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Conferenza di coordinamento degli organi della costruzione e degli immobili dei committenti pubblici
Coordination Group for Construction and Property Services

Recommendation

Generic communication cabling (GCC)

Edition 3, March 2012

KBOB Members
BBL, armasuisse, ETH, ASTRA, BAV, BPUK, SGV, SSV

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Significance of KBOB recommendations

KBOB recommendations define the general standard in the corresponding specialised field of activity. Any deviations must be justified.

Overview

KBOB has prepared and published the following general standards for property management to date:

- Building services systems
- Measurement and control technology
- Generic communication cabling (GCC)
- Energy measure concept
- Environmental management of building projects
- Building materials in structural engineering
- Implementation of the Service Model (SIA)

In addition, KBOB has published numerous recommendations in the following fields:

- Sustainable building
- Price change issues
- Planner services

Publisher

The recommendations are published and updated by KBOB. The present recommendation has been prepared by Siegfried Burkhalter (BBL), in charge, Victor Arni (armasuisse), Fredy Baumann and Rolf Hunziker (ETH, IT Services / Communications) and Urs Egger (PSI). The project team was supported by Dr. Martin Saner (SNT Saner Netzwerktechnik).

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- January 2000: Edition 1 (based on Generic Communication Cabling Recommendations, AFB, August 1996)
- February 2006: Edition 2, generally revised and updated
- March 2012: Edition 3, Earthing and bonding, diameter of copper conductors, copper connectors category 6_A, link class E_A, multimode fibre OM3.

Table of contents

Summary

This KBOB recommendation and the branch-specific guidelines of the relevant Building and Property Organisation form the basis for planning and realisation of generic communication cabling (GCC) systems.

The application of the recommendations in this document in the context of newly constructed buildings or renovations is recommended to KBOB members and private building owners.

Technically speaking, this recommendation describes the following cabling system:

- Generic communication cabling with a star structure according to SN EN 50173-1
- Backbone cabling with optical fibre cables (singlemode OS2 and multimode OM3) as well as trunk cabling for classical telephony
- ST connector system for multimode fibres, E-2000 connector system for singlemode fibres
- Tertiary cabling with S/FTP copper cable from category 7
- RJ45 connector systems from category 6_A, shielded [1].
- Permanent link class E_A [1]

In this document there are detail descriptions of

- Earthing and overvoltage protection (Chap. 3, p. 22)
- Installation (Chap. 4, p. 31)
- Quality requirements (Chap. 5, p. 33)
- Quality assurance in the course of the project (Chap. 6, p. 34)
- Structure and content of the documentation for a cabling installation (Chap. 7, p. 37).

All requirements are described without reference to specific manufacturers or products.

1 Introduction

1.1 Goals

This recommendation shall, in general,

- ensure compliance with the branch-specific guidelines for *Generic communication cabling (GCC)*
- define the minimum requirements for a GCC installation.

The recommendation shall, in particular,

- advise planners and contractors of the necessary cooperation with the relevant person responsible for GCC systems in the particular branch.
- support a data rate of up to 10 Gbit/s to the work area and up to 100 Gbit/s in the backbone.

1.2 Scope

KBOB recommends to its members and to all interested construction and properties services to apply this document for all new buildings and building modifications (cf. Figure 1).

In case of doubt, the responsible, branch-specific building institution decides on the extent to which this recommendation must be applied.[1]

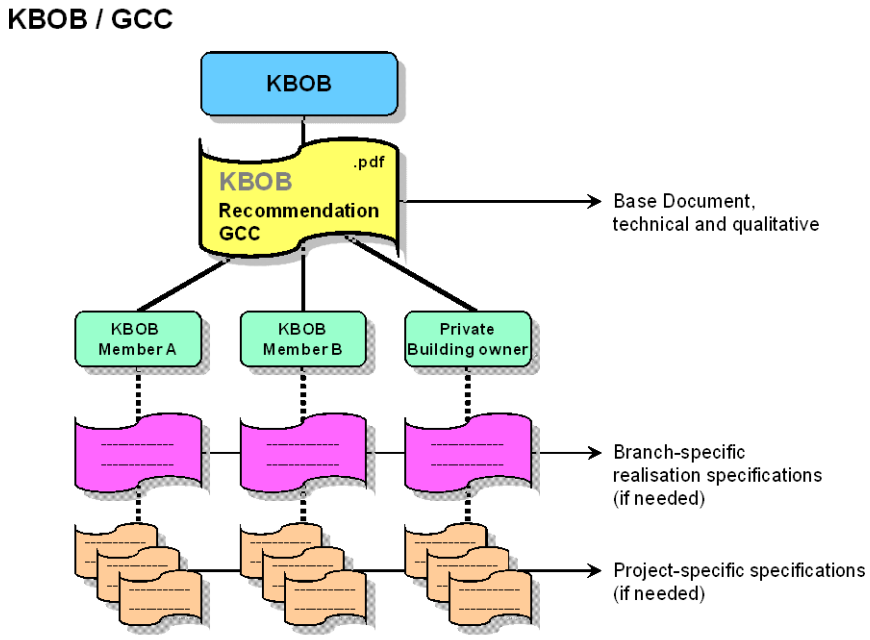


Figure 1: Scope of this document.

[1] The construction and properties services of ETH, armasuisse and BBL intend to declare this document as mandatory.

1.3 Authoritative documents

The current recommendation is based on the following standards and documents:

- The standards and recommendations [1]-[12] listed in Annex A (p. 39), in particular

  EN 50173-1:2007 incl. EN 50173-1:2007/A1:2009
  Information Technology – Generic Cabling Systems –
  Part 1: General requirements [3].

  EN 50173-2:2007
  Information Technology – Generic Cabling Systems –
  Part 2: Office areas [4].

- The rules and standards (i.e. the technical instructions, principles and guidelines) of the individual branches.

At the time of the realisation of a cabling project the **current** standards that are accepted as state-of-the-art are determining. These must be consulted and taken into account in every phase of the project.

1.4 Addressees

The recommendations in this document are aimed primarily at architects, engineers and project managers working for appointed planning companies. They are also aimed at contractors.

1.5 Branch-specific specifications

The branch-specific specifications (cf. Figure 1, p 6) must be taken into account.

Sources for branch-specific specifications are:

BBL: Projektmanagement Haustechnik,
Fellerstrasse 21, CH-3003 Bern

VBS: armasuisse Immobilien, Umwelt Normen und Standards,
Blumenbergstrasse 39, CH-3003 Bern

ETH: ETH Zürich, ID-Kommunikation (NIP),
Weinbergstrasse 43, CH-8092 Zürich

PSI: Paul Scherrer Institut, Telematik, WHGA,
CH-5232 Villigen PSI

2 Generic communication cabling (GCC)

2.1 Structure and functional elements (minimum requirements on the GCC)

A GCC must always be structured as shown in Figure 2, according to national and international standards.

The functional elements of a GCC are:

- Campus distributor (CD)
- Building distributor (BD)
- Floor distributor (FD)
- Telecommunications outlet (TO)

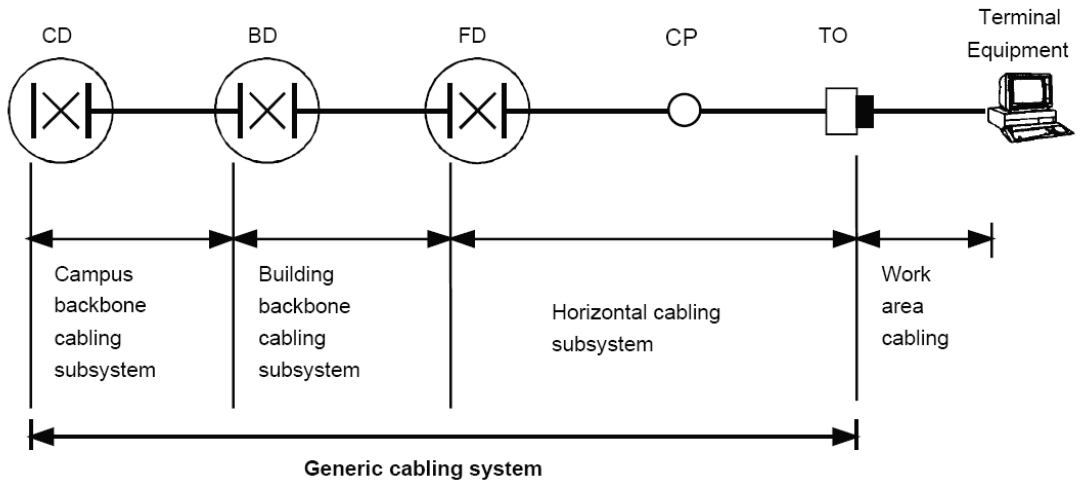


Figure 2: General structure of generic communication cabling (source: [3]).

The following requirements apply for distributors:

Campus distributor (primary concentration point): In general, each building distributor must be connected directly (i.e. in a star topology) to the campus distributor with optical fibres (at least 24 fibres). Fewer than 24 fibres may be used upon approval by the relevant GCC project manager. Halogen-free cables with low fire conduction are required. Loose tube cables („water conduits“) shall be avoided. Cable routing over public property must be coordinated with the relevant authorities. The routing must offer protection against vandalism and unintentional mechanical damage.

Building distributor (secondary concentration point): In general, each floor distributor must be connected directly (i.e. in a star topology) to the building distributor with optical fibres (at least 24 fibres). Fewer than 24 fibres may be used upon approval by the relevant GCC project manager. If special requirements concerning system availability apply, the floor distributors shall be connected with a genuine path redundancy. Halogen-free cables are required in normal cases.

Floor distributor (tertiary concentration point): The cabling to the work areas ends on RJ45 connectors. The quantity structure (number of connectors) shall be determined by the floor area.

Telecommunications outlet: Terminal equipment is connected to the TO by work area cabling.

