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SERIES L: CONSTRUCTION, INSTALLATION AND
PROTECTION OF CABLES AND OTHER ELEMENTS OF
OUTSIDE PLANT

Electric power supply for equipment installed as outside plant

ITU-T Recommendation L.44

(Formerly CCITT Recommendation)

ITU-T Recommendation L.44

Electric power supply for equipment installed as outside plant

Summary

This Recommendation describes the provision of electric power supply for outside plants of telecommunication networks. It deals with the methods of power feeding and backup systems.

Source

ITU-T Recommendation L.44 was prepared by ITU-T Study Group 6 (1997-2000) and approved by the World Telecommunication Standardization Assembly (Montreal, 27 September – 6 October 2000).

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

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Introduction

Some equipment (e.g. repeaters) needing a power supply had existed before optical fibres were installed. At that time, electrical power had been mainly supplied from the central office by using a superimposition technique or by having insulated communication and power conductors in the same cable.

After optical fibres were introduced, many kinds of optical/electrical equipment which require a power supply system were installed into a telecommunication network, in order to increase capacity. The problem is that optical fibre cannot be used to directly transmit electrical power.

Power is supplied by one of three ways:

- to feed power from the central office by using metallic wires. To connect the power supply between the central office and the equipment, individual metallic cables or cables with both fibres and copper conductors may be used;
- to use a local power supply. In this method, one power supply provides power to all the equipment located within its area by using metallic cables or cables with both fibres and copper conductors. The numbers of equipment that can be supported in this way may be from two to several tens;
- each equipment has its own power supply.

This Recommendation deals with the methods of the power feeding and back-up systems.

ITU-T Recommendation L.44

Electric power supply for equipment installed as outside plant

1 Introduction

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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.

- [1] ITU-T Recommendation K.50 (2000), *Safe limits of operating voltages and currents for telecommunication systems powered over the network*.
- [2] ITU-T Recommendation K.51 (2000), *Safety criteria for telecommunication equipment*.

3 Power supply methods

In order to select a power supply method, telecommunication companies should consider:

- 1) the outage rate of commercial power suppliers;
- 2) the cost when using commercial power suppliers;
- 3) the time to repair power source failure.

Based on the suitability of the electric power supplies in each country, telecommunication companies should select a power supply method from the following.

3.1 Power supply from central office

3.1.1 Metallic transmission

In case of transmission with copper conductors, the superimpose method may be used in order to feed the electrical power. The basic configuration of this method is shown in Figure 1. Communication signals and electrical power are combined and launched on the same conductors or alternatively communication copper pairs and power copper wires (insulated conductors) are combined into one cable at the central office. The sent signal and power are divided at the electrical network unit (ENU).

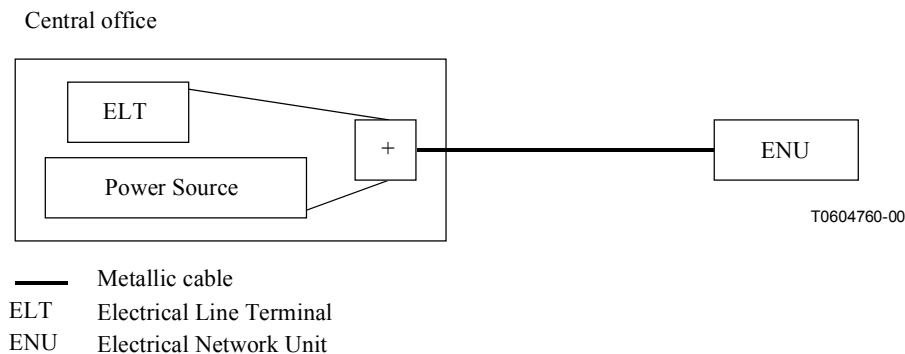
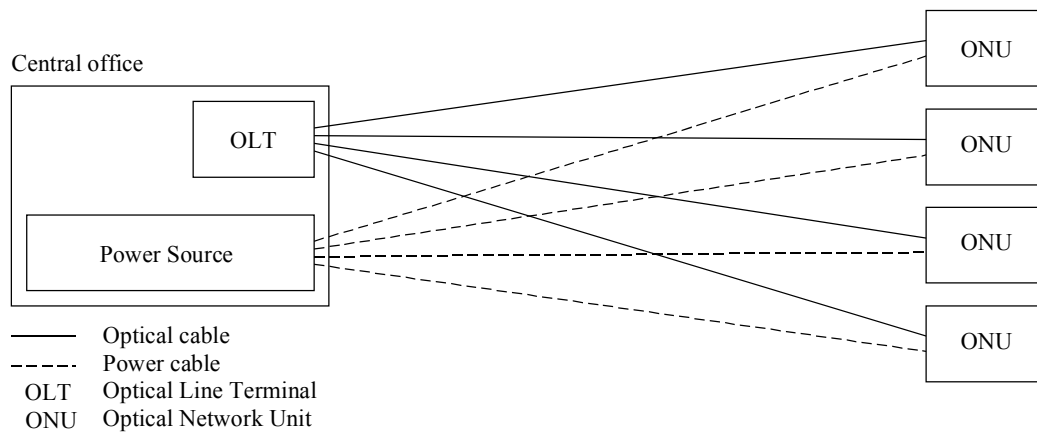


