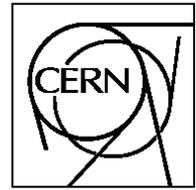


The Compact Muon Solenoid Experiment

CMS Note

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland



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Functions and Requirements of the CMS Centre at CERN

Final Report of the “CMS Centre RTAG”¹

Lucas Taylor (RTAG Chair), *Northeastern Univ., Boston, USA*
David Barney, Michel Della Negra, Hans Hoffmann, Werner Jank, Martijn Mulders
CERN, Geneva, Switzerland
Giuseppe Della Ricca, *Univ. di Trieste e Sez. dell' INFN, Trieste, Italy*
Erik Gottschalk, Kaori Maeshima, *Fermi National Accelerator Lab., Batavia, USA*
Christoph Paus, *Massachusetts Inst. of Tech., Cambridge, USA*
David Stickland, *Princeton Univ., Princeton, USA*

Abstract

This report of the “CMS Centre” Requirements and Technical Assessment Group describes the functions of the CMS Centre on the CERN Meyrin site in terms of data quality monitoring, calibrations and rapid analysis and operations of the offline computing systems.

It then defines the corresponding requirements for building space, computing consoles and other equipment, technical services and refurbishments, and communications systems.

¹ Requirements and Technical Assessment Group

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1. Introduction

“CMS Centres” are large rooms for CMS physicists and support staff working on offline operations and monitoring activities². They contain desks, computers, monitoring screens, communications systems, and are located in or close to major CMS office buildings and meeting rooms.

Ongoing activities in offline computing, online operations and data quality monitoring have already led to the establishment of several interim CMS Centres, including the:

- “Green Barrack” control room at P5, Cessy (~15 seats; ~20 screens);
- CERN Meyrin offline area in building 40 (3A) (~10 seats; ~15 screens);
- US-CMS Remote Operations Centre at FNAL (~15 seats; ~30 screens).

These were highly successful in the recent Magnet Test and Cosmic Challenge (MTCC) and the offline Computing, Software and Analysis (CSA06) challenge.

To prepare for LHC data-taking, these facilities will be replaced in 2007 by:

- a new purpose-built “CMS Control Room” at P5;
- a “CMS Centre” on the CERN Meyrin site in the former PS Main Control Room (PS-MCR in Building 354)³;
- an “LHC@FNAL” centre at Fermilab;

and possibly other such centres at Tier-1 or Tier-2 centres and in CMS Institutes.

In December 2006 a Requirements and Technical Assessment Group (RTAG) was launched to rapidly assess the functions and requirements for the “CMS Centre” in Meyrin, which should support two main activities: 1) Monitoring, Calibrations and Data Analysis Operations, and 2) Offline Computing Operations.

This report constitutes the completion of the RTAG work. Section 2 describes the **Functions of the CMS Centre** in particular the top-level tasks which it is to support. Section 3 defines the **CMS Centre Requirements** to enable it to perform the above functions and concludes with a summary table. Annex A includes the **RTAG Mandate and Schedule**.

This report provides the main input to a subsequent Project Plan for implementing the CMS Centre, which addresses the technical scope, work breakdown, schedule, and costs.

² They are not to be confused with the Tier-0, -1, and -2 Computing Centres (CERN/IT, FNAL, etc.).

³ The main operations room of the CMS Centre was previously referred to as the CCAR; the “CMS Centre” includes this main room as well as the adjoining rooms and facilities.

2. Functions of the CMS Centre

The main CMS Centre on the CERN main site in Meyrin should provide effective facilities to support the following two mission-critical activities:

- 1) **Monitoring, Calibrations, and Data Analysis Operations**, including tasks such as data quality monitoring (DQM), prompt sub-detector calibrations, and time-critical data analysis of express-line and calibration streams; and
- 2) **Offline Computing Operations** for coordinating the processing, storage and distribution of real CMS data and simulated data, at CERN and together with collaborating offsite centres.

The co-location in the CMS Centre of expert teams from the trigger, HLT, sub-detector and offline computing groups will enhance communications and enable cross-system solutions to be developed and implemented rapidly.

In addition to the core functions of the CMS Centre, there are related activities in the neighbourhood of the CMS Centre, which have implied needs. These include: office space for physicists; offices for offline computing personnel; large shared offices for specific working groups; and a number of meeting rooms, with associated professional phone- and video-conference equipment.

