

European XFEL. Building a Mega-Project made easy.

Re-inventing Cabling, Rack management and cable trays planning & implementation

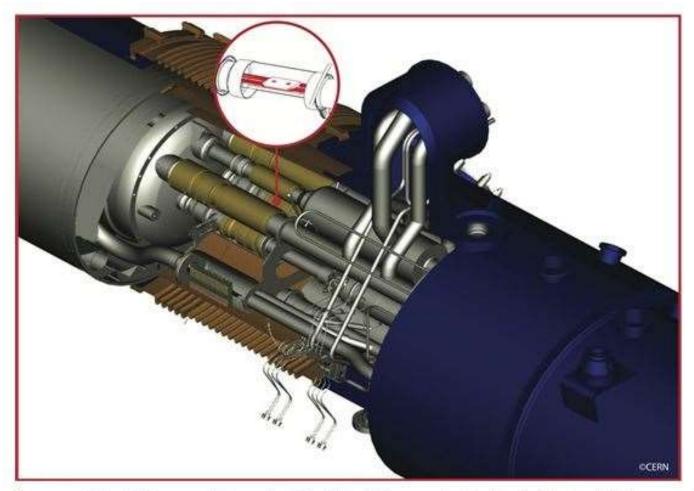
Dr. Antonios V. Lalechos





600 magnets 000s km of cables 000s Patch Panels

> **EMPLOYED ONLY THE BEST**



Damage of the LHC magnets in sector 3-4 of the LHC, provoked by the incident which happened on 19 September 2008 (Image: CERN)

Geneva, 16 October 2008. Investigations at CERN¹ following a large helium leak into sector 2-4 of the Large Hadron Collider (LHC) tunnel have confirmed that cause of the incident was a faulty electrical connection between two of the accelerator's magnets. This resulted in mechanical damage and release of nelium from the magnet cold mass into the tunnel.

Editorial: The lesson from CERN: Why scientists should celebrate getting it wrong



A technician works in the Large Hadron Collider tunnel Feb. 16, 2016, during a press visit in Meyrin, near Geneva, Switzerland. (Laurent Gillieron / AP)

What went wrong then?

No Unified Documentation!

on the design and the documentation. And we are hardly acting any of the helf' components:

Most components are being developed especially for European XFEL and if ye do use standard components, we often end up using them for put the documentation is of central importance because the entire plant is being constantly further developed and modified during operation. For this reason, the engineers always need the latest documentation."

Automated schematic creation - practical even for special projects

Antonios Lalechos is supported in his work by three employees. A concept was initially



Dr. Antonios-Vassilios Lalechos is responsible for the electrical planning of the experiments for the



the electrotechnical planned and

at

View into the 2.1-kilometre long accelerator tunnel of European XFEL with the yellow superconducting accelerator modules hanging from the ceiling.

Premium services - Newsroom Video Multimedia Πρωτοσέλιδα Χρηματιστήριο Real Time My Βαρόμετρο Κίντ

Οικονομία & Αγορές Πολιτική Κοινωνία Κόσμος Αθλητικά Απόψεις Πολιτισμός Περιβο

ΤΕΧΝΟΛΟΓΙΑ-ΕΠΙΣΤΗΜΗ

Πρώτη δέσμη στο μεγαλύτερο λέιζερ ακτίνων Χ στον κοσμο

Δευτέρα, 08 Μαΐου 2017 22:27 UPD: 22:28



To European XFEL θα μας παράσχει τις πιο λεπτομερείς εικόνες της μοριακής δομής νέων υλικών και φαρμάκων, όπως επίσης και πρωτόγνωρες καταγραφές της εξέλιξης βιοχημικών αντιδράσεων", δήλωσε ο Χέλμουτ Ντος, Διευθυντής του DESY.

Σε λειτουργία το Ευρωπαϊκό XFEL το ισχυρότερο λέιζερ ακτίνων-Χ στον κόσμο



Greece

Newsroom, CNN Greece Ο 13:00 Σάββατο, 02 Σεπτεμβρίου 2017











Πηγή: ΑΠΕΜΠΕ

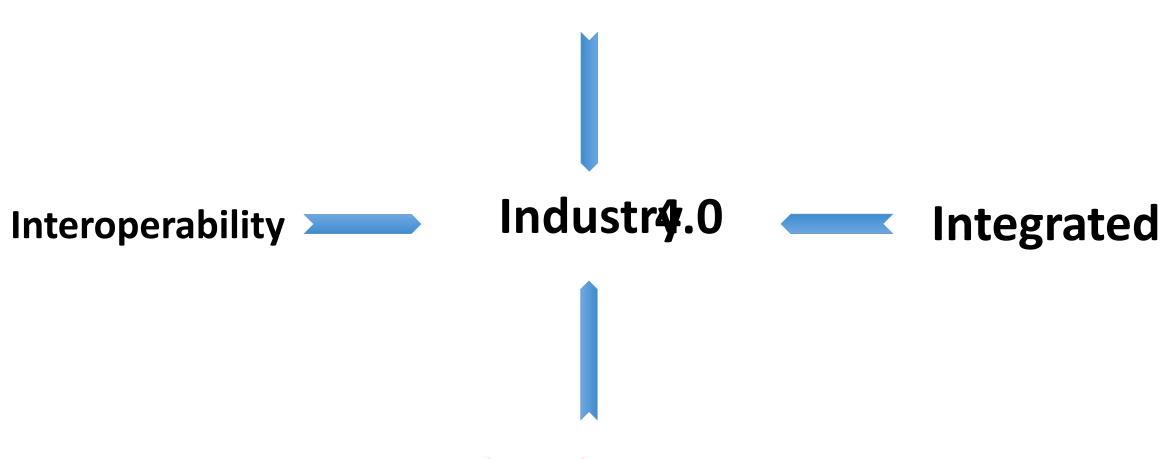
Το ισχυρότερο στον κόσμο λέιζερ ακτίνων-Χ, το ευρωπαϊκό XFEL (European X-ray Free Electron Laser), άρχισε επίσημα τη λειτουργία του στο Αμβούργο της Γερμανίας την Παρασκευή.

Διαβάστε επίσης



Με κόστος κατασκευής σχεδόν ενάμισι δισεκατομμύριο ευρώ, η νέα επιστημονική υποδομή θα χρησιμοποιηθεί για τη μελέτη της ατομικής δομής της έμβιας και άβιας ύλης (κυττάρων, ιών, μετάλλων κ.α.). Χάρη στο νέο λέιζερ, που αποτελεί ταυτόχρονα κάμερα υψηλής ταχύτητας και μικροσκόπιο, θα καταστεί εφικτή η δημιουργία εικόνων και φιλμ του νανόκοσμου. Μεταξύ άλλων.

