DAQ and ECS Ethernet cabling in UXA85

LHCb Technical Note

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Abstract

This document describes the Ethernet cabling in the electronics barracks D1 to D3. It lists all available Ethernet connections between and in the barracks for both the DAQ and the ECS LANs. **This network does not cover the Technical Network used by the LHC and the magnet group**. *This revision takes into account the changes brought about by the decision to install switches in the D3 racks.*

Document Status Sheet

Table 1 Document Status Sheet

1. Document Title: DAQ and ECS Ethernet cabling in UXA85			
2. Reference: EDMS 497862/2			
3. Issue	**4. Revision**	**5. Date**	**6. Reason for change**
2	4	4/19/05	Include description of IT labelling. Removed obsolete section on planning.
2	3	4/22/05	Add switches for CCPCs in D3
2	2	16/11/2004	Change OT distribution
2	1	15/11/2004	Final version (corrected DSS racks in D2)
2	0	11/3/04	New revision in EDMS (with all comments)
1	2	10/25/04	Comments from PUS (Martin)
1	1	10/25/04	Final comments from Werner & Beat
1	0	10/22/04	Version for approval
Draft	1	9/16/2004	Initial version

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1 Introduction

Ethernet forms the backbone of both the DAQ and the ECS in LHCb. A very dense network with over 6000 connections provides the connectivity needed. This document details the connections for each rack in barracks D1, D2 and D3 in the UX85A cavern.
The document lists the details for each ordered by barrack (the two parts of D3 are considered as one here). For sub-detector responsibles only the connectivity in D3 is relevant, see section 4.
LHCb has two (also physically) distinct Ethernet networks installed. The Controls Network (CN) is the backbone of the Experiment Control System (ECS). Every board, module, power-supply etc… which is controlled via Ethernet must be connected to the Controls Network. Some modules deliver data to the Level-1 trigger, the HLT or both. These data are sent via the Data Network (DN). There are only three types of modules, which are connected to the Data Network: the TELL1, the UKL1 and the Readout-Supervisor. Figure 1 shows a logical schema of the connections between D3 (the detector electronics barrack) and D2 (the central networking barrack).

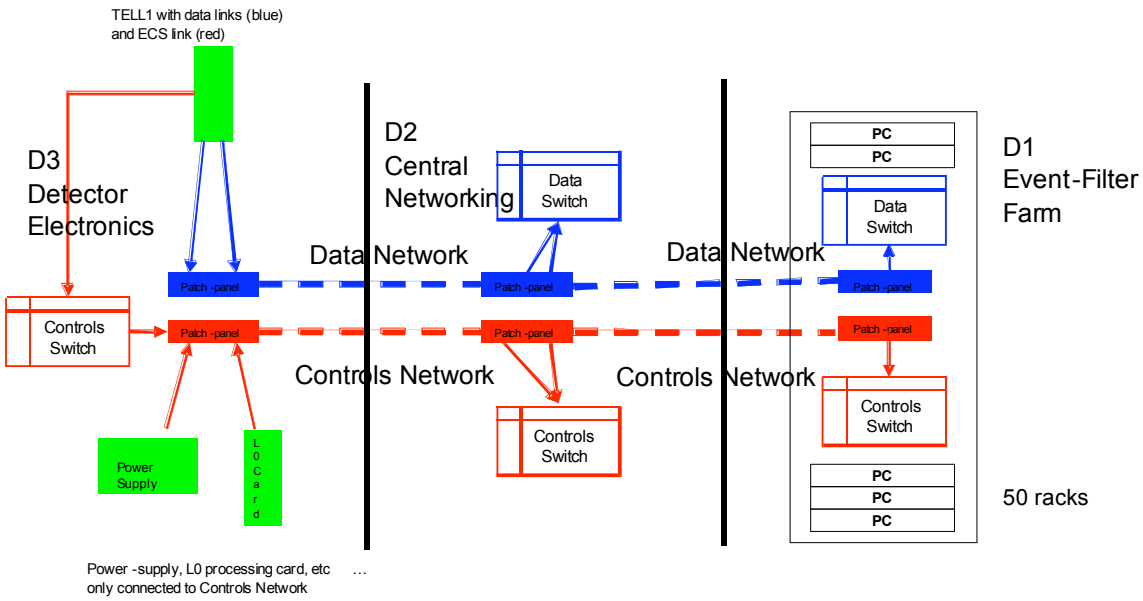

Figure 1 The controls and data networks in the D3, D2 and D1 barracks. Network connections always go via patch-panels. The patch-panels in D3 are connected to counter-parts in D2. The patch-panels in D1 are connected to the Subfarm Controller racks in D2. There are no data-switches in the D3 racks.

The document also includes a section on the labelling of the patch-panels and the cables. This last part is for reference only. The cables are not labelled in this way, because this is not required by INB regulations.

2 D1

D1 houses the event filter farm. It consists of 50 completely identical racks. In the baseline design each rack will house up to two sub-farms. The following connectivity is required for each rack.

Table 2 Links for D1 racks to D2

Data SFC	2 + 2 spares
ECS uplink	1
Rackcooler	1
ECS CPC link	1
ECS SFC link	2 + 1 spare

The rack-cooler links are not Ethernet signals, but will use the same cable infrastructure. They will go to D2C09. The readout of these signals will be done using ELMBs (Embedded Local Monitor Box).
The overall connectivity from D1 to D2 is shown in Table 3. In this table the 10 racks indicated in the left-most column are always treated in exactly the same way. That means that the numbers in the second to seventh column are to be divided by 10 to give the actual number of connections from one of the racks to the racks listed in the top row.
The racks in D1 are 59 Us high. **The patch-panel will be mounted in the back of the rack at the 29th U counted from the bottom**. The layout of all the sub-farm racks is shown in Figure 2.