2.1 Monitoring, Calibrations, and Data Analysis Tasks

The first key role of the CMS Centre in Meyrin is to support data quality monitoring, calibrations, and rapid data analysis, as described below.

The CMS Centre will host dedicated trigger and sub-detector offline software experts who will communicate closely with their counterparts in the CMS Control Room. They will develop coherent solutions to offline problems and benefit greatly from the co-location in the CMS Centre of experts from the other trigger and sub-detector groups.

The following tasks are typical of the CMS Centre at startup; clearly the needs will evolve with time and the Centre should be flexible enough to respond to them.

Data Quality Monitoring

Although many experts will work at P5 during data-taking, the majority of CERN-based CMS personnel will be on the Meyrin site. The CMS Centre should therefore enable physicists to follow the status of CMS data-taking, by mirroring the main Control Room displays (e.g. exported screen snapshots updated frequently on a Web server).

The CMS Centre should have excellent communication links to the Control Room and remote monitoring centres.

The shift personnel in the CMS Control Room are responsible for ensuring the integrity of data for each sub-detector and for top-level global data quality monitoring. In addition, there will be dedicated DQM shifts in the CMS Centre, with help from similar offsite centres. This is particularly critical at LHC start-up when the machine, trigger and detector conditions are

evolving quickly.

As far as it is possible, all monitoring applications should be location independent (e.g. Web-based) so that experts may monitor their quantities of interest from wherever they are, be they in the CMS Control Room, the CMS Centre, an offsite centre (e.g. LHC@FNAL), in their office, or at home.

The CMS Centre will host teams doing systematic data quality monitoring of very recent CMS data for all subdetectors, using information from the online as well as processes running offline on the CMS Analysis Facility (CAF) and the Tier-0 centre. These activities should provide rapid feedback to the Control Room.

Each sub-detector group in the CMS Centre should have an area with monitoring screens, as above, and PCs for working on DQM activities. Offline experts will work in the CMS Centre to diagnose and fix problems that arise during data-taking, working closely with people in the Control Room. The CMS Centre will reduce congestion in the P5 Control Room and the time wasted traveling between Meyrin and Cessy.

The CMS Control Room at P5 is responsible for controlling the operations of the CMS data-taking. For certain applications, such as access to monitoring data, it may be useful for the Control Room to be able to give an expert in the CMS Centre temporary control of an application running at P5 to help debug a problem.

Rapid Calibrations, Alignments, and Analysis

The CMS Centre should provide a focal point for offline detector experts to work on calibrations, alignments, good/bad run lists, and rapid (express-line) analysis. They will use offline computing resources, in particular the CAF and the Tier-0 centre.

The rapid provision of updated constants is required for subsequent processing of events, notably the Tier-0 offline reconstruction, as well to provide feedback to the online operations, such as the higher level triggers.

This work is a key factor in making CMS competitive and will include both routine daily tasks and rapid responses to unforeseen problems. The co-location of experts from each sub-detector in the CMS Centre will greatly facilitate work on the (many) calibrations which involve several sub-detectors.

The details of the calibration, alignment and analysis tasks are still being refined for startup. Even after startup these needs will continually evolve. Therefore the CMS Centre should provide generic facilities that can meet a broad range of changing needs.

2.2 Offline Computing Tasks

The second main function of the CMS Centre is to support the Offline Computing operations team.

This task is mostly carried by a core team of about 10 people, support for which has already been foreseen as part of CMS Maintenance and Operations (Category-A). The majority of the team is already established in building 40; they will ultimately re-locate to the CMS Centre.

This team works closely with the physicists in the CMS Centre doing monitoring, calibrations and express-line data analysis as well as with the CMS Control Room, the CERN Tier-0 centre and CAF, the large offsite computing centres (Tier-1s), and the more numerous smaller computing centres (Tier-2s).

The CMS Centre should provide monitoring screens to display the status of the offline computing operations (e.g. data storage, processing, movement, heartbeats of centres and systems, etc.). Each group of monitoring screens should have an associated working area with PCs and several screens, which are distinct from the dedicated monitoring screens.

Data Operations

The CERN-based data operations team collaborates closely with data operations teams at the offsite centres and the data managers representing the offsite centres, particularly the Tier-1 centres. The data operation teams are responsible for coordinating the storage and distribution of CMS data and simulated (Monte-Carlo) data.

The CERN data operations team is responsible for the receipt of event data and slow-control / calibration data from the online, storage of data at CERN, and distribution of data to Tier-1 centres.