Information transparency

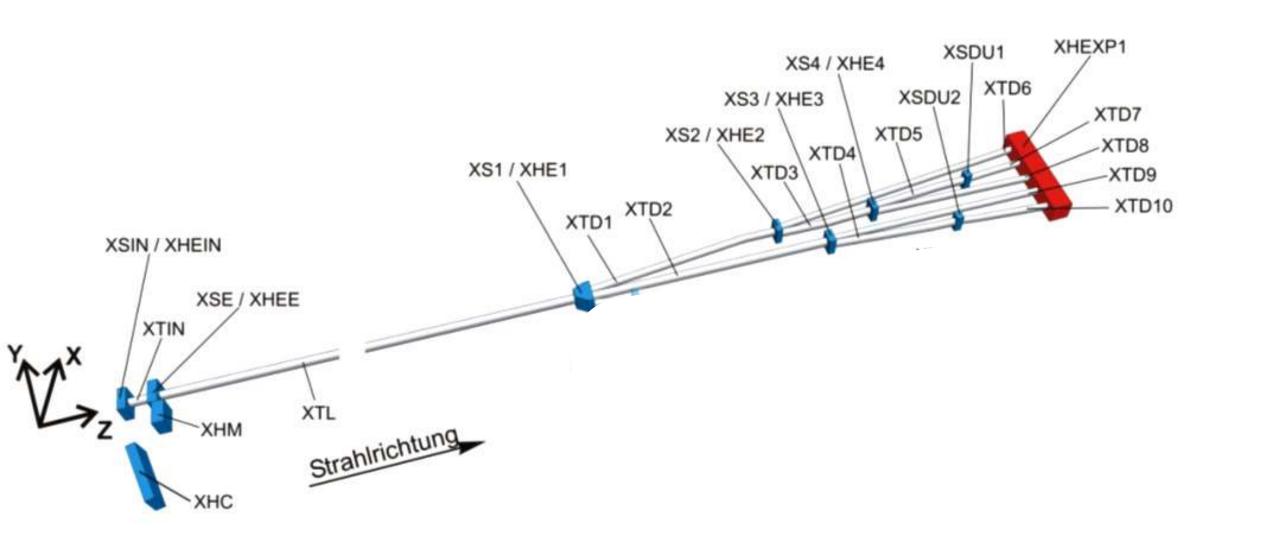


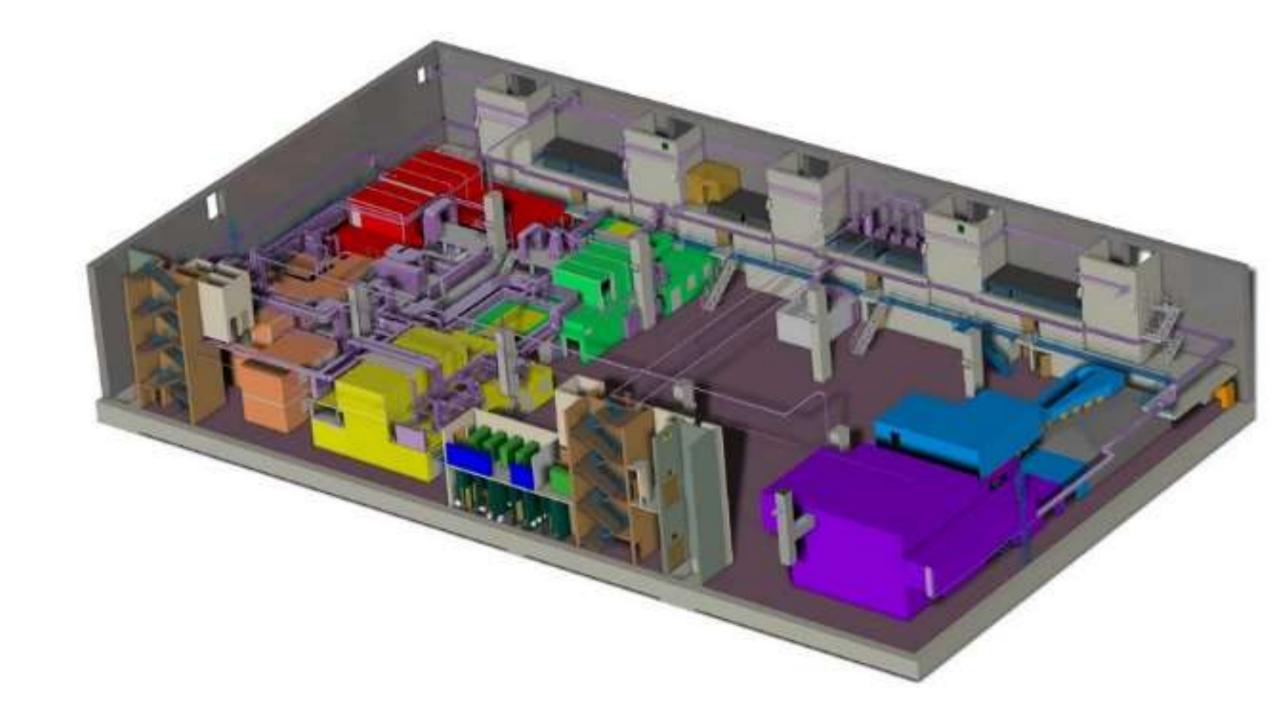
Technical assistance

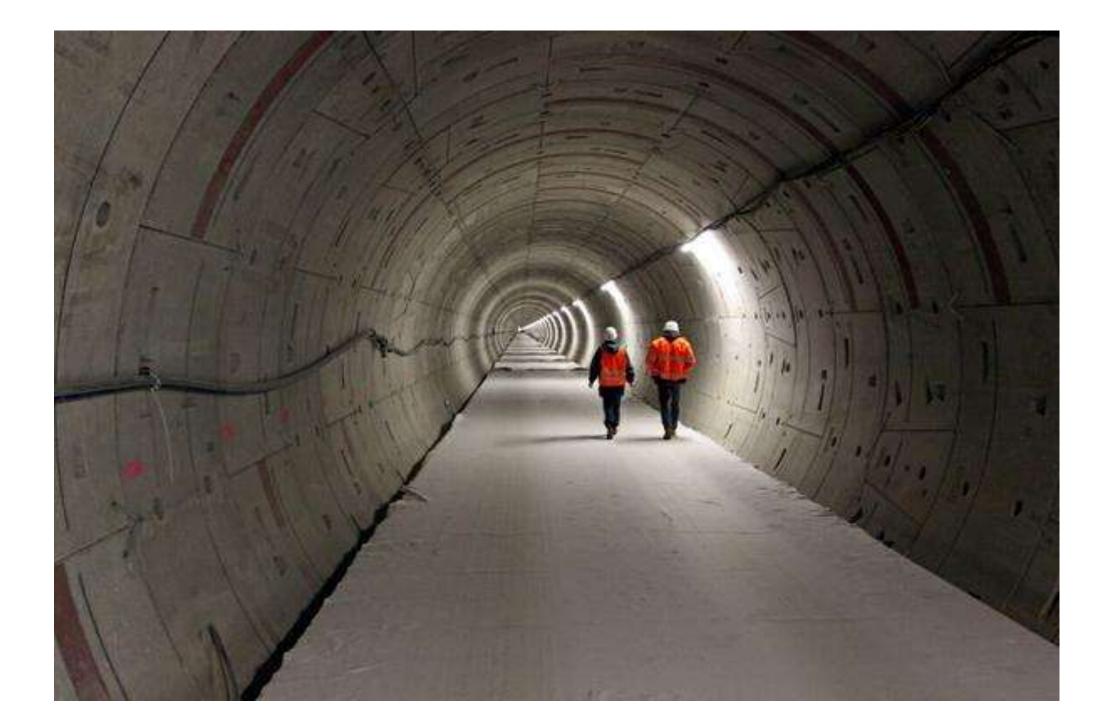
What we need to build a Mega Project

- Brilliant Idea
- Cash
- Accurate Status Update
 - Milestones
 - Performance
 - Interfaces
- Deliverables

How, what, who, when Why







"Networks"

Infrastructure

DAQ

Control

Console

Timing

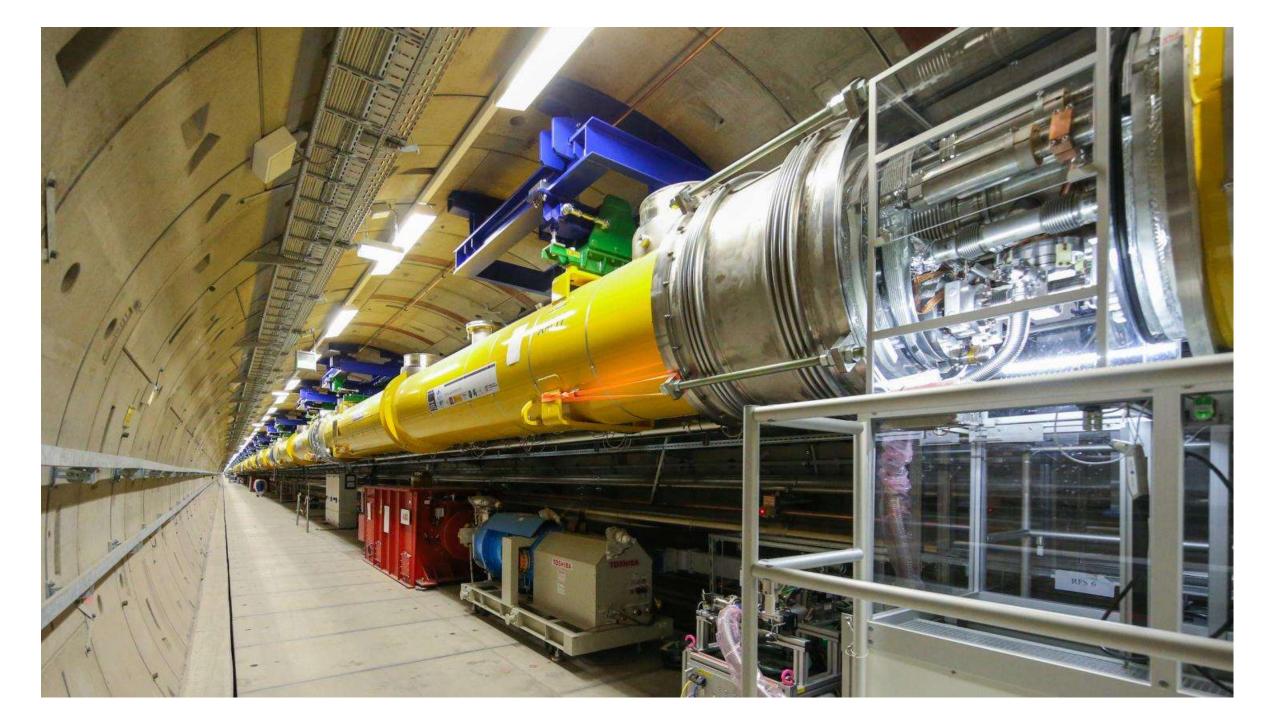
Triggering

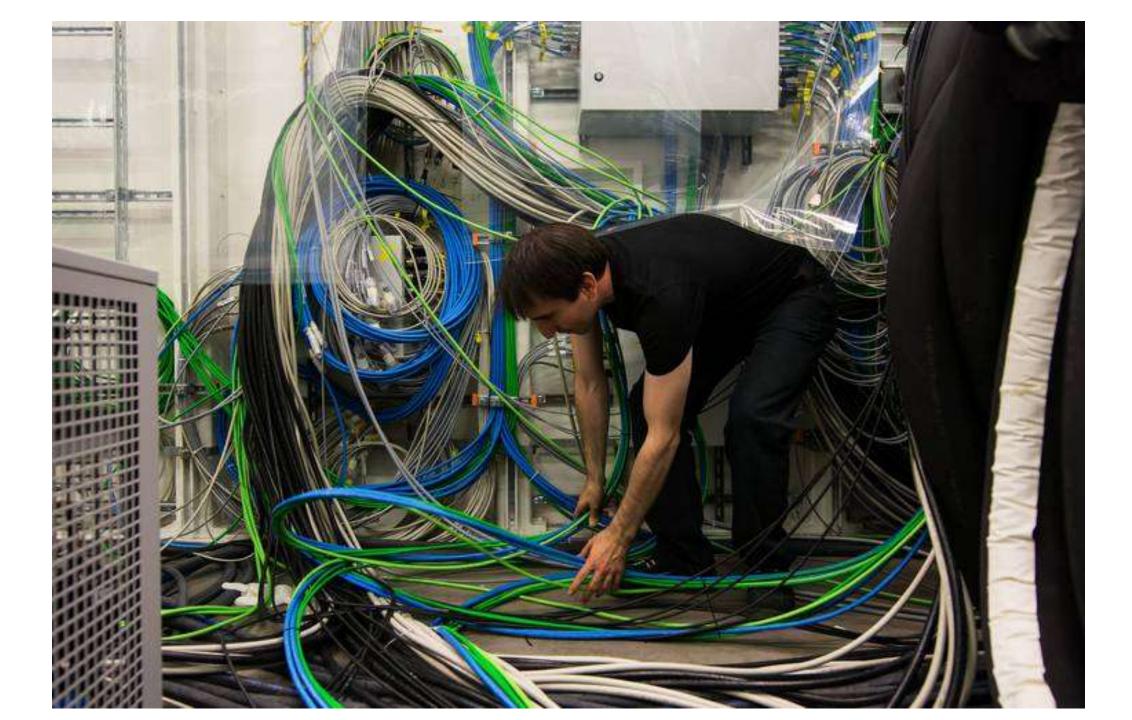
Safety

Storage

Processing

Other...





