Specification document of the BMW Group for the passive IT infrastructure of building type G2

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1 General planning notes

The present planning specifications for the passive IT infrastructure are the basis for the construction of infrastructure for the correct use of the IT IS components (network, server, storage, mobile radio, communications facilities) installed in the rooms. The passive IT IS has to be implemented as part of the facility equipment during the construction of PA-x building projects. **The IT infrastructure of data centres is not described in this document and must be planned separately.**

The document is addressed to the planners in charge (internal/external), to the on-site operators (facility management), and to the users of the IT IS rooms.

The planner's own responsibility will continue to apply fully.

The content focuses on the electrical and air-conditioning infrastructure components. In addition to the availability requirements (redundancy), planning also needs to take energy efficiency and the sizing of components into account. Planning must also include potential energy-saving environmental conditions at the site, for example cooling by groundwater and indirect free cooling with outside air.

The basics for the development of sites and buildings regarding the areas of transport, building services and communications engineering have been described. Detailed planning must be completed in line with the local conditions by external/internal planning functions.

Environmental conditions in connection with elementary risks, such as flooding and earthquakes, have not been taken into account. Emissions at and around the site, such as air pollution by neighbouring industrial operations, electromagnetic interference and the like have been considered in the planning specifications.

The area of security is limited to the items of access control and protection against forced entry. Terrorist attacks or war-like threats have not been covered.

The passive IT infrastructure has to provide extensive support for **10 Gigabit Ethernet** both via Twisted Pair (= Class EA) and via optical fibre. The passive IT infrastructure has to meet the specific requirements laid down by the BMW Group in addition to the standard specifications pursuant to **ISO/IEC 11801,** which always have to be complied with. The **maximum channel length of twisted-pair connections must not exceed 100 m (= 90 m permanent link plus max. 10 m patch cable).** The maximum admissible channel length must also be taken into account for optical network applications.

In this context, the most important standards are the following ones:

EN 50600 (2012)	Information technology - Data centre facilities and infrastructures Part 1: General concepts → Definition of building types following data centre classes
IEC TR 29106 (2007)	Information technology - Generic cabling - Introduction to the MICE environmental classification → Presentation of minimum requirements to be met by classes E2 or, as the case may be, E3
EMC Directive 2004/108/EC	Application of the EMC law in machine and plant construction → The protection objectives described therein must be complied with.
DIN EN 61000-2-4	Environment; Compatibility levels in industrial plants for low-frequency conducted disturbances → Definition of voltage quality
DIN EN 50174-1 (2011)	Information technology - Cabling installation - Part 1: Installation specification and quality assurance - The specifications must be complied with and must be taken into account.
DIN EN 50174-2 (2011)	Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings - The specifications must be complied with and must be taken into account.
ISO/IEC 11801 (2011)	Information technology - Generic cabling for customer premises → The standard specifications are minimum requirements.

1.1 Scope of application

The present document is binding and must be used for the installation and expansion of the passive IT infrastructure in **type-G2 buildings** of the BMW Group.

Insofar as there are differences between standard requirements and the specification document of the BMW Group, the specifications of this document shall govern.

The continuous further development of standards is taken into account by updating this document at regular intervals. Therefore care must be taken to ensure that the most up-to-date version is used for every planning project.

1.2 Contact

The central point of contact for the specification document and any technical matters is:

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1.3 Planning services

All planning services must be provided by the planning office commissioned on their own responsibility. In this connection, it is in particular not allowed to assign any planning services to installation companies.

Any deviations from this rule require the written approval by the BMW Group.

The planning process has to follow the structure of the **German HOAI plan of work**[1] and has to include the following:

(1) “Grundlagenermittlung” (appraisal; establishing the basis of the project)
(2) "Vorplanung" (= preliminary design)
(3) "Entwurfsplanung" (= final design)
(4) "Genehmigungsplanung" (= building permission application)
(5) "Ausführungsplanung" (= execution drawings)
(6) "Vorbereitung der Vergabe" (= preparation of contract awards)
(7) "Mitwirkung bei der Vergabe" (= assisting award process)
(8) "Objektüberwachung" (= project supervision) (construction supervision or site management)
(9) "Objektbetreuung und Dokumentation" (= project management and documentation)

1.4 Electromagnetic compatibility

Electromagnetic compatibility (EMC) is the capacity of a device or a system to work smoothly within the electromagnetic environment, without causing any electromagnetic interference that would be unacceptable for other equipment operated in this environment.

[1] HOAI: Honorarordnung für Architekten und Ingenieure (Official german scale of fees for services by architects and engineers)

This means that the functioning of a system is not restricted by the following influence factors either:

- Overvoltage impact and electromagnetic lightning pulse caused by a direct and nearby lightning stroke; lightning strokes can, for example, cause damage up to a distance of 2 km.
- Electrostatic discharge. Touching connections can, for example, cause damage to electronic equipment.
- High-frequency fields, such as the ones caused by broadcasting or transmission equipment (radio stations, radar, radio relay, radio in general).
- Burst pulses caused by switching. Burst pulses are, for example, caused by the switching of fluorescent lamps.

For designers of the passive IT infrastructure this means that they have to design "their" system so as to enable operation of the system without any restrictions under the given environmental conditions, and without causing any interference to other systems.

Project-specific risk assessment must be carried out in order to ensure EMC depending on the scope and availability requirements. As a rule, the requirements laid down in the "Planning specifications for IT equipment rooms" must be taken into account; all rooms in which IT cabling is installed must be analysed for their MICE[1] conditions according to IEC TR 29106, and subsequently suitable cabling components must be used for the environmental conditions prevailing in each case (MICE classes). Please refer to the following table for details on the MICE environmental classification for the electromagnetic part.

Electromagnetic	E_1	E_2	E_3
Electrostatic discharge-Contact (0.667 µC)	4 kV	4 kV	4 kV
Electrostatic discharge Air (0.132 µC)	8 kV	8 kV	8 kV
Radiated high frequency, amplitude-modulated	3 V/m at (80 to 1,000) MHz 3 V/m at (1,400 to 2,000) MHz 1,V/m at (2,000 to 2,700) MHz	3 V/m at (80 to 1,000) MHz 3 V/m at (1,400 to 2,000) MHz 1,V/m at (2,000 to 2,700) MHz	10 V/m at (80 to 1,000) MHz 3 V/m at (1,400 to 2,000) MHz 1,V/m b at (2,000 to 2,700) MHz
Conducted radio frequency	3 V at 150 kHz to 80 MHz	3 V at 150 kHz to 80 MHz	10 V at 150 kHz to 80 MHz
Fast electric transient/burst (EFT/B) AC including protective conductor	1,000 V	1,000 V	2,000 V
Fast electric transient/burst (EFT/B) E/A (signal/data/control)	500 V	500 V	1,000 V
Surge voltage (transient ground potential difference) - signal line/earth	500 V	1,000 V	1,000 V
Magnetic field (50/60 Hz)	1 A/m	3 A/m	30 A/m

Table 1: Excerpt from MICE table

Structured IT cabling has to comply with class E2 at least in order to ensure EMC in office areas and with E3 at least for all other areas (for example industrial, workshop areas, computer centre).

