

Mini Workshop, 2014.03.21

**CERN EN-EL  
Cabling and Optical Fibre Section**

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▶ **SUMMARY**

- ▶ EN-EL-CF SECTION
- ▶ FIBER UNIT MAIN ACTIVITIES
- ▶ ORGANISATION FOR LSI
- ▶ COLLABORATION WITH CERN EXPERIMENTS
- ▶ OVERVIEW ON THE COLLABORATION FOR CMQ DAQ UPGRADE

▶ **THE SECTION**

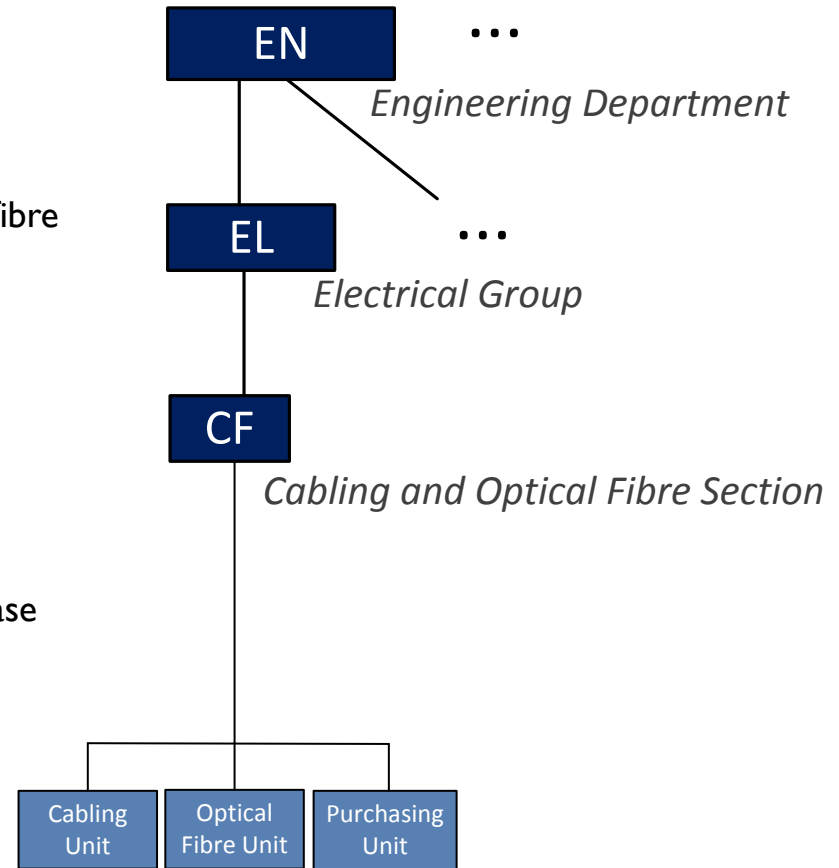
- ▶ EN-EL-CF : Cabling and Optical Fibre Section

▶ **MANDATE**

- ▶ Provide and standardise copper (DC & control) and fibre cabling systems for all CERN users
- ▶ Organise cabling installation and removal campaigns
- ▶ Assure preventive and corrective maintenance
- ▶ Provide and manage an optical fibre installation database

▶ **ORGANISATION**

- ▶ 3 Units



▶ **FIBRE UNIT MAIN ACTIVITIES:**

- ▶ In collaboration with CERN users, design and manage the optical fibre infrastructure
- ▶ Establish and manage industrial contracts for the supply and installation of passive optical fibres components
  - ▶ A large contract for supply and installation of all standard components (fibres, cables, terminal equipment, patchcords)
  - ▶ Large contracts for supply of RAD-RESISTANT fibres (~ 2500 km) plus cabling (~ 100 km) within existent frame contract
- ▶ Qualification, quality assurance and quality control of specialty optical fibres and new passive optical components through frame contract.
  - ▶ Laboratory equipped with microscopes, interferometers, OTDR, insertion loss/return loss meters for single and multi-fibre connectors.
  - ▶ CERN Safety Instructions Compliant
  - ▶ Standard Passive Solutions for all CERN users