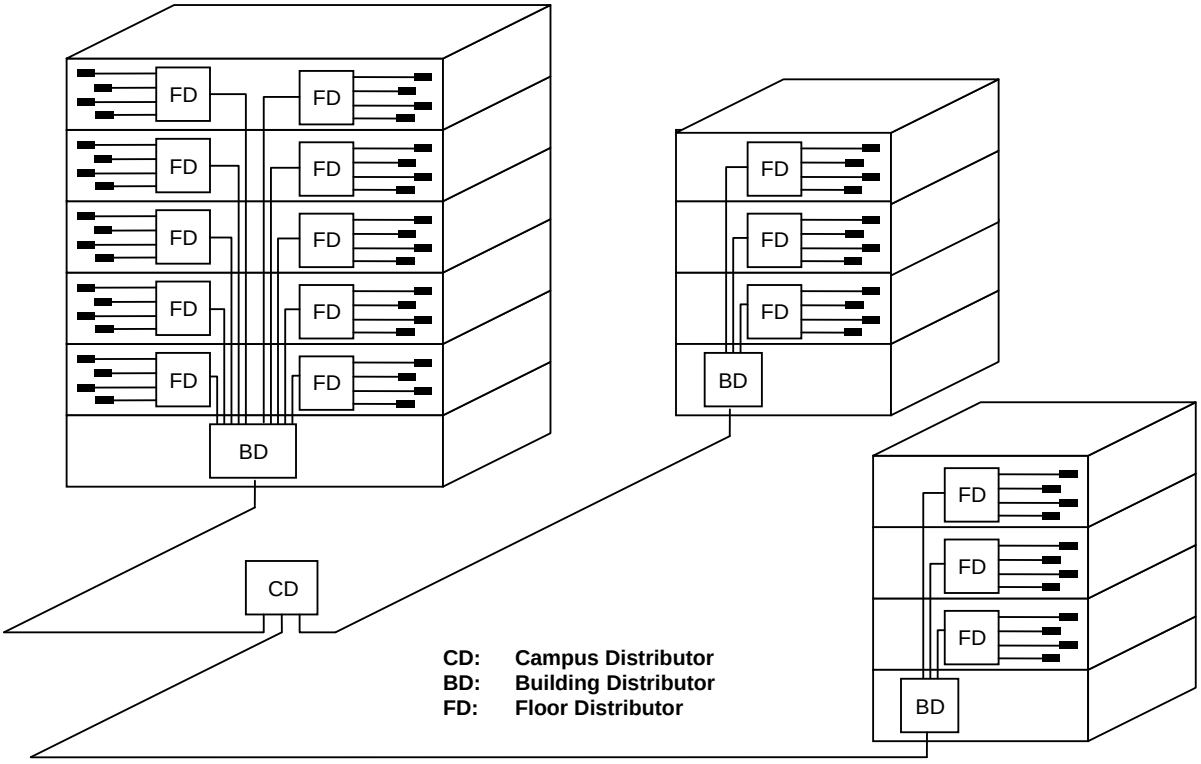


Figure 3: Overview of the generic communication cabling (source: [12]).

The GCC consists of various cabling subsystems (see Figure 2) that are realised as follows:

Primary cabling subsystem (Campus backbone cabling subsystem):
- optical fibre cable
- copper cable (telephony)

Secondary cabling subsystem (Building backbone cabling subsystem):
- optical fibre cable
- copper cable (telephony, compensating lines connecting adjacent floor distributors)

Tertiary cabling subsystem (Horizontal cabling subsystem):
- optical fibre cable (depending on application)
- copper cable;
  Note: Installations with twisted-pair cables are *not* allowed outside of buildings.

Cabling subsystem for special applications (not shown in Figure 2):
For special applications that cannot be patched for security reasons (alarm, lift telephone, paging systems, etc.) at least one cable of the type U72M 10 x 4 x 0.6 must be installed from the building distributor (telephony distributor) to every communication room. This cable shall be connected to an intermediate distributor (ID) for special applications in the communication room. The special application systems are connected to the intermediate distributor (ID) via a cable of the type U72M 1 x 4 x 0.6. Connection is made either via a connector (TO) or directly depending on the application.

- Safety-relevant interfaces
- Remote alarm devices
- Lift telephones
- Paging systems (transmitter, amplifier, etc.)

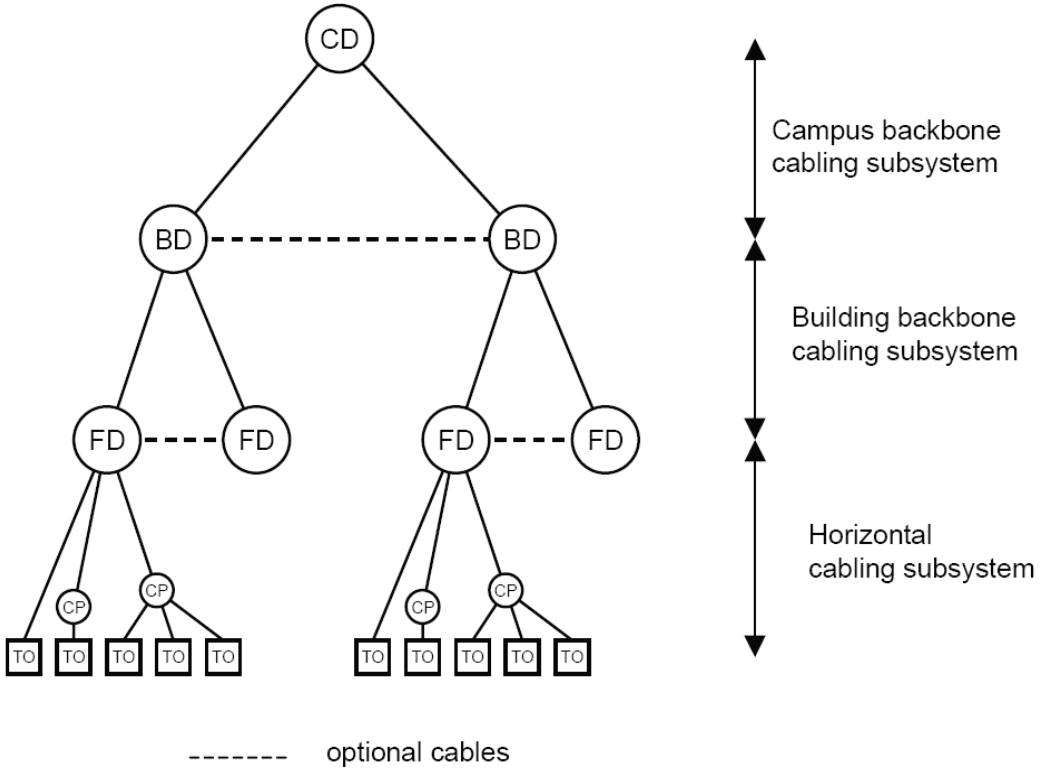


Figure 4: **Hierarchical star structure for the primary, secondary and tertiary cabling subsystems (source: [3]).**

2.2 Network design

A GCC is usually planned with a hierarchical star structure according to Figure 4.

If there are special requirements concerning system availability, building distributors shall be connected with a genuine path redundancy.

When safety-relevant applications will be using the GCC, the requirements with respect to system availability of active components (emergency power / UPS) must be defined at the start of the project.

The secondary cabling can be omitted completely in small multi-storey buildings (old buildings, timber houses, etc.). The decision lies with the GCC project manager. The rules of the tertiary cabling then apply for all services.

The IT operator decides on the possible use of the GCC for applications that are **not** conventional IT applications (with RJ45 components). Examples include TV signals, video signals or control signals that are not transmitted as an IT service. These shall **not** be connected to a GCC by default.

The IT operator has access authorisation to the communication rooms and to free slots in the GCC racks.

2.3 Quantity structure

Figure 5 shows the procedure for planning a GCC as a flow chart, in particular the determination of the quantity structure and space requirements.

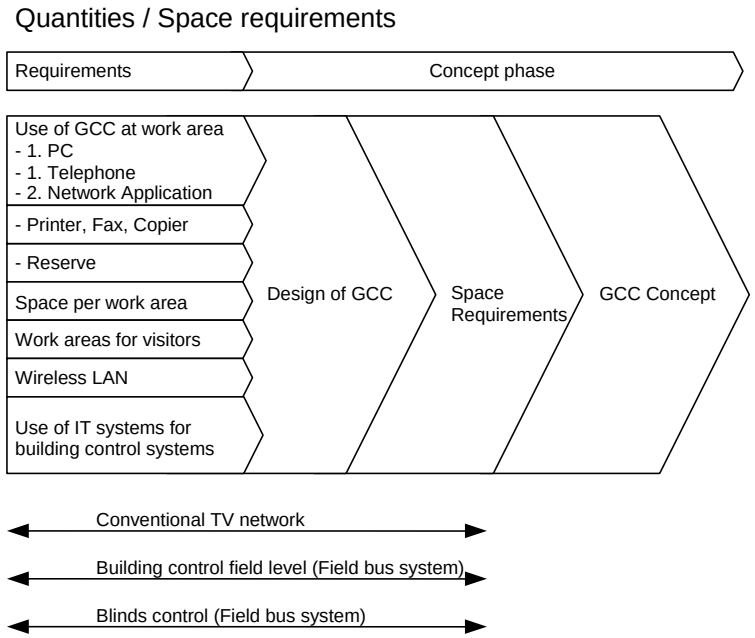


Figure 5: Planning process of a GCC and determination of the quantity structure.

The Generic communication cabling (GCC) shall be installed exclusively for IP-based networks and voice services.

Conventional TV networks, the building control field level and blinds controls are **not** part of the GCC. A separate cabling shall thus be provided for these applications.

Quantity structure:
The minimum requirement for a work room (office, laboratory etc.) is always determined by the branch-specific specifications.

2.4 Communication rooms (distributor rooms)

Communication rooms fulfil the following functions:

- Installation of passive and active network components
- Transfer point for offered communications services
- Connection point between different GCC subsystems (primary, secondary, tertiary)
- Connection point for change of media
- Access point for measurement and maintenance

Note: Communication rooms are not server rooms!

2.4.1 Location

Rooms for building distributors (BD rooms)
BD rooms form the border between the backbone network (primary cabling) and in-house cabling, so they belong to both parts.

The BD room shall be located at a suitable position, if possible,

- near the entry point of the campus pathway system into the building
- near a riser zone
- in a room without windows which can be used at long term
- far away from any strong electromagnetic (EM) sources of interference

Rooms for floor distributors (FD rooms)
FD rooms shall be situated as centrally as possible and near the riser zones.

No section of cable between the floor distributor (FD) and a TO may be longer than 90 m.
The communication rooms must thus be located so that all rooms can also be cabled at a later point in time without exceeding the maximum cable length of 90 m.

For large buildings FD rooms are to be provided on every floor, according to ISO/IEC 11801, EN 50173, ANSI/TIA/EIA-568 and the SEV/ASV SIA manual for communication cabling.

2.4.2 Dimensioning of communication rooms

The communication rooms must be large enough to allow the installation of the appropriate number of 19" racks (determined by the size of the building) with approx. 42 rack units (RU).

A rack row shall consist of a maximum of 5 racks. The room sizes must be planned so that at least one additional rack can later be added.

Floor communication rooms must have space for a small work area.
Campus and building communication rooms must have space for a work area and, in addition, storage space.

Space for ventilation or cooling systems, a telephony distributor and possibly a PBX shall also be taken into account.

The racks shall be freely accessible from the front and rear (see Figure 6, following page).
This entails a minimum gap between the rear of the rack row and the wall of 85 cm and a clear space of at least 1.20 m in front of the rack row.

A room layout plan must be drawn up for the final determination of the room size.

The following illustrations show the minimum dimensions (in meters) of the communication rooms for the corresponding number of racks. All dimensions are without a PBX and a telephony distributor.