The data operations teams also coordinate the processing of CMS data and simulated data. This includes the quasi-real time processing at the Tier-0, re-processing at Tier-1 centres, and the simulation and reconstruction of Monte-Carlo event samples at Tier-1 and Tier-2 centres.

Offline Services

The CMS Centre is expected to be the focal point for the offline software activities, both for the sub-detector software experts, as discussed above, and also for core services such as software testing, release management, software distribution, database administration, etc.

User Support

CMS requires a number of user support services such as a user support helpdesk, user registration, virtual organisation administration, and so on. The user support staff also coordinates the computing and offline documentation and training activities. These could either be located at the CMS Centre together with the majority of the offline and computing experts, or in building 40 where most users have their offices.

2.3 Summary of Responsibilities

The following table summarises the main roles of the CMS Centre compared to those of the CMS Control room. It should be noted that many of the functions of the CMS Centre are identical to the functions of Remote Operations Centres (ROCs) who share this work.

The tasks for each sub-detector will depend on specific needs therefore the sub-detector tasks in the table are indicative only. The number of personnel involved per sub-detector can be quite significant. As a specific example, the ECAL expects to need about ten people at the CMS Control Room and nearby⁴ and about six people at the CMS Centre and nearby⁵.

⁴ Online SW Operation Manager, Control SW Expert, Trigger SW Expert, DAQ SW Expert, Pre-Shower Control / DAQ Expert, Online Data Operation Manager, Parameters Expert, DB Operator, Laser Calibration Expert, and DQM Expert.

⁵ ECAL Offline Survey Manager, L1 Trigger Survey Commissioner, Laser Calibration Commissioner, Pi0 Calibration Commissioner, W/Z Calibration Commissioner, a DQM Commissioner.

CMS Group	CMS Operations Responsibilities by Location	
	CMS Control Room and CMS Site at Point 5	CMS Centre at CERN and CERN Meyrin Site
Run Control / DAQ	<u>Tasks / responsibilities include:</u> <ul style="list-style-type: none"> ▪ Operate / control CMS detector ▪ Liaison with LHC operations ▪ Acquire data from detectors ▪ Operate filter farm ▪ Write events to local storage ▪ Transfer data to CERN / IT ▪ Manage online databases 	
Trigger / HLT	<u>Tasks / responsibilities include:</u> <ul style="list-style-type: none"> ▪ Operate L1 trigger and HLT ▪ Set trigger conditions according to policy of Trigger Coordinator 	<u>Tasks / responsibilities include:</u> <ul style="list-style-type: none"> ▪ Monitor L1 and HLT together with offsite centres / experts and give feedback to Control Room ▪ Prepare and test new trigger configurations ▪ Trouble-shoot problems (e.g. using the CAF)
Offline / Computing	<u>Tasks / responsibilities include:</u> <ul style="list-style-type: none"> ▪ Software installations for HLT ▪ Deploy tools for global DQM, histograms, event display 	<u>Tasks / responsibilities include:</u> <ul style="list-style-type: none"> ▪ Store CMS data at CERN ▪ Operate Tier-0 reconstruction ▪ Run CAF operations for calibration, alignment and rapid analysis - schedule and prioritise CAF work ▪ Manage offline databases and monitor DB services ▪ Operate and monitor data productions at CERN and remote centres, together with offsite centres ▪ Operate and monitor data transfers to Tier-1 centres
Typical sub-detector	<u>Tasks / responsibilities for a typical sub-detector include:</u> <ul style="list-style-type: none"> ▪ Ensure safe operation of sub-detector and monitor hardware ▪ Take calibration data (e.g. pre-fill pedestal runs) ▪ Provide constants to HLT ▪ Check real-time DQM for the specific sub-detector 	<u>Tasks / responsibilities for a typical sub-detector include:</u> <ul style="list-style-type: none"> ▪ Coordinate sub-detector offline operations ▪ Detailed sub-detector DQM together with offsite remote centres / experts ▪ Liaise with counterpart in Control Room ▪ Run dedicated jobs on express-line and calibration streams (e.g. in CAF) ▪ Provide updated constants for HLT and Tier-0 processing of event data
Global run / data quality monitoring	<ul style="list-style-type: none"> ▪ Monitor trigger / detector status ▪ Monitor online DQM results (e.g. histograms and event displays) ▪ Communicate issues of data quality to other shift personnel in Control Room ▪ Liaison with CMS Centre person (e.g. to request further studies of specific problems) 	<ul style="list-style-type: none"> ▪ Real-time monitoring of trigger / detector status and DQM results from Control Room (e.g. mirrored displays) ▪ Monitor global DQM histograms & event displays from offline processes running in CAF and Tier-0 ▪ Collate run quality information from all detectors ▪ Coordinate preparation of global good/bad run lists ▪ Coordinate (with computing operations) the scheduling of Tier-0 bulk processing of events ▪ Check data quality after Tier-0 bulk processing ▪ Liaise with offsite remote centres / experts
Global calibration / alignment		<ul style="list-style-type: none"> ▪ Monitor content and quality of AlcaReco stream(s) ▪ Coordinate with sub-detector groups the processing of AlcaReco data (e.g. for full tracker alignment) ▪ Coordinate offline database updates ▪ Provide updated constants to HLT ▪ Liaise with offsite remote centres / experts