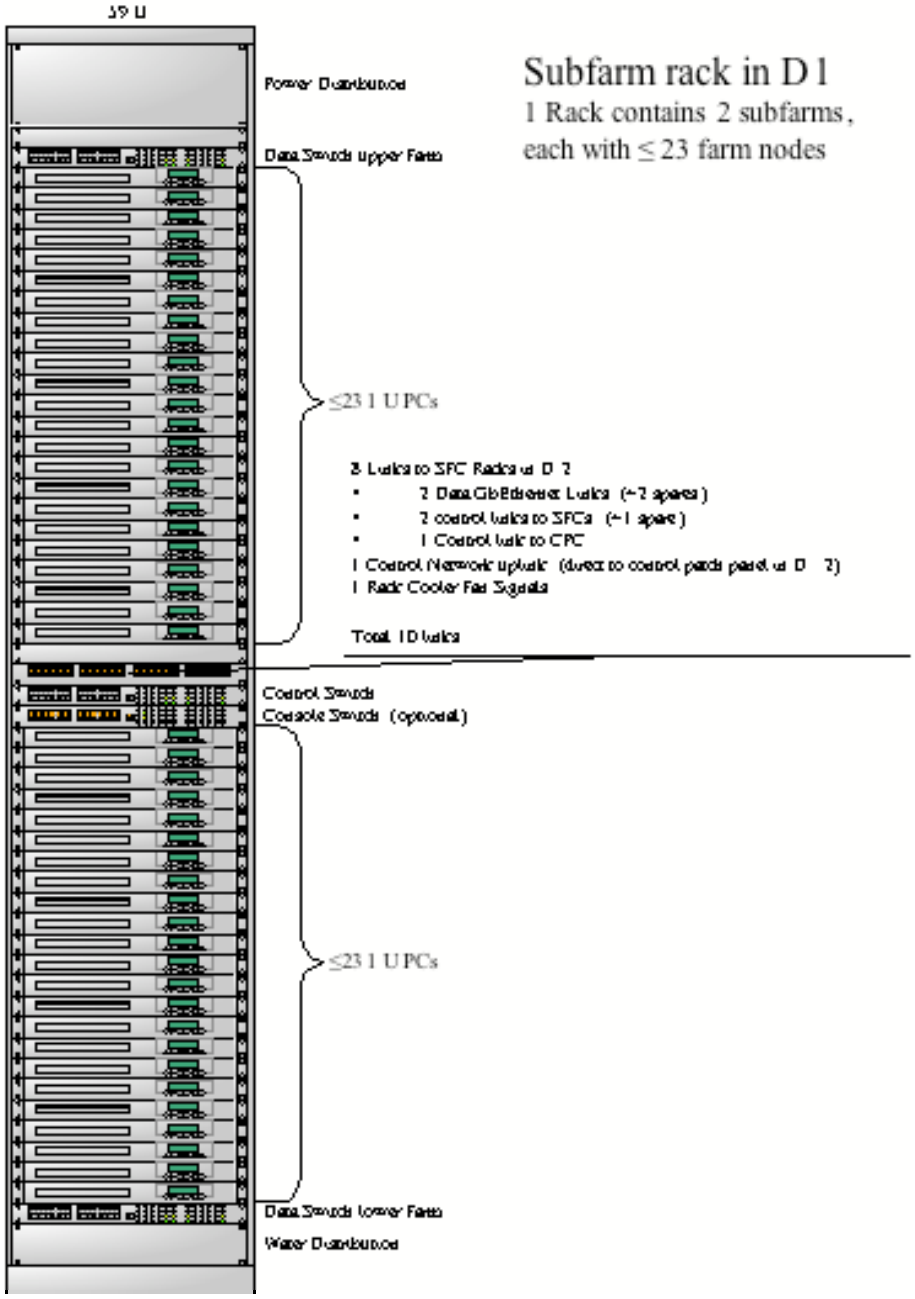

Figure 2 Layout of the sub-farm racks in D1. The patch-panel and the switches are shown on the front for clarity. They will be mounted facing the back of the racks[1].

Example: from each of the racks D1A01, D1A02 etc. 8 DAQ links go to a patch-panel in rack D2B05, 4 ECS links go to a patch-panel in D2C06 and 1 link for the rack-cooler goes to a patch-panel in D2C09.

[1] The reason for this is that most PCs have their network connection mounted in the rear of the chassis.

Table 3 Cabling from D1 to D2

	D2B05	D2B04	D2B03	D2B02	D2B01	D2C06	D2C09
D1A01 - D1A11	80					40	10
D1B01 - D1B11		80				40	10
D1C01 - D1C11			80			40	10
D1D01 - D1D11				80		40	10
D1E01 - D1E11					80	40	10

3 D2

D2 houses the central part of the DAQ and the ECS. It receives all cables from D1 and D3. It houses most of the network switches and receives also all the fibres from the surface (SX85). The **Subfarm Controllers (SFC**) and Controls PCs for **Detector Control (DCS**)[2] and **Creditcard PC (CCPC)**[3] control are also installed here. The racks in D2 are all 59 Us high. The cabling between racks in D2 is shown in Table 4.

Table 4 Connections between racks in D2

The layout of the racks in the D2 barrack is shown in Figure 3.

[2] These PCs will house the CAN and SPECS master-cards.

[3] The CPCs are the file-servers for the Credit-card PCs which are controlling the majority of the detector electronics boards in D3.