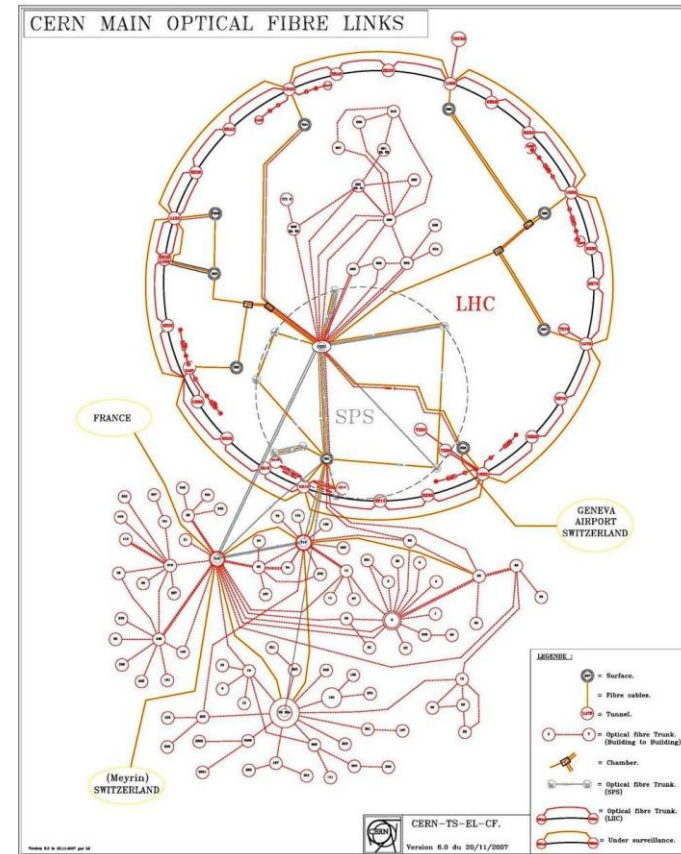


Fig. 1 - Overview on the complex and capillary fibre infrastructure at CERN with approximately 30'000 km

► ORGANISATION OF FIBRE UNIT FOR LSI

► ANTICIPATION OF LSI: PREPARATION STARTED ABOUT 1.5 YEARS BEFORE

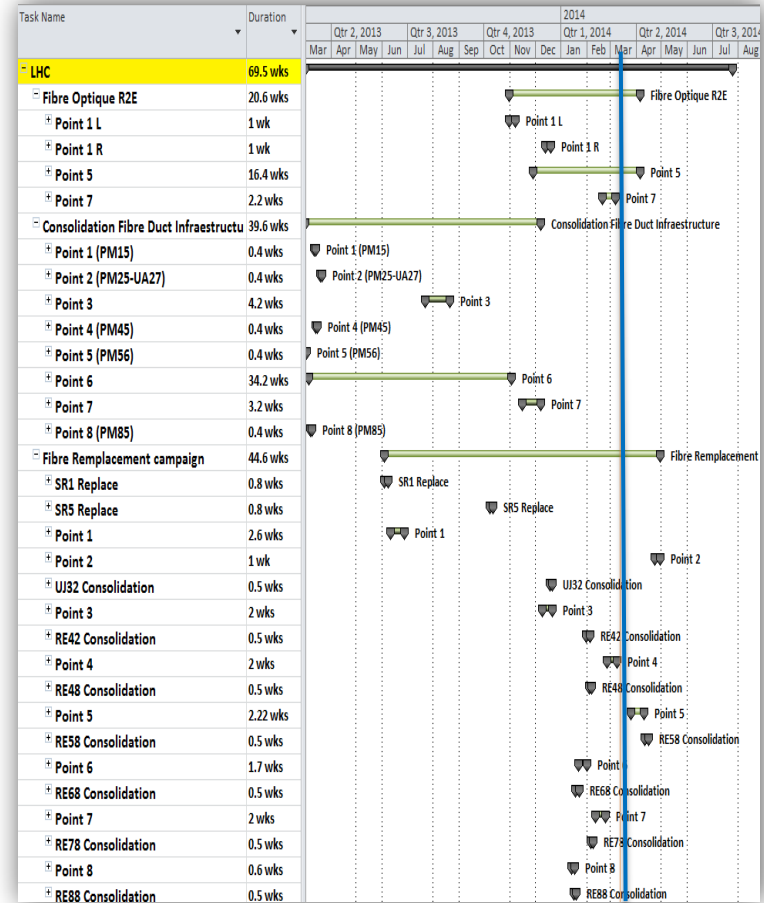
- Studies, qualification and procurement components
- Establish deadline for new projects requests
- 18 Large projects and 350 works for LSI

