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SERIES K: PROTECTION AGAINST INTERFERENCE

EMC, resistibility and safety requirements and procedures for co-located telecommunication installations

ITU-T Recommendation K.58

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EMC, resistibility and safety requirements and procedures for co-located telecommunication installations

Summary

With the liberalization of telecommunications, many services are provided by several Operators on the same cable, and equipment owned by different Operators is installed in the same telecommunication facilities and in many cases these are interconnected with each other. Therefore, there is a possibility of trouble related to EMC, resistibility, and safety occurring. This Recommendation describes necessary steps to ensure safe and problem-free operation in multiple Operator environments. Co-location arising from telecommunication liberalization should be taken into account, and necessary subjects are described from the viewpoints of EMC, resistibility, and safety.

Source

ITU-T Recommendation K.58 was approved by ITU-T Study Group 5 (2001-2004) under the ITU-T Recommendation A.8 procedure on 29 July 2003.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

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CONTENTS

Introduction

With the liberalization of telecommunications, equipment owned by different Operators is installed in the same telecommunication facilities and in many cases these are interconnected with each other. In this situation, there is some possibility of problems occurring in relation to EMC, resistibility and safety. In multiple-Operator environments, requirements affecting EMC, resistibility and safety are necessary to ensure safe and problem-free operation. Therefore, this Recommendation describes minimum requirements and procedures for countermeasures in a co-location environment.

ITU-T Recommendation K.58

EMC, resistibility and safety requirements and procedures for co-located telecommunication installations

1 Scope

The purpose of this Recommendation is to provide safe and problem-free operation in a co-location environment.

The environment where equipment owned by several Operators is installed should be considered in this Recommendation. Environments that should be considered are:

– telecommunication centres;

– remote electronic sites;

– in some instances, the customer premises when the equipment owned by Operators is installed.

Minimum requirements are given in this Recommendation in order to ensure safe and problem-free operation and to reduce troubles affecting EMC, safety and resistibility. Main aspects are: safety for human and equipment, emission and immunity, resistibility against overvoltage and overcurrent, and earthing. The procedures and countermeasures that are used in case of trouble are also described in this Recommendation.

Requirements that are not related to EMC, safety and resistibility, are outside the scope of this Recommendation.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1] ITU-T Recommendation K.10 (1996), *Low frequency interference due to unbalance about earth of telecommunication equipment*.

[2] ITU-T Recommendation K.11 (1993), *Principles of protection against overvoltages and overcurrents*.

[3] ITU-T Recommendation K.20 (2003), *Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents*.

[4] ITU-T Recommendation K.27 (1996), *Bonding configurations and earthing inside a telecommunication building*.

[5] ITU-T Recommendation K.31 (1993), *Bonding configurations and earthing of telecommunication installations inside a subscriber's building*.

[6] ITU-T Recommendation K.33 (1996), *Limits for people safety related to coupling into telecommunications system from a.c. electric power and a.c. electrified railway installations in fault conditions*.

[7] ITU-T Recommendation K.34 (2003), *Classification of electromagnetic environmental conditions for telecommunication equipment – Basic EMC Recommendation*.

[8] ITU-T Recommendation K.35 (1996), *Bonding configurations and earthing at remote electronic sites*.

[9] ITU-T Recommendation K.37 (1999), *Low and high frequency EMC mitigation techniques for telecommunication installations and systems – Basic EMC Recommendation*.

[10] ITU-T Recommendation K.43 (1998), *Immunity requirements for telecommunication equipment*.

[11] ITU-T Recommendation K.44 (2000), *Resistibility tests for telecommunication equipment exposed to overvoltages and overcurrents – Basic Recommendation*.

[12] ITU-T Recommendation K.46 (2003), *Protection of telecommunication lines using metallic symmetric conductors against lightning-induced surges*.

[13] ITU-T Recommendation K.47 (2000), *Protection of telecommunication lines using metallic conductors against direct lightning discharges*.

[14] ITU-T Recommendation K.48 (2003), *EMC requirements for each telecommunication equipment – Product family Recommendation*.