Following the integration of all passive and active components (active components, cabling components and connectors for grounding, earthing, etc.), the overall system must comply with the EMC standards listed in the following and also achieve the protection objectives defined in the **EU EMC directive No. 2004/108/EEC.**

[1] MICE :Mechanical, Ingress, Climatic, Electromagnetic

(Excerpt)

- IEC/CISPR 22 (Radio disturbance characteristics - limits and methods of measurement)
- IEC/CISPR 24 (Immunity characteristics - Limits and methods of measurement)
- IEC 61000-4-8 (Electromagnetic Compatibility ('EMC) - Part 4-8: Testing and Measurement Techniques - Power Frequency Magnetic Field Immunity Test)
- IEC 61000-4-9 (Electromagnetic Compatibility (EMC) - Part 4-9: Testing and Measurement Techniques - Pulse Magnetic Field Immunity Test)
- IEC 61000-4-10 (Electromagnetic Compatibility (EMC) - Part 4-10: Testing and Measuring Techniques - Pulse Magnetic Field Immunity Test)
- IEC 61000-6-2 (Generic standards - Immunity for industrial environments)

If designers cannot comply with the specifications because the structural or organisational requirements are not met, they must point this out explicitly and indicate the restrictions and the reasons for this.

1.5 Quality assurance by specialists

Within their purview, designers have to ensure that any faulty or defective implementation of the specifications laid down is identified within the framework of (partial) acceptance and that the repair of said faults or defects according to good professional practice is monitored. To this end, special experts recognized by the BMW Group (EMC experts, cabling experts) should be involved in the project early on for the purposes of quality assurance if required.

1.6 Construction logistics

As early as during the design of the passive IT infrastructure, special focus must be placed on the systematic implementation following construction logistics aspects.

This includes among other things:

- Any requirements that the designers of other areas are responsible for must be defined early on and in writing for them.
- As early as during the installation phase, care must be taken to ensure that sensitive cabling components are handled carefully and are not exposed to any inadmissible stress and environmental conditions.
- The installation sequence of cabling components is to be scheduled so as to exclude damage during and after installation of the components by fitters that are active at the same time or subsequently.

Experience has shown that failure to comply with the instructions listed above leads to serious installation defects, such as:

- undue mechanical stress on IT cabling, for example caused by increased transverse pressure;
- contamination of cabling components (for example connector front faces of optical fibres) by dirt and construction dust:
- contamination of network (LAN) components (for example, interior and connectors) by dirt and construction dust.

The cost incurred for eliminating defects will be charged to the party that caused the defects.

2 Requirements to be met by building type G2

Following the upcoming standard EN 50600, three categories have been established for the purposes of developing the various scenarios. Every type thus represents a specific type of building or necessary structure.

Building type G2
Detached office building (for example, GMA)
Branch establishments and Training Center branches
Structures with equivalent availability requirements

Table 2: Assignment of building use to building type G2

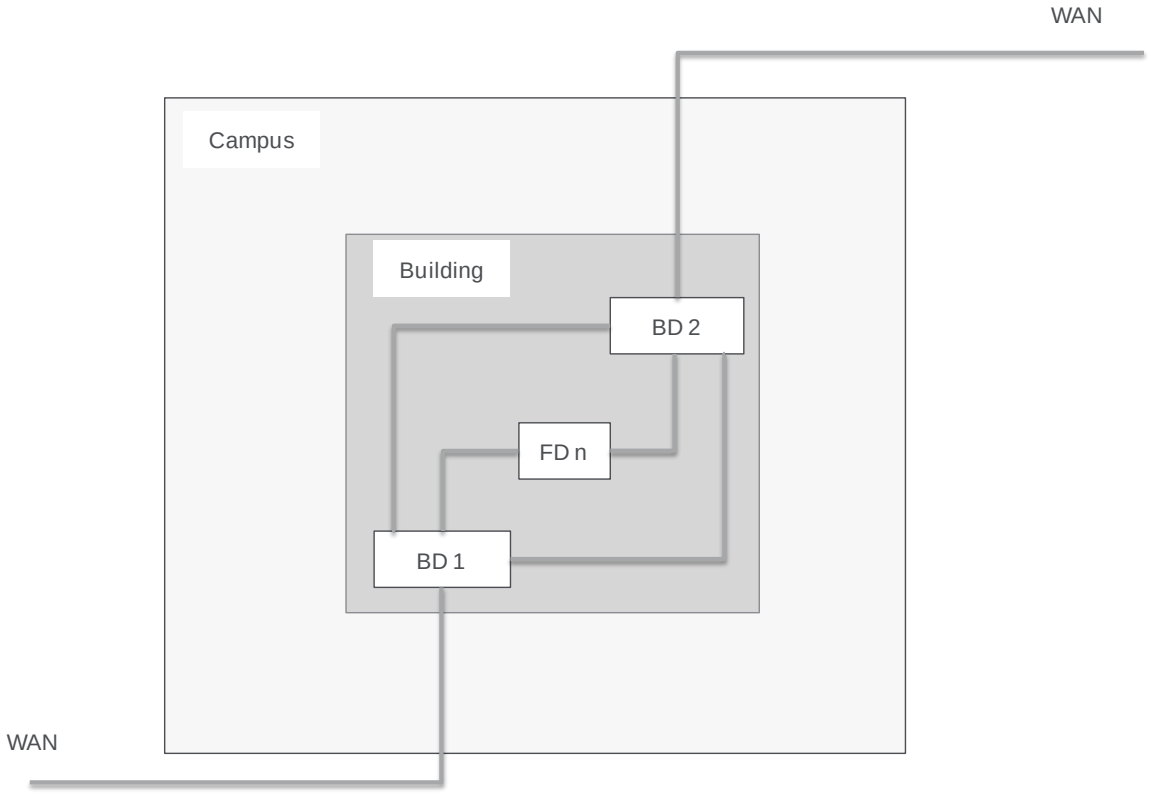

Figure 1: Diagram showing the BD and FD structures

Definition of building type G2	Redundancy requirement
2 separate WAN connections	Functionality is maintained in the event of damage caused to a WAN connection by earth works, for example
2x BD	Two BDs have to be provided per building or hall. Functionality is maintained thanks to two separate BDs, the BDs are connected by two separate routes
All FDs	Each FD is connected to both BDs
UPS	UPS with a number of n in both BDs; UPS in all FDs with a number of n
Refrigeration	Refrigeration with a number of n in both BDs; Refrigeration in all FDs with a number of n
Shielded (EMC) cabinet as per definition in the BD	

Table 3: Requirements to be met by the equipment in building type G2

Definition of the term "separate":

The following points must be considered, complied with and implemented as regards the aforementioned term "separate":

- cables are inserted into the building at a maximum distance from each other;
- BDs must be implemented such as to ensure maximum distance between the rooms;
- FDs are each connected to the BDs through physically isolated cable routes;
- separate cable routes must be implemented at a maximum distance and without intersections.

