Remote training course "Bases of design, installation and testing of the structured cable system EUROLAN"

The course is focused on the technicians who are engaged in design, installation, certification and operation of the structured cable systems. Materials of a course can be useful to customers of SCS. The course includes only theoretical part.

Training material is based primarily on the international standard ISO/IEC 11801, as well as a number of other domestic and foreign documents.

Skills gained on the course will help students to solve specific problems using optical and symmetrical cables in conjunction with the corresponding patch-panels of EUROLAN-company based on the latest and advanced cable and network technologies.

The course ends with a test exam. Successful completion of the test means a certificate of the designer and installer SCS EUROLAN and entitles the customer to provide extended warranty on an installed cable system.

1. TABLE OF CONTENTS

2. SUMMARY OF SCS-STANDARDS

SCS – Structured Cabling System

SCS - is part of a telecommunications cabling infrastructure or buildings, in other words, the medium of transmission of any low-voltage signals within the (complex) of residential, office and industrial buildings.
SCS is the basis of local computer and office telephone networks and gaining recognition through a number of advantages - flexibility, ease of use and reliability.
The success of this technology depends largely on organizations that develop, implement, and use of SCS, and including, from standardization organizations.

Need for Standards

Standards are designed to serve the public interest by eliminating misunderstandings between manufacturers and consumers, enabling interchangeability and the desired quality of the products along with its accessibility and use of literate.

Standards telecommunications infrastructure buildings should maintain the functioning of different types of equipment from any manufacturer. Installation of cable systems carried out during the construction of buildings and SCS itself is calculated on their long-term operation.

Advantages of use of standards

Standards provide:

End users - a structured cabling system that does not depend on the type of applications;

Installers - instructions for the design and install cable systems before they are made known to the specific requirements of users, which provides planning construction and repair;

Market - elements to create such systems, flexible cabling scheme that makes it easy and economical to perform modifications to the system;

Industry and standards organizations - cable system, providing work and existing network hardware base for the development of new products.

SCS in USA

Standards development is conducted jointly by the respective committees Electronic Industries Association (EIA) and Telecommunications Industry Association (TIA).
Committee members work voluntarily on a voluntary basis. Companies that they represent are not necessarily members of the Association. Thus, the received documents are the result of joint work of interested professionals and reflect their diverse experience in this field.
Standards issued by the American National Standards Institute ANSI. Participants develop standards presented in the names together as ANSI / TIA / EIA.

International Organization for Standardization

At international level, the development of standards lead SCS International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC).
National organizations - members of ISO and IEC - participate in the development of standards as part of the Technical Committees. The development results are transmitted to the national standards organizations in order to vote. For the adoption of the standard requires at least 75% of the vote.

European organizations for standardization

Comité Européen de Normalisation Électrotechnique (CENELEC) operates regionally in close coordination with the International Organization for Standardization.
Countries belonging to CENELEC, accept European standards as national without any amendments, often assigning them the same numerical index.
European standards are published in the three official languages - English, French and German. Translations into other languages are made by members and certified CENELEC Central Secretariat, given the status of official versions.

Basic Standards SCS

Basic Standards SCS are:

ANSI/TIA/EIA-568 Commercial Building. Telecommunications Cabling Standard.
ISO/IEC 11801 Information technology – Generic cabling for customer premises

EN 50173 Information technology - Generic cabling systems

Some differences standards SCS

Modern edition basic standards SCS do not have serious differences from each other (they are very well harmonized)
International and European standards are specialized in nature and deal exclusively with the cable system as such, information on the components shall be in separate documents. American Standard includes a large amount of information on the components to build a symmetric channel.
Permissible length of single-mode optical channel in TIA/EIA-568 is 3,000 m vs. 2,000 m in ISO/IEC 11801.
American standard allows the connection of floor distributor directly to the campus distributor, the international standard requires intermediate building distributor.