3. CMS Centre Requirements

This section describes the requirements of the CMS Centre which enable it to be used to perform the functions described in the previous section.

These requirements should constitute a top-level scope definition which is adequate to develop a subsequent project plan for the creation of a functional CMS Centre.

3.1 Delivery Date

The target milestone dates are:

- **Nov 2007: basic CMS Centre ready for LHC engineering run.**
- **Mar 2008: full CMS Centre ready for LHC physics pilot run.**

This allows for the possibility that some services may need to be provided on an interim basis, for example temporary installation of IT equipment in nearby rooms if the installations of the main room cannot be completely finished for the engineering run.

A realistic schedule aiming to satisfy these target dates should be established as part of a coherent project plan for implementing the CMS Centre requirements, including: the design phase, planning of the work, procurement, installation and commissioning.

3.2 Building Space

Office Space near the CMS Centre

Following a survey of the collaboration, CMS has requested 1600 sq. m (~250 people) of new offices from CERN to meet the growing needs for CMS physicists coming to CERN, especially at the time of the first LHC running. Much of this space should be in the neighbourhood of the CMS Centre. The provision of adequate parking should be considered.

Core developers of the offline software and computing systems who are based on the CERN site should be located in or close to the CMS Centre, as should key support staff such as system managers, document system maintainers, or software release and deployment responsible persons.

Space for CMS Groups

A number of the larger offices should be allocated for use by trigger, sub-detector offline working groups and computing and offline project personnel. Such offices would accommodate people on a dynamic basis who need to work closely with CMS Centre personnel – they would not be permanently assigned to individuals. Space should also be foreseen for visiting persons doing offline shifts.

Space for Short-term Visitors

Assigning offices to fixed institutes or persons does not make optimum use of space for visitors therefore it is proposed to establish shared working areas which may be freely used by visitors on a temporary basis.

Shared space should have desks with good wireless networks for laptops, a few fixed terminals with access to standard CERN Linux and/or Windows systems, and perhaps other services such as lockers and provisions for receiving mail.

Several such areas should be foreseen in buildings with significant numbers of CMS people both near the CMS Centre and also elsewhere (e.g. buildings 40, 32, 28, 27, etc.).

Such shared space would use existing or already requested CMS office space; it does not constitute an additional request to that mentioned above.

Main Room of the CMS Centre

To meet the needs above, the CMS Centre needs two zones in a large room:

- Zone 1: Monitoring, Calibrations and Data Analysis Operations
- Zone 2: Offline Computing Operations

The main room should be approximately 300 sq m in area to include space for consoles with several screens for interactive work, and several additional and largely passive monitoring screens. There should be some tables and chairs for discussions and overflow work, as well as a modest amount of space for shelves, cupboards, etc.

The photo below shows an example of how the CERN Control Centre (CCC) for accelerators is laid out. With a floor area of 600 sq m and four circles of 10 consoles each it is twice the size of the proposed CMS centre. For CMS, two such circles would approximately suffice, although the details of the console layout need to be adapted to suit the specific CMS needs and the dimensions of the room.



A false floor will greatly simplify cabling of the room, particularly the power and networks for the consoles. The floor tiles should preferably be noise reducing tiles faced with carpet which provide acoustic damping. Alternatively carpet could be laid in sections so as to allow sections of the floor to be raised without causing excessive disruption.

Auxiliary Rooms adjoining the Main Room of the CMS Centre

The following rooms are required to support the activities carried out in the main room of the CMS Centre. All these room should be located in the immediate vicinity of the main room (preferably adjoining). They all require air-conditioning.