[15] ITU-T Recommendation K.50 (2000), *Safe limits of operating voltages and currents for telecommunication systems powered over the network*.

[16] ITU-T Recommendation K.51 (2000), *Safety criteria for telecommunication equipment*.

[17] ITU-T Recommendation K.53 (2000), *Values of induced voltages on telecommunication installations to establish telecom and a.c. power and railway operators responsibilities*.

[18] ITU-T Recommendation K.54 (2000), *Conducted immunity test method and level at fundamental power frequencies*.

[19] ITU-T Recommendation K.60 (2003), *Emission limits and test methods for telecommunication networks*.

[20] IEC 60950-1:2001, *Information technology equipment – Safety – Part 1: General requirements and its Corrigendum 1*.

[21] IEC 60950-21:2002, *Information technology equipment – Safety – Part 21: Remote power feeding and its Corrigendum 1*.

3 Definitions and abbreviations

3.1 Definitions

This Recommendation defines the following term:

3.1.1 co-location: The environment where telecommunication equipment owned by more than one Operator is installed on the same floor or in the same building.

3.2 Abbreviations

This Recommendation uses the following abbreviations:

CBN Common Bonding Network

DSL Digital Subscriber Line

EMC Electromagnetic Compatibility

ESD Electrostatic Discharge

IBN Isolated Bonding Network

LCL Longitudinal Conversion Loss

MDF Main Distribution Frame

POTS Plain Old Telephone Service

4 Configuration and problems in a multiple-Operator environment

An example of an installation configuration for a multiple-Operator environment is illustrated in Figure 1. For co-location, equipment belonging to several Operators is installed close together and interconnected by interface cables. Furthermore, an earthing system, AC power supply, DC power supply, and MDF connected with a primary protector may be also shared by different Operators. One Operator may maintain the whole telecommunication installation of several Operators, or each Operator may maintain its own installation.

In this situation, the reliability and safety of equipment may be ensured by unifying equipment specifications or testing equipment installed in a telecommunication facility, when the equipment is owned by one Operator. However, in a multiple-Operator environment, reliability and safety are difficult to ensure by usual procedures applied for a single Operator environment, because different Operators have different equipment specifications and different working practices. Therefore, minimum requirements for equipment or systems related to EMC, resistibility, and safety should be established to avoid malfunction or damage arising from electromagnetic interference, and to ensure the safety of service personnel and customers. Moreover, ensuring problem-free operation requires providing an earthing method, a working procedure, and protection measures.