Terminological differences standards

ISO/IEC 11801 and EN 50173	ANSI/TIA/EIA-568-A
Campus distributor	Main cross-connect
Campus backbone cabling subsystem	Interbuilding backbone cabling
Building distributor	Intermediate cross-connect
Building backbone cabling subsystem	Intrabuilding backbone cabling
Floor distributor	Telecommunications room
Horizontal cabling subsystem	Horizontal cables

Choose the standard

Taken into account when selecting a standard:

- geographical region SCS installation;
- customer requirements.

SCS components EUROLAN meet all major standards: ANSI/TIA/EIA-568, ISO / IEC 11801, EN 50173 etc.

Important!

SCS EUROLAN creators in the development of element base, regulations and rules of designing installations guided by the international standard ISO / IEC 11801.

More stringent standards of ISO/IEC 11801 as compared to ANSI/TIA/EIA-568 provide increased quality of installed cable system.

3. DEFINITION OF SCS AND ITS ADVANTAGE

Definition of SCS

SCS - is a universal telecommunications cable system office building, designed to support the operation of a wide range of applications:

- computer, phone and TV networks;
- fire and security alarm systems;
- CCTV etc.

SCS refers to the low-voltage cable systems. It is the basis of the physical layer of the information infrastructure of any company or its parts and is designed to solve the problem of automation jobs of its employees and support the functioning of other engineering systems.

SCS serves all engineering systems businesses located in its buildings and in its territory.

Signs of SCS:

- Has a standardized structure and topology;
- Uses components (cables, panels, connectors, etc.) only a certain standard of a closed list;
- Provides standardized parameters (attenuation, frequency bandwidth etc.) communication lines, organized with the help of;
- Managed (administered) standardized methods.

Proprietary cabling system

Any cable system that has at least one of the four main signs is considered exceptional and the consumer qualities necessarily to a greater or lesser extent inferior SCS.

SCS advantages

- **Allows connection of any standard active and passive equipment**, support any standard application in its class.
- **Allows you to change the topology of a wide range without changing the existing network**. Can support a variety of custom applications using adapters.
- **It has high efficiency** due to the long duration of operation without obsolescence.
- **High reliability**, provides ease of transition to promising high-speed protocols by simply replacing the active equipment without reconstruction of the cable system.

A direct result of the basic features are the major benefits of SCS:

- ability to support a wide range of applications, ie universality;
- possibility to install with no prior knowledge of the application that will be used (data: Ethernet, Fast Ethernet, voice, video conferencing, graphics and multimedia);
- drastic reduction of the nomenclature of the equipment used;
- quick organization and modernization of custom jobs.

Components of SCS

SCS - presents a hierarchical cabling system of a building or group of buildings with a standardized structure and topology.

The composition of the SCS includes the following main components:

- balanced and/or optical cables;
- patch panels;
- telecommunications outlets;
- patch-cords.

All components:

- integrated into the system by the same rules;
- operated according to certain rules.

4. TOPOLOGY OF SCS

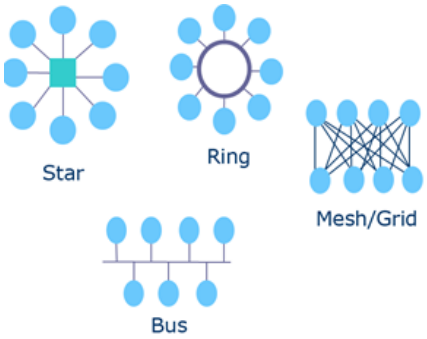
Topology of SCS

Physical topology – describes the real connections between individual nodes in the network..

Logical topology - describes how the signal to the individual components of the physical topology of the connector to the connector of the active equipment.