Dedicated Meeting Room

A dedicated meeting room is required for specific CMS Centre activities. The room must be available all the time, in particular for meetings of CMS Centre operations personnel with connections to Point 5 and offsite centres. It should be professionally equipped for phone and video-conferencing.

The room should be about 40 sq m in area, in order to accommodate all the operations personnel in the CMS Centre, i.e. up to about 25 people.

Equipment / Storage Room

A small room is required for modest amounts of equipment and storage. Initially this would contain printers, faxes, and storage space for office supplies, spares, tools, documentation, etc.

The room should be about 20 sq m in area.

Rest Area / Kitchen

A rest area (a room) with modest kitchen facilities is required, particular for shift-takers. It should include a table and several dining chairs, several low comfortable chairs, and a low table. It should be equipped with a coffee machine, fridge, microwave, and sink. Shower facilities in the general vicinity would be desirable.

The room should be about 30 sq m in area.

Outreach Space

Dedicated space of about 30 sq. m is required for outreach displays.

This may be a separate room, or part of a room which is also used for other purposes. It may be co-located together with the CMS Centre activities described above but this need not necessarily be the case.

Meeting Rooms near the CMS Centre

Meeting rooms are required to support the CMS community located in offices near the CMS Centre. These include an auditorium (~100-200 people), several large rooms (~50-100 people), several medium sized rooms (20-50 people) and a number of small rooms (from 5 – 20 people). These may be shared with non-CMS people provided all parties have sufficient access. One large room should be available daily for a run meeting. This would include a

video link to the run meeting in the meeting room at P5, next to the CMS Control Room.

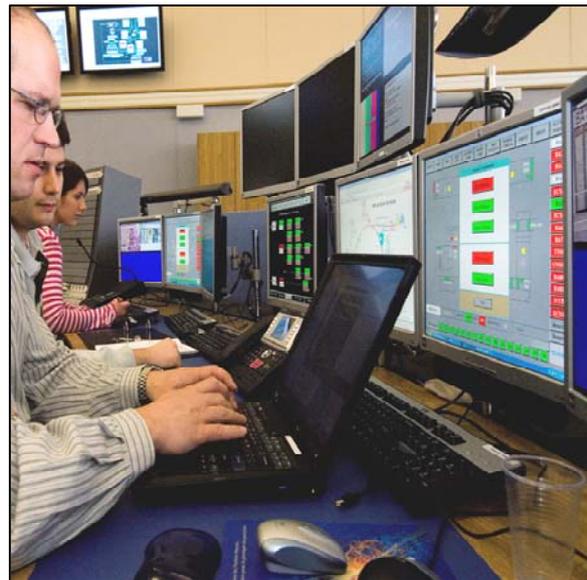
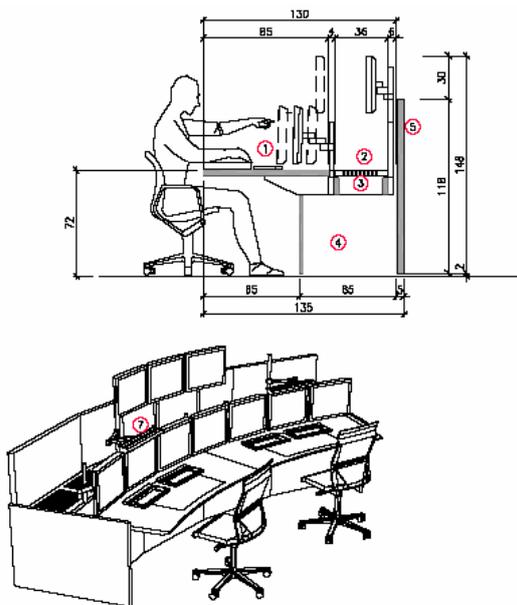
All meeting rooms should be professionally equipped with phone- and video-conferencing systems. Attention should be paid to the acoustics of the room. Some of the smallest rooms may have rather basic, but nonetheless functional, systems.

3.3 Computing Equipment and Furnishings

Consoles in the Main Room

A set of almost identical working areas will be established. Each area, called a console, comprises a desk with a set of raised monitoring screens, and several working screens at normal height. A console seats one person by default. Sufficient space is needed to accommodate additional experts at a console working closely for short periods with the main user, for example to diagnose and fix a problem.