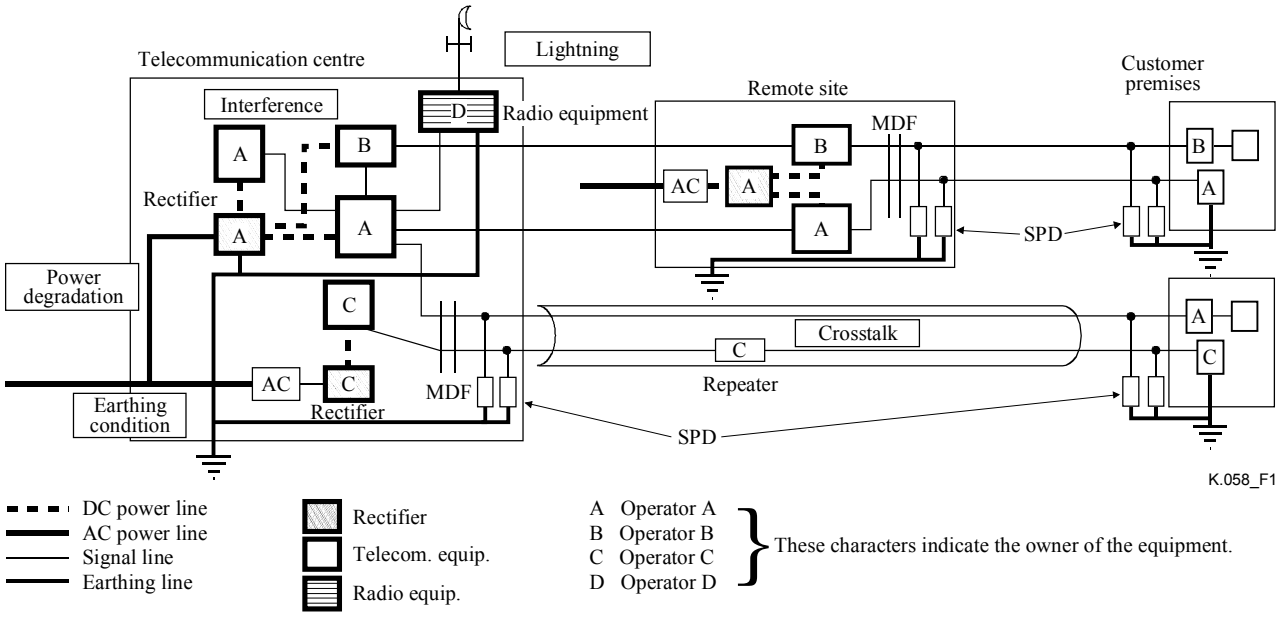

Figure 1/K.58 – An example of multiple Operators environment

5 Issues to be considered

1) *Electromagnetic interference*

Interference by both radiated and conducted emission should be taken into account, because telecommunication equipment may be installed close to radio equipment, and its power-feeding cable and telecommunication cable are interconnected between equipment owned by different Operators.

2) *Quality and stability of power supply*

There is a possibility of fluctuations in operating voltage occurring when another piece of equipment connected to the same power supply is turned on. Another possibility is that unintentional oscillations in the power feeding system could occur when the relationship between output impedance of the power system, load impedance, and inductance of the power line cable is in a specific condition. In the worst case, equipment connected to the system would break down.

3) *Lightning*

In the case of a direct lightning stroke at a telecommunication facilities building, lightning current flows from the radio tower or lightning rod to earth through building structure or radio equipment. In this case, a surge voltage is induced on its interface cable, or the lightning surge directly invades from the antenna feeder into the equipment through the interface cable, earthing and bonding cable, or power supply cable. The influence of these surges depends on the earthing and bonding configuration in the telecommunication facilities. Characteristics of the primary protector or earthing and bonding method are important factors to prevent a lightning surge invading from outside through a power feeding cable or telecommunication cable.

4) *Electrostatic discharge (ESD)*

An ESD problem may arise when measures for reducing ESD do not meet the immunity level of the equipment. Moreover, electrostatic discharge caused by service personnel of one Operator may cause a malfunction in another Operator's equipment.

5) *Emission beyond the telecommunication facilities*

When radio interference caused by emission from equipment in telecommunication facilities occurs in a co-location environment, it is difficult to investigate the source and apply mitigation measures. Operators should collaborate with each other to solve problems and take countermeasures.

6 Requirements

Requirements essential to ensure safe and problem-free operation in multiple-Operator environments are described as follows. Existing Recommendations are referred to, to avoid duplication. Where existing Recommendations cannot be applied, the following requirements are applicable. If additional requirements or enhanced requirements are required in national or other local regulations, Operators involved should discuss them and determine the solution. In some instances, special measures may need to be agreed upon between Operators.

6.1 Classification of environment

Classification of the environment complies with ITU-T Rec. K.34.

6.2 General conditions

Equipment and cables installed in a multiple-Operator environment shall comply with requirements for signals in interfaces, and characteristics required for operation.

6.3 Safety

6.3.1 Requirements for equipment

Telecommunication equipment shall comply at least with the IEC 60950 series, and with ITU-T Recs K.50 and K.51 for safety.

6.3.2 Requirement for working practices

Telecommunication equipment powered over telecommunication networks shall comply with ITU-T Recs K.50 and K.51 for human safety. Also, working practices in a particular environment shall comply with relevant standards for human safety. In cases of higher voltages or currents appearing, and in agreement with national limits, cautionary measures, such as labelling or marking, should be added at appropriate points to ensure that human safety is upheld.