Installation instructions for:

- Cables
 - Fixed installation
 - Patch cables



- Cable trays
 - Content management
 - Cable routing
- Rack Content
 - Lists racks' content
 - Components allocation inside racks
 - Space reservation / free space calculation

Fixed Installation & Patch Cables

Cable overvi	ew								XFEL_F10_001_	
Cable races	Sturse (fon)	Target (to)	Cathie type	One Constanting		Cross-section [mm]	im):	Function (ext.	Graphital page of cable dagren	
-ptc.axes-W1	-DYC GOD (+1040) A SABELOW GUST +BIT - 200X (8/04/07 LID)	Unit 7/00-GigE1 Unit ETA-4/0 (EIPT SAIET DISEAUHTPET X/P	STREETLINGS Carda + Carl	Def 1	1.6	2,12	11/11		-PXERENDA	
-DTC-RISE1 WC	+mile PXExtligEt sine ETAHXX+EXP+ (\$486 + CXENsis+FPR+XXIII	+ mile FIE-Sys turks STA++IH-SSP1.5ASE: 02: ROXIN-PPIZ-ICE	ETHERUMEN Carls + Carl		111	3,50	21.62		white mit	
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-DTC-DOMENING	-DTC-GOETHYWEXP- SAGET DOM: CamPleba-UT	*DTC-DIGET+KHEDP1 SABEY DISHWALKDY	OUTUBRE CLASSIC HOW	3.1	3	1.3			-031084	
KLTC.9KBELWW	+D1C3GE1+KHESPL348E1D0FinCanRelayU1	+OTC GGEH++H-EHPT SATE! DOM: (Switch) Own COT	SparrCapa	10	2	1.1			HPAEBENIAN	
		ISTCCMOHINESPI AMENDISHEN DON								
(CTCG/GES-W18		*OTO GOEH+XHOP: AASELONE SIJEH-DKI-BUT	SymmOdia	121	12	13			xoaaadag	
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-drcaesaa	+++04 FXE+OgR2+ha ESA+X0+ESP+ BARES DIR Aus+FFS1-118	*****FIE-SigEz-Ni ETAHTHERM SASELEM RODG-PREJICE	ETHERLISER Data + CAT	1		0.32	21.62		HPISBBIG	
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STC SHELVIS	+010 0000+1040P1 MEE+00K 0y61-810-803-32	+SigE2 HPs CNH+ SHESPY SASEY DISK WARSH-SP25-WP	ETHERUNES CARS+ DAT	8		3.0	32.91		APTEMBRIS	
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1-3-1		+OTC:CAVG++XHEIP1:GASEL000+6IQ-DO1	A. A						7 7 -	
etcassavre .		-DECEMBER SALES DISSIPATED BIO	SymmOstra	10	2	13			-0.0000000	
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-01C-3063-W4	-DTC 0000+39400H1540011004 0960+D0-D03	+OTC GOED+OHERF EASE DES ONES-EIG-ERG (EIG-EF)	STHERLINDS Cards + Cach	1	- 1	3,12			HFX0885/8/24	
40TC (80E3-WS	401C00EH+D+DHP15HEF1DHEGyE3+BH5-BQ-XD	+DigEtINACH+ IHERPLS4881 DIE WALSL-IP20 AVE	ETHERUNER Carls + Car?	1	- 1	3,52	36.22		w/1880m25	
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STCREAM	+07C36E++1HER156E128C9E+E1489	CTC/GGE+-HHEOPI AREI SOLUMEH-BULEES EILAGY	ETHERUNES Carlor Carl	1		330			HEISENION	
orcidents.	+010 90E+++0-6091546E+100 GgE+-804-804-00	*SigEs life CN++1RESES SASES DAT WAS BL-SESS XVE	ETHERLINES CARD + Cart	à.	11	0.33	3710		-cathening	
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ICTC-SSSAWN	+DTC-DGEH+VivEXF13A8E1D0MiniCamRalw/UI	HOTO GISENA (HESPI MASE) DOOMS Segrent Cree COI	SaurCare	10	- 2	53			HEXERENNOS	
	The second state of the second	-010 CARD+1040071 XASE1 0054014-001				- 77				
(CTC (IGE) WIN)		+D1C G66++094EXP1-546E1.D05.GigE4+EX4-81W	SammCatha	10	- 2	3.5			INFESSION IN	

Cable overview

Cable name	Source (from)	Target (to)	Cable type	Conductors	Conductors used	Cross-section [mm]	Length [m]
=DTC.GIGE1-W1	=DTC.GIGE1++XHEXP1.SASE1.D05.GigE1+BX1-EBOX_BX1-KF1-X1	==Infra,FXE=GigE1.Infra,ETA++XHEXP1.SASE1.D05.field+PP51-X1F	ETHERLINE® Cat6a + Cat7	8	1	0,32	11.11
=DTC.GIGE1-W2	==Infra.FXE=GigE1.Infra.ETA++XHEXP1.SASE1.D05.field+PP51-X1B	==Infra,FXE=GigE1.Infra,ETA++XHEXP1.SASE1.D21.RCK99+PP52-X2B	ETHERLINE® Cat6a + Cat7	8	1	0,32	21.52
=DTC.GIGE1-W3	==Infra.FXE=GigE1.Infra.ETA++XHEXP1.SASE1.D21.RCK99+PP52-X2F	==Infra.FXE=GigE1.Infra.TN.mTCA++XHEXP1.SASE1.D21.RCK99+mTCL34.Slo	ŒX₩ERLINE® Cat6a + Cat7	8	1	0,32	21.73

Cable overview



Cable name	Source (from)	Target (to)
=DTC.GIGE1-W1	=DTC.GIGE1++XHEXP1.SASE1.D05.GigE1+BX1-EBOX_BX1-KF1-X1	==Infra.FXE=GigE1.Infra.ETA++XHEXP1.SASE1.D05.field+PP51-X1F
=DTC.GIGE1-W2	==Infra.FXE=GigE1.Infra.ETA++XHEXP1.SASE1.D05.field+PP51-X1B	==Infra.FXE=GigE1Jnfra.ETA++XHEXP1.SASE1.D21.RCK99+PP52-X2B
=DTC.GIGE1-W3	==Infra.FXE=GigE1.Infra.ETA++XHEXP1.SASE1.D21.RCK99+PP52-X2F	==Infra.FXE=GigE1.Infra.TN.mTCA++XHEXP1.SASE1.D21.RCK99+mTCL34.Slog

Cable type	Conductors	Conductors used	Cross-section [mm]	Length [m]
ETHERLINE® Cat6a + Cat7	8	1	0,32	11.11
ETHERLINE® Cat6a + Cat7	8	1	0,32	21.52
ŒŒŒRLINE® Cat6a + Cat7	8	1	0,32	21.73
T				

Similar reports needed

- ☐ Connector types at source/destination of cable
- ☐Pin Assignment
- **□**Labels
- ☐Phases of work

Installation instructions for:

- Cables
 - Fixed installation
 - Patch cables
- Cable trays
 - Content management
 - Cable routing



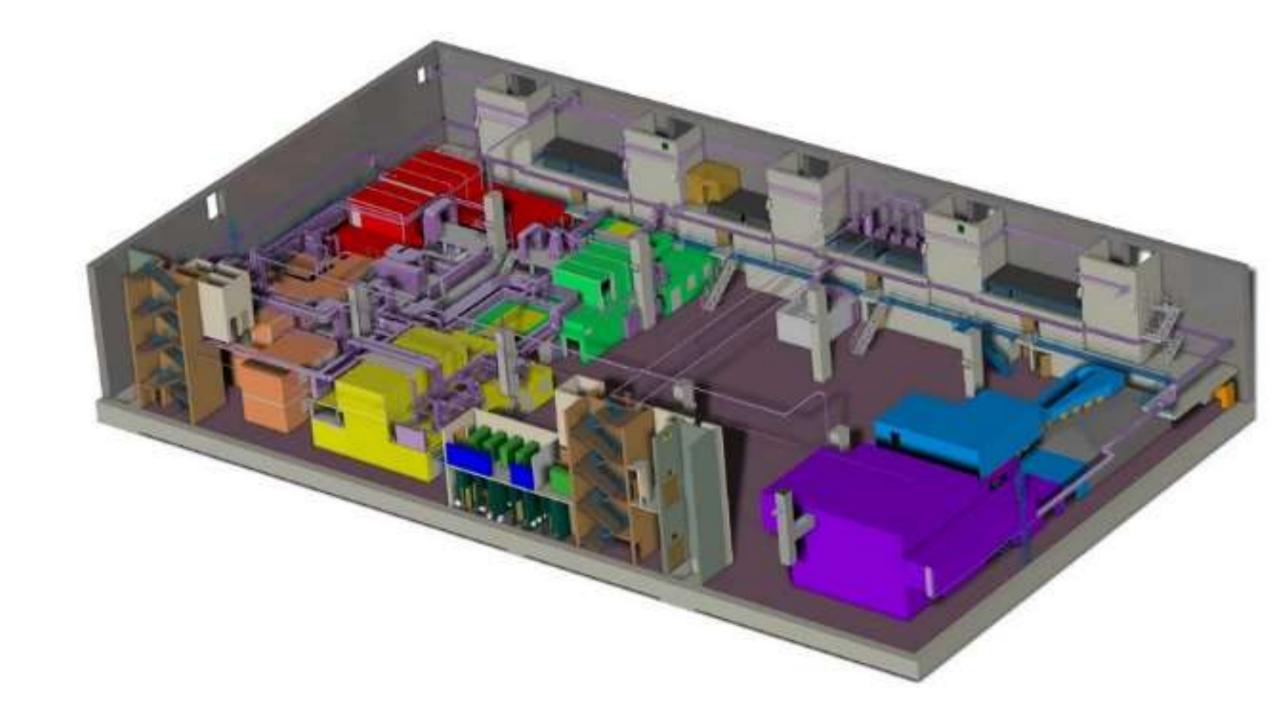
- Rack Content
 - Lists racks' content
 - Components allocation inside racks
 - Space reservation / free space calculation