As an example, the diagram shows the design for a pair of similar consoles as implemented in the CERN Control Centre (CCC) and the LHC@FNAL centre. The lower row of screens is for interactive work and the upper row is for monitoring displays. The photo shows a pair of consoles (10 screens total for 2 console areas) as implemented for the CCC.



Specification of a Console

Each console is equipped with:

- one desk approximately 1.6 m wide, one chair, one desk lamp, one telephone with headset, small shelf space for documentation;
- one PC with three screens (in a row at normal height) for interactive work and communications (Email, Web, chat, and possibly videoconferencing);
- one PC with three screens (in a raised row) for monitoring displays;
- electrical power for the above equipment and modest additional items such as laptops (total of 10 power sockets); and

- three network sockets, one of which is on DHCP.

The consoles should be designed with robust and adjustable mounts for the screens, space to contain the PC away from the user, and cable conduits. The design should consider cooling needs and acoustic damping.

Ergonomics should not be neglected in the design since many people will use the CMS Centre for sustained periods of time and may otherwise suffer unnecessary fatigue, stress, or even injury.

Number of Consoles Required

Approximately 25 consoles are required in the CMS Centre.

Most of the consoles are identified with a specific task and will frequently be associated with a specific operator on shift. Some additional consoles are needed which can be assigned on a dynamic basis to cope with unforeseen and changing needs. Many screens are passive “for information only” displays showing, for example, various monitoring screens mirrored from the CMS Control Room.

A possible allocation of consoles to tasks is shown in the table below; this will be refined as the needs are better defined.

Functions of consoles	
General	1) CMS Centre shift leader
	2) Luminosity, LHC conditions, CMS top-level status
	3) Trigger / HLT
	4) TriDAS
	5) Global run quality (DQM, event display)
	6) Global calibration / alignment
Sub-detectors	7) Pixels
	8) Tracker
	9) ECAL
	10) HCAL
	11) Muon / DTs
	12) Muon / CSCs
	13) Muon / RPCs
	14) Forward detectors
Offline Computing	15) General IT monitoring: CERN systems and CMS Centre
	16) Data management / movement
	17) Tier-0 and CMS Analysis Facility (CAF) operations
	18) Production operations (MC, re-reconstruction, skims,...)
	19) Database operations
	20) Offline software management / distribution
For dynamic assignment as required	21) Console A
	22) Console B
	23) Console C
	24) Console D
	25) Console E

Miscellaneous Equipment and Furnishings

Some desk space is required in the main room for working discussions and overflow work of experts working together with CMS Centre operators. Several large tables are needed seating a total of about 20 people. Each person should have about 80cm width of desk, a power socket, and a wireless network connection.

Several large computer displays (or projectors with screens) are needed in prominent locations for all operators to see. These should display the top-level status of CMS online and offline operations. One large display in a prominent location should be reserved for outreach purpose (e.g. showing an automatically updating live event display).

Two printers should be available, at least one of which can print large documents rapidly.

At least one (possibly electronic) whiteboard should be installed, possibly on wheels.

Collaborative Working Tools and Equipment

Phone- and Video-conferencing Systems

All meeting rooms should be professionally equipped for phone- and video-conferencing. Installations should aim to be in accordance with relevant agreed-upon CERN-wide standard configurations. The systems should preferably be supported by CERN / IT. The rooms should include measures to improve acoustics, for example carpets, curtains, and wall or ceiling tiles.

The two top priorities in the neighbourhood of the CMS Centre are (1) the small dedicated meeting room attached to the main room of the CMS Centre and (2) a nearby auditorium for larger meetings, for example to connect to a daily CMS Run Meeting.

Webcam + Phone Links from CMS Centre to CMS Control Room and Offsite Centres

High quality web camera (webcam) views should be displayed in the CMS Centre, showing the CMS Control Room and major offsite centres (initially the LHC@FNAL centre, with possibly others later). Similarly, it would be useful to display a CMS Centre view in the other rooms. These significantly enhance the sense of proximity of the various communities. The displays could use large LCD screens, projectors and screens, or possibly even HDTV.

There should be a telephone adjacent to these displays that also supports conference calls. Then individuals or groups of people in the various rooms could discuss simply by approaching the screen and making a phone call.

Public Address System

A public address system may be useful for making general announcements of interest to all occupants of the CMS Centre. It may potentially be useful to allow the CMS Control Room to make announcements to the CMS Centre staff in this way.