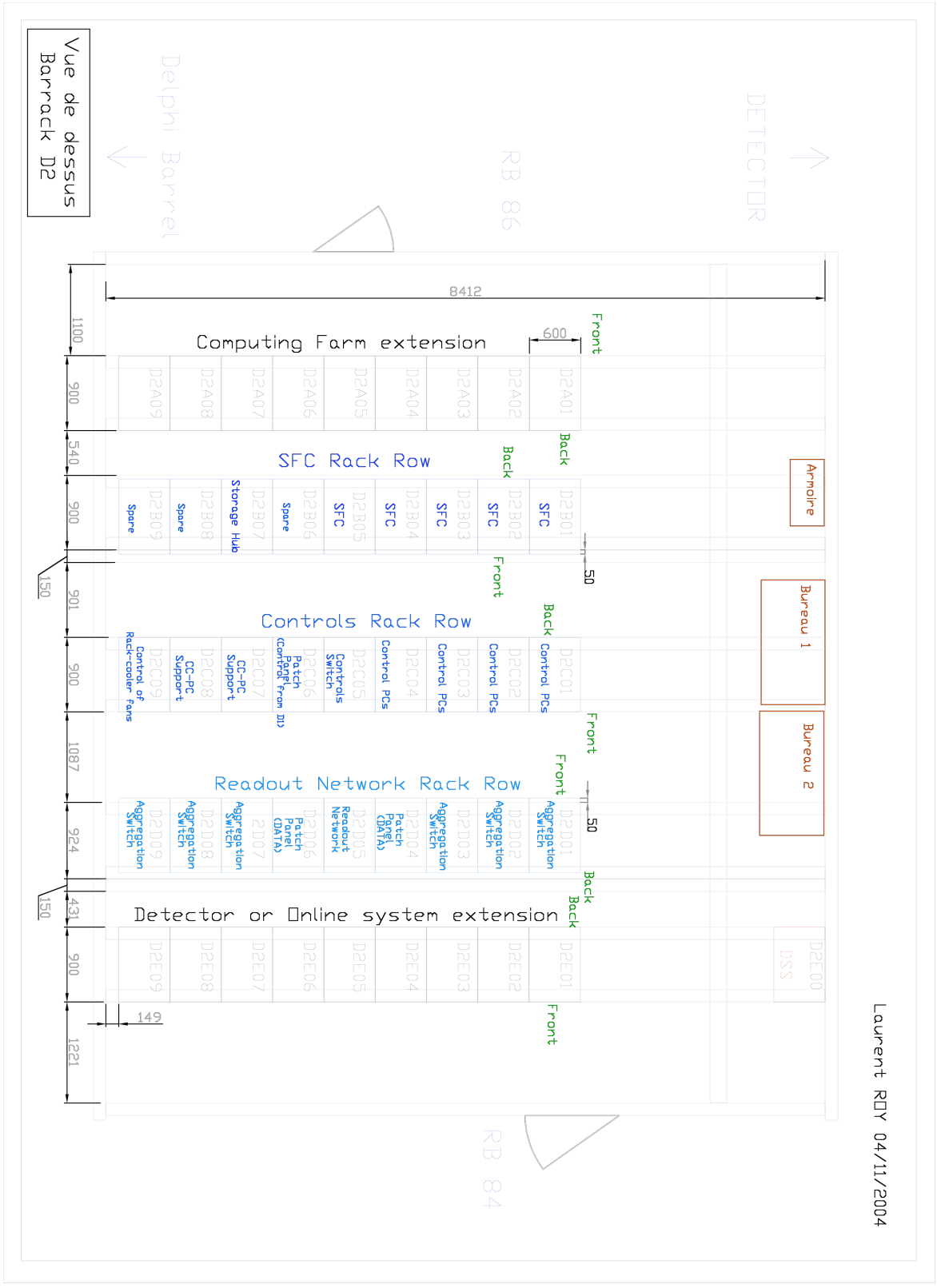

Figure 3 Rack-layout in D2

The distribution of the patch-panels in D2 is shown in Table 5. If there are several patch-panels in a rack, then the first one will be mounted at the position indicated in the right-most column as counted from the bottom. The following patch-panels will be mounted in the following higher slots. No space will be left between patch-panels.
The remaining racks in D2 are spares and not cabled[4].

Table 5 Distribution and position of patch-panels in racks in D2

Rack	Function	# Patchpanel	Position of PP from the top
D2B01	SFC	6	***back***: from the 34th U
D2B02	SFC	6	***back:*** from the 34th U
D2B03	SFC	6	***back:*** from the 34th U
D2B04	SFC	6	***back:*** from the 34th U
D2B05	SFC	6	***back:*** from the 34th U
D2B07	Storage hub	1	***front:*** from the 29th U
D2D02	Spare		
D2D03	Data aggregation	2	***front:*** from the 50th U
D2D04	Data from D3	27	***front:*** from the 50th U
D2D05	Data switch	13	***front:*** from the 50th U
D2D06	Data from D3	23	***front:*** from the 50th U
D2D07	Data aggregation	2	***front:*** from the 50th U
D2D08	Spare		
D2C01	DCSPC	1	***back:*** from the 56th U
D2C02	DCSPC	1	***back:*** from the 56th U
D2C03	DCSPC	1	***back:*** from the 56th U
D2C04	DCSPC	1	***back:*** from the 56th U
D2C05	Controls Switch	5	***front:*** from the 50th U
D2C06	Control from D1	3	***front:*** from the 29th U
D2C07	CCCPC	2	***front:*** from the 29th U
D2C08	Controls from D3	16	***front:*** from the 48th U
D2C09	Fibers from SX85 Rackcooler Control from D1	1 optical and 3 Cat6 from D1	***optical: front***: from the 15th U ***copper: front:*** from the 39th U

[4] The false floor in D2 is not nearly as busy as the three layers in D3. Adding future cables is therefore easy and no installation for possible needs will be done now.

4 D3

Barrack D3 houses the sub-detector and the TFC electronics. Figure 4 shows the rack layout in D3. Rack D3A07 and D3A08 are not operated by the online system and will not be cabled with Ethernet.