Installation instructions for:

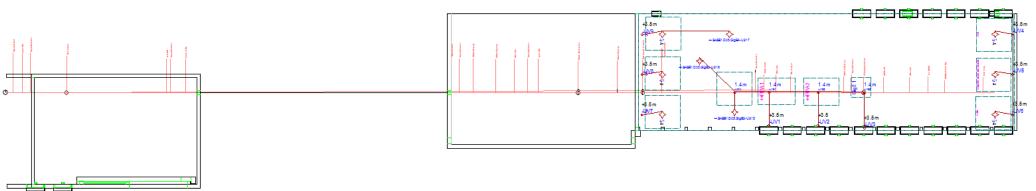
- Cables
 - Fixed installation
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- Cable trays
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 - Cable routing



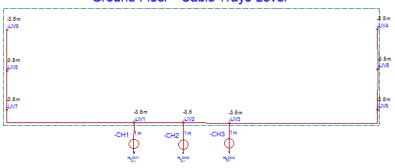
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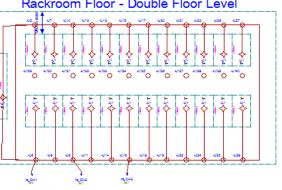
++D05.field Ground Floor - Zero Point Level



++D05.field
Ground Floor - Cable Trays Level

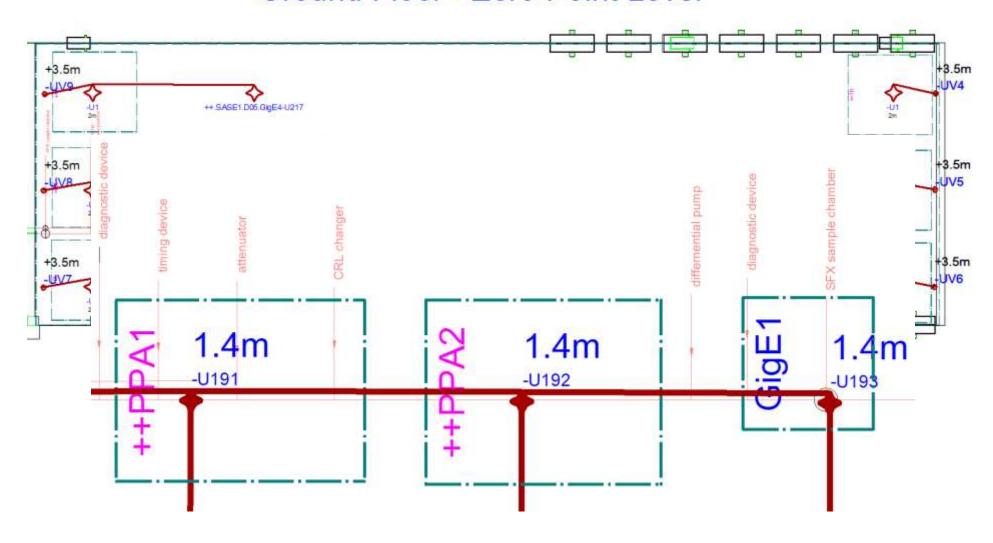


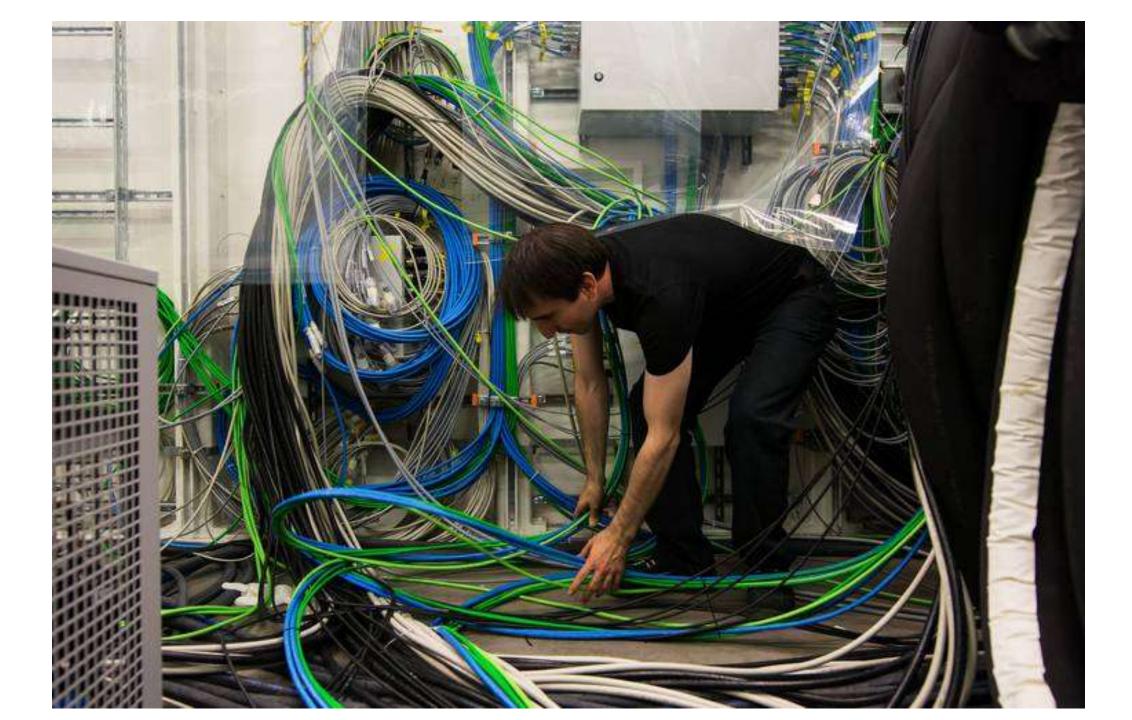
++D21
Rackroom Floor - Double Floor Level