The usage profile of IT IS rooms is derived from their definition. The following section describes the individual IT IS rooms and demonstrates their usage.

Floor distributor (FD)

The floor distributor is the point of distribution for the floor cabling system (horizontal cabling), to which the IT workplace systems (PC, printers, production control, telephone, telefax) are connected.

In production environments, a floor distributor (FD) may also be designed as a closed cabinet combination consisting of an active and a passive cabinet instead of as a room. Said cabinet combination must be provided with a cooling unit mounted on the side wall. Please refer to **Annex B: Network cabinets and patch cable management"** of the **"BMW Group cabling standard for structured IT cabling"** for the specific requirements.

Building distributor (BD)

The building distributor is the point of interconnection between premises cabling (campus backbone cabling) and building cabling (building backbone cabling). The FDs of the building are connected to the BD.

For the G2 building type, the BD must be implemented using a redundant system (two separate rooms, as far away from each other as possible), the FD are connected to each of the two building distributors (without a single point of failure).

Communications equipment, which does not interfere with the IT IS in terms of EMC, may also be installed in the building distributor if sufficient space is available. The building distributor may also accommodate the floor distributor function (LAN access). The building distributor function (LAN distribution) must be installed in a **shielded cabinet (EMC cabinet).** Please refer to **Annex B: Network cabinets and patch cable management"** of the **"BMW Group cabling standard for structured IT cabling"** for the specific requirements.

Mobile radio communication room MCR (GSM, UMTS, LTE)

Depending on the location and the design of mobile radio coverage, planning must provide for a room for the installation of mobile radio components. The requirements to be met by the infrastructure and room equipment must be requested from the **BMW Group IT IS Function Real-Time Communication (Echtzeitkommunikation)**

Mobile radio communication planning must be coordinated with WLAN planning.

Area and workplace

The term "area" refers to the floor cabling system (horizontal cabling outside the FD), to which the IT workplace systems (PC, printers, production control, telephone, fax) are connected.

Storage rooms for IT IS components (storage, staging and unpack area)

must be included in the plans; number and size are part of the planning task; power connections and LAN connections must also be included in the planning.

3 Implementation conditions and risk assessment (new buildings and conversion of existing buildings)

3.1 Implementation conditions

3.1.1 Framework conditions for implementation

The operational function and user representatives who will be in charge later on must be involved during all project stages from the beginning to the end. This applies in particular to the planning stage, the examination and coordination of specifications prior to the awarding of contracts, as well as to acceptance and hand-over for operation.

Above all appropriate measures must be taken for protection against damage caused by dust and water ingress or overheating. These must be agreed on and coordinated with the individual operator and user representatives in charge.

3.1.2 Special characteristics regarding the conversion of existing buildings and during operation

If existing buildings must be converted with ongoing IT operation, care must be taken to ensure that the functionality of active IT components is not impaired by the construction measures. It must be possible to maintain and service active IT components without any restrictions. If the impairment of ongoing IT operations cannot be avoided, this must be coordinated and approved by the operator and user representatives in charge.

If protective equipment, such as fire protection equipment, access control facilities, etc. has to be taken off-line in active areas either temporarily or for a long period of time, adequate substitute measures (for instance, fireguard, lock cylinder) must be taken in order to comply with the quality of regular protection equipment.

In addition it is important to ensure that the on-site construction management know and inform the infrastructure partners (IT IS).

3.2 Risk assessment/quality assurance/renunciation of implementation →assessment

The final plan must be compared to the present specification document for any deviation from the target values. The result must be documented.

Any deviations require the written approval of the responsible BMW Group IT IS Function Datacenter Technology "Rechenzentrumstechnik".

During the completion and acceptance stages, a final actual versus target comparison must be carried out and documented.

4 Infrastructure specifications for IT IS rooms and areas within the coverage area

It is absolutely necessary for planning to take into account and document regional site conditions with regard to local supply infrastructure, such as the availability of the local utility supplying power (mains failure statistics). Any exposure to frequent lightning strikes in the region must be reduced by EMC protective measures.

Complementary BMW planning specifications (such as fire protection, passive IT infrastructure) which are referred to in this document must be implemented in the planning process.

Further conditions to be taken into consideration in planning result from the fire protection expert opinion, specifications laid down by the property insurance company as well as from the BMW security concept that was created in-house for access control (key/badge reader/factory security) and protection against forced entry (intrusion detection system with video, glass breakage detector/motion detector, security services, etc.)

Country-specific official requirements define the minimum requirements for the infrastructure areas described in the following (for example, emergency illumination, light intensity, manual fire extinguishers).

The **implementation of any installations that have been commissioned must only be carried out by qualified technical personnel** with the requisite personal certification.

The infrastructure components and the related supply structures must be designed such as to enable on-the-fly repairs or maintenance.

4.1 General comments

The following planning specifications apply to IT IS rooms (building distributors, floor distributors).

4.1.1 Differentiation by function

The LAN components required for cascading and for connecting the end user devices are installed in the building distributors (BDs).
Floor distributors (FDs) serve to connect end user devices.

Mobile radio systems must be installed in the Mobile radio Communications Room (MCR).

Separate power distribution units must be provided for every IT IS room. Switching status and operating parameters are visible from outside (no opening required). **Electrical system and IT system distributors must be installed in different cabinets.** Horizontal cabling must be laid in separate metal cable management systems. The minimum bending radius of the horizontal cabling laid must be adhered to. Cabling must be fastened with cable clamps and shims or with velcro strips only.

The use of cable ties is not permitted.