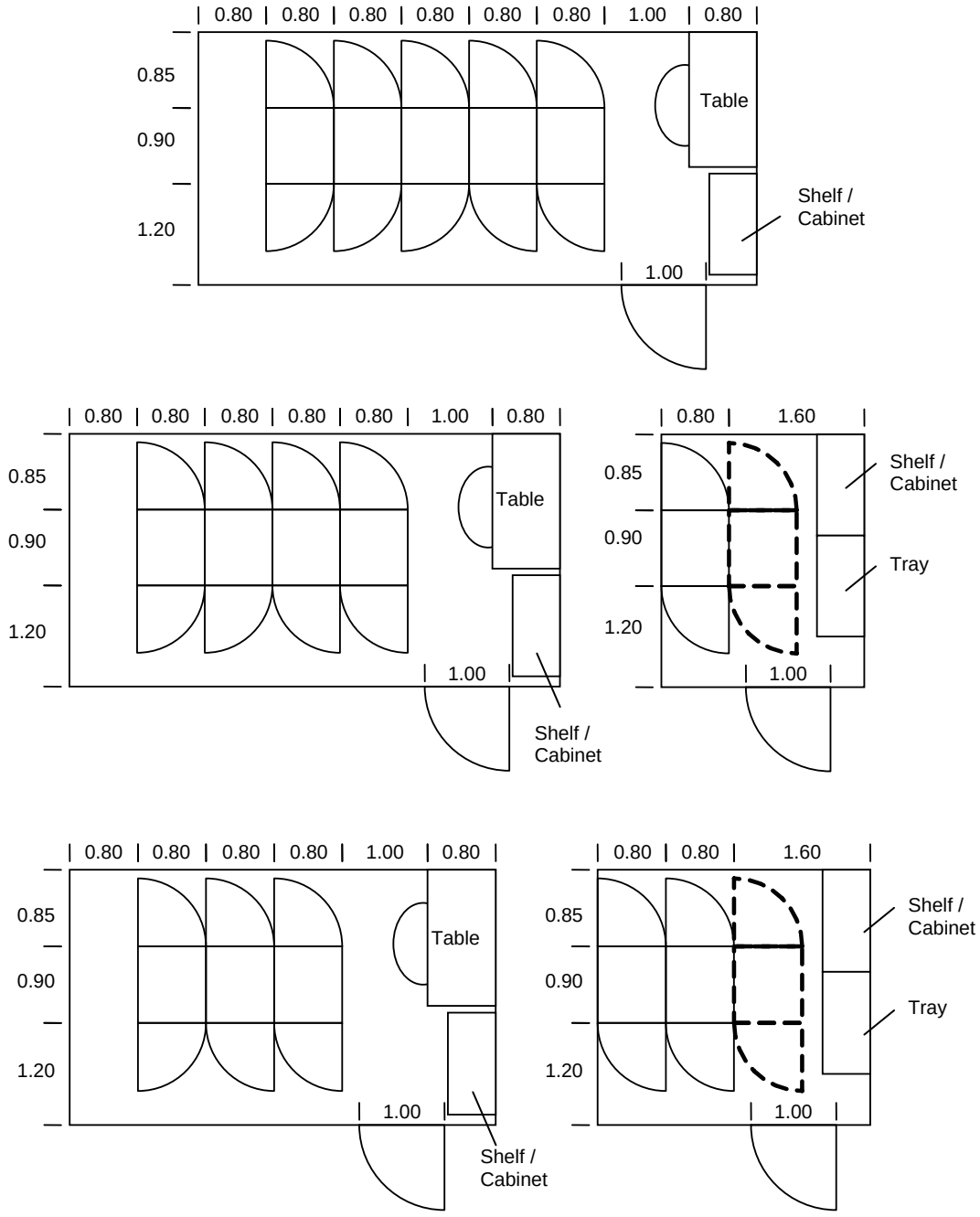


Figure 6: Minimum dimensions [m] of the communication rooms for 1 to 5 racks.

2.4.3 Facilities in communication rooms

Security: All communication rooms shall be separate and separately lockable. Communication rooms shall not be used for other purposes (not even for building automation or IT). Communication rooms shall be secured against unauthorised access.
Access media (e. g. key, badge) issued to operators, security and facility management services must guarantee autonomous access to the building and communication room 24 h / 365 days a year.
Third parties are only granted access following consultation with the responsible organisation.

Locking: The communication rooms must be locked according to the master key plan.

Ventilation: A minimum air exchange must be guaranteed to allow work in the room.

Ducts and Cabling: Only media pipes and cables which are functionally necessary for a communication room shall be installed (e. g. ducts for cooling).

Moisture: The relative humidity must be between 20% and 60% with no possibility of condensation.

Working temperature: An ambient temperature of 10°C to 26°C must be guaranteed at all times. The heat emission of active components depends on the size of the installation.

Heat emission
- In BD rooms can be between approx. 0.2 kW and 10 kW
- In FD rooms can be between approx. 0.2 kW and 4.5 kW

The exact values must be clarified at the start of the planning process with the responsible project manager.

Heat emission per Ethernet port (1 Gbit/s, PoE) is typically in the range of 1 W to 3 W. So for 100 ports a total heat dissipation between 100 W and 300 W results.

If total heat dissipation exceeds 500 W active cooling has to be considered.

Any measures to maintain the room temperature must be optimised in terms of cost and energy consumption.

Lighting: Normal lighting of 350-450 lux must be provided. Emergency lighting must also be installed in the campus (CD) and building distributor (BD) rooms. Emergency lighting must be fed from a separate mains power distributor.

Electrostatic charging: Communication rooms are classified as **Class B** according to SN 429 001. The only exception is the floor covering which shall be according to Class A.

False floors: If technically possible, false floors with conductive, halogen-free flooring according to SN 429 001 must be installed in communication rooms wherever cables are led into the rack from below. The clear height of the false floor shall be at least 20 cm.

Floor covering: A conductive, halogen-free floor covering according to SN 429 001 of class A (max. 10^8 Ω) shall be provided.

Paint/plaster: The design shall be abrasion-proof.

Power supply: The design depends on the type of the communication rooms.

For BD rooms a feed line 400 / 230 V, 50 Hz, 3LNE, at least 16 A (separately fused) shall be provided depending on the size of the installation. The sockets shall be of type 23, triple.

For FD rooms a feed line 230 V, 50 Hz, 1LNE, 16 A (separately fused) shall be provided. The sockets shall be of type 23, triple.

Multiple socket strips shall not be equipped with switches and be suitable for rack installation.

The detail design of power circuits has to be approved by the GCC project manager.

Equipotential bonding connection: The connection to the EBS shall be designed with a standardised earth terminal (see also Chap. 3, p. 22, EMC concept).

Telephone connection: At least one telephone with national authorisation shall be installed.

Workplace equipment: Each campus and building communication room must be equipped with a desk. For this purpose a free space of 160 cm x 160 cm must be planned in each room layout.

Storage possibilities: A metal cabinet is to be installed in the campus and building communication rooms to store jumper and connection cables as well as other locally needed components.

2.5 Components

2.5.1 Optical fibre cabling

Fibres and cables in accordance with EN 50173-1 [3] must be installed.

If multimode fibres will be installed they must of type **OM3** or better according to ISO/IEC 11801 and EN 50173-1. A GCC design without multimode fibres shall be considered and discussed with the GCC project manager.

Multimode 50/125 µm, metal-free

Useful distance:	between 2 m and 300 m
Fibre type:	At least **OM3** according to EN 50173-1 [3] Attenuation (cabled) at 850 nm ..... ≤ 2.7 dB/km Attenuation (cabled) at 1300 nm ..... ≤ 0.7 dB/km Bandwidth at 850 nm ..... ≥ 1500 MHz km Bandwidth at 1300 nm ..... ≥ 500 MHz km
Protective sheath:	indoor or outdoor cable depending on application
Cable structure:	metal-free including rodent protection
Longitudinal waterproofness:	acc. to EN 60794-1-2-F5
Transverse waterproofness:	1 bar
Transverse compressive strength:	under permanent load at least 250 N/cm
Tensile strength:	at least 6000 N (pulling during installation)
Bending radius:	according to specifications of manufacturer
Bending properties:	without load < 350 mm / with load < 450 mm
Halogen-free:	acc. to EN 50267, IEC 60754
Fire conduction:	EN 50265, IEC 60332
Smoke emission:	EN 50268, IEC 61034

Designs not adhering to these requirements must be approved by the GCC project manager.

Singlemode 9/125µm, metal-free

Useful distance:	between 2 m and 100 km
Fibre type:	At least **OS2** acc. to **EN 50173-1** [3] and fibres of type **G.652.D** acc. to ITU G.652 [23] Attenuation (cabled) at 1310 nm ..... < 0.36 dB/km Attenuation (cabled) at 1550 nm ..... < 0.25 dB/km
Protective sheath:	indoor or outdoor cable depending on application
Cable structure:	metal-free including rodent protection

Longitudinal waterproofness	EN 60794-1-2-F5
Transverse waterproofness:	1 bar
Transverse compressive strength:	under permanent load at least 250 N/cm
Tensile strength:	at least 6000 N (pulling during installation)
Bending radius:	according to specifications of manufacturer
Bending properties:	without load < 350 mm / with load < 450 mm
Halogen-free:	acc. to EN 50267, IEC 60754
Fire conduction:	EN 50265, IEC 60332
Smoke emission:	EN 50268, IEC 61034

For link distances between 2 m and 300 m **singlemode fibres** shall be installed. Multimode fibres shall be installed if required.

For link distances over 300 m **only singlemode fibres** shall be installed.

Designs not adhering to these requirements must be approved by the GCC project manager.

2.5.2 Copper cabling

In general, only halogen-free cables with limited fire conduction and low smoke emission shall be used [11].

The detailed requirements are:

Twisted pair (GCC cable):
For Generic cabling systems twisted-pair cables (S/FTP, 100 ohm, 8 conductors, 4 x 2, AWG 22) which are generally available on the market are used.
The cable must be at least **category 7[2] acc. to [2]**. The conductor diameter shall be between 0.6 mm and 0.65 mm.

Patch cables and equipment cables:
For new installations
- Patch cables and equipment cables shall be category 6_A for 10 GB applications.
- Patch cables and equipment cables shall be of the same type.
- Patch cables must always be of type S/FTP.

The colours of the patch cables are to be chosen according to the operator's instructions.
S/UTP and S/FTP patch cables may never be mixed.

Equipment cables for telephones:
The equipment cables are delivered with the terminal devices (paying heed to the connector system).

Telephony trunk cable for outdoor installation (also energy ducts):
- PE-ALT-CLT

Telephony trunk cable for indoor installation
- U72M
The cable used shall be at least of type U72M 20 x 4 x 0.6, halogen-free. A cable reserve of 50% shall be planned.

Cables for special applications:
- U72M

Jumper wires:
- V83 2 x 0.5 / colours according to branch-specific operator organisation.

[2] The combination of cat. 7 (cable) and cat 6_A (connecting hardware) results in a system margin. To raise the performance of the tertiary cabling subsystem, only the connectors, not the installed cables must be exchanged (cf. section 4.2 p. 29).

2.5.3 Optical connector systems

The following requirements apply:

Connector system singlemode: **E-2000 connector system** with APC (Angled Physical Contact) acc. to IEC 61754-15 [21] and specification CECC 86275-802 [10] (LSH-HRL) with zirconium ferrule

Insertion loss: .....≤ 0.4 dB
Repeatability: .....max. ± 0.1 dB
Reflectance: .....≥ 65 dB
Temperature range:.....- 40 °C to + 85 °C
Dust protection and accident prevention: .....metal cover

Connector system multimode: **ST connector system** acc. to IEC 61754-2 [20]
Insertion loss: .....≤ 0.5 dB
Repeatability: .....max: ± 0.1 dB
Reflectance: .....≥ 30 dB
Temperature range:.....- 10 °C to + 60 °C

ST connectors shall primarily be used for extending existing installations.