Figure 1/L.44 – Structure of power supply from central office (Metallic transmission)

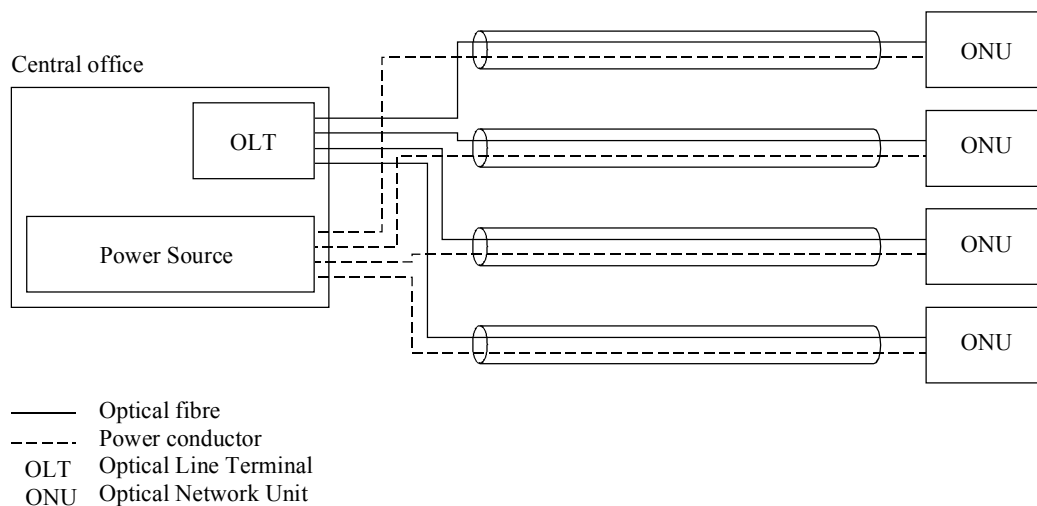
3.1.2 Optical transmission

When optical transmission is used, the basic structure of power supplies from the central office is shown in Figure 2. The power source is located in the central office. Power is fed by power cables or composite cables (power conductors and optical fibres). This method allows telecommunication companies to control the quality of electrical power (that is, those technical issues covering the stability of the current, voltage and frequency, and the outage rate). However, the telecommunication companies then have the duty to operate and manage power networks.



a) Individual cables for optical transmission and power feeding

T0604770-00



b) Power feeding through composite cable

T0604780-00

Figure 2/L.44 – Structure of power supply from central office (Optical transmission)

3.2 Local power supply

3.2.1 Metallic transmission

This type of power supply is not usual. The principle of this method is shown in Figure 3. Communication signals and electric power are combined either by superimposition or on separate conductors in the same cable between the local station and the ENU. Power is fed into the cables at the local station.