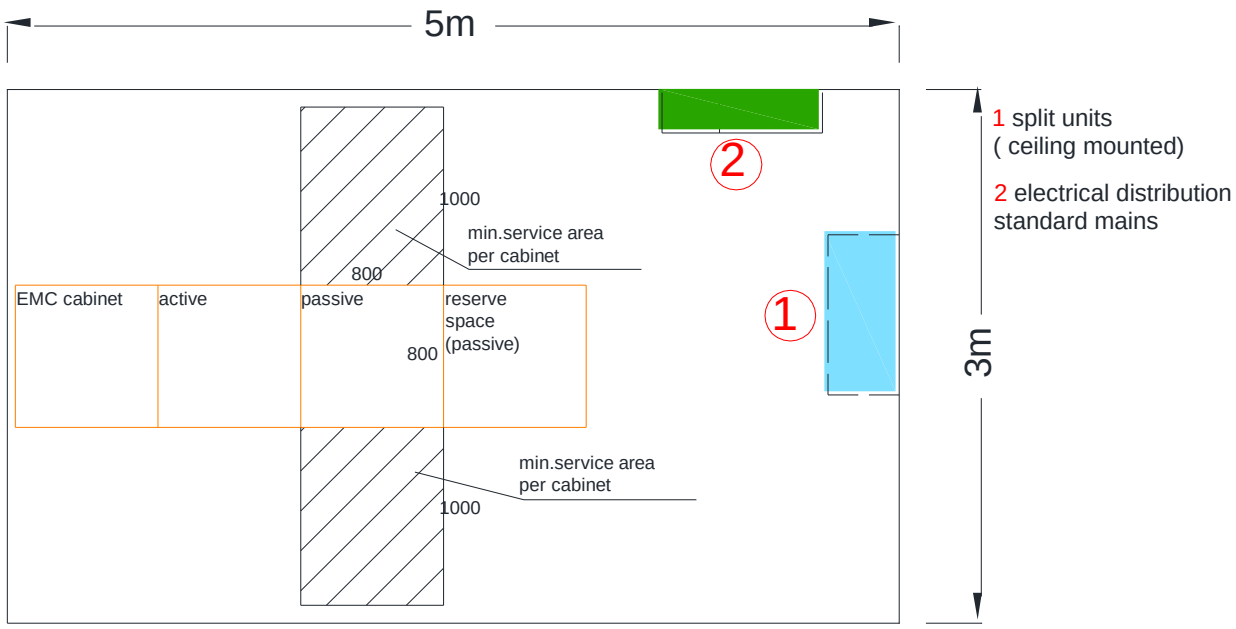

Figure 2: Diagram showing the spatial separation of electrical system and IT system distributors

4.1.2 Space requirements of IT IS rooms

The size of the IT IS rooms depends on the number of network cabinets and IT IS components. IT IS rooms must be provided in the interior of the building, without windows if possible.

	FD	BD
Room size	Preferred dimensions – 5.0m x 3.0m, no space restrictions. Please provide for additional space requirements of at least 3 m² for every further network cabinet.	
Number of racks / cabinets	1 active racks 1 passive racks for a maximum of 240 ports Space for 1 spare rack	1 active racks 1 passive racks for a maximum of 240 ports 1 EMC cabinet Space for 1 spare rack
Access to cabinets	cabinets accessible from the front and the rear (clearance of at least 1.0m at each side)	
Access to room	Barrier-free access for the entire transport route, for example by means of the ramps and freight elevators required, which are accessible without any obstacles and are amply dimensioned for the system parts used (IT cabinets etc.).	
Room height	At least 3.0m	
Raised floor	No	
Room door dimensions	Equipment room door of sufficient dimensions (minimum width 1,000 mm; minimum height 2,300 mm)	
Opening the room door	Swing-out equipment room door, if the building design allows for that (please take escape routes into account).	

Table 4: Space requirements of IT IS rooms

Planning also needs to take into account that depending on **the length constraints applicable to the permanent link (≤ 90 m),** at least one floor distributor (FD) is to be provided per 1,000 m² of office space.

At least one floor distributor is to be provided per floor. Exceptions: floors with a low number of telecommunications outlets and a permanent link length of ≤ 90 m; in this case, the floor distributor of the adjacent floor will be sufficient to handle both floors.

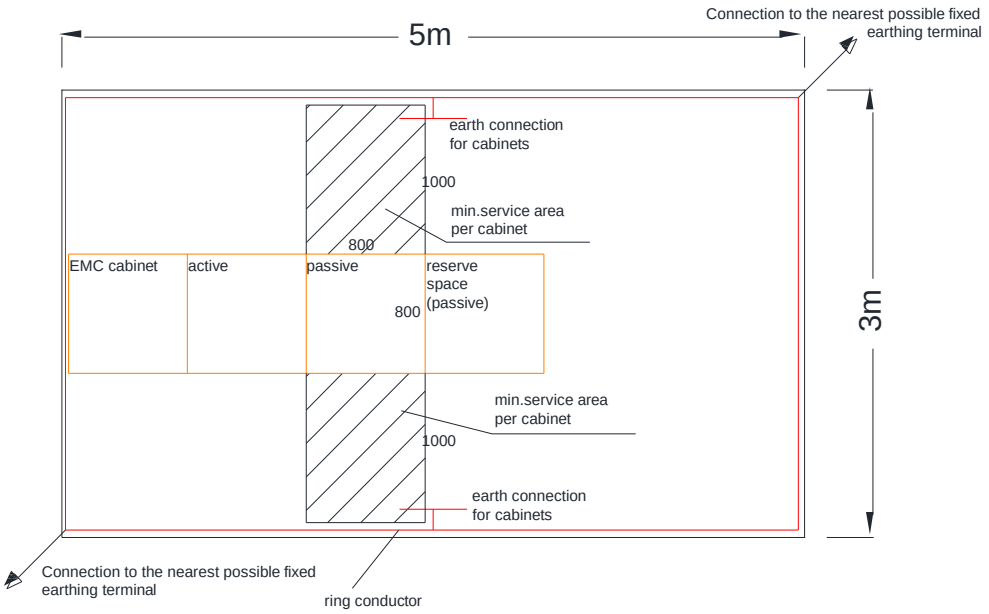

Figure 3: Schematic room layout

4.1.3 Usage

All FD and BD are designed for exclusive use by the IT IS infrastructure and for communications equipment that does not cause EMC interference for the IT IS.

It is mandatory to consider and to comply with the specifications laid down in the study performed in this area:

Mobile radio systems in BD rooms (valid as at: 11/2012)

Rooms must not be used for any other purposes, i. e. for printers or for paper storage.

Storage facilities, toilets, kitchens, escape routes, storage rooms for cleaning material, flood-prone rooms, etc. are not suited as IT IS rooms for reasons of safety and availability.

Please refer to the "Planungsvorgaben für IT-Räume“ (Planning specifications for IT equipment rooms) for additional requirements to be met by the design of IT equipment rooms.