For new installations the use of alternative connecting hardware (e.g. LC, LX.5, MPO, E-2000, and SC etc.) shall be considered. The exact details shall be approved by the project manager.

2.5.4 Electrical connector systems

Connector system copper: Minimum requirement is **Category 6_A according to [2]**, shielded[3].

A higher category connector system has to be approved by the project manager.

All telecommunication outlets (TOs) shall be provided with a dust protection device.

2.5.5 Telephony main distributor

A basic differentiation is made between two types of telephony main distributors:

- Campus distributors (preferred)
- Wall distributors (for smaller installations).

Standalone distributors are to be designed with vertical bays for the system side and horizontal bays for the installation side. Only vertical bays are used in wall distributors.

Both distributor types are to be designed for 20-pin VS-83 strips.

Distributors shall be dimensioned in coordination with the branch-specific telephony department.

[3] The combination of category 7 (cable) and category 6_A (connecting hardware) results in a system margin. To raise the performance of the tertiary cabling subsystem, only the connectors, not the installed cables must be exchanged (cf. section 4.2 p. 29).

2.5.6 Telephony building distributor

The telephony building distributor is normally a wall distributor. Bays with 50 spaces are to be provided that are designed for 20-pin VS-83 strips as in the main distributor.

Distributors shall be dimensioned in coordination with the branch-specific telephony department.

2.5.7 Telephony intermediate distributor (ID)

An intermediate distributor (ID) is to be installed in each communication room. It is fed from the corresponding building distributor by a cable of at least the type U72M 10 x 4.

Per default an intermediate distributor must be realised as a wall-mounted distributor with size 220 x 260 x 80 mm, designed to accommodate at least 20-pin VS-83 strips. The corresponding mounting base with installation kit and earth terminal shall also be used. The installation height (upper edge) is 1600 mm from the finished floor.

2.5.8 Insulating and connecting strips

20-pin VS-83 strips are to be used.

Insulating strips: Surge absorbers are to be installed on the system side and on the line side.

Connecting strips: All connecting cables from the building distributor to the rack, to intermediate distributors and for special applications shall be led to connecting strips.

Surge absorbers: The use of surge absorbers in building and intermediate distributors depends on the system and must be defined in cooperation with the responsible department.

2.5.9 Communication cabinets

All communication equipment is housed in communication cabinets. These shall meet the following requirements:

- **Very sturdy 19-inch design with approx. 42 rack units** (RU)
- self-supporting frame, enclosed on all sides
- **Depth-adjustable 19-inch bracket profiles,** (the vertical profile rails must be depth-adjustable)
- **four vertical profile rails** with T-groove or ASA holes (as instructed by project manager)
- **Base** (approx. 100 mm) with levelling feet
- **Front doors** of steel with sight window or perforated steel plate, lockable (master key plan of building owner or service provider), door can be hung left or right; position of hinges in agreement with GCC project manager
- **Rear doors** of steel, lockable (master key plan of building owner or service provider), door can be hung left or right; position of hinges in agreement with GCC project manager
- **Removable side walls** of steel; if the cabinets are placed against the wall (only in exceptional cases and with approval of the GCC project manager) lockable side doors of steel must be used
- **Cable inlets** in the base and top panels
- **Brush strips or rubber clamp profile** on cable inlets (protection against foreign bodies)
- **Lateral space for cable guidance**
- **Cable guidance clip on sides**
- **Ventilation slots** integrated in the side walls or rear wall (rear doors)
- **Dust protection** which can be fitted out for IP 21 or better

- **Forced ventilation only as required;** Roof fan with thermostat for heat dissipation in all cabinets in a row.

  The heat dissipation of active equipment is covered in section 2.4.3, p. 14.
- **Tray (device base),** telescopic, perforated tray, min. load 50 kg.
- **Mains connection** via multipoint connector (multipoint connector with at least 6 sockets), **without** mains filter, positioned at rear; Connecting cable with device plug, label to identify the mains power distributor

The cable routing in the cabinet may not hamper the installation of the active components. Similarly, the accessibility of the components (cable, splice box, etc.) must be guaranteed after the installation of the active devices.

Figure 7 (next page) shows examples of cabinet configurations for various numbers of communication connections.

For cabinet configurations branch-specific specifications apply.

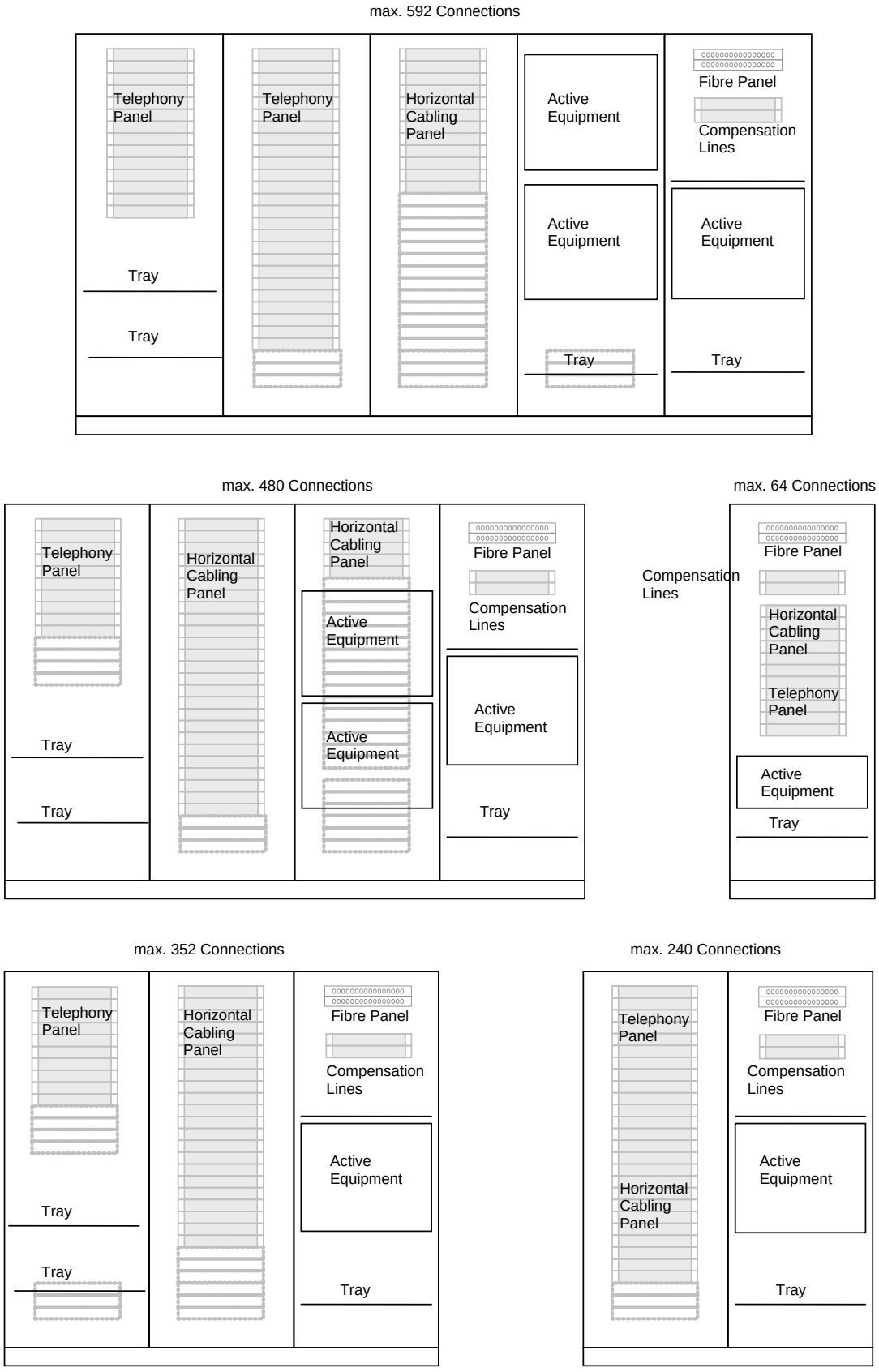


Figure 7: Examples of cabinet layouts and configurations.

2.5.10 Panels for optical fibre and copper connections

The panels (for IT or telephony) shall meet the following requirements:

Optical fibre (OF)

The panels for installation of the optical fibre connectors must be designed as follows:

- **Metal construction**
- **Modular, flat design** with 19" rack module (no compact systems)
- **High connection density,** preferred type: 24 connector positions per rack unit (RU)
- **Space for labels:** there must be enough space on the front panel for adhesive labels
- **Drawer for reserves and splices**
- **Cable guidance clips** mounted on both sides.

Twisted-pair cable (TP)

The panels for installation of the RJ45 connectors must have the following properties:

- **Metal construction**
- **Modular design**
- **Connection density:** preferred type is 16 connectors per rack units (RU)
- **Space for labels:** there must be enough space on the front panel for adhesive labels or engraved plates
- **Prepared earth terminals:** earth terminal mounted insulated against frame;
  the separate, low-impedance earthing of each cable shield via an earth terminal must be possible.

Telephony panel (voice panel)

Voice panels (e. g. 25 RJ45 connectors per RU) can be used for terminating telephony trunk cables.

2.5.11 Extensions and subsequent cabling

In the event of extensions to the building or any subsequent cabling, the same products are to be used as for the existing cabling.

If not possible, products according to the directions of the GCC project manager shall be used.

3 Earthing and overvoltage protection concept

This chapter describes EMC measures, in particular earthing, bonding and overvoltage protection.

3.1 Introduction and goals

In order to ensure the trouble-free operation of the various systems connected by the generic communication cabling and to minimise the risk of damage due to lightning surges, special attention must be paid to the aspects of earthing, equipotential bonding, overvoltage protection and electromagnetic compatibility (EMC).

3.2 Planning principles

The following principles shall be observed when planning and implementing generic communication cabling systems ("cookbook solutions" are not possible):

- The elaboration of a defined *earthing concept* that is adapted to the requirements of the relevant systems (voice communication, data communication) and the types of cables used.
- An optimum arrangement of vertical riser zones in terms of lightning protection.
- The avoidance of low-frequency compensating currents via GCC links.
- The avoidance of disturbances such as lightning and switching surges in lines of a GCC.
- The limitation of line-conducted lightning surges to a value that is harmless for the devices connected to GCC lines.
- Compliance with the *Principles of SEV on Lightning Protection* for buildings where a lightning protection system exists or is planned.

3.3 Measures

The following measures must be taken to implement the EMC planning principles:

3.3.1 Defined earthing concept

For **each** GCC system a defined, EMC-compatible earthing concept is to be drawn up.

Safety requirements according to NIN (cf. [9]) and the requirements of applications using the GCC have to be taken into account.

The earthing concept must ensure that no interference caused by low frequency compensating currents and no damage caused by lightning strikes occurs in the GCC system.

The generic use of the GCC cabling may not be restricted by the earthing concept.

From an EMC point of view, low-impedance bonding shall be practised. If present metallic cable pathways shall be reliably bonded with low impedance with each other and integrated in the equipotential bonding system (EBS).

Earthing of metallic cable shields can be accomplished by **single point earthing** or **multipoint earthing.**

Single point or multipoint earthing?