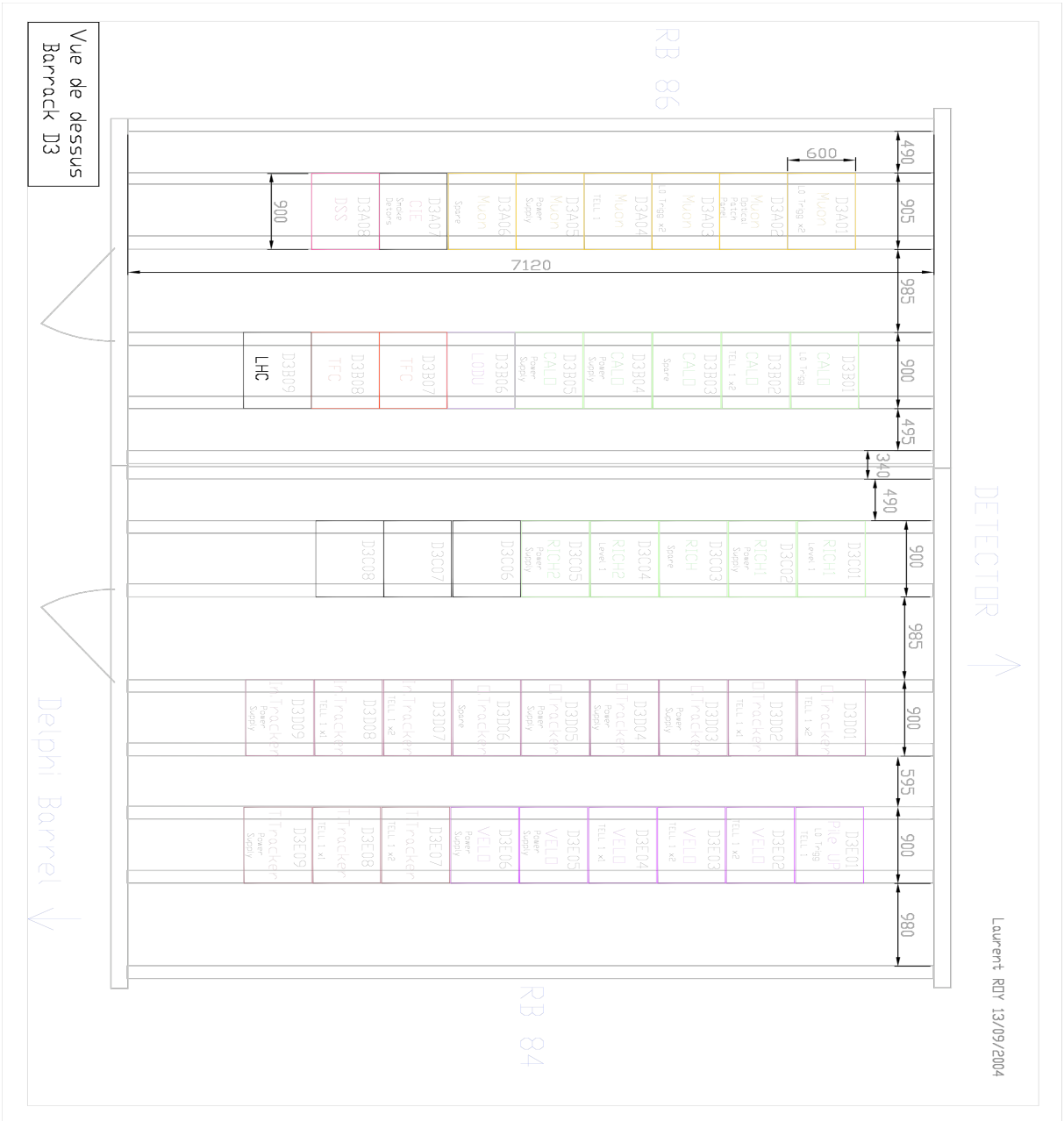

Figure 4 Current rack-layout in D3 (see [1])

4.1 TELL1 crates

The major part of connections is needed to connect the TELL1[5] boards to the DAQ network. The TELL1 boards are housed in TELL1 crates. A TELL1 crate can contain a maximum of 20 TELL1-boards. At least one slot must be kept free for the Throttle-OR, if boards in the same crate can belong to different TFC partitions (i.e. they can be driven by different Readout Supervisors, because they have their own connection to the TFC switch), then as many Throttle-ORs as potential partitions must be installed.
Each TELL1 needs 4 connections to the DAQ network and one to the Controls Network for its Creditcard PC. That makes 5 Ethernet connections in total per TELL1/UKL1 board.
Most detectors will not need all 4 connections, in particular when they do not participate in the Level-1. These additional connections should be viewed as reserve and spares. The TELL1 crates have all Ethernet connections at their back; hence the patch-panel will be mounted also at the back of the rack. A drawing of D3 rack equipped with two TELL1 crates can be seen in Figure 5.
The Creditcard PCs will be connected to switches, which are located in the D3 racks. Two types of switches can be used as needed: 48-port and 24-port devices. Only one such device will be maximally installed per rack. For each switch 4 up-links to the ECS network in D2 will be provided.

Table 6 Links for TELL1/UKL1 board and crate

	DAQ links	CCPC	ECS switch with 4 up links	ECS links	Total links
1 TELL1/UKL1	4	1	n/a		5
1 full TELL1 crate (20 TELL1s and one Throttle-OR)	80	21	1	4 + 4[6]	101

[5] In the following the term TELL1 always includes the UKL1 board, unless explicitly stated otherwise.

[6] 4 general purpose ECS links will always be provided.