4.1.4 No routing of media through IT IS rooms

Media lines (such as for water, heating, waste water, energy supply, air-conditioning, BOS equipment (public-security authorities and organisations) and other plant equipment) **that are not required for the operation of ICT equipment or its components must not be routed through IT IS rooms.**

If need be, IT IS rooms and their facilities must be protected by adequate structural measures (for instance, troughs, ramps, etc.).

4.1.5 Trunk lines or signal lines and control circuits

If multi-pair telecommunications cables in use then the cables are terminated on Cat.3 patch panels or LSA+ terminals. Cat.3 patch panels are installed in the passive network cabinet of the building distributors and positioned at the lower end of the 19" rack.

National or local regulations may require special components for the connection of outdoor cabling and also have to be taken into account accordingly.

4.1.6 Routing of microwave or mobile radio links into the building

Microwave and mobile radio antennas are frequently installed at an exposed position outside the building. If lines from these facilities are routed into the building, suitable measures must be taken to avoid the introduction of interference signals (EMC protection concept, surge protection).

4.1.7 Coding of optical-fibre cabling segments

Optical-fibre cabling segments must be installed with "uncrossed" coding for every fibre pair. This means that every optical fibre of a fibre pair must be assigned in the same way at both ends (= assignment A-A or B-B).

4.1.8 Telecommunications outlets

The telecommunications outlets may be located in walls, on floors or at any other location depending on the building structure.

The outlets are to be distributed over the entire usable area in order to ensure maximum telecommunications outlet density and they have to be mounted at easily accessible locations. A high degree of outlet density increases flexibility for change.

If the furnishings layout for the user-related coverage of office areas is not yet available at the relevant planning stage, a blanket coverage of the office areas is to be implemented by way of installing at least 1.5 RJ45 telecommunications outlet per workplace,
and at least 2 RJ45 telecommunications outlets per workplace (according to BMW standard areas) must be provided for development areas (R&D).

This requirement may have to be reconsidered for workplaces with special user requirements. If necessary, additional or different terminals must be provided.

4.1.9 Installation of mobile radio equipment without antennas

	Area	FD	BD
Installation permitted?	N	Y	on a case-by-case basis[1]
Transmitters permitted? (for example, base stations)	N	N	N

Table 5: Installation of mobile radio equipment without antennas

Mobile radio equipment includes coaxial cables and fibre-optic repeaters, for example.

Transmitters (for example base stations) are not permitted in IT rooms and must be accommodated in a separate **Mobile radio Communications Room (MCR).**.

4.1.10 Antennas

	Area	FD	BD
WLAN and antennas	Y	Y	Y
Mobile radio (GSM, UMTS and LTE) antennas	Y	N	N
BOS antennas[2]	Y	Y	Y

Table 6: Antennas

Antennas that primarily serve to cover IT IS rooms are permitted if the maximum level of 1V/m is not exceeded.

[1] The permission as to whether or not the installation of mobile radio equipment is allowed in the BD must be discussed on a case-by-case basis, depending on the availability requirements and the redundancy parameters specified for the network distribution structure.

[2] BOS stands for "Behörden und Organisationen mit Sicherheitsaufgaben", i.e. public-security authorities and organisations. BOS radio is a radio telephony system that is used by the members of a wide range of organisations, such as the police, federal border guards, fire brigades, civil-protection units or rescue services for communicating with one another.

4.2 Electrical installation:

	Area	FD	BD
Electric power per active cabinet incl. UPS (planning may provide for higher value on the basis of actual requirements)		at least 8 kW per active cabinet	at least 8 kW per active cabinet
UPS		Y	Y
UPS position		Preferably outside, otherwise in IT room	Preferably outside, otherwise in IT room
Autonomy time (UPS) under full load conditions		6 min.	6 min.
Standby power supply		N	N
Redundant supply (A/B structure)		Y	Y
Separate electric distribution cabinet for IT		Y	Y
Electric distribution cabinet (site)		in the IT IS room	in the IT IS room
Average number of power take-off points in the IT distributor (alternating current or three-phase alternating current take-off points) per active cabinet[1]		6x single-phase AC + 1x single-phase AC or 1x three-phase AC.	6x single-phase AC + 1x single-phase AC or 1x three-phase AC
Equipotential bonding strip in visible area, with connection to the earthing system (meshed bonding network)		Y	Y
Inside trays (IT, electrical)		separate	separate
Lightning protection (risk analysis)		N	N
EMC (protection concept)		N	depending on environment
Emergency stop switch	On-site shut-off of power supply is not admissible. Exceptions: country-specific regulations where applicable.		
Monitoring, building services control system		on a case-by-case basis	Y
Recording of consumption data PUE (room-related)		N	N

Table 7: Electrical installation

The parameters stated must be used for a rough cost estimate. Project-specific quantities / values (electric power, autonomy time and power take-off points) must be coordinated with those responsible locally during the detailed planning stage.

Electrical installation must be made available that is able to provide peak-value availability on a permanent basis.

The **UPS installations** must meet the requirements defined for on-line installations and must be selected and sized according to energy efficiency aspects. If battery-operated installations are used, they must be installed in temperature-controlled and ventilated separate rooms.

[1] The specific requirements are listed in "Annex B: Network cabinets and patch cable management" of the "BMW Group Cabling Standard for Structured IT Cabling".

The two BDs must be spaced as far apart from each other as possible (disaster recovery). Feeders must be redundant for every building.

BDs require compatibility levels for conducted low-frequency disturbances in accordance with DIN EN 61000-2-4, class 1/ IEC61000-2-4. A potential implementation option may consist in selecting the UPS equipment pursuant to the VFI-SS-111 specification (following DIN EN 62040-3 "Uninterruptible power systems - Part 3: Methods of specifying the performance and test requirements").

4.3 Air conditioning and ventilation installation:

	Area	FD	BD
Max. power dissipation per rack		at least 8 kW per active cabinet	at least 8 kW per active cabinet
Temperature range (measured at 1.5 m above the ground) in accordance with ASHRAE (2012)		max. 27°C[1] min. 20°C[2]	max. 27°C min. 20°C[2]
Relative humidity in accordance with ASHRAE (2012)		20% - 80 %	20% - 80 %
Fresh-air installation as replacement for air conditioner		possible	
Air cleaner		according to environmental conditions, min. F5 Filter	
Location of air conditioner		possible in the IT IS room; condensate discharged to the outside	
Monitoring, building services control system		on a case-by-case basis	

Table 8: Air conditioning and ventilation installation

The active components installed in the wiring closets generate considerable amounts of waste heat. Therefore measures must be taken to ensure ventilation or the installation of air conditioning. The values in the FD and BD must neither exceed nor fall below the limit values.