Cable Trays Planning

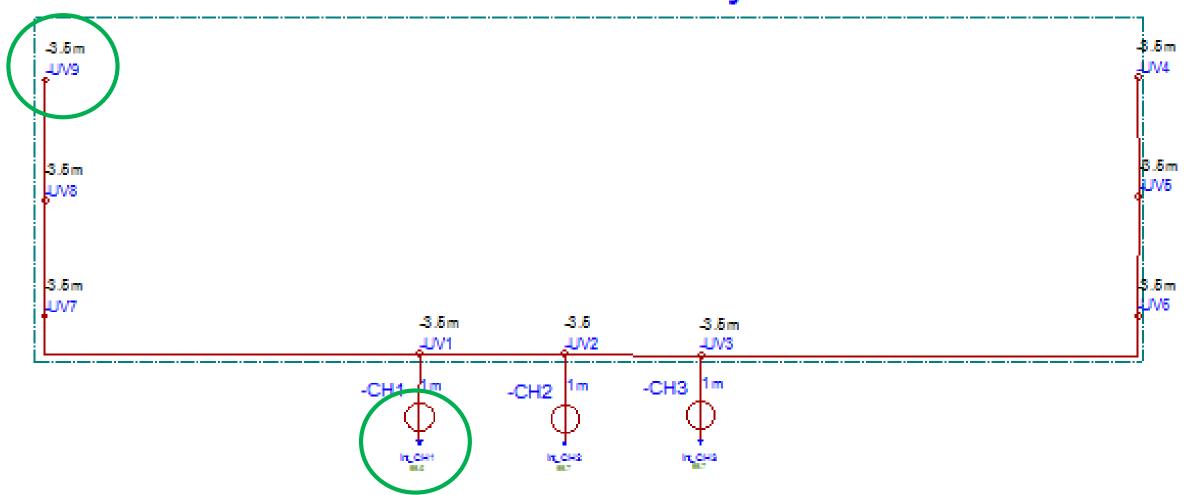
Ground Floor - Zero Point Level





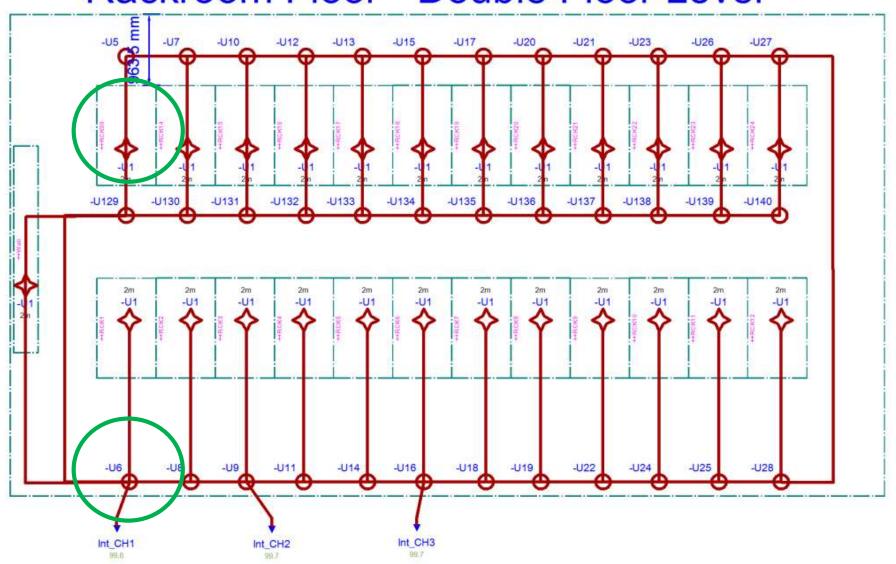
Cable Trays Planning

Ground Floor - Cable Trays Level

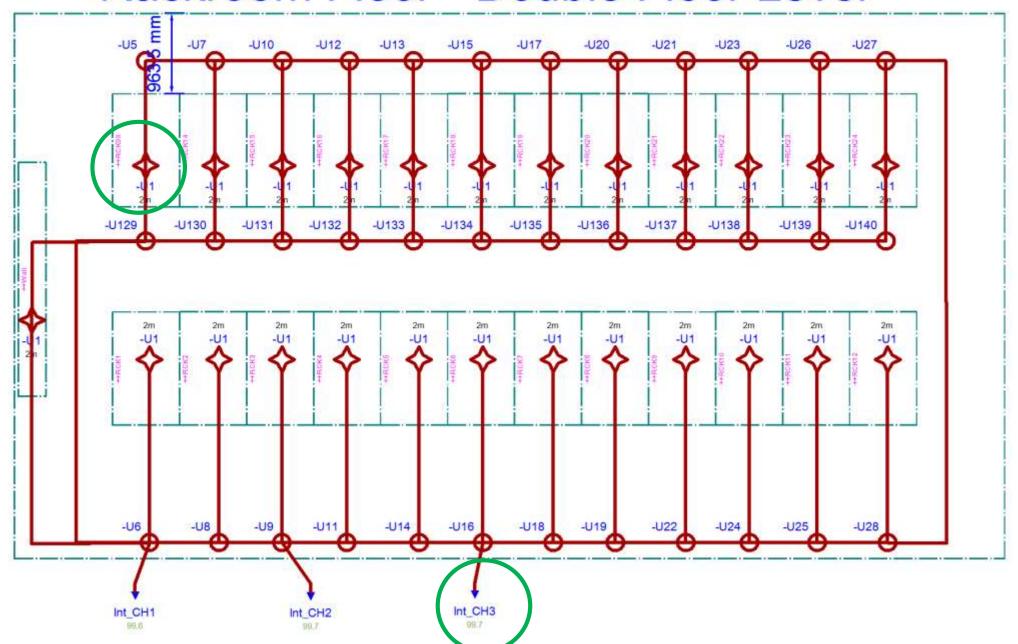


"Rack-room" Planning

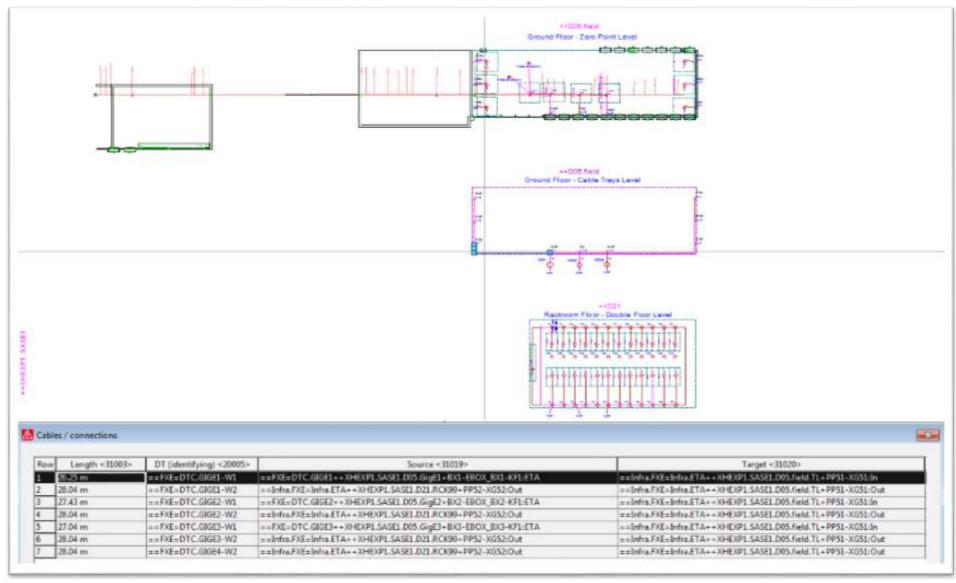
Rackroom Floor - Double Floor Level



Rackroom Floor - Double Floor Level



Cable Trays Content Management



Dynamic Data Completion – IEC Norm

Example: Power Socket

Main Function

Sub Function

Location

Installation Location

Distribution

220VAC

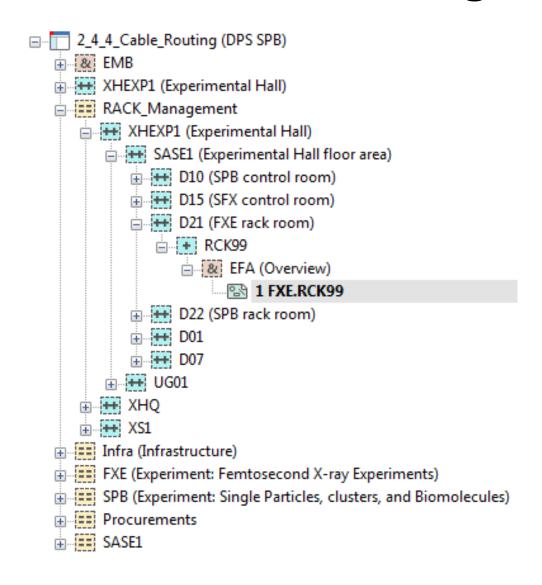
Building_X.Floor_Y.Room_Z

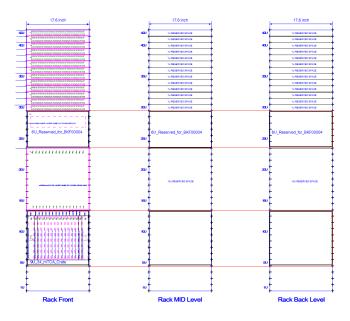
Wall_NW

IEC Norm example:

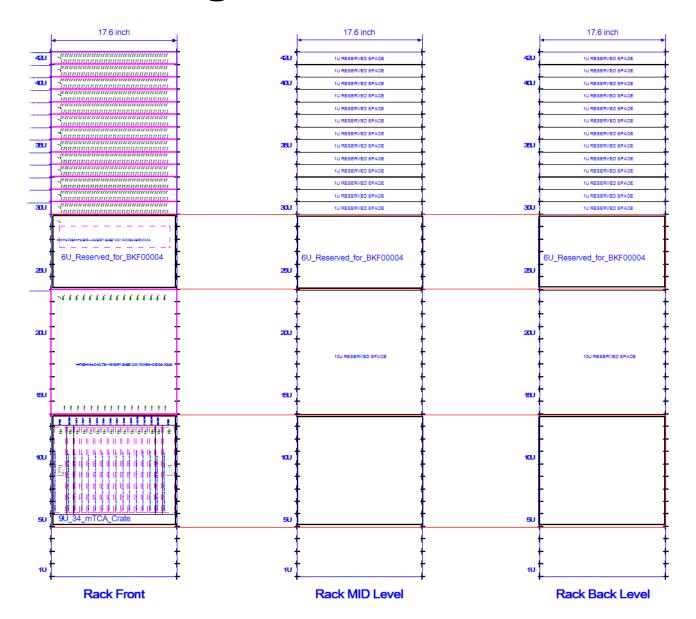
==DISTR =220VAC ++BLD1.FL5.RM21 +WL_NW

Rack Content Management – Rack Views

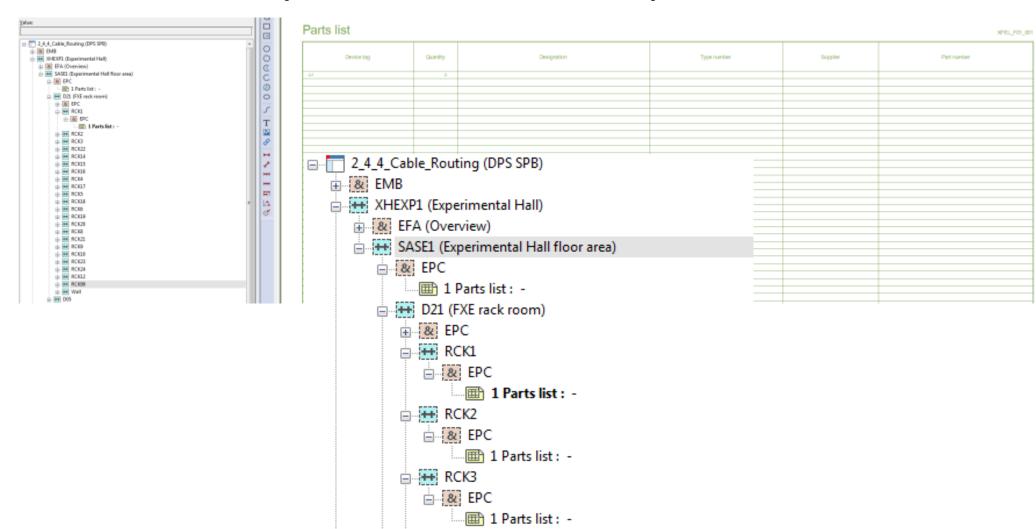




Rack Content Management – Rack Views



Rack Content ("BOMs"/ Views)