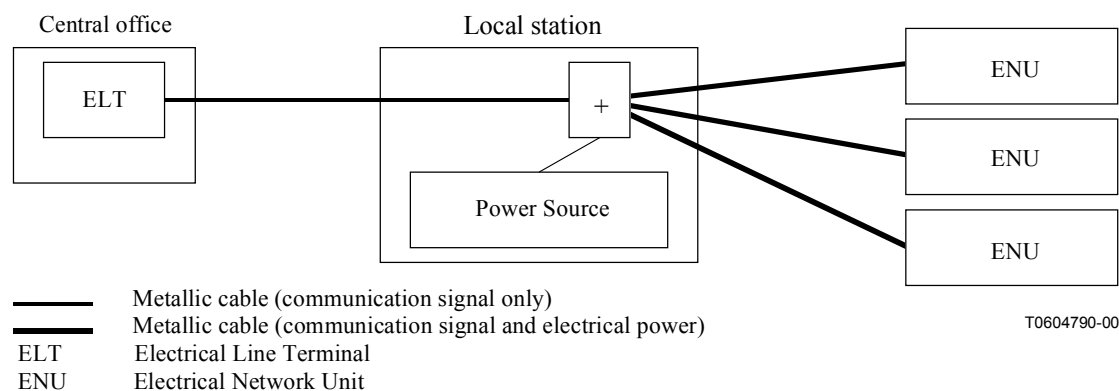
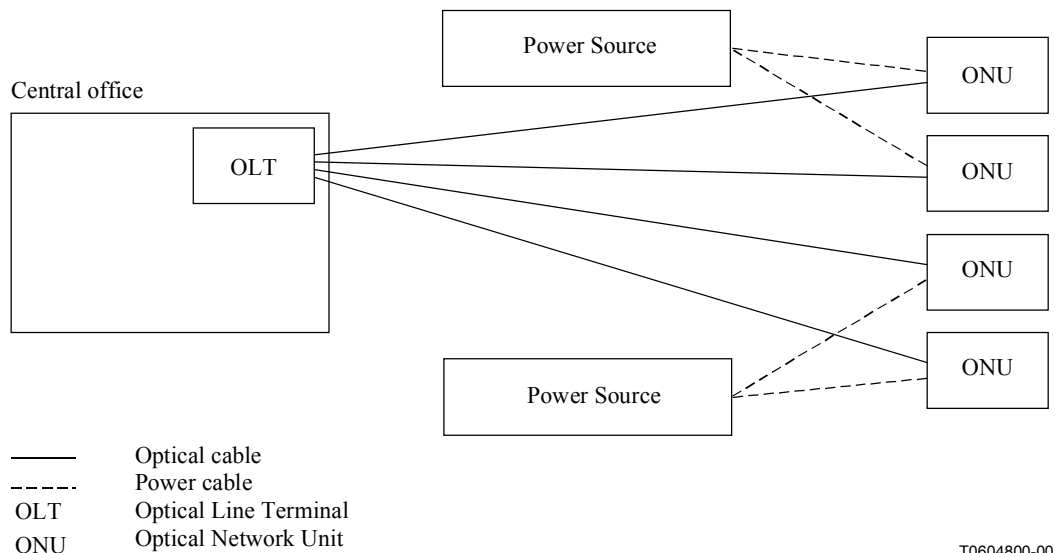


Figure 3/L.44 – Structure of local power supply (Metallic transmission)

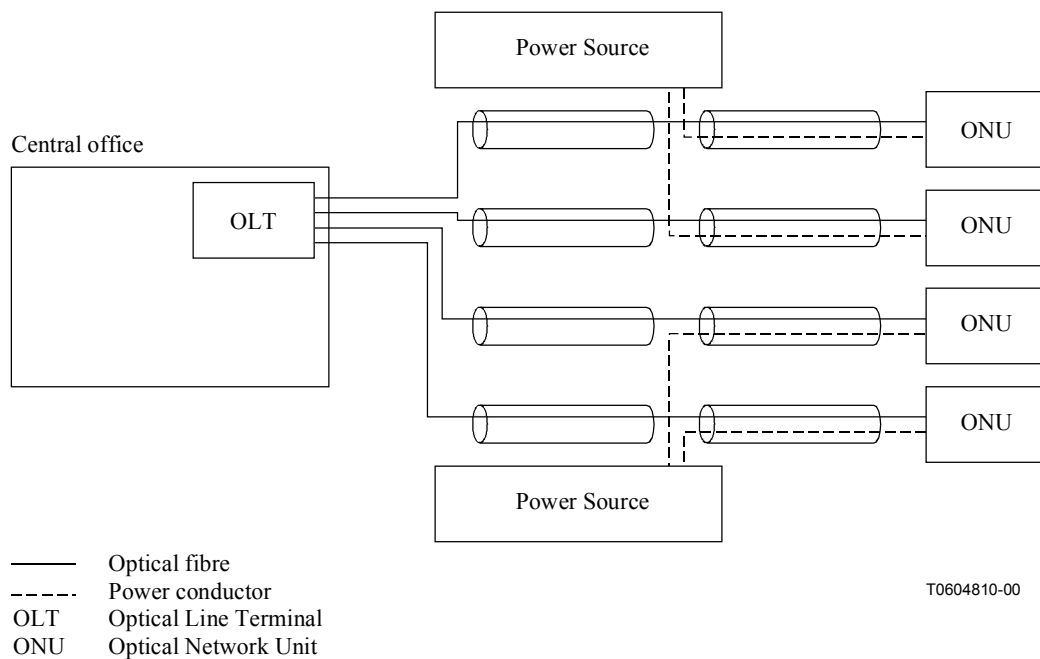
3.2.2 Optical transmission

Using optical transmission, the basic structure of local power supplies is shown in Figure 4. Power sources are set up near the ONU locations. Power can be supplied to several ONUs from each power source. The number of ONUs which are covered by one power source is dependent upon supplied power from the power source, the power consumption of ONUs and the power losses in the power cables. Power is fed by power cables or composite cables (combined power and communication cables).