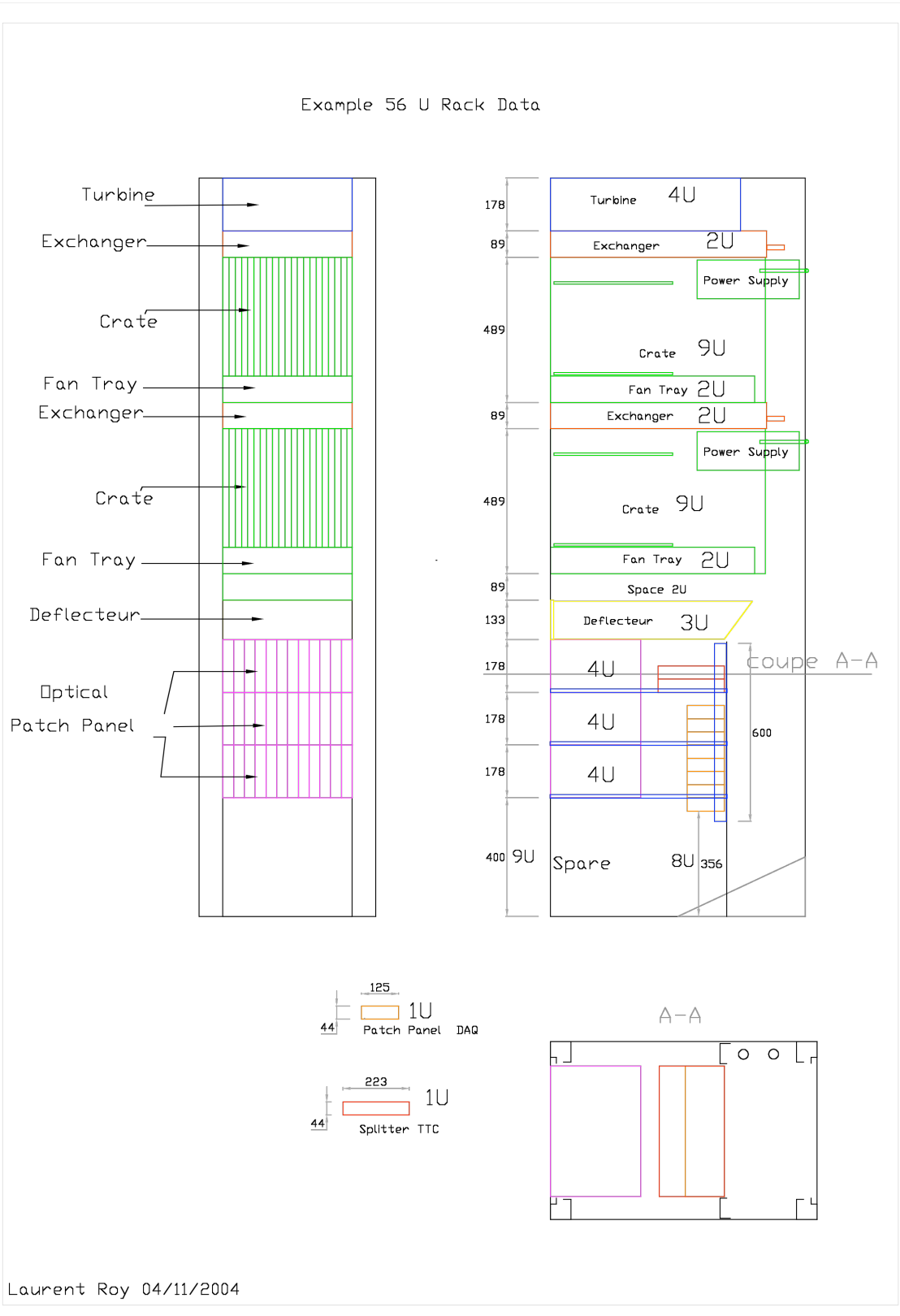

Figure 5 Rack with two TELL1 crates

4.2 Connections to the Controls Network

As discussed above each TELL1 and each Throttle-OR require one connection to the Controls Network. There are other cards in devices in D3, which also require a connection to the ECS network. These include the L0-processing cards and items such as Ethernet controlled power-supplies.
In some cases the number of required connections is known and can be seen from Table 7. Moreover in all TELL1 racks 4 additional connections to the Controls Network will be installed. Where no definitive numbers are known, 8 Ethernet connections to the controls network will be provided. These can be used to connect power-supplies and other Ethernet attached devices. **If need be the number of connections can easily be increased by installing small network switches in the racks**.

4.3 Ethernet connections in D3 racks

Table 7 lists all racks in D3 with the number of TELL1/UKL1 boards, if any, the Throttle-ORs and the additional connections to the controls network (labelled ECS in the table). The table follows the attributions of racks to functionalities in sub-detectors prepared by the electronics group [1][2]. **Only the indicated number of cables will be installed: i.e. even with there are two crates for 26 TELL1 there will be only 132 links and not 202!**

Remarks

- All patch-panels in TELL1 racks are mounted beginning at the 8th U counting from the bottom of the rack as shown in Figure 5.
- The patch-panels in the SPARE and POWERSUPPLY racks will be mounted at the 5th U counting from the bottom see Figure 6.
- Except for MuonL0 (Figure 7) and TFC all patch-panels will be mounted in the back of the racks[7].

[7] This has the additional advantage of leaving front-panel space free for devices which are not too deep (approx 70 cm).