RCK22

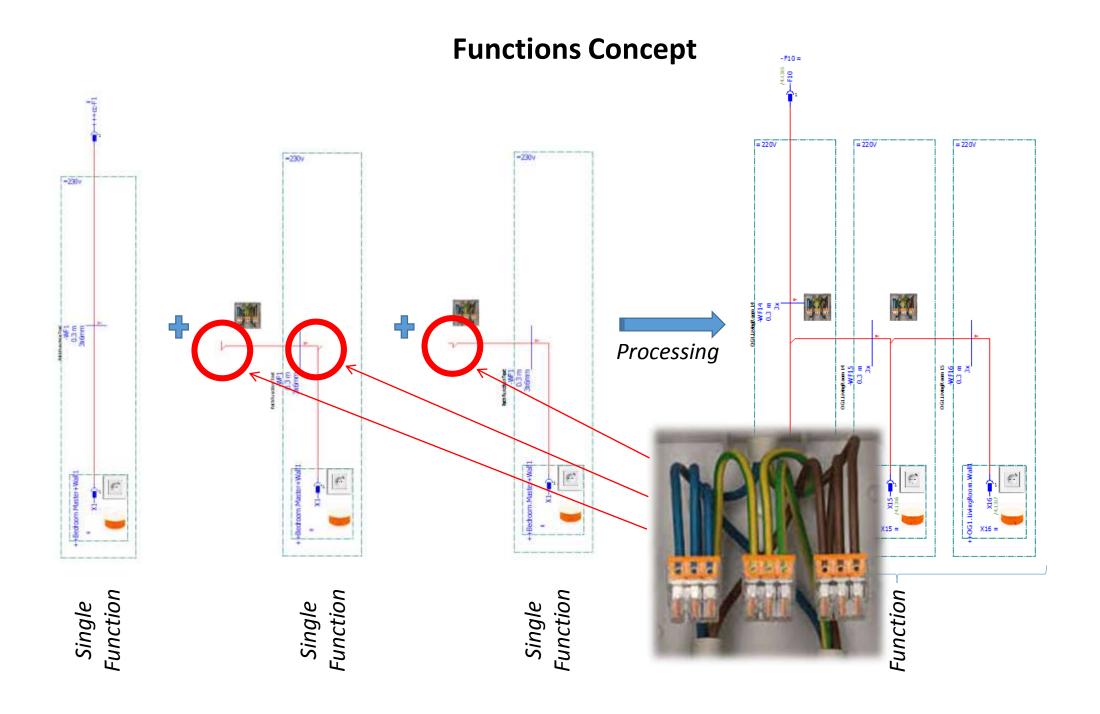
Framework Definition

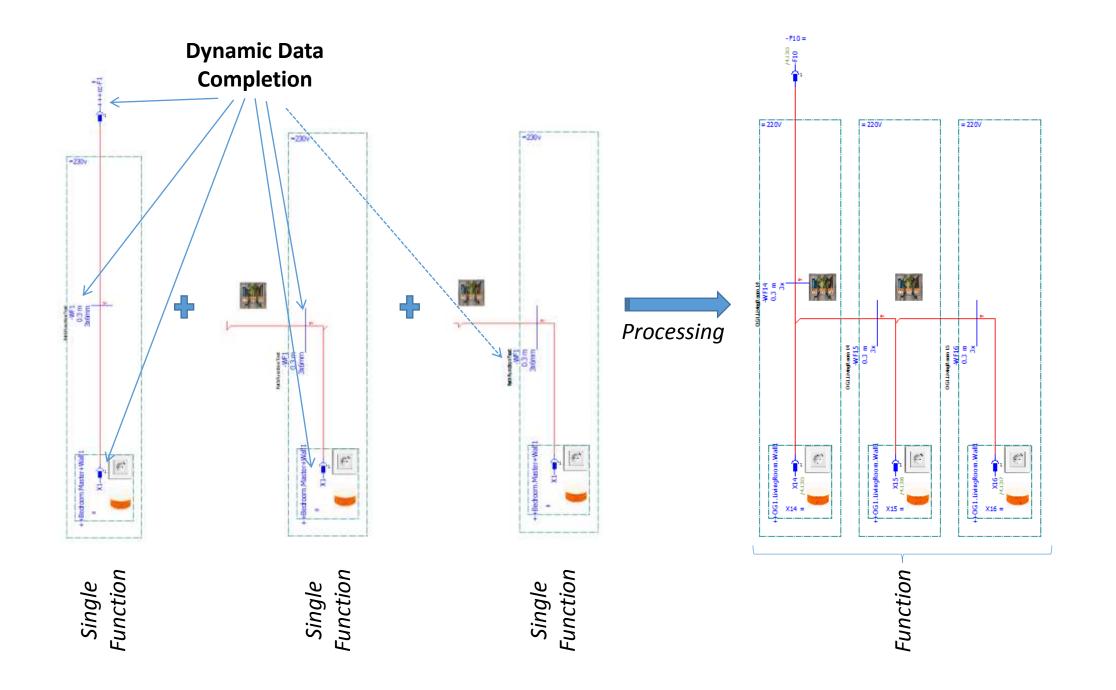
"A combination of software utilities able to "automatically" produce BOMs, cable lists, Connection diagrams etc"

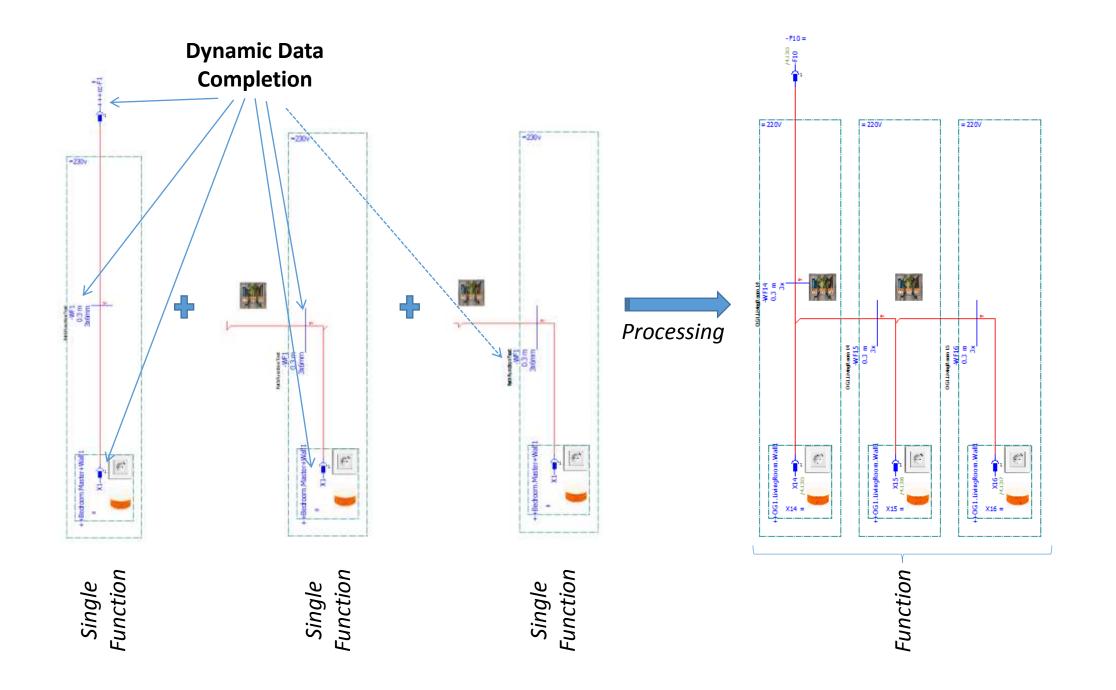
Custom Solution to overcome **limitations**

Complexity:

- 1000s sensors
- 1000s motors
- 1000s PLC components
- 1000s Network components
- 100s Racks
- 1 person



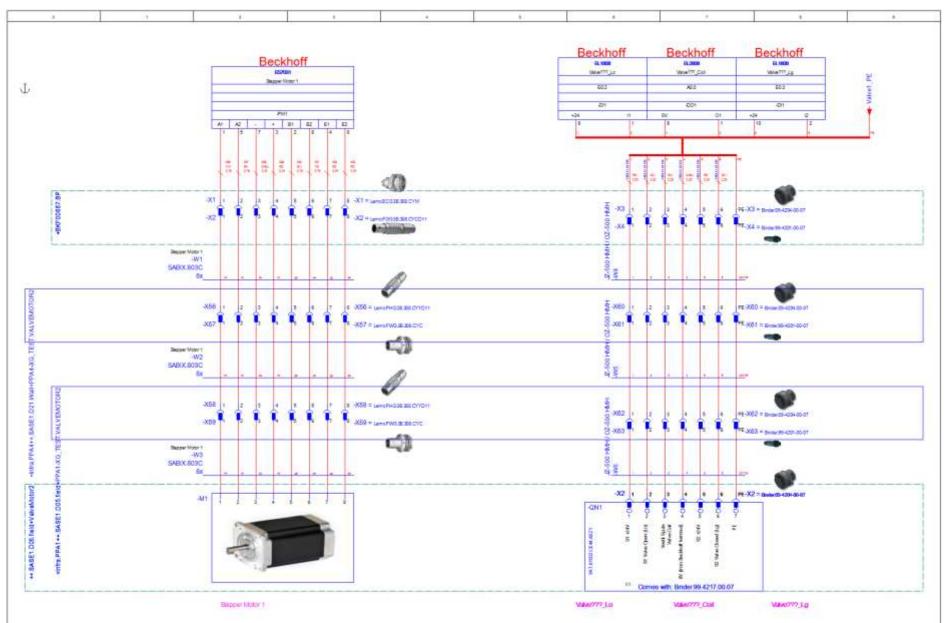




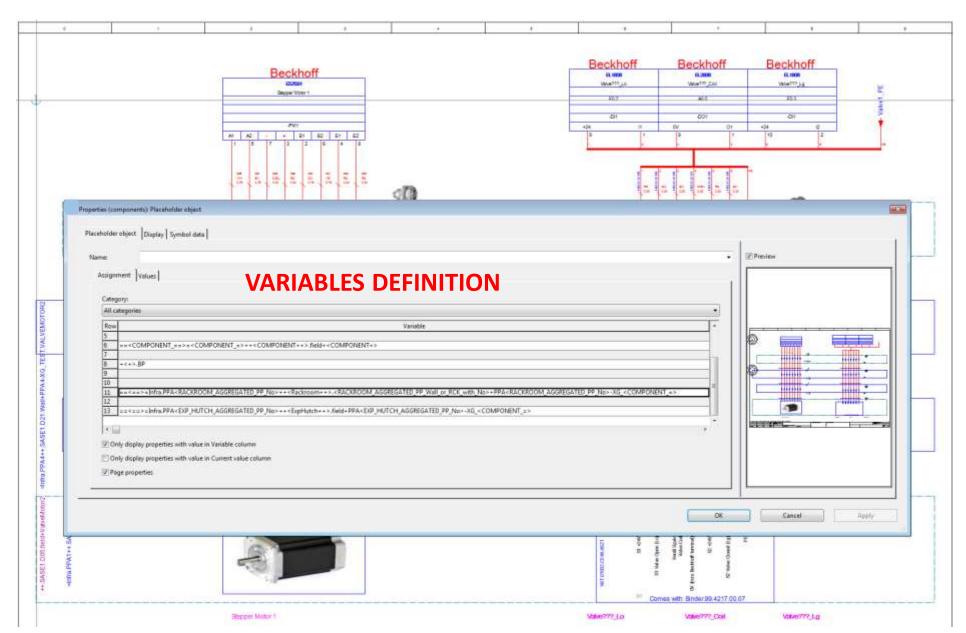
Project Specs

- X amount of motors
- Y1 amount of thermal sensors of Z2 type
- Y2 amount of thermal sensors of Z2 type
- ...
- ...
- ...