To control the local power supplies, monitoring systems or alarm systems are set up in the central office in order to obtain information about the condition of the power sources. Usually, the duty to operate and manage the power sources belongs to telecommunication company. However, when the power sources are located in the customer premises, then customers may operate and manage the power sources themselves. The supply of electrical power from other customers' power sources should be avoided.



a) Individual cables for optical transmission and power feeding



b) Power feeding through composite cable

Figure 4/L.44 – Structure of local power supply (Optical transmission)

3.3 Individual power supply

3.3.1 Metallic transmission

In case of transmission with metallic wire, this type of power supply method would be used for digital or high speed transmission. The basic configuration of this method is shown in Figure 5. Electric power is fed to each ENU from each power source. Usually, the duty to operate and manage the power source belongs to the customers.

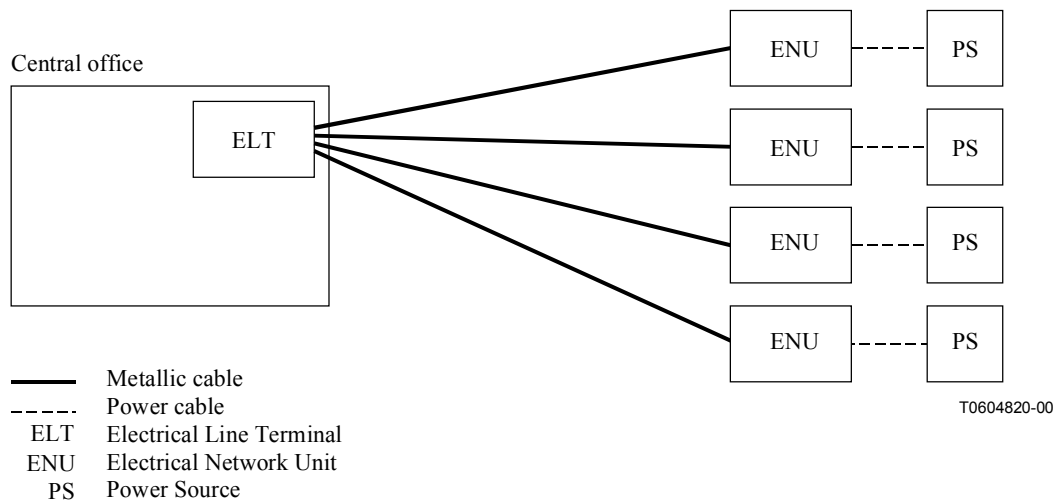


Figure 5/L.44 – Individual power supply (Metallic transmission)

3.3.2 Optical transmission

The basic configuration of this method is shown in Figure 6. Electrical power is fed to each Optical Network Unit (ONU) from each power source. Usually, the duty to operate and manage the power source belongs to the customers.

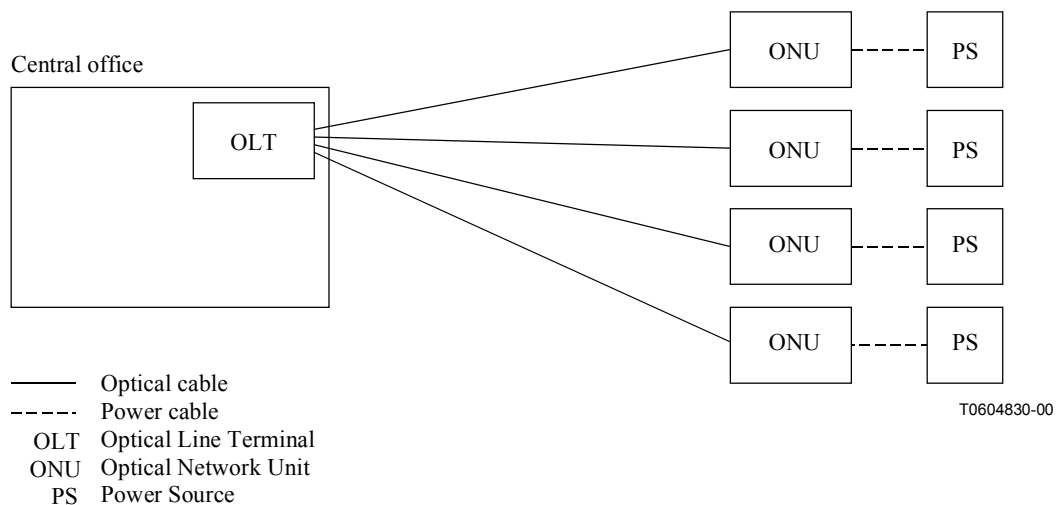


Figure 6/L.44 – Individual power supply (Optical transmission)

4 Power sources for usual operation

In order to select a power source for usual operation, the following should be considered:

- capacity;
- stability of power feeding;
- quality of electrical power;
- operating cost.

4.1 Power company

Where the electrical power is supplied by a power company, a telecommunication company should condition the electrical power in order for it to be suitable for the telecommunication equipment. When conditioning electrical power, a telecommunication company should consider the power quality supplied by a power company. Poor power quality may affect the quality of transmission or in the worst case damage telecommunication equipment.