► SMOOTH SECTION MANPOWER INCREASE BEFORE LSI

► DELIVER PLANNING OF ACTIVITIES TO CONTRACTOR

- Organisation of contractors resources and expertise

FIBRE UNIT PLANNING for LSI at LHC



▶ **COLLABORATION WITH CERN EXPERIMENTS DURING LSI**

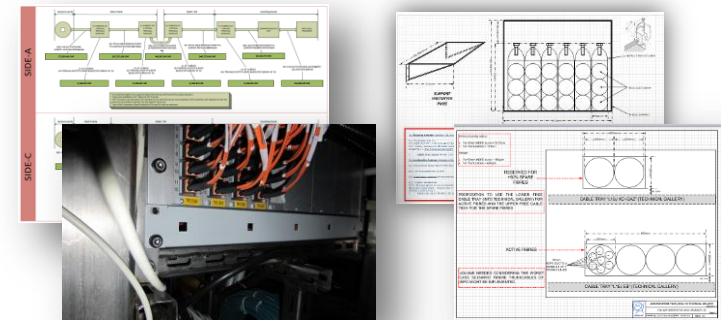
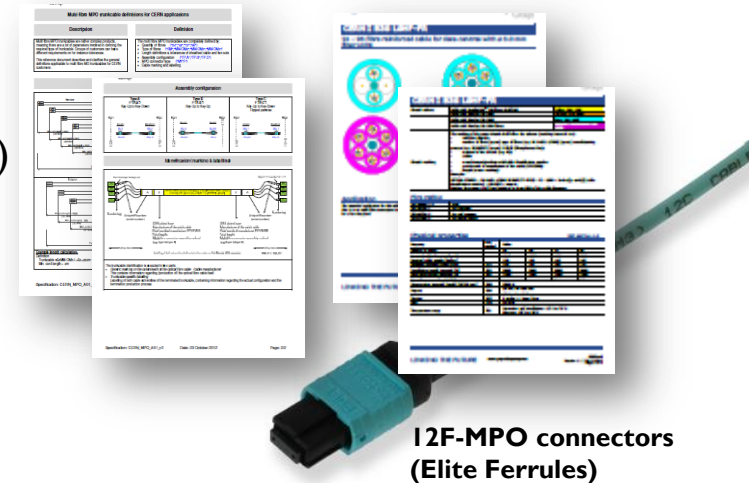
▶ **EXAMPLES OF OPTICAL FIBRE REQUESTS**

▶ Qualification and supply of components (ex: Trunk Cables)

- ❑ CMS DT Barrel Muon Detector
- ❑ CMS Trigger Upgrade
- ❑ TOTEM

▶ Project design, supply and installation of components

- ❑ CMS Data Acquisition System Upgrade
- ❑ CMS Fibre Sensor System
- ❑ ALICE T0/V0 Upgrade
- ❑ ALICE TPC Upgrade for LS2
- ❑ LHCb DAQ Upgrade (17000 FO)



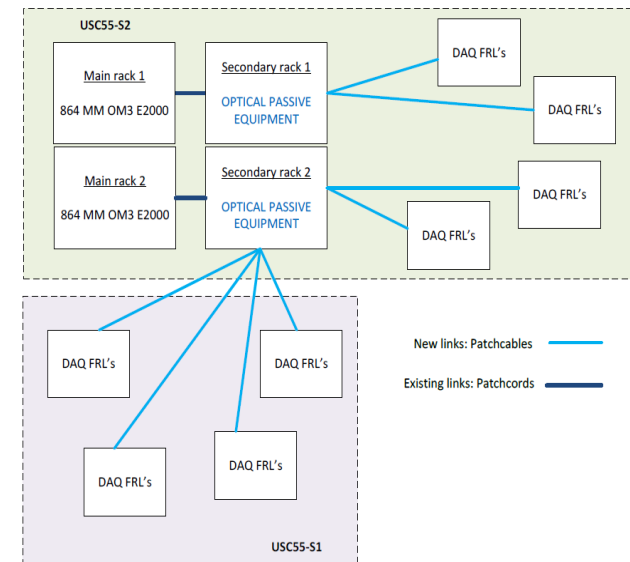
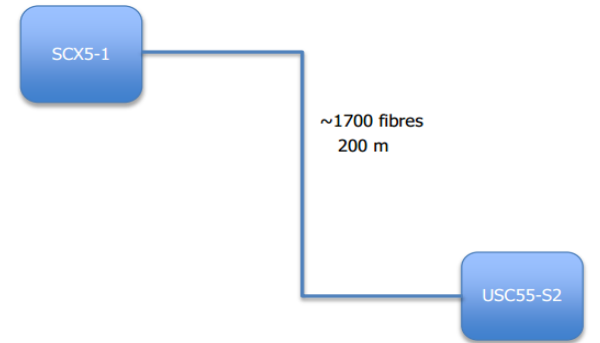
► **COLLABORATION FOR CMS DAQ UPGRADE**

► **1<sup>ST</sup> Phase:** Project design, supply and installation of components