If the components used for connecting the IT workplace systems cannot be accommodated in a specifically assigned room (FD), the operation of closed distribution racks incl. cooling and secure access is possible; this option is, however, not recommended for office areas on account of its noise emissions.

Refrigeration must be designed as an energy-efficient system according to the conditions prevailing at the site.

[1] The temperature setting of IP54 protected IT racks must be at 27°C.

[2] For reasons of energy efficiency, the minimum temperature was set at 20°C.

The implementation of a fresh-air installation as an indirect free cooling system must be designed as an option for floor and building distributors. If the exchange of air volumes is unrealistic, a non-redundant active cooling system must be designed and installed in the room.
The information on the installed power dissipation in the rooms must be coordinated with local LAN operation. Planning in particular must take the ambient conditions of the installation site (dust, oil vapours, etc.) into account. The heat recovery potential must be analysed.
Air-conditioners must be controlled by means of a closed loop system based on actual requirements (for instance, rpm, flow, etc.).

A suitable filter unit must be provided for handling poor air quality. If the exchange of air volumes is unrealistic, a non-redundant active cooling system must be designed and installed in the room.
The information on the installed power dissipation in the rooms must be coordinated with local LAN operation.

Air conditioners must not be installed directly above the racks (danger of leakage).

4.4 Fire protection:

Within BMW Group, the building and energy specialist department (Fachstelle Gebäude- und Energie) is responsible for fire protection standards. Please ensure that external planners are notified of the relevant content.

As a matter of principle, fire extinguishing equipment has to be avoided and a switch-off matrix has to be implemented instead!

Whether or not fire-fighting equipment such as sprinklers, gas extinguishing systems, water mist is required, depends on the national and local statutory provisions and the specifications laid down by the property insurer.

	Area	FD	BD
Fire protection classification category: room		F90	F90
Fire protection classification category: doors		T30	T30 RS
Smoke detection for cavities (ceiling, floor, room)		Y	
Leakage detection	See footnote [1]		

Table 9: Fire protection

The shutdown matrix (shutting down of back-up energy and ventilation) must be coordinated with the local operators and users of the IT IS rooms. The consequences for the technical design of electrical system, air conditioning / ventilation systems must be taken into consideration in the planning.

Air conditioners and UPS must be capable of restarting automatically following a shutdown (for example, after a malfunction event). However, the activation follows country-specific regulations. Furthermore, a start-up matrix must be created during the planning stage and must be submitted for review.

If a sprinkler system is required, sprinkler lines must be made of stainless steel. The trigger is pilot-operated. The drain line is located outside the IT area.

[1] Leakage detection systems must be installed in IT IS rooms that are exposed to damage caused by the ingress of fluids. In general, only those fluid-carrying lines are admissible in IT IS rooms that serve to supply the room with media.

4.5 Building:

	Area	FD	BD
Redundant rooms		N	Y
Single-leaf doors / Dimension (WxH)		1.0m x 2.3m	1.0m x 2.3m
Room dimensions		Based on actual requirements (please refer to sample layout) BD min. 5,0 m x 3 m	
Distribution cabinets (mm, WxDxH) + base		800x800x 2,000+200	800x800x 2,000+200
Service area in mm (front, rear) distributions cabinets (overlaps possible)		Cabinets and racks accessible from front and rear (clearance of at least 1.0m at each side)	
Area load of ceiling or reinforced floor per m²	The area load must be coordinated with the construction management.		
Earthing resistance and minimum insulation resistance		$R_a < 10^8\ \Omega$, $R_{iso} > 10^5\ \Omega$	
Earthing system (meshed bonding network)		Yes, earthing lugs are implemented in IT IS rooms	
Dustbinding paint		Y	Y

Table 10: Building

As a matter of principle, it must be possible to transport loads into the relevant rooms **without any barriers**. If it is required for structural reasons to provide ramps in the access area, the inclination delta must not exceed 8%.

4.6 Security:

Local plant security officers and the specialist department for in-house security must be involved in the planning stage.

IT IS rooms represent a particularly sensitive area that requires protection within a company and must prevent unauthorized access.

	Area	FD	BD
Key (handing-out documented)		Y	Y
Escape route markings	according to statutory provisions		
Intrusion detection system	depending on location of building or adjacent buildings		
Door fittings outside		Door knob	Door knob
Door closer		Y	Y

Table 11: Security

Due to their function as a central alarm system, intrusion detection systems represent a special security element for sites.

Due to their on-site presence, security services offer an increased potential of deterrence in regions at risk (for example industrial zones, third countries). The employment of a security service must be coordinated with the local users and central corporate security.

4.7 Monitoring:

If a monitoring structure is present, the operating state of the IT rooms and their technical infrastructure is monitored permanently.

	Area	FD	BD
Warning threshold and limit value Room temperature		Y	Y
Leakage detector		N (except for media-carrying pipes in the room)	
Smoke detector (at least group alarm)		Y	Y

Table 12: Monitoring

The function may also be integrated in a building services control system (GLT) or may be designed as an independent monitoring system that works in parallel to the building services control system.

Any deviations, such as exceeding the permissible room temperature, will then be reported to the operational units in charge through secured alerting routes.

5 Planning specifications

In addition to the instructions, the following specifications must be taken into account in the planning of structured cabling:

5.1 Passive IT infrastructure

For the passive IT infrastructure to meet the requisite stringent quality standard, only cabling components and systems may be installed that are approved by the **BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik)** at the time of planning or implementation.

Please refer to the B2B portal of the BMW Group or the BMW Group IT intranet for a list of **currently approved IT IS components;** you may request said information from these BMW units.

If an IT IS component is prohibited for use during the project implementation period, approved back-up products are to be used in consultation with the technical construction management.
If special solutions that deviate from the specifications laid down in the BMW Group cabling standard need to be installed, this must be coordinated in advance with the technical construction management.

As a rule, the use of materials that contain silicone or substances harmful to paint structures (LABS free) is not allowed in production environments (paintshop). The manufacturers of passive network components have to present a written confirmation on said substances.

The BMW Group specifies stringent requirements in terms of quality and performance both of the individual cabling components used and of the quality of installation in order to achieve a smooth communication of the information technology systems. The specific requirements defined relate to

- balanced copper cabling
- fibre optic cabling

These requirements include normative and additional specifications laid down by the BMW Group.

The inter-building installation of balanced copper cabling is not permitted. Only optical fibres must be used for campus backbone cabling.

In addition, supplementary requirements have been defined for the specific applications industrial environment / production area and computer centre. Special components must be provided for special applications (temperature, bending), such as bodyshop (welding).

BMW car workshops also require special connection components since the number of mating cycles per LAN connection is particularly high, for example due to changing the vehicle testers. Specific connection components have therefore been defined for these applications.