- If the mains supply is *not* designed according to system TN-S then single point earthing shall be used.
- If the whole mains supply is designed according to system TN-S and if there is only a minimal risk of field coupling due to lightning, then either principle may be used.

A) Principle of single point earthing

The principle of **single point earthing** for voice communication is an optimal solution for the prevention of low-frequency currents over cable shields. In combination with surge protectors on the mains side it reduces the risk of damages due to overvoltages caused by lightning to a low value. Single point earthing shall be used if the mains supply is *not* designed according to system TN-S.

All metallic cable shields are only earthed on the telephony main distributor. It is the central earthing point for this system area. It is the only connection to the earthing system of the building.

All voice communication equipment, for example connecting hardware etc. must be insulated against the building earthing system and against external systems (e.g. data communication systems).
To ensure a sufficient isolation also against lightning an electric strength of 10 kV (1.2/50) must be achieved.

In the communication cabinets (distributor rooms), the connection to the horizontal cabling (TOs) is made by means of shielded patch cables.

In the area of data communication the secondary cabling is always optical fibre cable and thus poses no problems in terms of EMC.

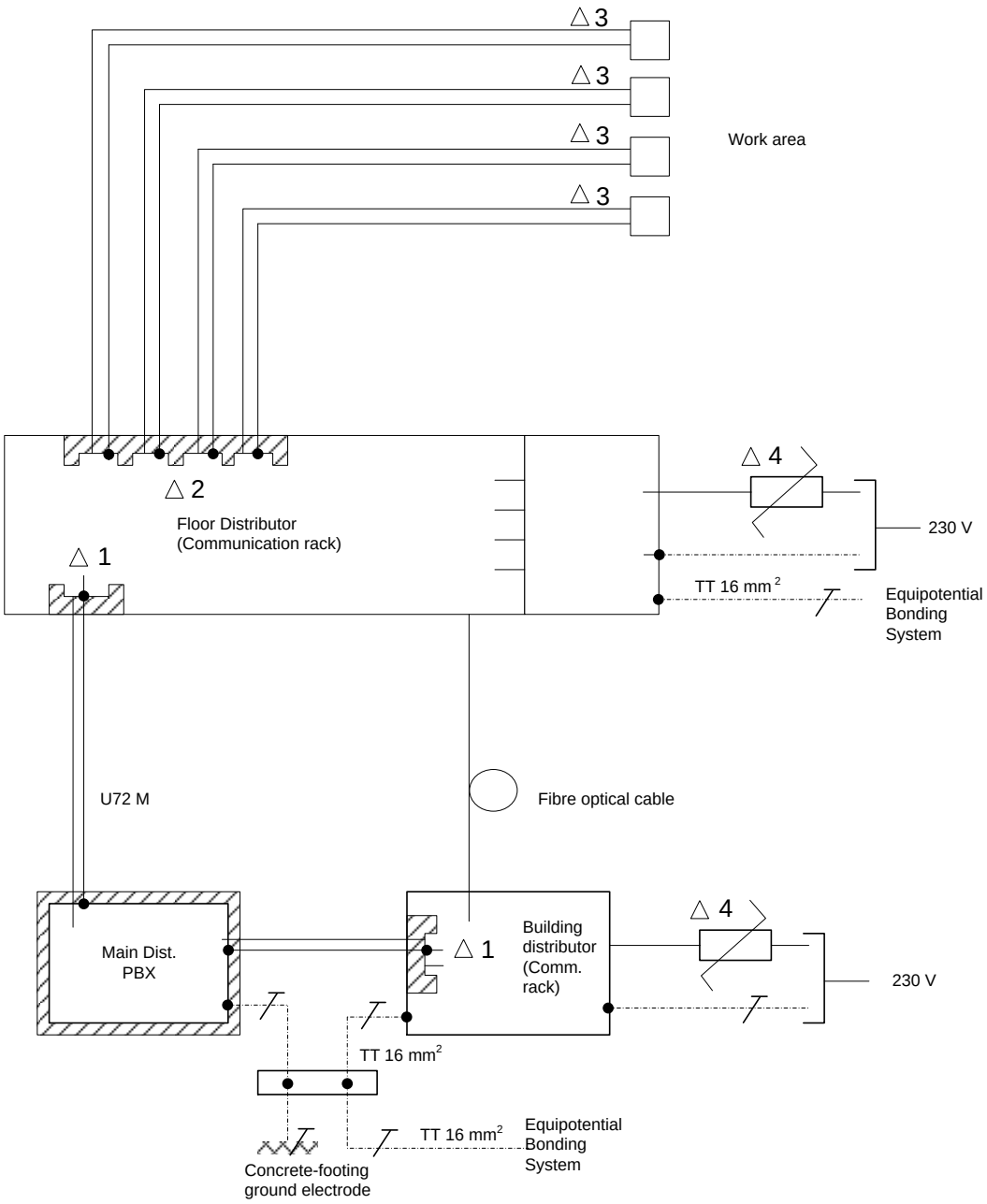
Copper cables are used for the tertiary cabling between the communication cabinets and the TOs in the work area. These lines shall be installed for universal use. Therefore the earthing of cable shield is very important.

If the lines are used for data communications the cable shields are earthed via the active components in the communication cabinet (central earthing point).

If the lines are used for voice communication (telephony) cable shields are earthed via the distributor of the PBX via trunk and patch cables.

All TOs must be isolated by at least 10 kV (1.2/50) against each other and against the building earthing system.

More detailed information is shown in the conceptual drawings on the next pages.



△1 TOs isolated against rack construction and against Δ2
△2 TOs isolated against rack construction and against each other
△3 TOs isolated against building earthing system and against each other
△4 Overvoltage protection device SPD Type 3
Earthing conductor

Figure 8: Principle of single point earthing.

B) Principle of multipoint earthing

The principle of **multipoint earthing** of cable shields, telephony main distributor and communication cabinets may only be applied if the whole mains supply is designed according to system TN-S and if there is only a minimal risk of field coupling due to lightning.

For voice communication cabling the principle of multipoint earthing is applied. All metal cable shields are earthed in the telephony main distributor *and* in the communication cabinets.

In the area of data communication the secondary cabling is always optical fibre cable and thus poses no problems in terms of EMC.

Copper cables are used for the tertiary cabling between the communication cabinets and the TOs in the work area. These lines shall be installed for universal use.
The cable shields of these lines are earthed directly in the communication cabinets. There is no need for an electrical isolation between connecting hardware and building earth.

More detailed information is shown in the conceptual drawings on the next pages.

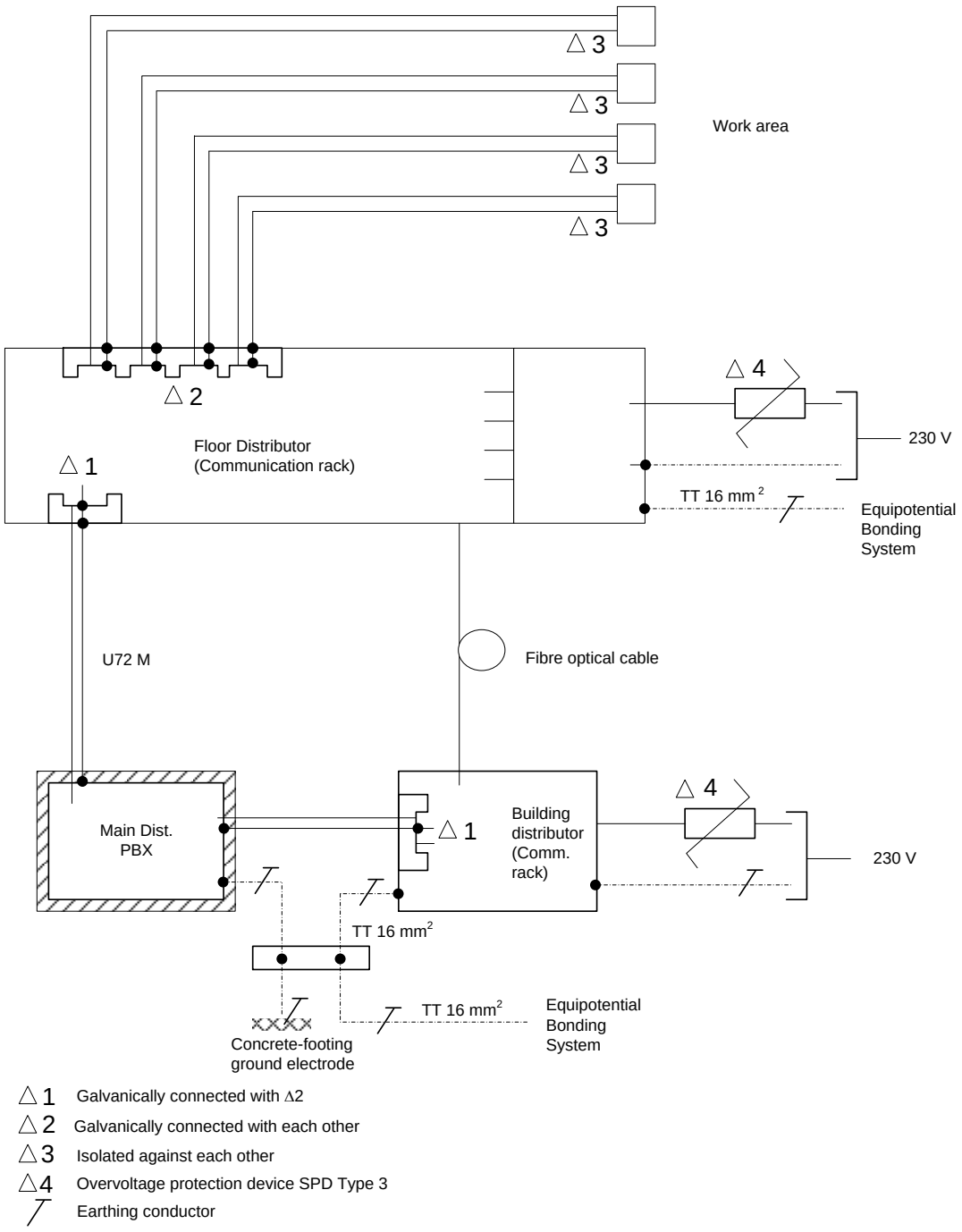


Figure 9: Principle of multiple point earthing.

3.3.2 Arrangement of the riser zones

Vertical riser zones around the periphery of the building shall be avoided for lightning protection reasons.

Wherever possible, the riser zones for the generic cabling and mains power (low voltage) installations shall be arranged alongside each other. This prevents a large-scale loop between the generic cabling and mains power supply (230 V), which has proven particularly disadvantageous when connecting equipment of protective class 1.

3.3.3 Low voltage installations

All mains power installations (low voltage) must meet the requirements of NIN [9].
In order to avoid any disturbances, no neutral conductor (N) compensating currents may be allowed to flow through the generic communication cabling.

This requirement can be met if all mains power (low voltage) installations for apparatuses and devices that are connected to a shielded GCC are designed in accordance with the layout **TN-S**.

For existing installations with feeds to the sub-distributors in accordance with TN-C for which a change to TN-S cannot be realised for technical or financial reasons, an individual solution must be found. The measures to be taken must be decided on a case-by-case basis by the relevant building and properties service.