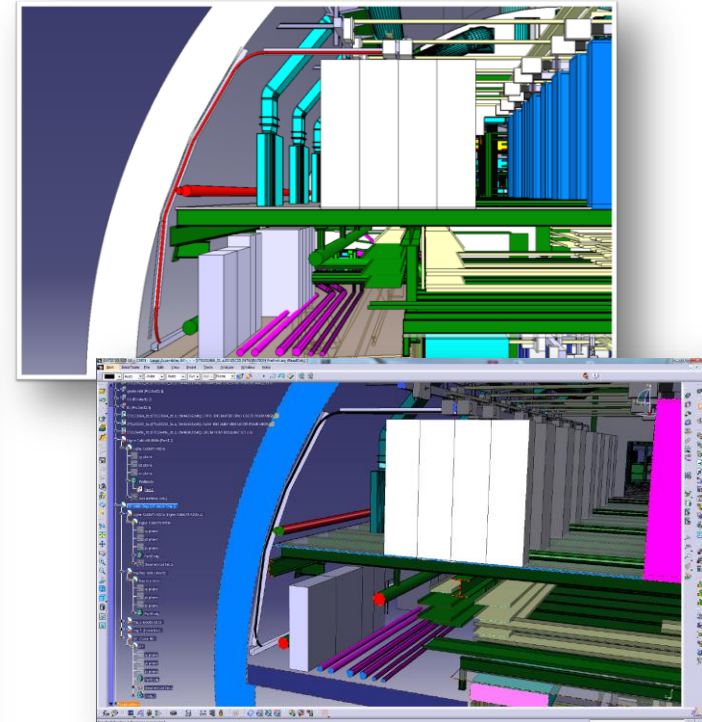
- From SCX5-1 to USC55-S2
- 1700 Multimode OM3 Fibres
- LC connectors for active equipment