Desktop Tools

Various standard desktop tools should be deployed throughout the various centres. These should include a platform-independent chat system, shared desktops to enable experts to perform tasks remotely, and desktop video-conferencing. Choices should be standardized throughout CMS as much as possible.

3.4 Technical Services

Heating, Ventilation and Air-Conditioning

The main room and the adjoining auxiliary rooms of the CMS Centre all require a controlled heating, ventilation and air-conditioning (HVAC) system due to the large quantities of computing equipment and the significant numbers of people.

The HVAC system should be able to maintain a reasonable working temperature of about 21–24 degrees Celsius depending on the time of year.

For the main room, the air conditioning capacity should be sufficient to cope with the electrical power consumption (estimated below), and a typical occupancy of 25-50 persons.

The air-conditioning of the dedicated meeting room should cope with an occupancy of up to 25 people. Air conditioning of the rest area / kitchen is desirable (but not critical) with a capacity adequate for about 5 persons.

Lighting

The lighting design should consider the need for both external (natural) light and internal (artificial) lighting, taking account that people will spend long periods of time in front of computer screens. Applicable regulations for shift and other workers regarding natural and artificial lighting need to be considered.

The lights should have dimmer switches to enable the luminosity of each of the various zones to be adjusted.

Electrical Power

The power budget for each PC is assumed to be 0.5 kW. This allows for fast CPU(s), several modern graphics cards each potentially driving multiple screens, and miscellaneous other peripheral devices.

Therefore a single console is estimated to require 1.5 kW, as follows:

- 2 PCs (2 * 0.5 kW) = 1.0 kW
- 6 screens = 0.5 kW

The power for 25 consoles is therefore about 38 kW.

In addition, power is required for up to about 40 laptops which, at about 50 W per laptop, implies a total need of 2 kW for all laptops.

A modest amount of power is needed for several printers, projectors, and wall-mounted display screens.

In total, the power required for all IT equipment in the main room is about 40 kW.

To ensure continued operation of key monitoring consoles in the event of power cuts, it is assumed that a minimum of about 10% of this power is on a secure supply (UPS).

In addition to the consoles' needs, power is required for other services for the main room, notably lighting and air-conditioning.

Neighbouring rooms (meeting room, rest-area / kitchen, etc.) require power for general equipment roughly consistent with normal office usage.

Each meeting room requires one electrical power socket per seat for use by laptops.

Acoustics

Some noise reduction measures are required due to the large number of people and equipment in the room. These should include acoustic damping measures for the floor probably in the form of acoustic carpet tiles. Acoustic damping may be needed for the walls and ceiling (tiles).

The PCs should be housed in cabinets that reduce the noise from their fans without undue restriction of the required air flow.

Access Control

Although the room will generally remain open during normal working hours a system of controlled access at other times should be in place, based on the CERN access card.

3.5 Networks and Telephones

Networks in the Main Room

The CMS Centre requires excellent connectivity to the general CERN / IT network, to the CMS Control Room, and to offsite CMS centres (notably FNAL and possibly others).

Typical applications running on the consoles include:

- constant refreshing of many screens to mirror remote monitoring displays;
- general interactive work (e.g. lxplus, CAF, cvs, afs, etc.);
- accessing moderate amounts of event data (e.g. event displays);
- accessing remote databases;
- sharing remote desktops; and
- communications such as VoIP (voice over Internet Protocol) or moderate amounts of video-conferencing.

The rather similar LHC@FNAL has a 1 Gbps link for 12 PCs and has seen sustained rates of about 30% of this capacity already, even before data taking has started. Scaling this to the CMS Centre which has about 50 PCs implies the required network capacity is 4 Gbps for all the consoles.

Each console needs two connections for fixed PCs and one DHCP connection, making 75 connections for the consoles. An additional 25 sockets are needed for outlets on the meeting tables and for peripherals such as printers and projector systems.

Wireless networking is required throughout the CMS Centre for up to about 50 laptops for the whole CMS Centre area. This number is easily reached for normal operations in the main room concurrent with a meeting in the adjacent room. The wireless installation should ensure that sufficient simultaneous connections are possible (at least 50). Assuming each laptop has a bandwidth of about 20 Mbps implies a total wireless capacity of about 1 Gbps is needed for the whole centre.

All network equipment should be on a secure electrical supply (UPS).

Networks in Meeting Rooms

Each meeting room requires several fixed Ethernet links (total bandwidth of about 100 Mbps) to support video conferences and the use of basic meeting services such as Indico.