In order to design a backup system, a telecommunication company should know the outage rate of the power supply.

NOTE – A separation (disconnection) point (e.g. switch) in the cabinets is provided in order to separate the competence of power and telecommunication companies as well as to allow safe maintenance of the telecommunication equipment.

4.2 Generator

Where the electrical power is produced by a generator, a telecommunication company should condition the electrical power in order for it to be suitable for the telecommunication equipment. When conditioning electrical power, a telecommunication company should consider the power quality produced by a generator. Poor power quality may affect the quality of transmission, or may damage telecommunication equipment in the worst case.

In order to design a backup system, a telecommunication company should know the failure rate (such as MTBF) of the generator.

4.3 Battery

When using batteries, a telecommunication company may condition the electrical power in order for it to be suitable for the telecommunication equipment. In this case, the capacity of a battery is most important. Use of a battery for equipment with high power consumption should be carefully evaluated.

5 Power wiring

In order to select power wiring, the following should be considered:

- 1) failure rate of the cable network (usually determined by failure caused by other contractors);
- 2) required power;
- 3) cable network environment;
- 4) safety issues for workers.

5.1 Individual power cable

Where power is supplied by individual power cables, the construction cost will be higher because two different kinds of cable have to be installed. The two cables can be operated and managed separately. This allows any maintenance work on either cable to be carried out separately and by personnel with different skills.

5.2 Superimposition method

This method can only be applied to metallic cables. Where power is fed with the superimposition technique, construction costs will be lower because the same wire is used for both

telecommunication and power feeding purposes. However, there are disadvantages on safety issues. Because high voltage is applied, workers are required to have knowledge of both electrical power and communications.

5.3 Composite cable (combined power and communication cable)

Where power is fed with combined cables, construction costs will be lower because both telecommunication conductors or fibres and power conductors are in the same cable. However, there are disadvantages on safety issues. Because high voltage is applied, personnel are required to have knowledge of both electrical power and communications in addition to skills of jointing both copper conductors and optical fibres.

6 Power sources for backup

In order to select a power source for backup operation consideration should be given to the following:

- 1) backup duration;
- 2) time to start backup system;
- 3) lifetime;
- 4) outage rate of power source for usual operation;
- 5) operating cost.

6.1 Generator

When a generator is used for a backup system, the most critical issue is time to start-up. Usually, some time is required in order to stabilize the electrical power when starting a generator. Therefore, this method is not suitable for systems which require quick recovery. Backup duration is determined by the amount of stored fuel. The power quality produced by a generator should be considered. Poor power quality may affect the quality of transmission or in the worst case may damage the telecommunication equipment.

6.2 Battery

A battery can supply high quality electrical power rapidly. Therefore, it is suitable for powering a backup system which requires a quick recovery. However, backup duration and lifetime is relatively short. Therefore, when designing backup systems with batteries, the following should be considered:

- 1) outage rate of usual power source;
- 2) time to repair the failed power source;
- 3) time to change batteries.

7 Environment for each equipment

The environmental conditions may affect the performance of each equipment.

7.1 Temperature condition

The temperature conditions may differ in each country. Each equipment should be designed to operate for such conditions or be protected by air-conditioning.

7.2 Humidity

The humidity conditions may differ in each country. High humidity is especially critical for power generating equipment. Therefore, each equipment should be designed to operate for such conditions or be protected by air-conditioning.

7.3 Others

Biological attack may cause failure of each equipment. Therefore, the equipment should be protected from a potential attack relating to a particular environmental situation.

APPENDIX I

Experience for electrical power supply for equipment installed into outside plant is shown in this appendix. The information is gathered from eight countries.

General questionnaire (1)

	Sweden (Telia)	Sweden (Ericsson)	Korea Telecom	Argentina	Thailand	Brazil	UK
(GQ1): Is there any equipment which requires electricity in the outside plant including customer premises except POTS?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(GQ2): Where is such equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	1, 2 and 6	1 and 2	1, 2, 3 and 7	1, 2, 6 and 7	6 and 8 (in the exchange)	2	1, 2, 3 and 4 (3 and 4 for CATV)

General questionnaire (1)

	Sweden (Telia)	Sweden (Ericsson)	Korea Telecom	Argentina	Thailand	Brazil	UK
(GQ3): Who has the responsibility of supplying electric power for such equipment in the customer building? 1) telecommunication carrier 2) the owner of the building 3) each customer 4) other: please write down in the bracket ()	1 and 3	*****	1 and 2	1 and 3	1 and 2	*****	3
(GQ4): Which type of electricity is usually used for each equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1, 2 (under study) and 3	1	1 and 3	1, 2, 3 and 4	1, 3 and 4	1	1
(GQ5): Is back-up power supply prepared? 1) for all equipment 2) usually 3) occasionally 4) none	3	1 and 2	1	1	1	1	1, 2 and 3 (1 for TPON) (2 and 3 for CATV)