The feeds to the mains sockets from the sub-distributor for apparatuses and devices that are connected to GCC must always be in accordance with **TN-S**.

3.3.4 Overvoltage protection measures

Whether or not an external lightning protection system exists, the main equipotential bonding system (EBS) of the building must be checked when implementing a GCC. The EBS must be supplemented if necessary.

In order to avoid damages due to line-conducted surges, the mains power (low voltage) supply shall be equipped with surge protection devices (SPD).

The overvoltage protection concept is based on a selective graduation of the corresponding protection devices. It is structured in the following way:

Low voltage main distributor (LV-MD):
Lightning conductor SPD type 1 (formerly class B).
Use of a combination overvoltage protection device SPD type 1 which has a sufficiently high lightning current protection capacity and a sufficiently low overvoltage limitation capacity.

Low voltage sub-distributors (LV-SD):
Overvoltage protector SPD type 2 (formerly class C).
Depending on the installation and under certain circumstances, an overvoltage protector SPD type 2 might not be necessary in the LV-SD if a combination overvoltage protection device SPD type 1 is used in the LV-MD.

Communication cabinets:
The mains power (low voltage) for active components in the communication cabinet is connected directly to an extra overvoltage protection device SPD type 3 (formerly class D) before it enters the communication cabinet.

No remote signalling of the overvoltage protection devices is needed. A correct placement and wiring of the overvoltage protection devices is absolutely essential for an effective overvoltage protection.

Further details of the overvoltage protection measures to be realised are shown in the conceptual drawings.

3.3.5 S/FTP cabling outside of buildings

S/FTP cabling links outside of buildings shall be avoided.

Two buildings may be connected by S/FTP copper cables only in justified, exceptional cases.

The conductors are to be wired with corresponding overvoltage protection devices at both ends.

Special attention shall be paid to the earthing of the cable shield. The cable shield is earthed directly in the communication cabinet and indirectly at the workstation socket via an overvoltage protection device. If problems still arise during data transfer due to low voltage compensating currents despite extensive equipotential bonding in both buildings, active equipment of protection class 1 must be operated in the auxiliary building via isolating transformers.

The relevant Building and Property Organisation (BLO) shall be contacted if this problem arises.

Figure 10 shows the earthing and overvoltage protection measures for copper connections between 2 buildings.

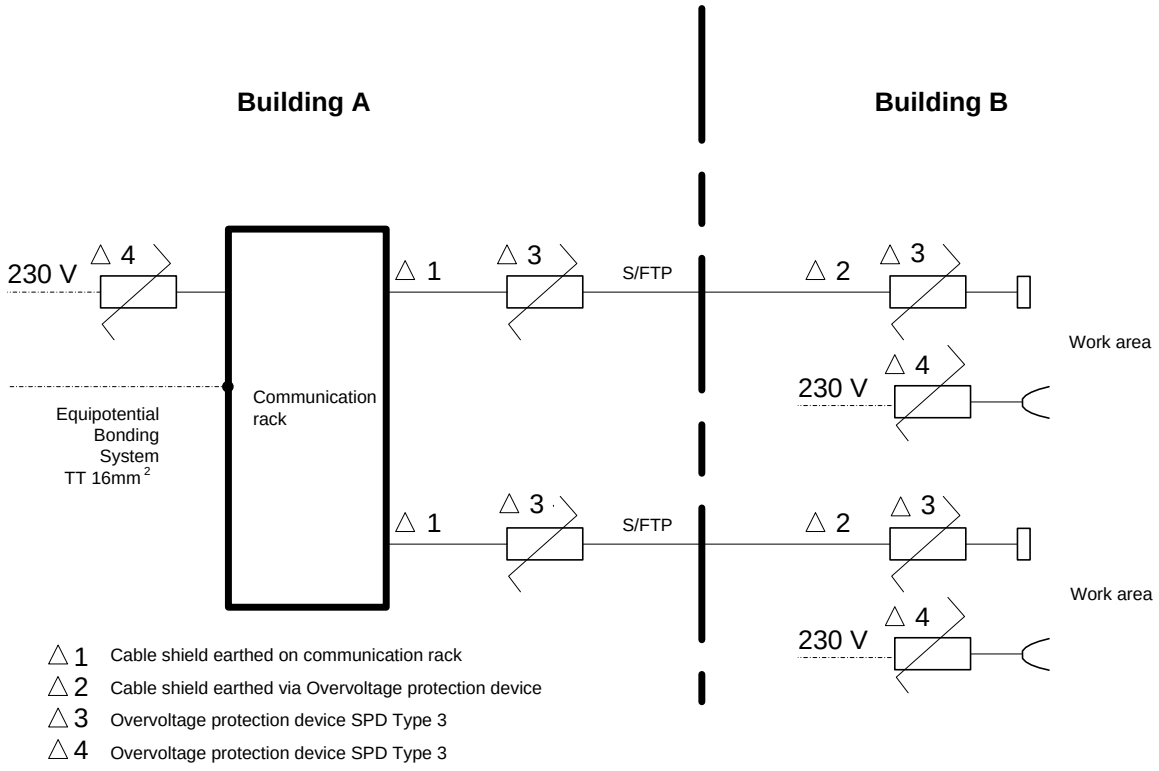


Figure 10: Earthing and overvoltage protection measures for copper connections between 2 buildings.

3.4 Project approval

For all EMC measures in connection with a GCC project documents must be drawn up and submitted for approval (cf. Section 6.1, p. 34).

3.4.1 Earthing and overvoltage protection measures (concept)

Figure 11 shows an overview of the earthing and overvoltage protection measures for mains low voltage installations.

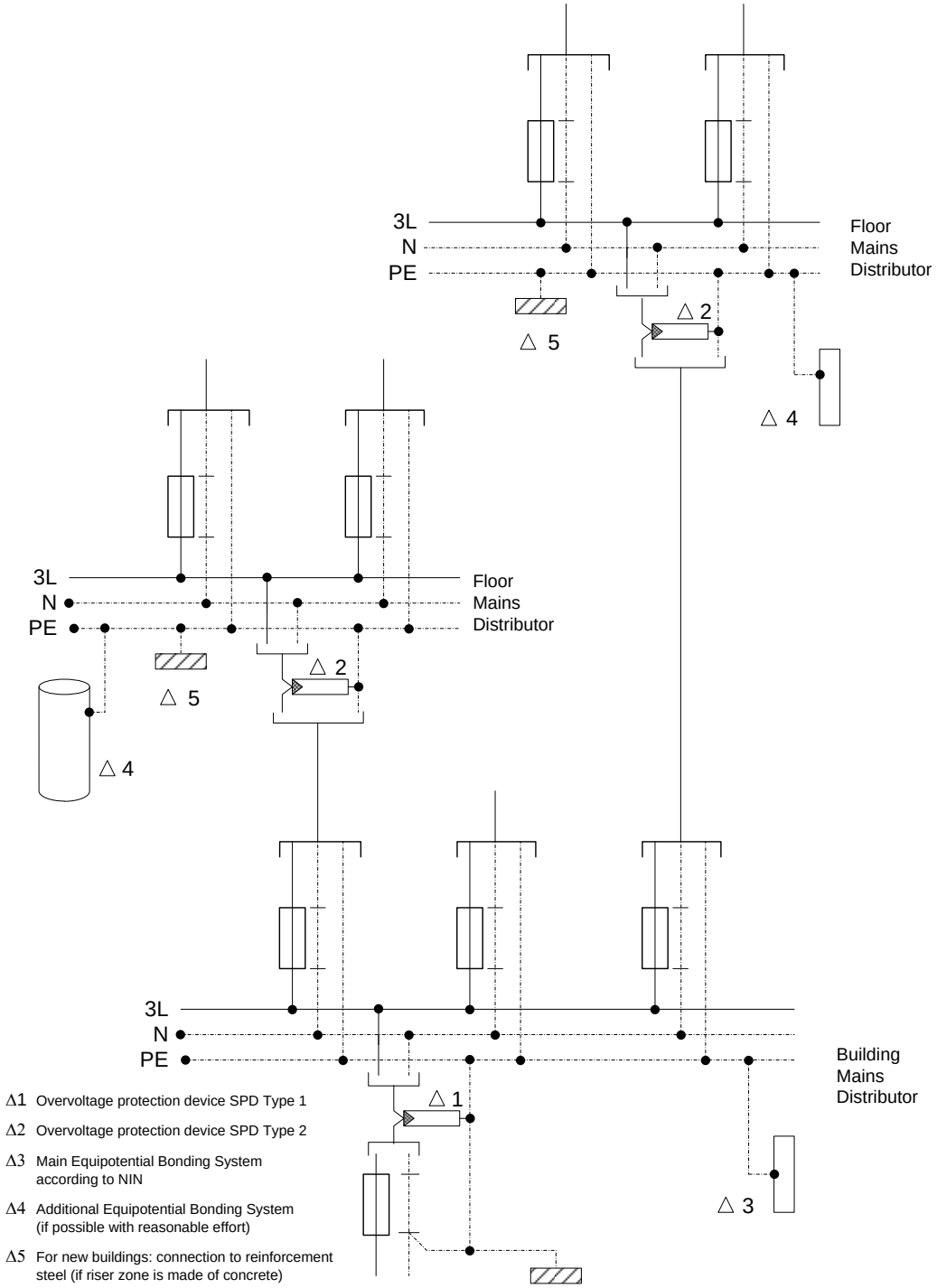


Figure 11: Earthing and overvoltage protection measures.

3.4.2 Earthing and overvoltage protection measures (detail)

Figure 12 shows the earthing and overvoltage protection measures for mains low voltage installations in detail.