► **2nd Phase:** Qualification and supply of optical components

- USC55-S1/S2
- Passive Terminal Equipment
- Patchcords and Patchcables



- ▶ **COLLABORATION FOR CMS DAQ UPGRADE (1<sup>st</sup> Phase)**
  - ▶ PRELIMINARY STUDY OF TECHNICAL FEASIBILITY

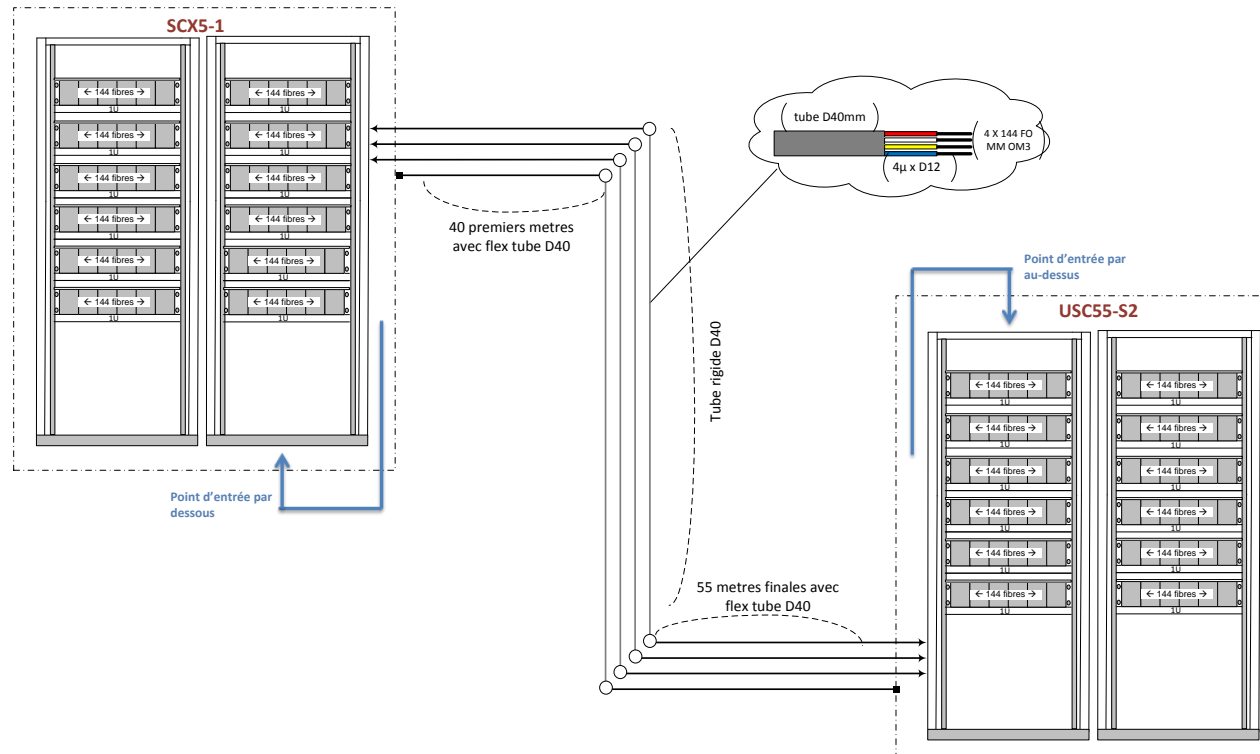




► **COLLABORATION FOR CMS DAQ UPGRADE (1<sup>st</sup> Phase)**

► **PROJECT DESIGN AND COST ESTIMATION**

**CMS DAQ: Liaison SCX5 (3562) – USC55 (3524)**



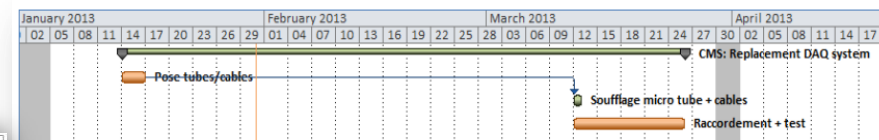
► **COLLABORATION FOR CMS DAQ UPGRADE (1<sup>st</sup> Phase)**

► **PROCUREMENT OF COMPONENTS**

- Ducts, microduct, cables
- Optical terminal equipment
- Patchcords



► **PREPARATION OF TECHNICAL DOSSIERS, SAFETY PROCEDURES AND PLANNING**

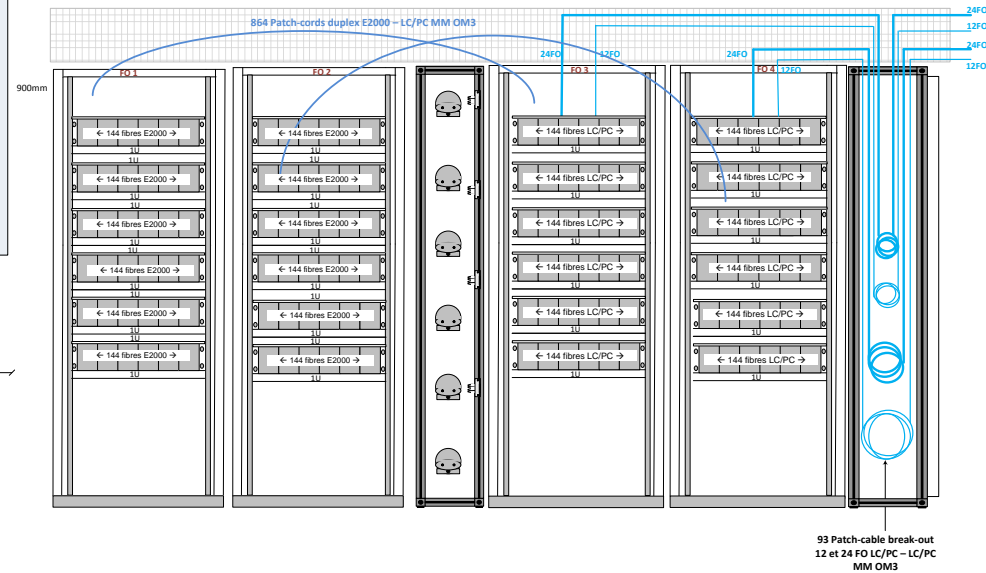
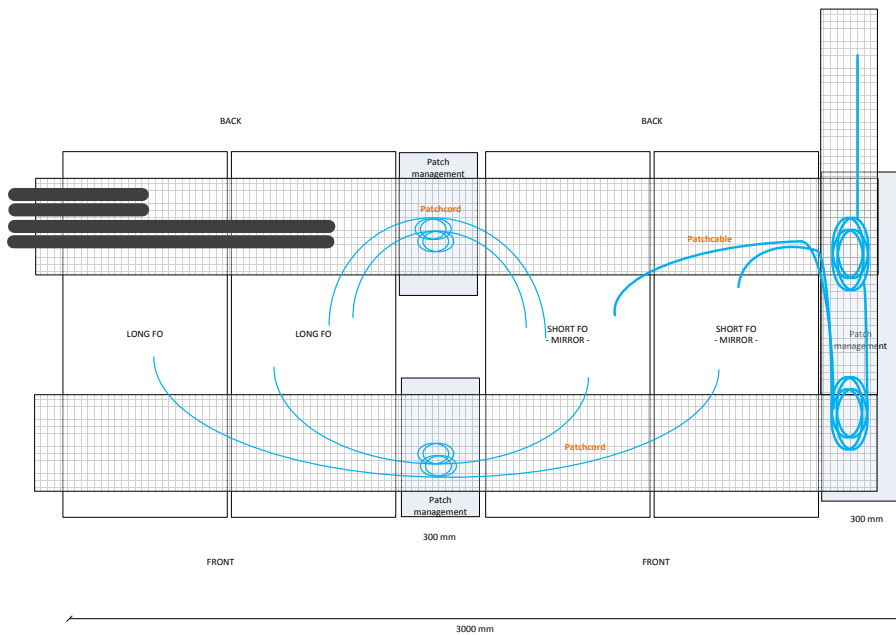