The specific requirements are listed in "Annex A: Technical requirements to be met by cabling components & specification text modules" of the "BMW Group Cabling Standard for Structured IT Cabling".

In addition, the annex defines supplementary requirements for the specific applications industrial environment / production area and computer centres.

5.2 Closed and open network cabinets

For the structured cabling to meet the requisite stringent availability and quality standards in this area, too, only closed and open network cabinets may be installed that are approved by the **BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik)** at the time of implementation.

Please refer to the B2B portal of the BMW Group or the BMW Group IT intranet for a list of currently approved network cabinets; you may request said information from these BMW units.

If a network cabinet is prohibited for use during the project implementation period, approved back-up products are to be used in consultation with the technical construction management. If special solutions that deviate from the specifications laid down in the BMW Group cabinet standard need to be installed, this must be coordinated in advance with the technical construction management.

The detailed configurations of the various cabinet types (for example, EMC cabinet) are listed in "Annex B: Network cabinets and patch cable management" of the "BMW Group Cabling Standard for Structured IT Cabling".

5.3 Requirements to be met by installation service providers

Only expert staff with the requisite personal qualifications and certifications may be commissioned with the installation of copper and fibre-optic components. The planner is in charge of checking the qualifications prior to commissioning and during the construction stage (for example at the construction site).

Any **subcontractors** that are used for carrying out the project must be mentioned in the contract documentation. The contractor shall be directly responsible for employing engineers or technicians for overall coordination and assembly foremen. The coordination of the subcontractors shall be fully incumbent on the contractor. The BMW Group and the technical construction management will not contact the subcontractors.

The following subjects and contents must be included in specifications for installers, with installation companies furnishing proof thereof:

- General basic principles of electrical engineering
- Qualification covering workmanlike installation and laying of cables (for example termination of cabling components, compliance with maximum tensile forces and minimum bending radii, etc.)
- Qualification according to a current training program on the cabling components used (copper technology) by the manufacturer
- Proof, test measurements taken on structured cabling according to good professional practice, using the measurement processes required (cf. "Annex C: Acceptance measurements" of the "BMW Group Cabling Standard for Structured IT Cabling").
- Good command of the national language spoken in the individual country (except for unskilled workers)

Additional requirement to be met by fibre-optic installers:

All fibre-optic installers have to furnish proof of their successful participation in a fibre-optic certification program approved by the BMW Group. A list of all fibre-optic installers that are currently certified for the BMW Group can be downloaded from the intranet of BMW Group IT.

Please note:

In addition, the construction management reserves the right to request proof of the installers' required knowledge prior to and during the construction phase.

The installation must be implemented in conformity with DIN EN 50174-1 and DIN EN 50174-2 as amended.

During the implementation stage, a qualified test laboratory / staff (for example GHMT AG, Bexbach) is to **carry out inspections** in coordination with the technical construction management in order to identify any deviations from the BMW standard defined for the passive IT infrastructure early on during the implementation stage, and to avoid repeating these deviations in the further course of the project as well as any project delays resulting from them. The inspection results will be forwarded to the technical construction management in charge and to the **BMW Group IT IS Function Datacenter Technology (Rechenzentrumstechnik)** in the form of a report.

The **accompanying inspection** during construction phase is thus a compulsory part of the planning and implementation stages of the project. To this end, the following checklist, which must be completed for every room, serves as the basis of assessment:

- **checklist for the assessment of passive IT IS of building types G1 - G3**

Furthermore, in particular the following requirements have to be taken into account during the installation and documentation processes:

- **BMW Group Cabling Standard for Structured IT Cabling**

  in particular the following chapter:

  - **Chapter 4:** Requirements to be met in the implementation of the installation

In addition, it must be taken into account that passive IT IS documentation must be completed by means of BMW's in-house documentation system Command (by FNT) and that relevant documents are stored on the **project server** in relation to the project at hand.

5.4 Acceptance measurements

All installed copper and fibre-optic data links must be tested by the installation company within the framework of quality assurance. The test methods to be employed and the applicable assessment criteria are explained in detail in the following section.

Any packaging/safety guards removed for the purposes of measurement-based tests must be replaced in order to restore the requisite protection against environmental impact and the physical damage of components.

If protective caps or similar items are used for the protection of components, these must only be removed for the purposes of performing the test and must be restored without delay or, if required, must be replaced until the installation has been completed.

The specific requirements are listed in "Annex C: Acceptance measurements" of the "BMW Group Cabling Standard for Structured IT Cabling".

5.5 Wireless Local Area Network (WLAN)

Within the BMW Group, a wireless local area network (WLAN) is part of the technical building services. Every WLAN at the locations run by the BMW Group requires reliable planning and measurement-based acceptance in accordance with the following BMW guideline:

- **Solution Building Block Wireless LAN of the BMW Group**

In general, a wired passive IT infrastructure must be implemented while WLAN must be considered an addition to a wired LAN and not as a replacement thereof. It should be noted that WLAN structures have to meet a wide range of requirements depending on the environment at hand.

In production areas, particular consideration should be given to the fact that critical applications that are relevant for production are operated via WLAN. In addition to full coverage in the frequency ranges of 2.4 GHz and 5 GHz, this environment therefore absolutely requires redundancy.

An SLA is not possible for the radio link since the ISM band is prone to interference at any time.

When budgeting the cabling of **WLAN Access Points** (WLAN APs), planners can use the following empirical values for a rough estimate of the number of WLAN APs:

Environment	Max. Area per WLAN AP (sqm)
Office	380
Production and open logistics areas	1,000

Table 13: Max. Area per WLAN AP in sqm

The definition of the connections for WLAN APs and their positions is based on a WLAN plan that is completed in accordance with the **BMW guideline "Solution Building Block Wireless LAN of the BMW Group".**

The planner in charge of the cabling contacts the relevant liaison at BMW. The BMW Group subsequently commissions an internal or external WLAN planning specialist, who completes the WLAN coverage plan in accordance with the BMW guideline and makes the planning results available, including layouts and the WLAN-AP positions.

Up-to-date furnishing layouts must be submitted for the WLAN planning to be completed since the propagation and attenuation of WLAN frequencies are significantly impacted by the type of furnishing (for example office, industrial, production lines, warehouses with mesh pallet boxes with varying filling levels, high-rise shelving, etc.).

WLAN planning must be coordinated with mobile radio communication planning.

The planner responsible for cabling includes the WLAN AP positions in the cabling plan, coordinates the implementation (insofar as this is included in the contract), and immediately informs the liaisons at BMW as well as the WLAN planning specialist about any potential collisions with other technical equipment, about changes to the planning of his/her and other functional areas, as well as about structural changes.