6.4 EMC requirements

6.4.1 General EMC requirements

Equipment shall comply with the general EMC requirements described in ITU-T Recs K.43 and K.48. The performance criteria in general shall comply with the description in ITU-T Rec. K.43. The performance criteria for telecommunication equipment shall comply with the description in ITU-T Rec. K.48.

When interconnected equipment does not satisfy these requirements, the Operator may need to take appropriate measures, such as using a shield, installing an isolation transformer, common mode choke coil, and so on. Mitigation measures are described in ITU-T Rec. K.37.

6.4.2 Immunity requirements on the fundamental frequencies and its harmonics for induced voltage from power line or railway

The immunity level on fundamental frequencies (16⅔, 50 and 60 Hz) shall comply with ITU-T Rec. K.54. Harmonics of these frequencies should be taken into account in order to avoid problems.

6.4.3 Emission below 30 MHz

With the widespread use of broadband access system, such as xDSL, radiated disturbance from interface cable or equipment may interfere with the existing radio broadcasts and radio communication, such as from a radio amateur. This problem is related not only to radiated levels from cable, but also to cable characteristics, such as LCL and length, field strength of radio broadcasts, characteristics of radio receiver, and the number and kind of broadband services in the cable. It is recommended that Operators should take this phenomenon into account when equipment is newly installed.

Emission from broadband access systems shall comply with ITU-T Rec. K.60.

Emission below 150 kHz may cause disturbances and some mitigation measures may be necessary.

6.5 Resistibility

6.5.1 Basic requirements

Equipment installed in a telecommunication facility shall comply with resistibility requirement in ITU-T Recs K.20, K.21 and K.45 at least. When high resistibility is required, Operators may choose to Enhanced level of these recommendations. Guidance on choosing the Enhanced level is given in clause 5/K.44.

If a requirement in ITU-T Recs K.20, K.21 and K.45 is not satisfied or does not have the necessary protection defined in each country, Operators involved should discuss and take appropriate measures.

6.5.2 Primary protection

Guidance on installing a primary protector is given in ITU-T Rec. K.11.

6.5.3 Protection co-ordination

Not only equipment resistibility, but also protection co-ordination between operators shall be taken into account in the co-location environment. For example, if the spark over voltage of the SPD, which is connected to the cable into a telecommunication facility from outside, differs between interconnected equipment owned by different Operators, then an over-voltage may occur. Therefore, it is recommended that equipment in the co-location environment should have sufficient resistibility, and protection co-ordination between Operators should be taken into account.

6.6 Interface and port condition

6.6.1 Interface condition between telecommunication ports

If there is a possibility of EMC, resistibility, and safety problems occurring as a result of interconnection of a telecommunication cable between telecommunication equipment, it should be necessary to take appropriate measures.

6.6.2 Interface condition for power feeding system

6.6.2.1 Quality of DC power

In a co-location environment, a set of power supply equipment may be dedicated to only one Operator or may be shared by several Operators. In the latter case, clarification of the quality of DC power supply is important to avoid malfunctions caused by the power system and to ensure steady operation. Interference below 150 kHz should be studied as a measure of DC power quality.

The example of the DC power quality is shown in Appendix I.

6.6.2.2 Transition current, voltage fluctuation

In the case of shared use of power supply equipment, there is a possibility of existing equipment being affected by voltage fluctuation caused by current inrush when newly installed equipment is switched on. Malfunctions can be mitigated by limiting the current inrush by adding measures in the equipment or reducing the voltage dip by adding capacitor at DC power supply.

Immunity test for DC voltage perturbations shall comply with ITU-T Rec. K.48.

6.6.2.3 Equipment impedance as a load for power supply

DC power system oscillation might occur for a specific impedance of equipment connected to the DC power system, impedance of connected cables, and power equipment condition. This phenomenon should been taken into account when new equipment is connected to the DC power feeding system or equipment is disconnected from the DC power feeding system. In this case, inserting a capacitor at the output port of the DC power supply and/or cutting a feeder length short can solve the oscillation of the DC power system.