- ▶ **COLLABORATION FOR CMS DAQ UPGRADE (1<sup>st</sup> Phase)**
  - ▶ WORK EXECUTION & CONTROL BILL OF QUANTITIES



► COLLABORATION FOR CMS DAQ UPGRADE (2<sup>nd</sup> Phase)

► PROJECT DESIGN OF HIGH DENSITY MANAGEMENT SYSTEM IN USC55-S2



▶ **COLLABORATION FOR CMS DAQ UPGRADE (2<sup>nd</sup> Phase)**

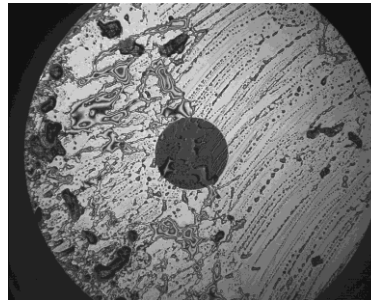
▶ **PROCUREMENT OF COMPONENTS**

- ▶ Optical terminal equipment
- ▶ Patchcables and Patchcords

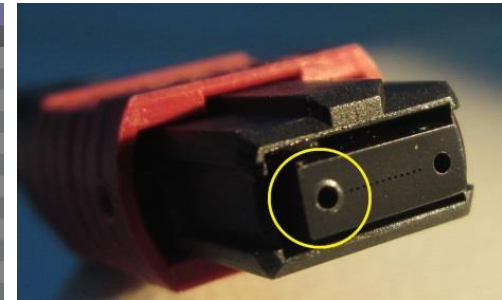


▶ **QUALITY CONTROL**

- ▶ Visual inspection of components (cables and terminal equipment)
- ▶ Measurements of ferrules end-face geometry (interferometer)
- ▶ Insertion and return loss measurements




	IL(dB)	Length(m)	RLusr(dB)
850 nm			
Ch.1	0.574	⚠	14.51
Ch.2	0.260	⚠	19.13
Ch.3	0.251	⚠	18.82
Ch.4	0.240	⚠	18.64
Ch.5	0.270	⚠	17.87
Ch.6	0.668	⚠	13.34
Ch.7	0.610	⚠	14.20
Ch.8	0.772	⚠	13.62
Ch.9	0.330	⚠	27.54
Ch.10	0.251	1.11	56.34
Ch.11	0.179	1.10	54.25
Ch.12	0.253	1.11	52.47





► COLLABORATION FOR CMS DAQ UPGRADE (2<sup>nd</sup> Phase)

► PROCEDURES FOR INSTALLATION & CLEANING

**Cleaning E2000 Connectors**



Connector Patch-cord	Bulkhead Module
<ol style="list-style-type: none"> <li>1. Make sure that the lasers are turned off before you begin the inspection.</li> <li>2. Remove the protective dust cap using the service adaptor to avoid any contact with your fingers in the ferrule.</li> <li>3. Identify the type of connector.                             <ol style="list-style-type: none"> <li>a. PC (flat end-face of the ferrule) Hold the connector with a perpendicular (90 degrees) angle against the cleaning area.</li> <li>b. APC (angled end face of the ferrule) Hold the connector at the same angle as the end face against the cleaning area.</li> </ol> </li> <li>4. Follow the pictures how to hold the connector against the cleaning area.</li> <li>5. Press down and hold the thumb lever. The shutter slides back and exposes a new cleaning area.</li> <li>6. Pull the fiber tip lightly down the exposed cleaning area in the direction of the arrow or from top to bottom. (do not use a "twist &amp; turn" motion).</li> </ol>	<ol style="list-style-type: none"> <li>1. Make sure that the lasers are turned off before you begin the inspection.</li> <li>2. Remove the protective dust cap and store it in a small clean container.</li> <li>3. Remove the cap from the tool and insert it firmly into the adapter / module connector. Keep the two arrows side facing up of the tool.</li> <li>4. Push the cleaner against the connector until the Loud Click is heard and then release and withdraw it from the connector.</li> <li>5. Put back the cap on the tool.</li> </ol>

**Cleaning Cassette**

It can be purchased at the CERN store:

- [24.10.01.020.2](#) : Reel cleaner with cleaning cassette
- [34.10.01.020.6](#) : Cleaning spare reel (refill)

ATTENTION: se rappeler de nettoyer les connecteurs et les adaptateurs avant de connecter!!