Main types:

- **Hierarchical star;**
- **Ring (Token Ring);**
- **Bus (Ethernet);**
- **Grid (more than one way the signal).**



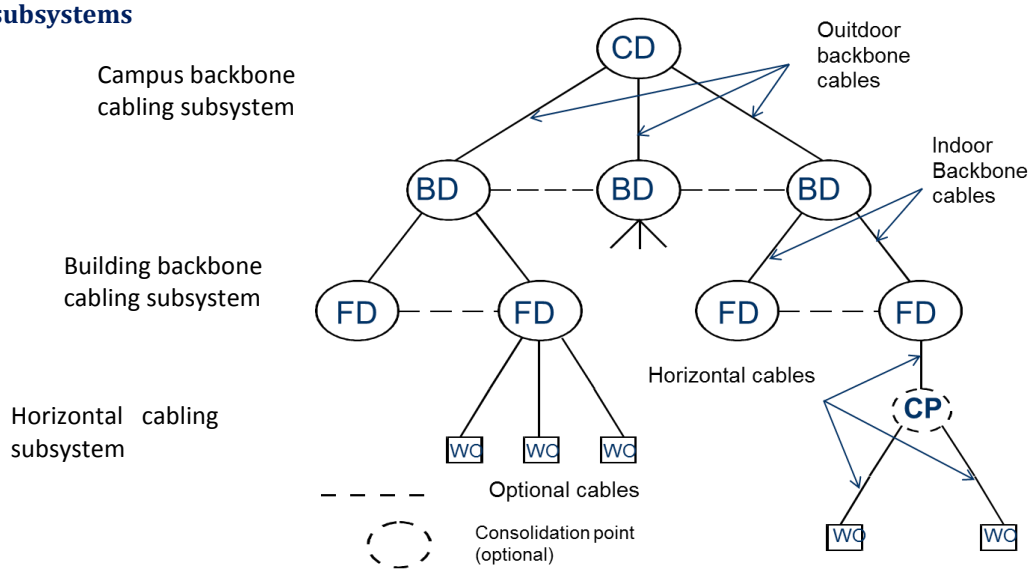
Hierarchical star topology of SCS

Any SCS constructed involving a tree topology.

The standard also recommends connecting cables redundant distributor same hierarchical level.

The presence in the SCS backup cables significantly increases reliability because they can be used for the rapid restoration of communications with possible broken cable line area or building backbone. It also provides flexibility and the ability to easily SCS reconfiguration.

Topology of SCS and its subsystems



CKC Hierarchical star - the traditional architecture of the SCS

Used for groups of buildings and one single building.

In the composition of the star are the following varieties of crosses, which are its nodes:

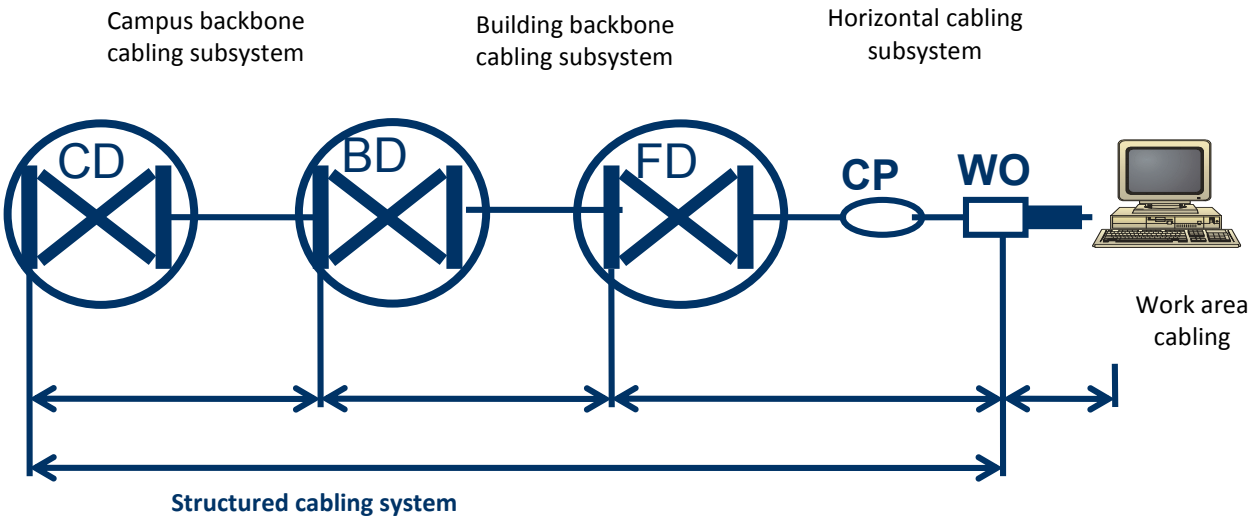
- central cross or distributor (set in a distribution point of the buildings);
- crosses (distributors) the main buildings (installed in a distribution point of the building);
- horizontal floor crosses (installed in the switchgear floor).