General questionnaire (1)

	Sweden (Telia)	Sweden (Ericsson)	Korea Telecom	Argentina	Thailand	Brazil	UK
(GQ6): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	2 (under study) and 3	3	2 and 3	3 and 4	3 and 4	3	3 and 4 (4 for CATV)
(GQ7): When using electricity which is supplied from the telephone office, is there any regulation about voltage or current? 1) maximum voltage 2) maximum current 3) both 4) other: please write down in the bracket ()	4 (none)	*****	1 and 2	1	*****	*****	*****
(GQ8): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	3 (under study)	*****	1	4	1	*****	*****

General questionnaire (2)

	Ukraine	Spain	Japan				
(GQ1): Is there any equipment which requires electricity in the outside plant including customer premises except POTS?	Yes	Yes	Yes				
(GQ2): Where is such equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	1, 2 and 6	1, 2, 3 and 6	1, 4, 5, 6 and 7				
(GQ3): Who has the responsibility of supplying electric power for such equipment in the customer building? 1) telecommunication carrier 2) the owner of the building 3) each customer 4) other: please write down in the bracket ()	1	1 and 3	1, 2 and 3				

General questionnaire (2)

	Ukraine	Spain	Japan				
(GQ4): Which type of electricity is usually used for each equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	2	1, 2 and 3	1 and 3				
(GQ5): Is back-up power supply prepared? 1) for all equipment 2) usually 3) occasionally 4) none	2	3	1				
(GQ6): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	3	2 and 3	3				

General questionnaire (2)

	Ukraine	Spain	Japan				
(GQ7): When using electricity which is supplied from the telephone office, is there any regulation about voltage or current? 1) maximum voltage 2) maximum current 3) both 4) other: please write down in the bracket ()	3	3	3				
(GQ8): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	1	1 and 2	*****				

Sectional questionnaire (1)

	Sweden (Telia)	Sweden (Telia)	Sweden (Ericsson)	Sweden (Ericsson)	Korea Telecom	Korea Telecom	Korea Telecom
(SQ1): What is the name of the equipment?	FTTC/FTTB-ONU	Multi-access	CATV systems, HFC	DECT, FTTC	FLC-A	FLC-B	FLC-C
(SQ2): How many subscribers can be supported by the equipment?	60	4	10 – 300	10 – 300	480-1 920 POTS	480-1 920 POTS	180 POTS and 64 VOD
(SQ3): Where is the equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	1 and 2	1 and 2	1, 2, 6 and 7 (6 and 7 are not so common)	1, 2, 6 and 7 (6 and 7 are not so common)	1	1	2
(SQ4): Is any specific place required: 1) air conditioned room 2) basement 3) office 4) other	2	2	2	2	1 and 3	1 and 3	1 (in the hat)

Sectional questionnaire (1)

	Sweden (Telia)	Sweden (Telia)	Sweden (Ericsson)	Sweden (Ericsson)	Korea Telecom	Korea Telecom	Korea Telecom
(SQ5): What kind of environment is required in order to use such equipment? Temperature range () Humidity range ()	Temp. –5 – +55 °C Humidity 5% – 95%	Temp. –5 – +55 °C Humidity 5% – 95%	Temp. –5 – +55 °C Humidity less than 98%	Temp. –5 – +55 °C Humidity less than 98%	Temp. 0 – 40 °C Humidity 5 – 90% (all)	Temp. 0 – 40 °C Humidity 5 – 90% (all)	Temp. not determined Humidity 5 – 90% (all)
(SQ6): Which type of electricity is used for the equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1	1	1	1	1 and 3	1 and 3	1 and 3
(SQ7): Is back-up electricity prepared?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
(SQ8): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	3	3	3	3	3 or 2 (city phone)	3 or 2 (city phone)	3 or 2 (city phone)

Sectional questionnaire (1)

	Sweden (Telia)	Sweden (Telia)	Sweden (Ericsson)	Sweden (Ericsson)	Korea Telecom	Korea Telecom	Korea Telecom
(SQ9): When using batteries or local generator for back-up, how many hours can be supported by such equipment?	4-8 hours	4-8 hours	3 hours	3 hours	at least 8 hours	at least 8 hours	at least 8 hours
(SQ10): Why is such back-up time decided?	Carrier's policy	Carrier's policy	*****	*****	KT's regulation. Due to traffic congestion, at least 8 hours are necessary to complete repair work for technicians.	KT's regulation. Due to traffic congestion, at least 8 hours are necessary to complete repair work for technicians.	KT's regulation. Due to traffic congestion, at least 8 hours are necessary to complete repair work for technicians.
(SQ11): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	*****	*****	*****	*****	1 (city phone)	1 (city phone)	1 (city phone)
(SQ12): What is the voltage? (AC, DC)	*****	*****	AC60V	DC48V	DC130V (city phone)	DC130V (city phone)	DC130V (city phone)