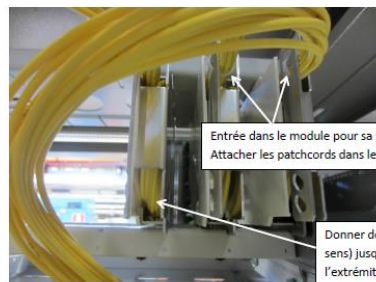


Faire entrer les patchcâbles per les trous du tiroir, et les attacher à la montée au côté du rack

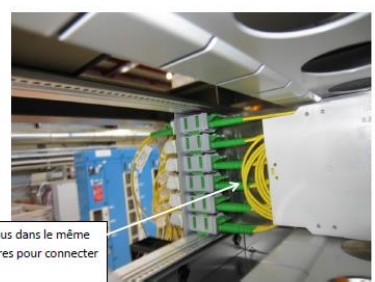


Attacher les patchcâbles à l'entrée du tiroir

Ne laisser pas trop longueur de patchcord dans le tiroir sinon on n'aura suffisant place pour tous



Entrée dans le module pour sa partie supérieur. Attacher les patchcords dans le module



Donner des tours dans le module (tous dans le même sens) jusqu'à avoir quelques centimètres pour connecter l'extrémité au adaptateur

▶ **COLLABORATION FOR CMS DAQ UPGRADE (2<sup>nd</sup> Phase)**



▶ **IMPLEMENTATION RESULTS**





► **COLLABORATION FOR CMS DAQ UPGRADE (2<sup>nd</sup> Phase)**

► **PROJECT DOCUMENTATION**

**(1<sup>st</sup> Phase)**

<b>CERN</b> CH1211 Geneva 23 Switzerland		EDMS NO. <b>1257443</b>	REV. <b>1.1</b>	VALIDITY <b>APPROVED</b>
REFERENCE <b>ELG-OPTFIB-EN-0002</b>				
 		Date : 2013-02-28		
Technical Note  <b>Optical Fibre installation for          DAQ system in CMS</b>  <b>SCX5 - USC55</b>  Abstract  This document presents a summary of the requirements and technical solution for the optical fibre link installation for a new Data Acquisition System (DAQ) in the CMS experiment.				
DOCUMENT PREPARED BY: Javier ROJAS (EN-EL)	DOCUMENT CHECKED BY: Simao MACHADO (EN-EL) Daniel RICCI (EN-EL)	DOCUMENT APPROVED BY: Attila RACZ (PH-CMD) Frans MEIJERS (PH-CMD) François DUVAL (EN-EL) Roberto SABAN (EN)		
Distribution: EN-EL-CF, PH-CMD (CMS)				