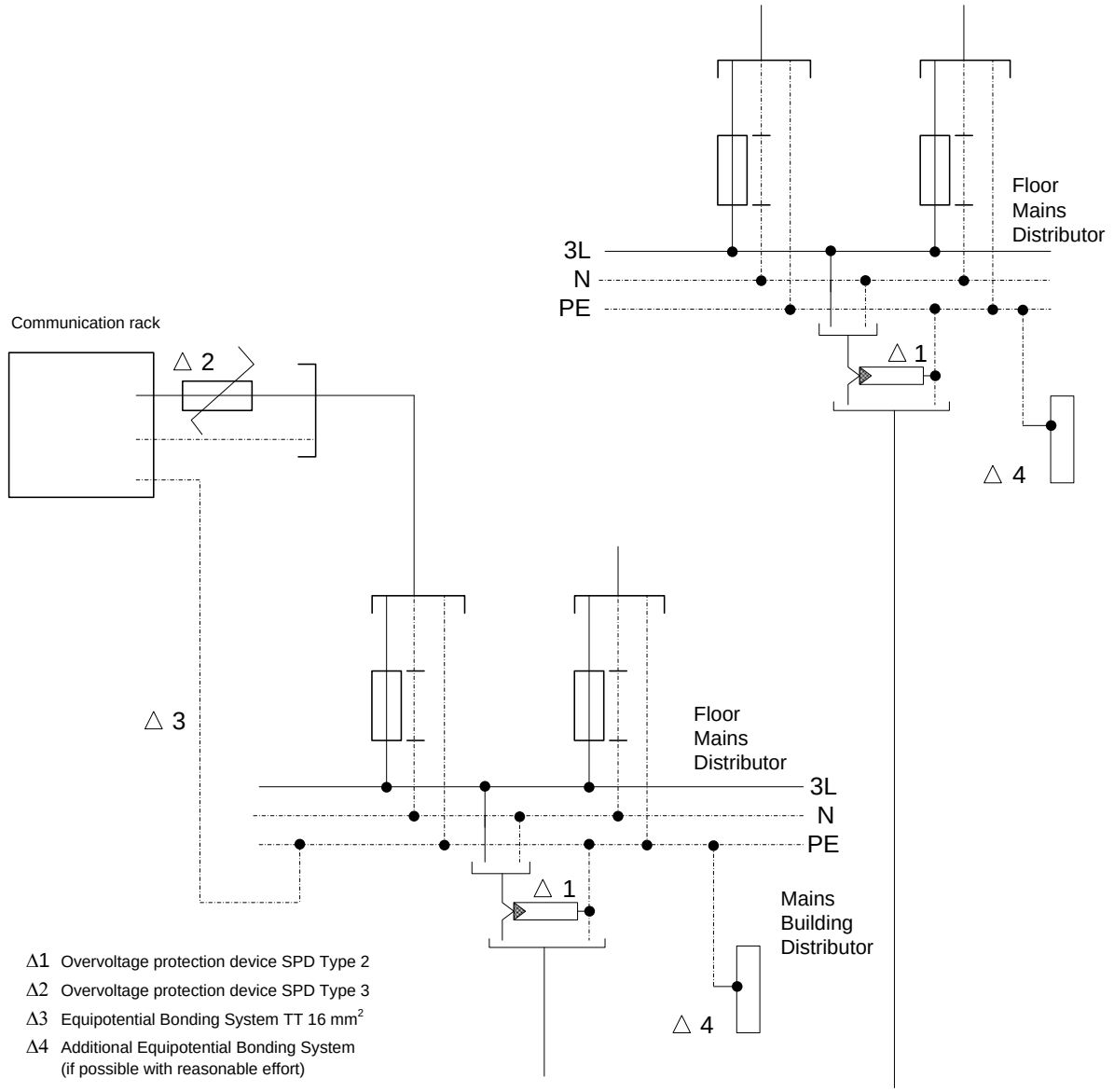


Figure 12: Earthing and overvoltage protection measures.

4 Installation

4.1 Connection plan (RJ45)

As shown in Figure 13, all GCC connections shall be connected in accordance with **EIA/TIA 568 A**.

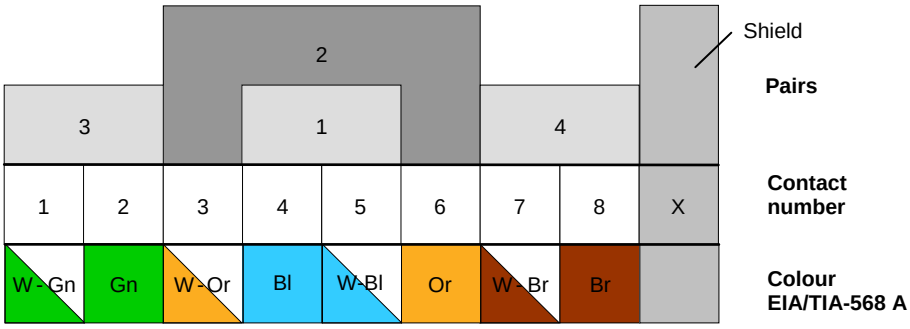


Figure 13: Connection according to EIA/TIA 568 A.

4.2 Work area connections

Dimensioning:
To allow for possible additional installations or a system change in the future the dimensioning of the workplace connection pathways (trays, dado trunking, etc.) shall be planned at 250% (150% reserve) of the initial design (number of connections). There shall be a working space of at least 15 cm above the cable lines.

Configuration:
A suitable configuration is dado trunking connected via cable trays along the ceiling.
Skirting or floor trunking as well as pipe installations are less suitable.

Partitions:
Fire-retarding sealing and soundproofing measures shall be provided for all installations. These must be restored after any changes to the GCC installation.

Installation and cable reserve:
The cables must be laid and connected in such a way that it is possible to replace the RJ45 connectors by other standardised connectors at a later point in time without having to change the cable, too. This calls for an adequate cable reserve.

4.3 Riser zones

Riser zones shall be dimensioned to 300% (i.e., 200% reserve). Easy access and an operating area of at least 15 cm must be guaranteed.

4.4 Bending radius

The manufacturer's recommendations concerning bending radius shall be observed.

4.5 Cable fastening

Cable fastening devices must be applied in such a way that the proper function according to manufacturer's specifications is achieved.

4.6 Cable separation

Wherever possible, GCC cables shall be installed in a separate line and not in the same pathway as cables from other applications.

In order to minimize the loop area GCC and mains cables shall be installed in parallel. The minimum distances according to EN 50174-2 [6] shall be met.

GCC cables shall be kept at least 130 mm away from fluorescent lamps, neon lamps, mercury discharge lamps and other gas discharge lamps.

4.7 Labelling concept

The labelling concept is branch-specific.

5 Quality requirements

5.1 Permanent Link (S/FTP cable)

In the permanent link (S/FTP cable and RJ 45 connectors) only links **of at least class E_A** are allowed.

This permanent link may not be more than 90 m long **(paying heed to branch-specific maximum lengths)**. Other copper cables (e.g. U72M) are not permitted.

The following requirement applies:

Each link is a permanent link, class E_A according to EN 50173-1, S/FTP 100 ohm, 8-wire, 4 x 2 with at least 4 dB reserve in NEXT.

The **channel**, consisting of:

- a maximum 90 m long permanent link,
- a maximum 5 m long patch cable and
- a maximum 5 m long connecting cable

may therefore **not be longer than 100 m**.

The channel must comply with at least the requirements of class **E_A** according to [2].

The patch cable must comply with at least the requirements of Category **6_A** according to [2].

5.2 Optical fibre links

The following requirements apply for optical fibre links:

1) Each link is a *permanent link* meeting all requirements of chapter 8 *(Optical Fibre Channel Performance)* of ISO/IEC 11801.

2) Each connection has a maximum attenuation that is no larger than the planned attenuation (attenuation budget).

The planned attenuation is calculated from the attenuation of the fibre, the attenuation of splices and the attenuations of connections.

Compliance with the planned attenuation is a good check for the proper handling and installation of an optical fibre cable.

6 Quality assurance

6.1 Project approval

Project documents must be drawn up and submitted to the GCC project manager for approval for each generic communication cabling (GCC) project.

These project documents include:

- Determination of needs, i.e., quantity structure of the GCC connections and supported systems
- Scope and type of generic cabling
- Network design
- Design of the PBX
- Design of the communication rooms
- Design of the communication cabinets
- Design of the pathways
- Configuration and design of the work area connections
- Mains low voltage feed concept
- Earthing concept
- Overvoltage protection concept

6.2 Testing copper and optical fibre

Before carrying out the measurements the GCC project manager shall be contacted.

6.2.1 Testing copper

After successful GCC installation, the completeness and functionality has to be ensured by a test of every single cabling link. The field measurement method shall allow for a compliance check with the required application **class E_A** according to EN 50173.
Using the measurement method according to IEC 61935-1 it shall be verified, that the requirements of EN 50173 are met.

In the case of a new generic cabling installation which has to fulfil application class E_A in accordance with ISO/IEC 11801 and EN 50173, a permanent link measurement, including all parameters according to ISO/IEC 11801 and EN 50173 for application class E_A, must be carried out by the contractor with the appropriate measuring equipment for each and every cabling link.
The location and time, ambient temperature, exact description and settings of the measuring device, labelling of the cable segment as well as the name of the test engineer must be recorded.

Care shall be taken during measurements that the measuring device settings are correct (test standard, application class, NVP, etc.). The conditions specified by the measuring device manufacturer (calibration, storage, etc.) must be observed.

The labelling of the GCC links in the installation and on the test protocol must correspond exactly.
All measurement data shall be saved in the original file format of the measuring device.

The test protocol shall be saved electronically in the original file format.

All values for all measured parameters must be saved. The protocol may not, for example, contain only the attenuation value for pair 7-8, but must contain the attenuation values for all other pairs, as well.

Measurement protocols must be saved in the original file format and as a PDF. An appropriate viewer must be provided on the data medium. Additional data formats are to be agreed upon with the GCC project manager.

6.3 Testing optical fibre

After successful installation, the contractor must ensure the completeness and functionality of each and every single fibre link through measurement (in particular with respect to the correct laying and splicing).

The following parameters must be measured for each fibre link using an *Optical Time Domain Reflectometer (OTDR):*

- Attenuation profile along the fibre,
- Splice, connector and overall attenuation,
- Echo time and length of the fibre link.

The measurements must be carried out from both sides (bidirectional measurement). A launch cord and a tail cord shall be used. An average value must be determined for attenuation.

Multimode fibres shall be measured at 850 and 1300 nm.

Singlemode fibres shall be measured at 1310 nm and 1550 nm. Upon agreement with the GCC project manager measurements at 1623 nm shall also performed.

The test protocols for each fibre connection must contain the place and time, ambient temperature, exact description and settings of the measuring device, name of the test engineer, labelling of the distributor and cable section, fibre type, fibre number, wavelength (of measurement), pulse width, refraction index of the tested fibre and refraction index set in measuring device, tolerance data for reflection, length of leading and trailing fibre, fibre length, overall attenuation (incl. connectors), attenuation of connectors and attenuation of splices.

Graphic diagrams of the measured parameters are desirable. The overall attenuation values shall always be compiled in an overview table. An attenuation balance shall be drawn up. The measuring set-up must be documented.

The test protocol shall be saved electronically on an agreed upon medium (e.g., CD) with all measured parameters. All values for all measured parameters must be saved.
All measurements must be saved in the original file format of the measuring device and as a PDF. An appropriate viewer must be provided on the data medium.

Additional data formats are to be agreed upon with the GCC project manager.

6.4 Project quality management (PQM)

A project quality management covering the following main topics shall be implemented:

- Costs: cost estimates, budgeting, contracts and assumed final costs
- Conceptual principles
- Manufacturer's and system warranties
- Liability for defects in workmanship

- Routine checks, routine installation monitoring by the contractor's project supervisor and by the commissioned planner.
- Ambient conditions (temperature, humidity, etc.). These requirements must be observed during delivery, storage and handling and throughout the service life of the installation and may not have any negative effects on the cabling.
- Space requirements in duct systems in which sockets are installed
- Space requirements and accessibility in the installation pathways: There shall be a working space of at least 15 cm above the lines.
- The technical requirements and guidelines of the component manufacturers must be observed in all phases (storage, installation, connection, wiring, bending radius, tensile force, ambient temperature, etc.)
- Incoming goods inspection (delivery check): incoming goods inspection or testing of the cabling components. The individual components shall be checked (by visual inspection or measurement) before they are installed.
- System compatibility: compatibility of the cabling components must be guaranteed by the contractor.
- Factory test report: The documents delivered with the components (e.g. optical fibre measurement report, article numbers, etc.) must be retained. A copy must be included in the documentation.
- Competence of personnel: Installation work may only be carried out by trained technicians.