6.7 Earthing and bonding

Earthing and bonding performances are important for EMC, resistibility and safety. They can control emission and immunity especially in the low-frequency range in a telecommunication facility. Basic concepts of earthing and bonding in a telecommunication facility are described in ITU-T Recs K.27, K.31 and K.35. The installation shall comply with the requirements of ITU-T Recs K.27, K.31 and K.35.

7 Procedure for countermeasures

The procedure for solving a problem or taking measures against it in multiple-Operator environments is as follows.

7.1 Countermeasures against trouble

If trouble occurs in a constructed installation in accordance with the Recommendations, the following should be taken into account:

1) It takes a long time to change telecommunication equipment and it is difficult to add countermeasures to existing equipment. Countermeasures should mainly be done for newly installed equipment.

2) It is necessary for countermeasures to investigate the earthing system, search out its interference source, and identify route of noise. Therefore, Operators should collaborate to solve the problems.

3) In the case of a failure caused by noise from outside, such as a lightning EM field, induction from power or railway lines, the noise flows from one Operator equipment to another Operation equipment. If the earthing system, insulation method, and protective measures against lightning are suitable in accordance with relevant Recommendations, then Operators should not be blamed for any failures.

7.2 Safety

7.2.1 Procedure for solving trouble

In case trouble related to safety occurs, the causes of the trouble should be identified in accordance with the following procedure:

1) Equipment that causes safety trouble should be determined by measuring normal-mode or common-mode voltage or current in steady-state condition.

2) By specifying the reason why measured voltage or current has occurred by malfunction or by normal operation, the cause of the trouble may be identified.

3) In case of trouble caused by induction from the power line, the cause of trouble should be estimated from the fault record of the power line and the condition of telecommunication equipment.

7.2.2 Countermeasures

It is necessary to unify the requirements for human and equipment safety in a telecommunication facility shared by multiple operators. To ensure human safety, cautions, such as labelling or marking, are necessary. In cases of higher voltages or currents appearing, and in agreement with national limits, cautionary measures, such as labelling or marking, should be added at appropriate points to ensure human safety.

7.3 Emission and immunity

7.3.1 Procedure for solving trouble

In case emission or immunity trouble occurs, the causes of trouble should be identified in accordance with the following procedure:

1) Electromagnetic environment around the equipment should be measured. Disturbance sources that cause emission or immunity trouble is identified by analysing these measurement results. Probability of malfunction and situation of trouble are important information to identify the cause of trouble.

2) By clarifying the relationship between disturbance and trouble or signal and noise, the mechanism of malfunction will be evaluated.

7.3.2 Countermeasures

Countermeasures against problems related to EMC are described in ITU-T Rec. K.37. For example, inserting common-mode choke coil or isolation transformer is an efficient measure for a telecommunication cable interconnecting equipment. Electric or magnetic shielding is effective at preventing emissions from equipment.

7.4 Resistibility

7.4.1 Procedure for solving problems

In case resistibility trouble occurs, causes of trouble should be identified in accordance with the following procedure:

1) The invading route of overvoltage and overcurrent is determined by investigating the damage to an installation and checking the configuration of its system.
2) Protection measures for each Operator should be checked. Protection co-ordination between Operators should also be checked.
3) The appropriate protection measure, such as adding SPD or lightning-protection transformer, should be installed if the cause of the trouble is specified.

7.4.2 Countermeasures

Installing an SPD outside the equipment or inserting a lightning protection transformer is one countermeasure against overvoltage and overcurrent. In a multiple-Operator environment, not only resistibility of each equipment, but also protection co-ordination between Operators, should be taken into account.

Appendix I

Example for quality of DC power

Examples for quality of DC power are shown in Table I.1. More information or requirements can be found in relevant International Standards, such as [I.1].

Table I.1/K.58 – Example for quality of DC power

a) –48 V DC power system

	Value
Nominal voltage	–48 V DC
Normal service voltage range	–40.5 to –57 V DC

b) –60 V DC power system

	Value
Nominal voltage	–60 V DC
Normal service voltage range	–50 to –72 V DC

Bibliography

[I.1] ETSI EN 300 132-2V2.1.2 (2003), *Environmental Engineering (EE)*; *Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc)*.

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