Sectional questionnaire (2)

	Argentina	Thailand	Brazil	Brazil	Brazil	Brazil	UK
(SQ1): What is the name of the equipment?	Power supply for base station in WLL system	Switching equipment	DLU Shelter from EQUITEL	DLU Shelter from EQUITEL	ELI from ERICSSON	NEAX61ELU from NEC	CATV
(SQ2): How many subscribers can be supported by the equipment?	30		168	432	512	473	CATV: 500-10 000 Telephony: 30-100 000
(SQ3): Where is the equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	2 and 6	4	2	2	2	2	2, 3 and 4
(SQ4): Is any specific place required? 1) air-conditioned room 2) basement 3) office 4) other: please write down in the bracket ()	*****	*****	*****	*****	*****	*****	*****

Sectional questionnaire (2)

	Argentina	Thailand	Brazil	Brazil	Brazil	Brazil	UK
(SQ5): What kind of environment is required in order to use such equipment? Temperature range () Humidity range ()	Temp. –25 – +60 °C Humidity 10% – 90%	Temp. +18 – +35 °C (during shutdown) +10 – +50 °C Humidity 30% – 50% (during shutdown) 15% – 85%	Temp. –35 – +45 °C Humidity 5% – 95%	Temp. –5 – +45 °C Humidity 5% – 95%	Temp. –35 – +50 °C Humidity 5% – 95%	Temp. –5 – +45 °C Humidity 10% – 95%	Temp. –10 – +40 °C or –20 – +60 °C Humidity no control
(SQ6): Which type of electricity is used for the equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1 and 2	3 and 4	1	1	1	1	1
(SQ7): Is back-up electricity prepared?	Yes	Yes	Yes	Yes	Yes	Yes	Yes and No depending on system used
(SQ8): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	3 and 4	3 and 4	3	3	3	3	3 and 4

Sectional questionnaire (2)

	Argentina	Thailand	Brazil	Brazil	Brazil	Brazil	UK
(SQ9): When using batteries or local generator for back-up, how many hours can be supported by such equipment?	5 hours	18 hours	6 hours	6 hours	8 hours	5 hours	usually 4 hours
(SQ10): Why is such back-up time decided?	Frequent outage	Follow standard ISO 9002	Manufacturer's decision	Manufacturer's decision	Manufacturer's decision	Manufacturer's decision	Related to restoration time and cost/size of batteries and time to connect generators
(SQ11): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	4	*****	*****	*****	*****	*****	*****
(SQ12): What is the voltage? (AC, DC)	DC 60V, 90V and 120 V	*****	*****	*****	*****	*****	(sometimes AC 50 V is used)

Sectional questionnaire (3)

	UK	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine
(SQ1): What is the name of the equipment?	TPON	PCM-4, TELEFONIJA	DIGILOOP PCM4 ECI Telecom	Rayplex 2N1 Raychem	Rayplex 4N1 Raychem	Telplus 10 VE	Telplus 4 VE
(SQ2): How many subscribers can be supported by the equipment?	Varies depending on services required	2 to 4	2 to 4	2	4	10	4
(SQ3): Where is the equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	1 and 2	1, 2 and 6	1, 2 and 6	1, 2 and 6	1, 2 and 6	1, 2 and 6	1, 2 and 6
(SQ4): Is any specific place required? 1) air-conditioned room 2) basement 3) office 4) other: please write down in the bracket ()	2 and 3	4 (not required)	4 (not required)	4 (not required)	4 (not required)	4 (not required)	4 (not required)

Sectional questionnaire (3)

	UK	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine
(SQ5): What kind of environment is required in order to use such equipment? Temperature range () Humidity range ()	ETS 300019 stds. subject to local requirements	Temp. –20 – +60 °C Humidity less than 95%	Temp. –40 – +60 °C Humidity less than 90%	Temp. –40 – +65 °C Humidity less than 100%	Temp. –40 – +65 °C Humidity less than 95%	Temp. –20 – +60 °C Humidity 10% – 95%	Temp. –30 – +60 °C Humidity 10% – 90%
(SQ6): Which type of electricity is used for the equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1	2	2	2	2	2	2
(SQ7): Is back-up electricity prepared?	Yes	Yes	Yes	No	No	Yes	Yes
(SQ8): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	3	3	3	*****	*****	3	3
(SQ9): When using batteries or local generator for back-up, how many hours can be supported by such equipment?	8 – 10 hours	2 hours	2 hours	*****	*****	2 hours	2 hours