6.5 Final acceptance

Conditions for final acceptance of a GCC are:

- With large projects a sampling procedure and interim inspections shall be defined with the GCC project manager so that errors can be detected early in the project.
- Preliminary testing (technical test) is carried out by the commissioned planner on the basis of the corresponding test protocols from the owner and does not constitute acceptance in the sense of Art. 157 ff. of the SIA standard 118.
- Faults detected during the preliminary test are to be rectified immediately and before final acceptance.
- The system description (certificates, components etc.) and the measurement protocols for all data connections must be present for final acceptance.
- The final acceptance is carried out by the owner and commissioned planner after a successful preliminary test and on the basis of the owner's acceptance report. The completely revised and updated project documentation must be submitted at the final acceptance.
- In the event that the contracted works and services are not provided completely or the systems do not function flawlessly, the contractor must carry out the necessary improvements at his own expense. The building owner reserves the right to charge for repeated final acceptances procedures necessitated by deficiencies on the part of the contractor.

7 Documentation

Every generic communication cabling (GCC) system shall be documented in the format agreed upon with the owner. The structure is specified in detail below. The cabling documentation is part of the project documentation and must be included in the project files.

Contents:
The project file and/or every sub-project file must be structured according to the following specifications:

- **Project organisation**
- **Brief description** and **installation overview**
  shall normally not be more than one page and shall contain details of the project (incl. name of project manager of planning engineers) and execution (such as time frame for installation, technical supervision, contractor, etc.).
- The installation overview is based on conceptual drawings showing the following:
- **Geographical location** of the building
- **Structure** of the cabling system
  with the exact room names of the distributor locations and number of telephone inputs, optical fibre connections and terminal connections for each distributor.
  The relationships between the individual rooms and the corresponding communication rooms must be apparent in the layout plans.
  The structure of the telephony trunk cabling, if applicable with exact names of rooms for coupling boxes and distributor locations, must be visible.
  If a paging system exists in the building, this shall also be shown in the structure.
- **EMC concept**
  Structure of the equipotential bonding system (weak and strong current), lightning protection, etc.
- Any further conceptual **features** of the GCC installation
  Problems, conceptual changes, and special considerations.
- **Configuration** of the distributors and cable installation lists
  with details of the position and labelling of all relevant components.
- **Front view of the distributors**
  Rack row showing the positions of the components.
  Main distributor or building distributor showing the position of the connections and type of VS83 strips.
- **Room layout** with position of the distributor racks (CD, BD, FD, telephony distributors, etc.)
- **Cable installation list** containing: precise description of the GCC connection (copper or fibre), terminal point of the cable (building, floor, room number), rack description, panel position, position in panel, comments, contractor, engineering firm and date.
- **Connection diagrams**
  These must be documented in full.
- **Numbering and labelling**
  These must be documented in full.
- **Installation plans**
  Layout plans and, if needed, sections/elevations showing the exact position of the cabling components (connectors, cable lines, riser zones, CD, BD, FD, telephony distributors, clocks, paging transmitters, distributor cabinets, etc.). The labelling for the components must be visible.
- **Components**
  This part shall be kept as neutral as possible and consist of a table listing all components with exact type designations as well as suppliers and data sheets for all relevant products.

- **Measurement protocols**
  A measurement protocol according to section 6.2 (p. 34) must be submitted for each cable segment.
- **Acceptance protocols** on forms provided by the owner
- **Data media**
  These (e.g., CD) contain the entire documentation in electronic form. The corresponding file formats are to be agreed upon with the owner's GCC project manager. Directories are to be created that correspond to the table of contents of the documentation, and the relevant files shall be saved in these.
- **Reserved for possible project-specific documents and miscellaneous**
  Problems, conceptual changes, special considerations, etc.
- **Labels for binders, title pages and registers:** These are sent in triplicate by the owner to the person or office responsible for producing the documentation.
- **Binders** for DIN A4 format shall be used.

Comment: Since the room names or even floor names can change in the course of a project, the owner's representative responsible for room coordination must be contacted so that the room names in the documentation correspond to the actual room names when the GCC documentation is submitted.

Annex

A References

B Abbreviations and technical terms

Annex A: References

The current KBOB recommendation is based on the following standards:

[1] **ISO/IEC 11801** ed2.1 Consol. with am 1 (2008-05)
Information technology – Generic cabling for customer premises.
- Including ISO/IEC 11801 Corrigendum 1 and Corrigendum 2
- Including ISO/IEC 11801-am1 ed2.0 (2008-04-18) Amendment 1 (Channel)

[2] **ISO/IEC 11801-am2** ed2.0 (2010-04-27)
Amendment 2 (Permanent Link)

[3] **EN 50173-1:**2007:
Information Technology – Generic Cabling Systems –
Part 1: General requirements.
- Including EN 50173-1:2007/A1:2009 (Amendment 1)

[4] **EN 50173-2:**2007:
Information Technology – Generic Cabling Systems –
Part 2: Office areas.
- Including EN 50173-2:2007/A1:2010 (Amendment 1)

[5] **EN 50174-1:**2009
Information Technology - Cabling installation –
Part 1: Specification and quality assurance.

[6] **EN 50174-2:**2009
Information technology – Cabling installation –
Part 2: Installation planning and practices inside buildings.
- Including EN 50174-2:2009/A1:2011 (Amendment 1)

[7] **EN 50174-3:2003**
Information technology – Cabling installation –
Part 3: Installation planning and practices outside buildings.

[8] **SN 429001**, Edition 1984
Electrostatic charges; classification and equipment of rooms.

[9] **SN SEV 1000**,
Low Voltage Installation Standard (NIN).

[10] CECC 86275-802 Detail Specification: Connector sets of assessed quality for optical fibres and cables - Type LSH-HRL universal

[11] KBOB Recommendation on the use of electric cables – retention of function and fire behaviour.

[12] SEV/ASV SIA Manual for generic communication cabling.

[13] EN 60794-1-2 Optical fibre cables - Part 1-2: Generic specification - Basic optical cable test procedures

[14] EN 50267 Common test methods for cables under fire conditions - Tests on gases evolved during combustion of materials from cables

[15] IEC 60754 Test on gases evolved during combustion of materials from cables

[16] EN 50265 Common test methods for cables under fire conditions - Test for resistance to vertical flame propagation for a single insulated conductor or cable

[17] IEC 60332 Tests on electric and optical fibre cables under fire conditions

[18] EN 50268 Common test methods for cables under fire conditions - Measurement of smoke density of cables burning under defined conditions

[19] IEC 61034 Measurement of smoke density of cables burning under defined conditions

[20] IEC 61754-2 Fibre optic connector interfaces - Part 2: Type BFOC/2,5 connector family

[21] IEC 61754-15 Fibre optic interconnecting devices and passive components - Fibre optic connector interfaces - Part 15: Type LSH connector family

[22] IEC 61935-1 Specification for the testing of balanced and coaxial
information technology cabling –
Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards

[23] ITU-T G.652 (11/2009) Characteristics of a single-mode optical fibre and cable

Annex B: Abbreviations and technical terms

Backbone cabling
An umbrella term for the ⇒campus and ⇒building backbone cabling of a ⇒GCC

BBL: Bundesamt für Bauten und Logistik
Federal Office of Buildings and Logistics

BD: Building Distributor
Distributor between the campus backbone and building backbone cabling

BIT: Bundesamt für Informatik und Telekommunikation
Federal Office of Information Technology, Systems and Telecommunication (FOITT)

BLO: Bau und Liegenschaftsorgane des Bundes
Federal Building and Properties Services

Building backbone cabling
The cabling links of a ⇒GCC between building distributors (BD) and floor distributors (FD)

Campus backbone cabling
The cabling links of a ⇒GCC between buildings on a campus.

Category (3, 4, 5, 6, 7, 8 ...)
A classification of symmetric copper cables and connectors according to ISO/IEC 11801 and EN 50173

CD: Campus Distributor
The central distributor of a ⇒GCC for several buildings on a campus

Class (A, B, C, D, E, F, FO)
A classification for cabling links according to ISO/IEC 11801 and EN 50173 based on their transmission properties.

Distributor
The interface between two levels of a ⇒GCC

EBS: Equipotential Bonding System.
The practice of intentionally electrically connecting all metallic non-current carrying items in a building

EMC: Electromagnetic Compatibility
The property of a system not to disturb its surroundings and not to be disturbed by this

FD: Floor Distributor
The distributor in a ⇒GCC linking the ⇒ building backbone cabling and the ⇒ horizontal cabling

GCC: Generic communication cabling
A cabling system that can be used for (almost) all communication applications; standardised in ISO/IEC 11801 and EN 50173

Horizontal cabling
Cabling between the floor distributor and telecommunications outlets at the workplace

ID: Intermediate Distributor (for classical telephony)

IEC: International Electrotechnical Commission
International standards organisation for electrical engineering

IP: Internet Protocol
A protocol on layer 3 of the OSI model. IP works without connections and with no guaranteed service quality.

ISO: International Organization for Standardization
International standards organisation in the field of general standards

ITU: International Telecommunication Union
International standards organisation for telecommunication

KBOB: Koordinationskonferenz der Bau- und Liegenschaftsorgane der öffentlichen Bauherren
Coordination Group for Construction and Property Services

LAN: Local Area Network
A network in a building or on a campus

LV: Low Voltage.

MD: Main Distributor (for classical telephony)

MMF: Multimode Fibre
Optical fibre with a typical core diameter of 50 or 62.5 μm; Multimode fibres have a lower bandwidth than ⇒singlemode fibres.

NVP: Nominal Velocity of Propagation
Propagation velocity of the signal in a cable

OF: Optical fibre.

PBX: Private Branch Exchange
Subscriber exchange for telephony; often referred in normal language as house exchange.

PQM: Project Quality Management
Project-based quality management

Primary cabling
⇒Campus backbone cabling

QA, QM: Quality assurance, quality management.

Riser zone cabling
Building backbone cabling, i.e. cabling between the building distributor and floor distributors

RU: Rack unit
1 RU = 44.45 mm.

SD: Site distributor
⇒Campus distributor

Secondary cabling
⇒Building backbone cabling (riser zone cabling)

S/FTP
⇒ Twisted-Pair cable with overall braid screen and with foil screened balanced elements

SF/FTP
⇒ Twisted-Pair cable with overall braid and foil screen and with foil screened balanced elements

S/UTP
⇒ Twisted-Pair cable with overall braid screen and unscreened balanced elements

SMF: Singlemode fibre
Optical fibre with a core diameter of approx. 10 μm. Singlemode fibres have a much higher bandwidth than ⇒multimode fibres.

SPD: Surge Protection Device
According to EN 61643-11, 3 categories

TO: Telecommunications outlet (communication socket)
The ⇒GCC connector at the work area.

Tertiary cabling
⇒Horizontal cabling

TP: Twisted-pair cable

UPS: Uninterruptible power supply

VILB: Verordnung über das Immobilienmanagement und die Logistik des Bundes
Ordinance on Federal Property Management and Logistics.

Wave impedance
The wave impedance of a cable characterises the relationship between voltage and current. In GCC systems 100 ohm cables have established themselves.