If necessary, the WLAN planning specialist will adapt the plan and forward information about any changes that must be factored into the cabling plan. Following the installation of the WLAN APs and the commissioning of the WLAN, acceptance measurements are taken in line with the BMW guideline, which are performed by a specialist commissioned by the BMW Group (for example, GHMT AG, Bexbach). During the acceptance measurements, the cabling planner will be available for any questions in relation to the WLAN implementation he/she is in charge of.

Please also refer to the **BMW guideline** listed before for more detailed information regarding the requirements to be met by a WLAN and its implementation.

5.6 Radio frequency management

Please bear in mind that a WLAN uses those sections of the frequency range that do not require the payment of any licence fees or approval and are also used by various other radio applications (2.4 GHz) or other (2.4 GHz and 5 GHz). These other frequency users might clash with WLAN operation, thus creating an adverse impact, which is why they must be taken into account during the planning process.

The BMW Group has therefore created a process referred to as **"Funk Frequenz Management System (FunkFMS)" (radio frequency management system),** which is implemented at most production sites and is coordinated by the local facility managers in each case.

This process was introduced in order to ensure the trouble-free operation of important radio applications within the BMW Group. In this process, the planner and the operator are responsible for the smooth operation of their radio application so that frequency management has to be taken into account as early as during the planning of said radio application.

In general a distinction must be made between office and production environments. In the office environment, a simplified coordination process provides for the frequency range of 2.4 GHz and 5 GHz to be used for WLAN only. Furthermore, potential licence fees incurred for specific frequency ranges must be clarified with radio frequency management. In this connection, it should be noted that the party making the request for fee-based licences must also bear the cost incurred.

Any other radio systems in this frequency range must only be planned upon obtaining the explicit approval by the responsible BMW department. Any radio systems that are operated without prior approval will be immediately shut down when detected.

Any radio systems must be reported to the coordinating unit in production environments, where WLANs and other radio systems for the frequency ranges that do not require a licence or permit are relevant for the business processes of the BMW Group. If you are now aware of who is the relevant contact in this matter, please contact your customer at the BMW Group in order to find out whom to contact.

The new radio application to be launched is subsequently compared to the existing range of radio applications, which are documented in the **radio management (FunkFMS) software** of the BMW Group. If a collision potential is detected, the relevant measurement-based analyses must be made in order to furnish proof of a possible coexistence. The radio application concerned must only be planned and launched after a proof of coexistence and a written approval from the competent BMW units have been obtained.

If there is a risk of interference, further analyses or suitable actions must be initiated in coordination with the relevant liaisons at BMW.

5.7 Referenced documents

The specification document of the BMW Group refers to further documents that must also be taken into account in the planning process as amended:

- **BMW Group Cabling Standard for Structured IT Cabling**

  in particular the following chapters:

  - **Chapter 2.1:** Routing and cable management
  - **Chapter 2.2:** Shielding and equipotential bonding
  - **Chapter 6:** Information to ensure EMC

- **Planning specifications for IT IS rooms**

  in particular the sections:

  - Maintenance, documentation and organisation
  - Safety and protective measures
  - Fire safety aspects with respect to horizontal cabling

- **Safety instructions for third parties**

- **BMW Fire protection specifications**

5.8 Interfaces to specialist BMW departments

Organizational structure 07/2014:

FG-94	Datacenter
FG-942	Datacenter Technology
FG-944	LAN, WLAN
FG-911	Realtime Communication
FG-914	Workplace Systems D, A
PA-12	Real Estate Transaction Management
PA-2/PA-60	Architecture and Construction
PA-3	Facility Management, Energy
PA-S-1	Group Security Management

6 Glossary

AP	Arbeitsplatz = workplace
BD	building distributor = Gebäudeverteiler (GVT)
BMUZ-IT	Brandmeldeunterzentrale für IT = fire-alarm substation IT
BOS	Behörden und Organisationen mit Sicherheitsaufgaben = public-security authorities and organisations
CISPR	Comité international spécial des perturbations radioélectriques = Special international committee on radio interference
DC	computer centre, data centre = Rechenzentrum (RZ)
DIN	Deutsche Industrie Norm = German Industrial Standard
EMA	Einbruchmelde Anlage = intrusion detection system
EMC	electromagnetic compatibility = Elektromagnetische Verträglichkeit (EMV)
EN	Europäische Norm = European Standard
FD	floor distributor = Etagenverteiler (EVT)
FFM	Funk Frequenz Management = radio frequency management
GLT	Gebäudeleittechnik = building services control system
GSM	Global System of Mobile Communications
HF	High Frequency
HOAI	Honorarordnung für Architekten und Ingenieure = Official scale of fees for services by architects and engineers
IEC	International Electrotechnical Commission
IS	Infrastructure
ISO	International Organization for Standardization
IT	Information technology
LABS	Substances containing silicone or harmful to the wetting properties of paints
LAN	Local Area Network
LEMP	Lightning Electromagnetic Pulse
LSA	Löt-, schraub und abisolierfreie Anschlusstechnik = connecting hardware without solder, screws or wire-stripping
LTE	Long Term Evolution
LV	Leistungsverzeichnis = specifications
LWL	Lichtwellenleiter = optical fibres
MICE	Mechanical, ingress, climatic, electromagnetic
NCC	network control centre = Netzwerkzentrale (NWZ)
NSC	National Sales Company
NSHV	Niederspannungshauptverteilung = low-voltage main distribution panel
PA	Potentialausgleich = equipotential bonding, bonding network
PDC	Part Distribution Center
POE	Power Over Ethernet
PUE	Power Usage Effectiveness
RDC	Regional Distribution Center
RJ45	Registered jack type 45
SEMP	Switching electromagnetic pulse
SF/UTP	Screened foiled unshielded twisted pair
SPOF	Single point of failure
TN-C	Terra Neutral Combined
TN-S	Terra Neutral Separate
TR	Technical Report
UKG	Umluft Kühlgerät = recirculating-air cooler
UMTS	Universal Mobile Telecommunications System
UPS	Uninterrupted Power Supply = Unterbrechungsfreie Stromversorgung (USV)
UV	Unterverteilung Elektro = electrical subdistribution
VDE	Verband Deutscher Elektrotechniker = association of German electrical engineers
VESDA	Very Early Smoke Detection Apparatus = Rauchansaugsystem (RAS)
VOB	Verdingungsordnung für Bauleistungen = contract procedures for building works
VOL	Verdingungsordnung für Leistungen = contract procedures for services
VPAA	Vermaschte Potential-Ausgleichsanlage = meshed bonding network
WAN	Wide Area Network
WLAN	Wireless Local Area Network
WLAN AP	WLAN Access Point