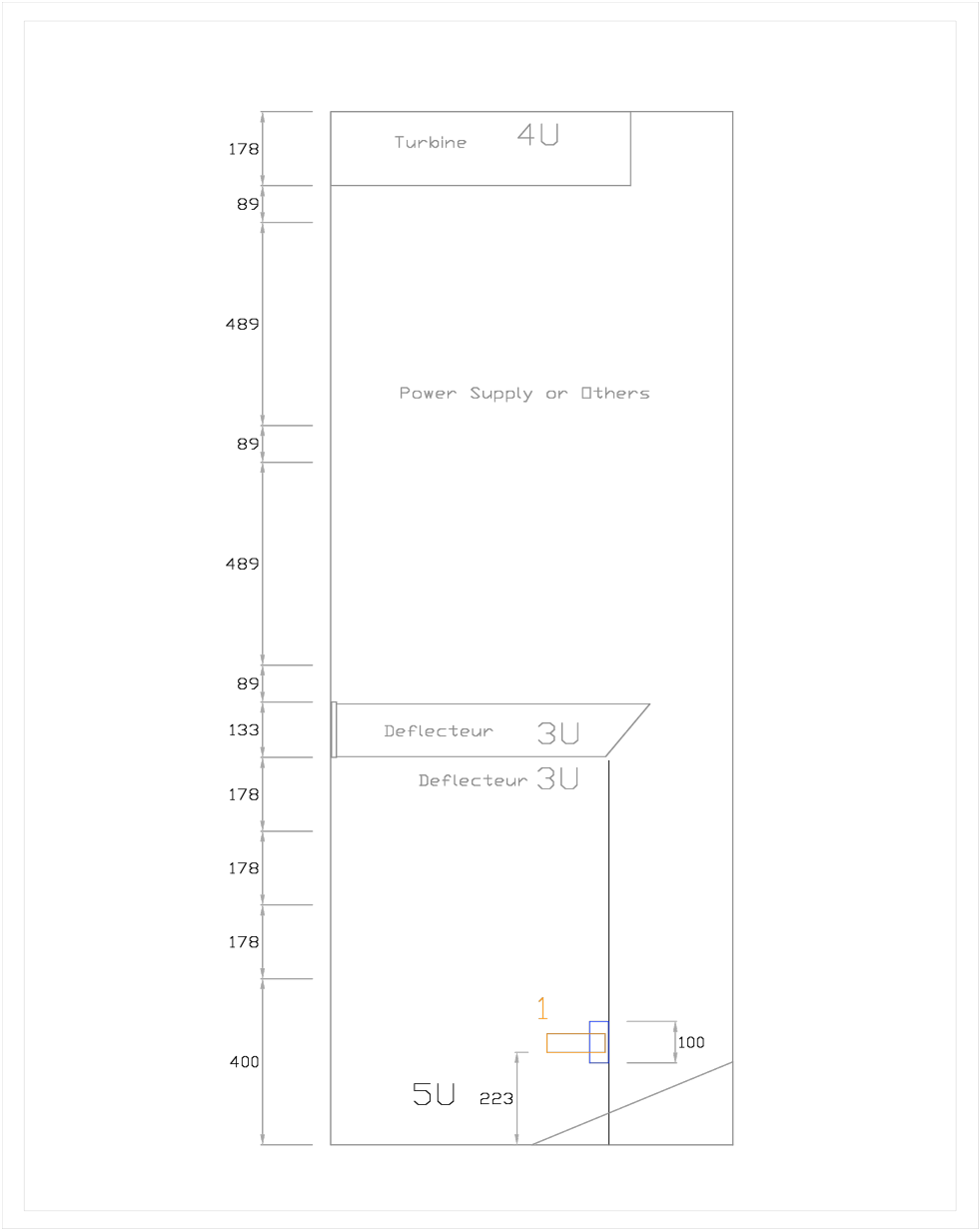

Figure 6 Mounting of patch-panel in POWER-SUPPLY / SPARE rack

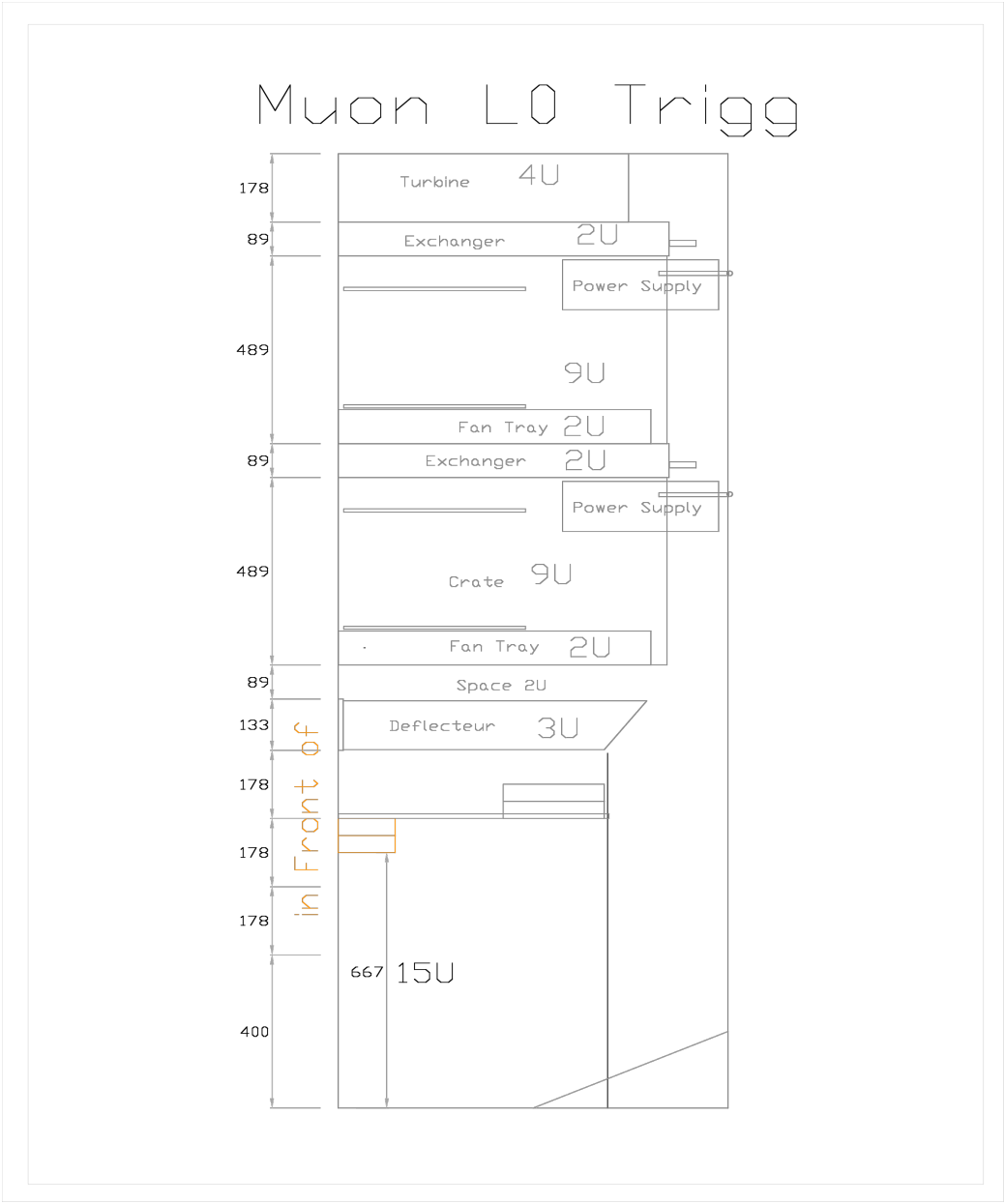

Figure 7 Patch-panel positions in MUON-L0 rack.

Table 7 Rack Distributions in D3. The first column names the sub-system; the second gives the designation of the rack, the third the number of TELL1/UKL1 boards

		UKL1/ TELL1 / RS	Throttle OR	ECS extra	CCPC	ECS	PP	PP pos	Total cables
MUONL0	D3A01	0	0	4	26	8	1	f	8
MUONL0	D3A02	0	0	0	0	0	0	b	0
MUONL0	D3A03	0	0	4	26	8	1	f	8
MUON	D3A04	15	2	4	17	8	3	b	68
MUON	D3A05			8	0	8	1	b	8
MUON	D3A06			8	0	8	1	b	8
CIE	D3A07			8	0	8	1	b	8
DSS	D3A08				0	0	0	n/a	0
CALOL0	D3B01	0		4	16	8	1	b	8
CALO	D3B02	23	5	4	28	8	5	b	100
CALO	D3B03			8	0	8	1	b	8
CALO	D3B04			8	0	8	1	b	8
CALO	D3B05			8	0	8	1	b	8
L0DU	D3B06	1		11	1	15	1	b	19
TFC	D3B07	8		4	24	8	1	f	24
TFC	D3B08	8		4	24	8	1	f	24
LHC	D3B09	0		12	0	12	1	f	12
RICH1	D3C01	11	1	4	12	8	3	b	52
RICH1	D3C02			8	12	12	1	b	12
RICH	D3C03			8	12	12	1	b	12
RICH2	D3C04	11	1	4	12	8	3	b	52
RICH2	D3C05			8	12	12	1	b	12
SPARE	D3C06			8	0	8	1	b	8
SPARE	D3C07			8	0	8	1	b	8
SPARE	D3C08			8	0	8	1	b	8
OT	D3D01	32	2	4	34	8	6	b	136
OT	D3D02	16	1	4	17	8	3	b	72
OT	D3D03			8	0	8	1	b	8
OT	D3D04			8	0	8	1	b	8
OT	D3D05			8	0	8	1	b	8
OT	D3D06			8	0	8	1	b	8
IT	D3D07	28	2	4	30	8	5	b	120
IT	D3D08	14	1	4	15	8	3	b	64
IT	D3D09			8	0	8	1	b	8
PUS	D3E01	0		8	12	12	1	b	12
VELO	D3E02	35	3	4	38	8	7	b	148
VELO	D3E03	36	2	4	38	8	7	b	152
VELO	D3E04	18	1	4	19	8	4	b	80
VELO	D3E05			8	0	8	1	b	8