How the Information are used by eCAD Design Team

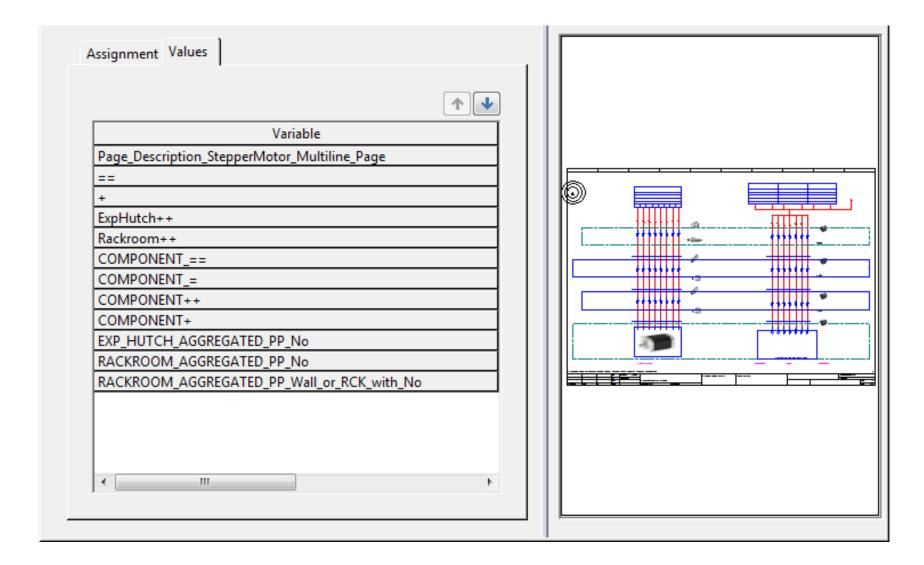


How the Information are used



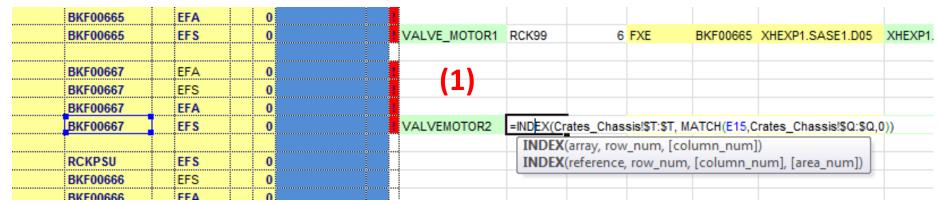
Master Project Integration

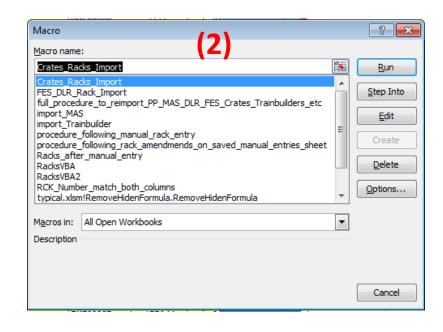
What variables are needed?

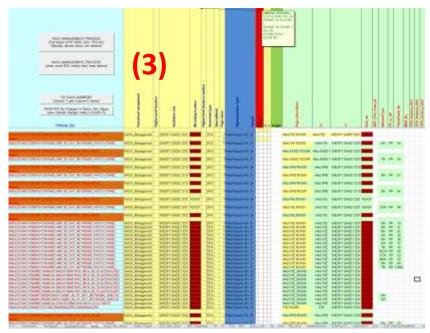


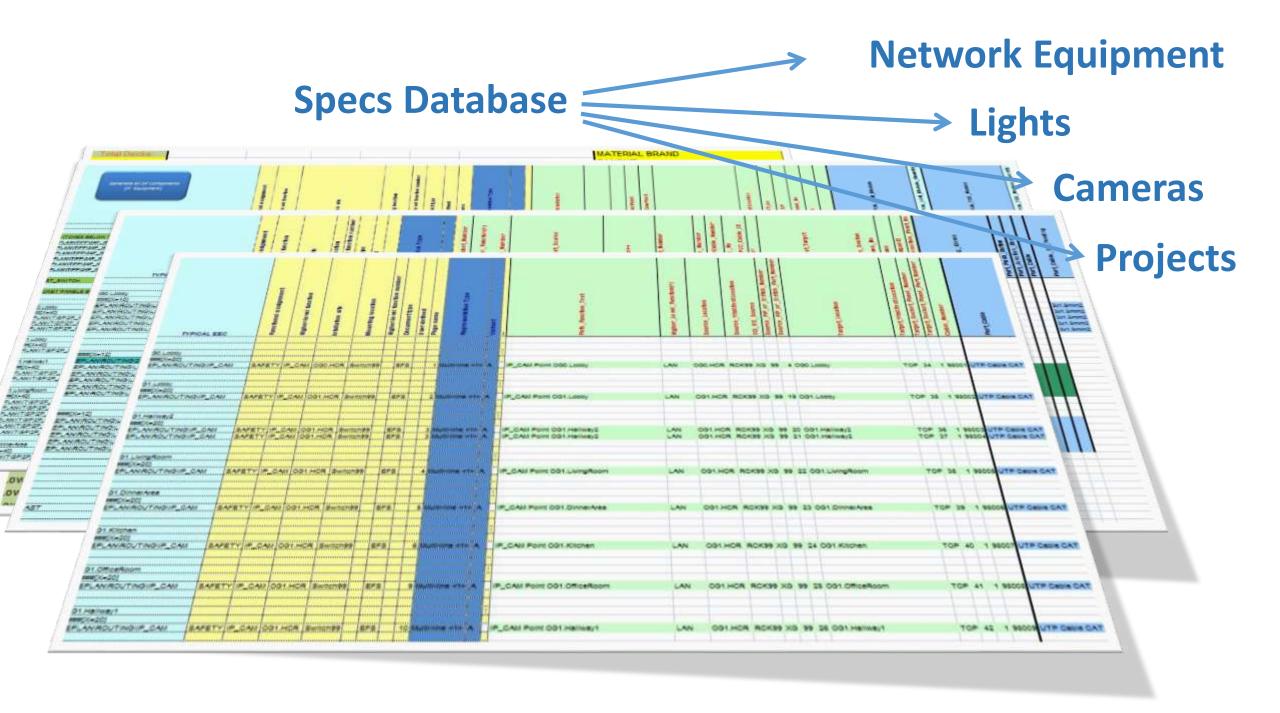
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Custom Solution Implemented





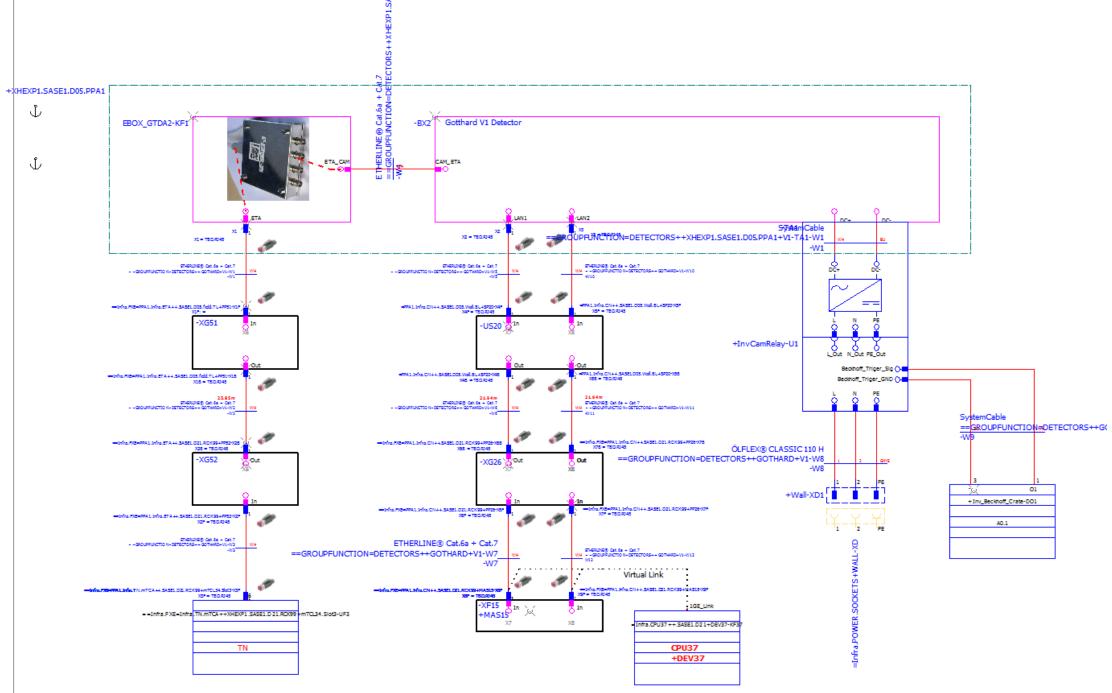




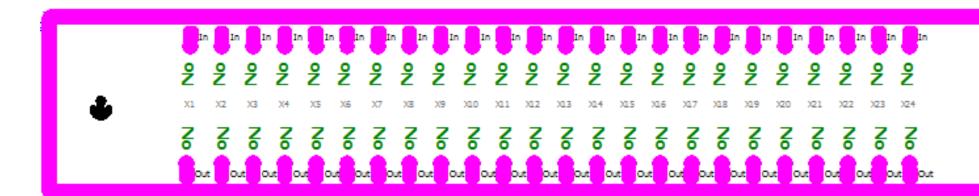
Custom Solution Implemented

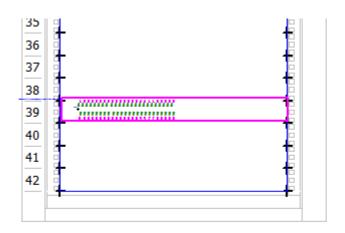
- Master Project Integration
 - Why
 - Unified installation documents (cable lists, parts lists...)
 - Error checking
 - i.e. Avoid short-circuits during design, No duplicate cable labels, etc
 - Reproducibility of existing projects without extra eCAD designer work/involvement
 - Managed by only 1 person