If necessary, cross built as a multifunctional device with the release of relevant areas.

5. STRUCTURE OF THE SCS AND INTERACTION OF ITS SUBSYSTEMS

СКС Block diagram of SCS

In general, SCS comprises three subsystems



Interaction of the subsystems of SCS

There are two ways of interaction between SCS-subsystems:

- using specific applications for each active equipment;
- using passive equipment.

Depending on the type of connection of subsystems selected various types of channels

- In the first case - inhomogeneous channel;
- In the second case, the complex channel.

Features separate subsystems SCS

Campus backbone cabling subsystem implemented mainly on the optical cable.

Building backbone cabling subsystem equally often used optical and symmetrical cables.

Horizontal subsystem in most cases is based on the 4-pair balanced cable.

All subsystems are built on the same principles that facilitates the design, construction and ongoing operation of SCS.

Certain differences trunk and horizontal subsystems minimal volumes, not of a fundamental nature and allow more fully realize the benefits available

Some system features of the SCS

Division into three subsystems are not dependent on the type or form of implementation of the network, that is basically the same regardless of the purpose and use of an office building.

Connection subsystems with each other and their connection to the active network equipment is carried out in distributors (areas - building - floor). This provides the ability to create paths with different topologies: "tire", "star", "multipoint" or "ring".

SCS standards do not record the type of crosses and panels, specifying only its characteristics

6. SUBSYSTEMS OF THE SCS

Subsystems of the SCS

One of the principles of the SCS is the presence of multiple levels of construction and strict hierarch.

In the structure of SCS subsystem allocated certain functionality, each of which are regulated by the rules of their construction and topology options for the structure, methods of physical connection lines.

This approach simplifies network administration, facilitates maintenance and allows it to increase the size of the network both quantitatively and structurally.

Any SCS based on the structure of hierarchical star (tree topology).

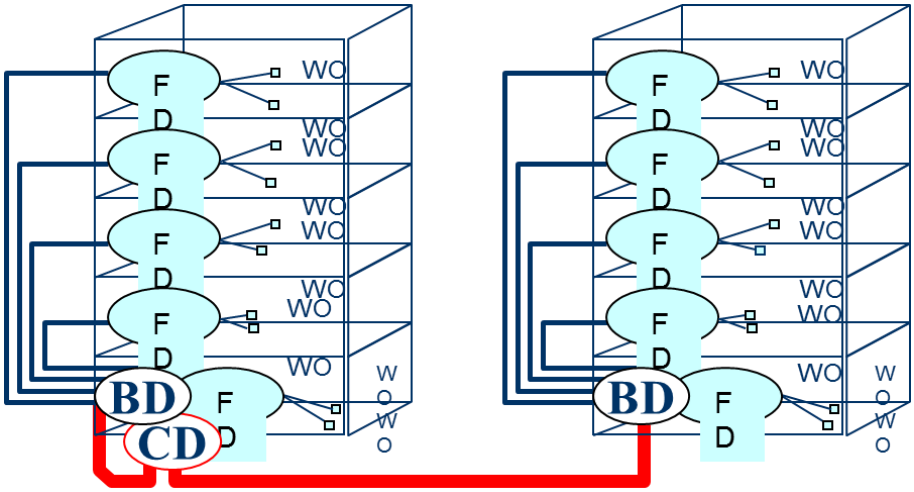
Full-scale SCS is divided into three subsystems:

- **Campus backbone cabling subsystem;**
- **Building backbone cabling subsystem**
- **Horizontal cabling subsystem**

Division into three subsystems are not dependent on the type or form of implementation of the network, that is basically the same regardless of the purpose and use of an office building.