Sectional questionnaire (3)

	UK	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine	Ukraine
(SQ10): Why is such back-up time decided?	Regulatory requirements	Capacity of batteries	Capacity of batteries	*****	*****	Average time to repair	Average time to repair
(SQ11): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	*****	1	1	1	1	1	1
(SQ12): What is the voltage? (AC, DC)	*****	DC \pm 75 – 100 V	DC \pm 90 V	DC \pm 60 V, 0/-120 V, 0/-130 V	DC \pm 60 V, \pm 80 V	DC \pm 90 V	DC \pm 90 V

Sectional questionnaire (4)

	Spain	Spain	Spain	Spain			
(SQ1): What is the name of the equipment?	Pair Gain Equipment	BBONT (Broadband Optical Network Termination)	NBONT (Narrow-band Optical Network Termination)	ISDN NT (Network Termination for Integrated Service Digital Network)			
(SQ2): How many subscribers can be supported by the equipment?	2 – 30 (POTS)	1 – several hundred	1 – several hundred	1			
(SQ3): Where is the equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	1, 2 and 6	1 and 2	1 and 2	1			

Sectional questionnaire (4)

	Spain	Spain	Spain	Spain			
(SQ4): Is any specific place required? 1) air-conditioned room 2) basement 3) office 4) other: please write down in the bracket ()	*****	*****	*****	*****			
(SQ5): What kind of environment is required in order to use such equipment? Temperature range () Humidity range ()	Outside temp. –5 – +45° C for indoors –25 – +65° C for outdoors	Outside temp. –5 – +45° C for indoors –25 – +65° C for outdoors	Outside temp. –5 – +45° C for indoors –25 – +65° C for outdoors	Outside temp. –5 – +45 °C for indoors –25 – +65 °C for outdoors			
(SQ6): Which type of electricity is used for the equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1 and 2	1	1	1 and 2			
(SQ7): Is back-up electricity prepared?	Yes	No	Yes	Yes			

Sectional questionnaire (4)

	Spain	Spain	Spain	Spain			
(SQ8): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	2	*****	3	2			
(SQ9): When using batteries or local generator for back-up, how many hours can be supported by such equipment?	*****	*****	2 hours	*****			
(SQ10): Why is such back-up time decided?	*****	*****	Service availability	*****			

Sectional questionnaire (4)

	Spain	Spain	Spain	Spain			
(SQ11): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	1	*****	*****	1			
(SQ12): What is the voltage? (AC, DC)	DC 96 V	*****	*****	DC 96 V			

Sectional questionnaire (5)

	Japan	Japan	Japan	Japan			
(SQ1): What is the name of the equipment?	RT-BOX	RT-cabinet	RT-on the pole	π -system			
(SQ2): How many subscribers can be supported by the equipment?	Max. 2 560 (POTS)	112 (POTS)	32 (POTS)	10 (POTS/ISDN)			
(SQ3): Where is the equipment located? 1) in the customer buildings 2) in the hat (box on the ground without air-conditioner) 3) in the manhole (not air-conditioned) 4) in the air-conditioned box on the ground 5) in the air-conditioned box under the ground 6) on the pole 7) hung on the aerial wire 8) other: please write down in the bracket ()	4 and 5	1	6	6 and 7			
(SQ4): Is any specific place required? 1) air-conditioned room 2) basement 3) office 4) other: please write down in the bracket ()	*****	3	*****	*****			

Sectional questionnaire (5)

	Japan	Japan	Japan	Japan			
(SQ5): What kind of environment is required in order to use such equipment? Temperature range () Humidity range ()	Outside temp. –30 – +40° C	not specified	Outside temp. –30 – +40° C	Outside temp. –30 – +40° C			
(SQ6): Which type of electricity is used for the equipment? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	1	1	1	1			
(SQ7): Is back-up electricity prepared?	Yes	Yes	Yes	Yes			
(SQ8): What type of back-up system is used? 1) commercially supplied power 2) supplied from the telephone office 3) battery 4) local generator 5) other: please write down in the bracket ()	3	3	3	3			

Sectional questionnaire (5)

	Japan	Japan	Japan	Japan			
(SQ9): When using batteries or local generator for back-up, how many hours can be supported by such equipment?	8 hours	8 hours	3 hours	3 hours			
(SQ10): Why is such back-up time decided?	Carrier's policy	Carrier's policy	Carrier's policy	Carrier's policy			
(SQ11): What kind of technique is used to provide electricity from the telephone office? 1) by using installed copper pair 2) by using installed coaxial wire 3) cable or wire only for electricity 4) composite cable for communication and electricity 5) other: please write down in the bracket ()	*****	*****	*****	*****			
(SQ12): What is the voltage? (AC, DC)	*****	*****	*****	*****			

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