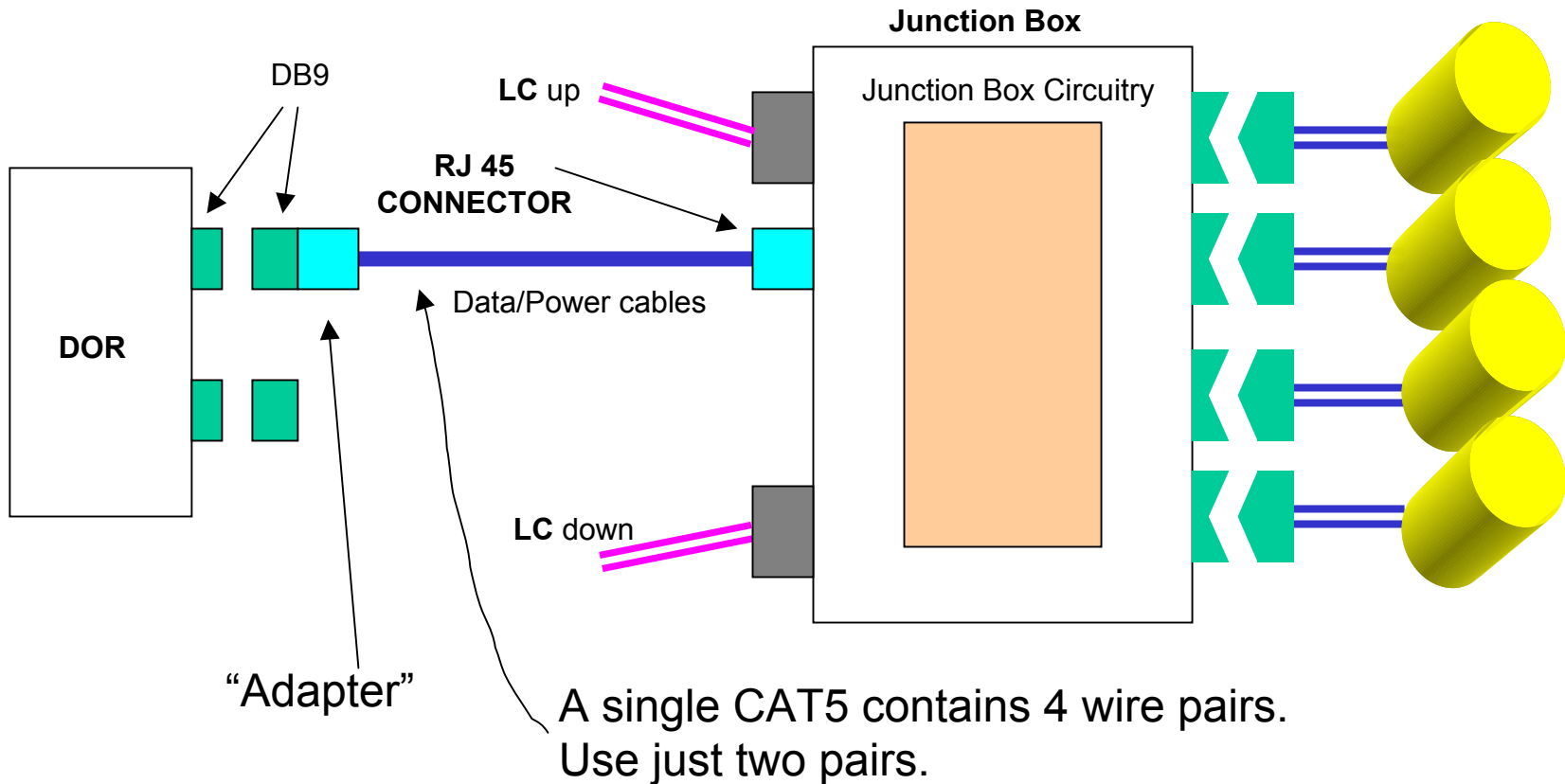
•Lab measurements show that pair-to-pair and cable-to-cable xtalk is acceptable. (A. Laundrie)
•Convenient connectorized solution.
•Needs impedance matching network.

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Proposed Solution

❑ Junction Box should support all three types of cabling:

➢ Terminal Block for two twisted pairs or a single quad.
➢ RJ45 connector for CAT5.
➢ Terminal Block for the LC connections.
➢ Junction Box circuitry to be replaceable / selectable

❑ CAT5 as interim solution while waiting for quad delivery.

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DOMMB / DOR Modification Proposal

➢Add a low-pass filter to the communication front-end of DOMMB and DOR.

➢Make the communications DAC output amplitude programmable.

➔Allow short cable for RAPCAL

➔Reduced cross-talk

➔Reduced EMI in counting house

Resource available

DOR card

Rev 3 DOMMB

Communication / RAPCAL program

<u>Goal:</u>

Rework / add a filter components to the boards and test COMM, RAP functionality.

Produce a report by Rev 4 deadline.

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