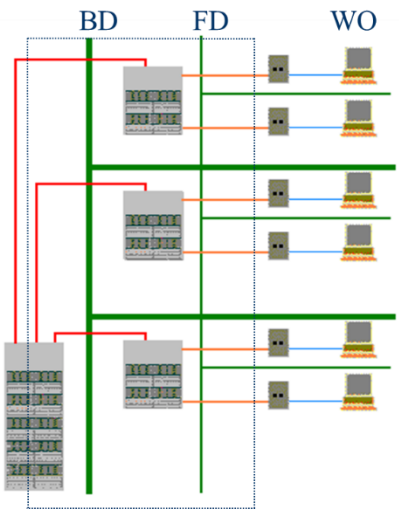
Connection subsystems with each other and their connection to the active network equipment is carried out in Cross (territory - building - floor). This provides the ability to create paths with different topologies, "tire", "star", "multipoint" or "ring".

Campus backbone cabling subsystem



Campus backbone cabling subsystem interrelate separate buildings that are on the same campus.

If SCS installed only in the same building, the campus backbone cabling subsystem missing.



Cables of building backbone subsystem:

- connects the individual floors of the building;
- and/or connects spatially separated spaces within one floor.

Building backbone cabling subsystem

- connects the individual floors of the building;
- and/or spatially separated distributors within one floor.

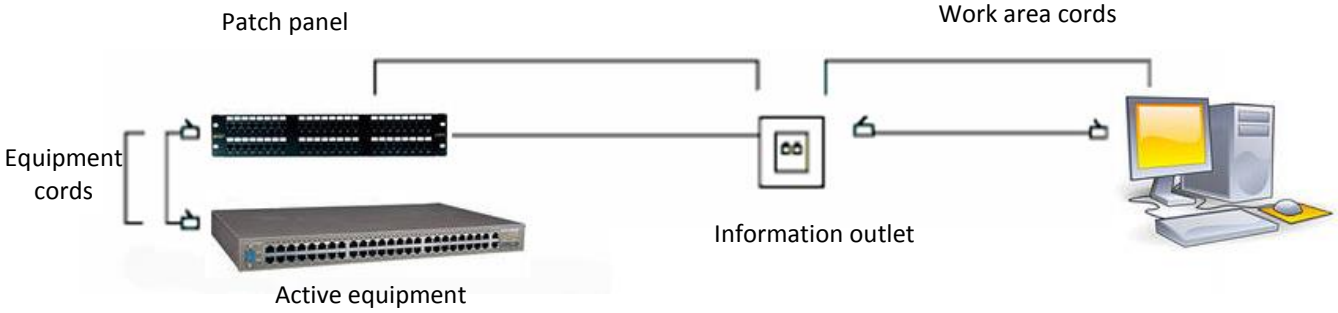
In the building with one floor of this subsystem may be missing

Additional requirements to the backbone subsystem and its features

The backbone subsystem of the SCS should not contain consolidation points!!!
The backbone cables can connect in through-and y-muff.
This provides flexibility SCS, the possibility of easy reconfiguration under the Application.
Unlike horizontal subsystem on the backbone level are sharply limited the universality of the SCS. A separate part of the backbone subsystems originally implemented for a specific application.

Horizontal cabling subsystem

Horizontal subsystem includes patch panels, horizontal cable and user information outlets, and cords of different purpose. Implemented in most cases, based on balanced cable.



All pairs of horizontal cable must be connected to one of the socket module information outlet!!!

Features horizontal subsystem of SCS

Horizontal subsystem is the only one of subsystem of SCS, which provides full property of universality.

Maximum length of the channel of the horizontal subsystem is 100 m

Horizontal subsystem, in contrast to backbone subsystems, provides services to end users.