VELO	D3E06			8	0	8	1	b	8
TT	D3E07	32	2	4	34	8	6	b	136
TT	D3E08	16	1	4	17	8	3	b	72
TT	D3E09			8	0	8	1	b	8

5 Labelling patch-panels as defined by IT/CS

There are two types of labels on a patch-panel. On the left-hand side a label with the exact location of the patch-panel can be seen. On top of each plug there is a label which indicates the other end of the connection. To uniquely identify a connection the rack must be known – this takes 3 letters (floor, rack-row and rack) the position of the patch-panel within the rack and the plug in the patch panel.
The field-codes and their possible values are listed in for the port labels are listed in Table 8 and for the patch-panel labels in Table 9 .

Table 8 Label on top of ports on patch-panels indicating the other end of this connection

Field code	Floor	Rack-row	Rack	Patch-panel	Port
Possible Values	D1, D2, D3	A, B, C, D, E	00 to 11	A, B, C, …,Z, 0, 1, 2	01,..,24

The Patchpanels are numbered in sequence from top to bottom, A being the top-most patchpanel in a rack. The ports are numbered consecutively from left to right.

Table 9 Label at the side of a patch-panel indicating the position of this patch-panel

Field code	Floor	Rack-row	Rack	Patch-panel
Possible Values	D1, D2, D3	A, B, C, D, E	0 to 11	A, B, C, …,Z, 0, 1,2

As an example consider D1A01A10. This is a label in D2 for a link to a Rack D1A01, a sub-farm rack in D1, the first patch-panel in this rack from the top and port number 10.
The reality is shown in Figure 8.