Each meeting room requires wireless Ethernet for laptops with support for the same number of connections as the maximum number of people which the room can accommodate.

Telephones

The CMS Centre requires one telephone connection per console fitted with a headset phone and several additional spare telephone sockets. There should be one conference phone in the main room. All phones should be capable of making international calls. Some, preferably all, phones should continue to operate in the event of failure of the Ethernet network.

All meeting rooms should support phone conferences and also be equipped with one standard CERN telephone.

3.6 Summary of CMS Centre Requirements

CMS Centre Requirements		Description / Values
Delivery Date	Basic CMS Centre	Nov 2007 : for LHC engineering run
	Full CMS Centre	Mar 2008 : for LHC physics run
Building Space Requirements	Office Space near the CMS Centre	1600 sq. m of offices for ~ 250 people. Includes some shared rooms for visiting physicists, sub-detector groups, and adequate parking nearby
	Main Room of the CMS Centre	300 sq. m (25 occupants typically; 50 occupants maximum)
	Auxiliary rooms adjoining the Main Room of the CMS Centre	Dedicated Meeting Room: 40 sq. m Equipment / Storage Room: 20 sq. m Rest room / kitchen: 30 sq. m Outreach Space: 30 sq. m
	Meeting Rooms near the CMS Centre	1 auditorium (~100-200 people) Several large rooms (~50-100 people) Several medium sized rooms (20-50 people) Number of small rooms (from 5 - 20 people). All rooms equipped for phone- and video-conferencing
Computing Equipment and Furnishings	Consoles in the Main Room	<u>25 Consoles each comprising:</u> 1 Desk (~1.6m wide), 1 lamp, 1 phone (headset) 1 PC for working and 1 PC for monitor displays. 6 screens
	Miscellaneous Equipment and Furnishings	<u>Main room:</u> 25 chairs for full time operators. 25 chairs for shorter-term visitors. Several meeting tables for total of 20 people. Shelf space. Cupboards for personal storage / lockers. <u>Kitchen / rest area:</u> small dining table, 4 dining chairs, 3 easy chairs, coffee table, coffee machine, fridge, microwave, sink.
	Collaborative Working Tools and Equipment	Phone- and Video-conferencing systems in all meeting rooms.
Technical Services	Air conditioning	Capacity to maintain 21 – 24 degrees (depending on season) in main room to cool equipment (40kW) plus up to 50 people.
	Lighting	Details to be determined
	Electrical Power	<u>Main room:</u> 40 kW for consoles plus whatever is needed in addition by lighting and HVAC, etc. (includes a minimum of 4 kW of UPS power). <u>Other rooms:</u> power consistent with general office use <u>Meeting rooms:</u> one power socket per seat (for laptop)
	Acoustics	Acoustic measures in Main Room of CMS Centre (floor / walls / ceiling as needed). Acoustic measures in all meeting rooms (following standard CERN/IT practices for new phone-/video-conference systems)
Networks and Telephones	Networks in the Main Room	4 Gbps for fixed network (100 outlets) 1 Gbps wireless capacity (50 connections)
	Networks in Meeting Rooms	<u>For each meeting room require:</u> Minimum of 100 Mbps for video equipment 1 wireless connection per occupant
	Telephones in the Main Room	30 telephone lines. 1 headset telephone per console. 1 conference phone.
	Telephones in Meeting Rooms	1 telephone and 1 conference phone per room.

A. RTAG Mandate and Schedule

Mandate of the RTAG

The RTAG should clearly establish the needs of CMS Centres in areas such as: Computing and Offline operations, user support, monitoring of data quality, detector calibrations, express analysis, collaboration communications and outreach.

The RTAG should focus on the CERN Meyrin centre but also consider the CMS online control room and offsite centres, especially with respect to communications needs and overall system coherence.

The RTAG should make technical & planning recommendations taking cost, schedule and other constraints into account and having consulted CERN and other interested parties.

The RTAG findings should be documented as a CMS Note.

Schedule

The original timescale for the RTAG is as follows

- Nov 2006 Informal discussions on mandate, scope, timescale, members of RTAG.
- Dec 2006 Establish RTAG. RTAG launch presentation to solicit broad input.
- Jan 2007 Weekly meetings of RTAG.
- Feb 2007 Weekly meetings of RTAG. First draft report.
- Mar 2007 RTAG complete