**(2<sup>nd</sup> Phase)**

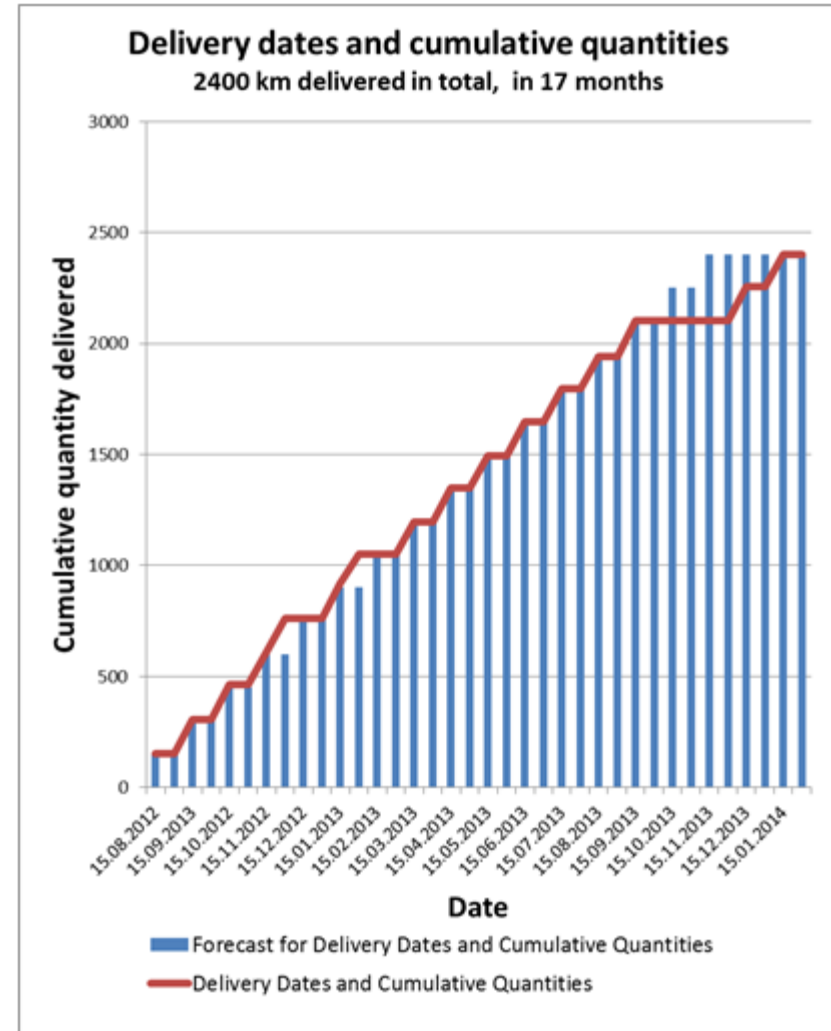
<b>CERN</b> CH1211 Geneva 23 Switzerland		EDMS NO. <b>1279775</b>	REV. <b>1.0</b>	VALIDITY <b>UNDER APPROVAL</b>
REFERENCE <b>ELG-OPTFIB-EN-0006</b>				
 		Date : 2013-05-15		
Technical Note  <b>Optical Fibre supply for          DAQ system in CMS</b>  <b>USC55-S1/S2</b>  Abstract  This document presents a summary of the optical fibre components to supply to CMS for connecting the existing Data Acquisition System (DAQ) with the new optical fibre infrastructure between SCX5 and USC55 (EDMS No.1257443).				
DOCUMENT PREPARED BY: Javier ROJAS (EN-EL)	DOCUMENT CHECKED BY: Simao MACHADO (EN-EL) Daniel RICCI (EN-EL)	DOCUMENT APPROVED BY: Attila RACZ (PH-CMD) Frans MEIJERS (PH-CMD) François DUVAL (EN-EL) Roberto SABAN (EN)		
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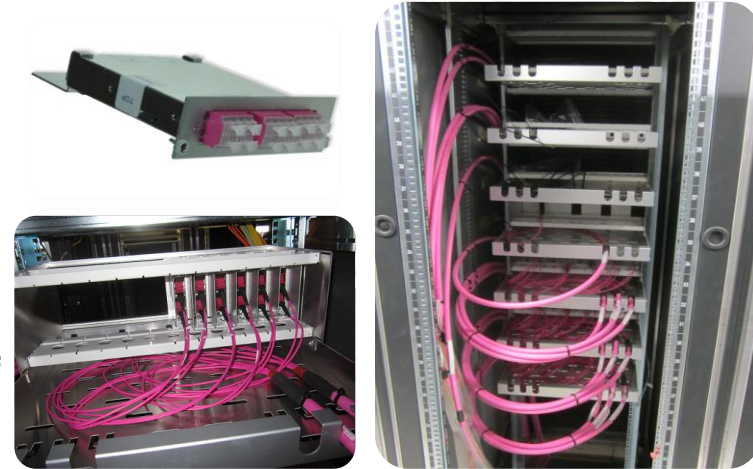
**Thanks**

# Backup slides

- ▶ **INDUSTRIAL SUPPLY CONTRACT SPECIFICATIONS:**
  - ▶ Detailed requirements on
    - ▶ Compliance with ITU-T international standards
    - ▶ Radiation resistance and optical properties
    - ▶ Spool minimum lengths, tracking, etc.
  - ▶ 2500 km procured in 2006 plus 2400 km procured in 2012 (~150 km/month)
  
- ▶ **A QUALITY ASSURANCE PLAN, WITH EXTENSIVE QUALITY CONTROL WAS PUT IN PLACE:**
  - ▶ Extensive fibre qualification tests performed during 2 years before contract placement
  - ▶ Each preform was tested (radiation).
  - ▶ Implemented cabling and fibre tracking system at both manufacturer's and CERN



- ▶ 10GbE, 40GbE and 100 GbE upgrade
- ▶ QUALIFICATION OF COMPONENTS FOR HIGH DENSITY SYSTEM
  - ▶ Sub-Racks 4U for 288 fibres
  - ▶ Terminal Modules (2\*12F MTP to 24 LC)
  - ▶ Trunk Cable with 12F MPO for 72 OM4 FO
  - ▶ High performance MPO connectors with **Elite Ferrule**



▶ SUPPLY AND INSTALLATION OF MODULAR CABLING SYSTEM

- ▶ Polarity Method B
- ▶ Max. Channel Insertion Loss **1.5 dB**
- ▶ Average MPO/MTP loss 0.1 dB (max. 0.35 dB)
- ▶ Minimum Return Loss 25dB