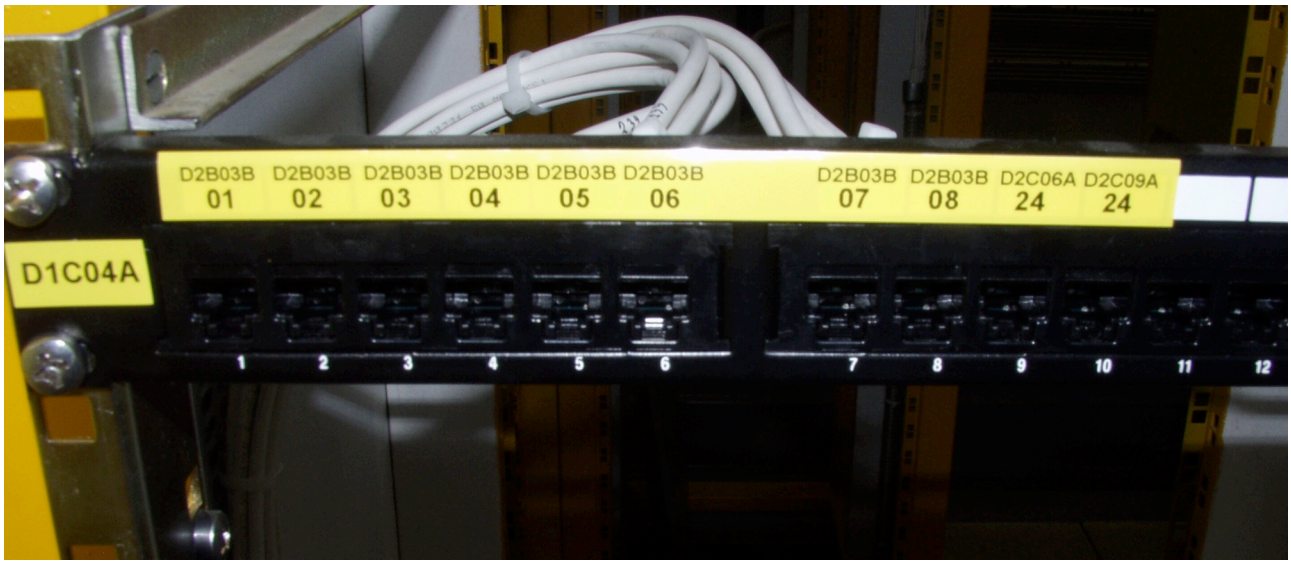

Figure 8 Patchpanel D1C04A in D1

References

[1] L. Roy, *Drawing Barrack D3*, https://edms.cern.ch/document/479599/1

[2] V. Bobillier, *Rack distribution in Point 8*, http://lhcb-elec.web.cern.ch/lhcb-elec/Point8Electronics/CountingHouse/PreliminaryRackDistribution.htm

[3] W. Witzeling, *System and Sub-system Codes*, https://edms.cern.ch/document/373610/1

[4] W. Witzeling, *Institute Codes*, https://edms.cern.ch/document/373611/2

Acronyms and Abbreviations

ECS Experiment Control System

ELMB Embedded Local Monitor Box

LAN Local Area Network

PP Patch Panel

RS Readout Supervisor

SFC Subfarm Controller

TFC Timing and Fast Control

Labelling of Cables

For reference a labelling scheme for the Ethernet cables in the D1, D2 and D3 counting houses compatible with the general LHCb labelling scheme is described here:
The cable-label consists of two 14 character alphanumeric lines and a bar-code. The top-line, which is represented also by the bar-code, contains the sub-system code described in [1] and the institute code described in [4].

Top line – bar-code

Table 10 First (top) line of Ethernet cable label

4	**O**	**C**	**C**	**E**	**R**	class	type	x	x	x	x	x	x

The first 6 fields are thus fixed for all cables in this document: 4 for LHCb, OC for system (Online) and sub-system (Cable) and CER for the institute (CERN). The eight remaining characters are chosen in the following way. The first ("system") is a digit describing the cable-class or category of the online project. They are listed in Table 11.
The next number "type" describes the physical type of the cable. The codes are listed in Table 12. Most of the cables in this document will be "type" 1, copper Ethernet that is in detail: Cat6 UTP cables with RJ45 connector for 10/100/1000 BaseT connections. The remaining 6 digits are a serial number of the cable in decimal notation.

Table 11 Online cable class codes

Online cable-class	*Code*
DAQ	0
ECS	1
Storage Network	2

Table 12 Online cable type codes

Cable type	*Code*
Ethernet copper	1
Ethernet MMF	2
Ethernet SMF	3
Rackcooler-control copper	4

Table 13 Example of first (top) line of Ethernet cable label

4	**O**	**C**	**C**	**E**	**R**	0	1	0	0	1	0	8	8

Consider Table 13 as an example. After the standard LHCb, Online-system Cable, CERN, "0" defines the cable class as DAQ, "1" defines the cable type as Ethernet Copper and 001088 is the six

digit serial number in decimal notation.

Bottom-line

This line will contain geographical information, which will allow telling the start and endpoint of the cable. The 14 characters will be re-partioned as shown in Table 14:

Table 14 Second “geographical” line of cable-label

Source address							Destination address						
Rack1	Rack2	Rack3	Rack4	PP	Port1	Port2	Rack1	Rack2	Rack3	Rack4	PP	Port1	Port2

Rack1 to 4 will be the standard designation of the rack as printed on the racks, except for the leading “D”. PP will be the number of the patch-panel in the rack. Some racks in D2 can have many patch-panels, so we might also use letters here. A patch panel can have a maximum of 24 ports, so “Port1” and “Port2” will display a number between 1 and 24 in decimal notation.

Table 15 Example for the “geographical” line of the label on Ethernet cables

Source address							Destination address						
3	D	0	7	4	1	0	2	D	0	5	9	1	0

An example is shown in Table 15. This is a label, which describes a cable going from rack D3D07 (a TELL1 rack of the InnerTracker in D3), patch-panel number 4, and port number 10 to rack D2D05 (one of the main patch-panel racks in D2), patch-panel number 9, port number 10