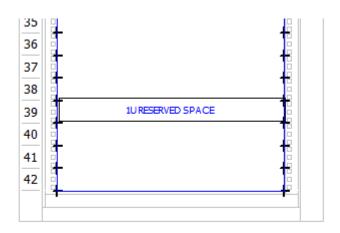


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ACCUPACION, DEPOSITOR, ANGLARIE, DES	DXE	Infra.BKF00005	XHEXP1.5A.SE1,021.8CK99	BK700005	EFART	0																
AUGUSTON, OCCUPANTA SANSATA	DIE	Infra.24VDC	XHEXP1. SASE1 D24 DC K99	BK700005	D'S.	0																
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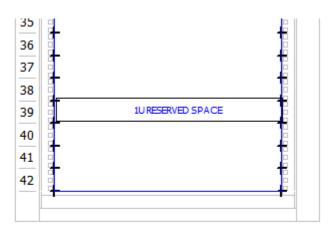




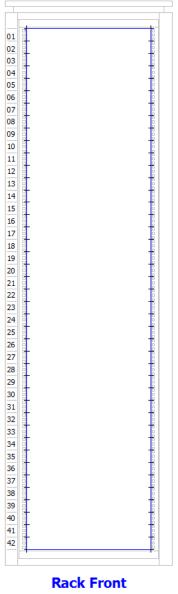
Rack Front

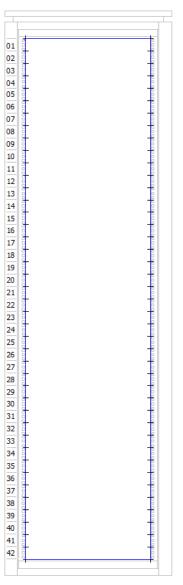


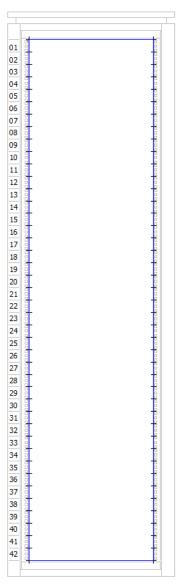
Rack MID Level



Rack Back Level



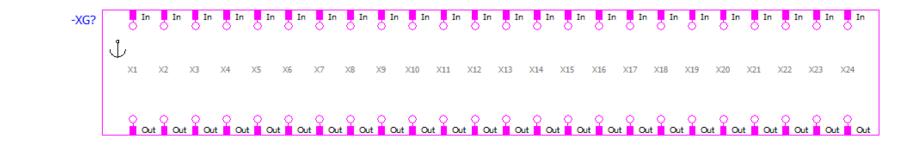




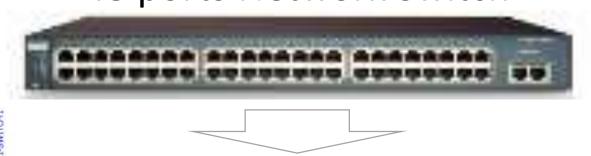


Rack MID Level

Rack Back Level









24 ports Patch Panel





DATACENTER CABLING / RACK MANAGEMENT

- Import Networks' Infrastructure:
 - Racks
 - Managed Switches
 - Unmanaged Switches
 - Patch-panels
 - Power Supply
 - UPS (rack mounted components)
 - Define Cooling direction of each rack

- Import
 - Components (CPUs, Automation Items, Rack mounted equipment

Switches Import Networks Infrastructure Patch-Panels **Racks** "Projects" 001 HOR RORSS NO 99 20 001 Hallways 001 HOR RORSS NO 99 21 001 Hallways 091 HCR RCK99 XD 99 22 001 LWngRoom TOP 36 1 95005 UTF CHUR CAT ov COLHON MOKES NO 99 23 COLDWINNER TOP 39 1 96000 UTP CRINE CAT PLANAGUTING P. CAM. 031 HOR ROKSS XS SS 24 001 KNOWN TOP 40 1 98007 UTP CROIR CAT OT.Officerfinors 001 HCR RCK99 X0 99 25 001 0fficeRoon DT. HIR THIRD T. EFLANMOUTING IF CAN 001.HOR ROKSS XS SS 26 001.Helike/1 TOP 42 1 96009 UTP CHUR CAT

Moving from planning to building...

- Parts List

- Wiring

- Installation Instruction

Reports:

Topology: Routed cables / connections

Designation Part number Type number Length [m]	Source	Routing track	Target
BOMs / Part Lists	==Distr=220V++OG1.HCR-F6	-U140;++OG1.HCR-U6;++OG1.Kitchen-U29;++OG1.Kitchen-U28 ++OG1.Kitchen.Wall-U2;-U150	==Distr=220V++OG1.Kitchen.Wall1-X1
==Distr=220V-WF5 NYA 3x1.5mm2 10.06	==Distr=220V++OG1_HCR-F7	-U141;++OG1.HCR-U6;++OG1.Ktchen-U29;++OG1.Bedroom.Single1-U11 ++OG1.Bedroom.Single1-U10;++OG1.Bedroom.Single1-U9;-U139	==Distr=220V++OG1.Bathroom,Wall1-X5
 Cable Laying Instruct 	tions	-U142;++OG1.HCR-U6;++OG1.Corridor-U9;++OG1.Corridor-U4 ++OG1.Corridor-U5;++OG1.Corridor-U6;++OG1.8edroom,Double1.Wall1-U2 -U153	==Distr=220V++OG1.Bedroom.Double1.Wall-X
==Distr=238/-WF7 NYA 3x2.5mm2 15.35	==Dstr=220V++OG1.8edroom.Double1.Wall-X6	-U153;++OG1.Bedroom.Double1.Wall-U2;-U99 ++OG1.Bedroom.Double1.Wall2-U2;-U155	==Distr=220V++OG1.Bedroom.Double1.Wal2-X
 Connection Instruction 	Gr= 20++OG1.8edroom.Double1.Waf1-X8	-U154;++OG1.Bedroom.Double1.Wall-U2;-U99 ++OG1.Bedroom.Double1.Wall2-U2;-U155	==Distr=220V++OG1.8edroom,Double1.Wali2-X
 Connectors Pin Assign 	==Kitchen=220V++OG1.Kitchen.Oven.Waii1-X2	nfectioning Instruct	IONS ==Kitchen=Infra++OG1.HCR-F3 ==Kitchen=Infra++OG1.HCR-F4
 Terminal Connection 	- Archen=220V++OG1.Kitchen.Wall1-X3	-U151;++OG1.Ktchen.Wali-U2;++OG1.Ktchen-U28;++OG1.Ktchen-U29 ++OG1.HCR-U6;-U148	==Kitchen=Infra++OG1.HCR-F5
==Ktrchen=220V-WF4 NYA 3x2 5mm2 13.73	==Kitchen=220V++OG1.Kitchen.Wall1-X3	-U151;++OG1.Kitchen.Wall-U2;++OG1.Kitchen-U28;++OG1.Kitchen-U22 ++OG1.Kitchen-U23;++OG1.Kitchen.Wall2-U2;-U152	==Kitchen=220V++OG1.Kitchen.Wali2-X4
 Rack Content Summa 	Ochev 220V++OG1.Kitchen.Wall2-X4	-U152;++OG1.Kltchen.Wall2-U2;++OG1.Kltchen-U31;-U149	==Kitchen=220V++OG1.Kitchen.Wal3-X5
	==NET=Alarm++OG1.Bedroom.Double1+Door-XG	-U156;++OG1.Bedroom.Double1-U5;++OG1.Bedroom.Double1-U4;-U99 ++OG1.Comdor-U6;++OG1.Comdor-U5;++OG1.Comdor-U4;++OG1.Comdor-U9 ++OG1.HCR-U6;-U144	==SAPETY=Alarm++OG1.HCR+OG1.IC60-XG5
==SAFETY=Alarm-W70003 19.16	==NET=Alarm++OG1.8edroom.Double1+Balcony-	xd 2 157;++OG1.Bedroom.Double1-U5;++OG1.Bedroom.Double1-U4;-U99 ++OG1.Comdor-U6;++OG1.Comdor-U5;++OG1.Comdor-U4;++OG1.Comdor-U9 ++OG1.HCR-U6;-U145	==SAFETY=Alarm++OG1.HCR+OG1.JC60-XG6

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Opportunity

Conceptual Design – Fast Budget Preparation

Prerequisites

- Draft Floor Plans (top & side view)
- Desired (Scientific) Equipment

Project phase

- Prepare quote for future project based on actual data
 - +/- 20% Concept Proposal
 - Based on Conceptual Floor Plan
 - Based on Conceptual Equipment
 - Cable Routing Paths
 - Cable Lengths
 - Summarised potential parts (list)
 - +/- 5% Detailed Plan
 - Based on Current/Actual Floor Plan
 - Based on Agreed Developed Equipment
 - Cable Routing Paths with Cable Run-Ways size/weight/Capacity estimate
 - Cable Lengths
 - Summarised actual parts (list)

Unify Everything

Concept -> Pre-Planning -> -> Design -> Commissioning

...get ready for "Datacenter 4.0"

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Thank you

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