Horizontal subsystem in most cases is based on 4-pair balanced cable.

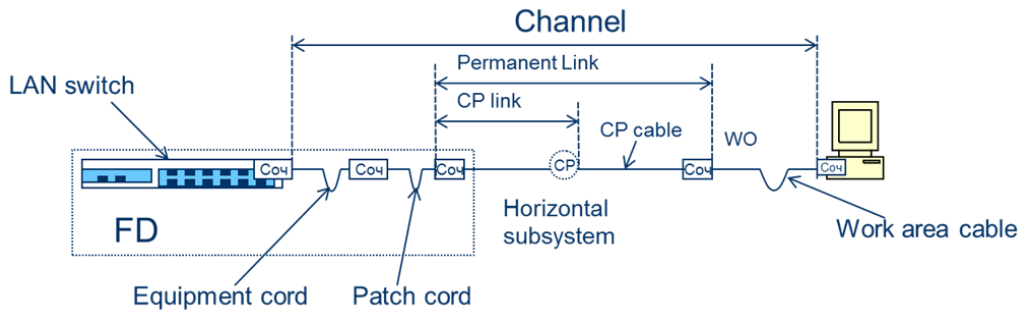
When building the horizontal subsystem can be used model of channel only with 2 or 3 connectors.

Horizontal subsystem can contain one consolidation point.

7. CHANNEL AND PERMANENT LINK

Channel and permanent link

Channel is called a complete way of signal transmission from the connector to the connector on the active network device (for example, from the workstation to the switch LAN).



The term "Permanent link"

Permanent link is called linear (installation) cable with patch panels and telecommunication outlets on both ends

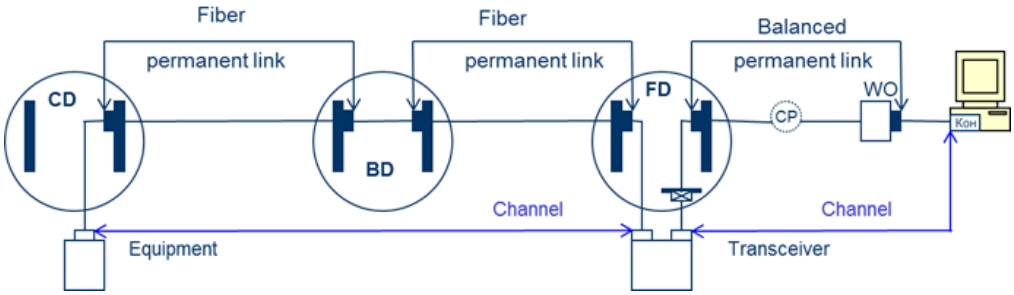
Permanent link can be realized both in balanced and on the fiber-optic cable.

In the structure of horizontal line can enter optional consolidation point.

Length horizontal permanent link cannot exceed 90 m.

SCS as a set of permanent links

Thus, any SCS consists of a combination of permanent links, in the process of formation of channel connected to each other and connected to an active network equipment using patch cords.



System characteristics of the channel and permanent links of the SCS

Tract always includes one or more permanent links and a variety of cords used for connection of active equipment and connection permanent links between them in the intermediate points (if any).

The requirements of standards for channel and permanent links take into account their structure and therefore differ. If you have special requirements at the stage of acceptance tests can be performed selective or complete check of parameters channel and permanent links.

The structure of horizontal channel

The structure of horizontal channel described in the normative part of the standards, and the implementation of their provisions ensures the specified parameters of cable communication lines
The composition of the channel on the basis of the balanced cable:

- max 90 m balanced cable with twisted pairs with rigid solid conductors;
- max 10 m diverse cords with flexible stranded conductors of twisted pairs;
- max 3 detachable connector (detachable connectors equipment are not included in the channel)!

Features of backbone channels

Structure of backbone channels described in the normative part of the standards and the implementation of their provisions ensures the specified parameters of cable communication lines.

Unlike horizontal paths backbone channel can:

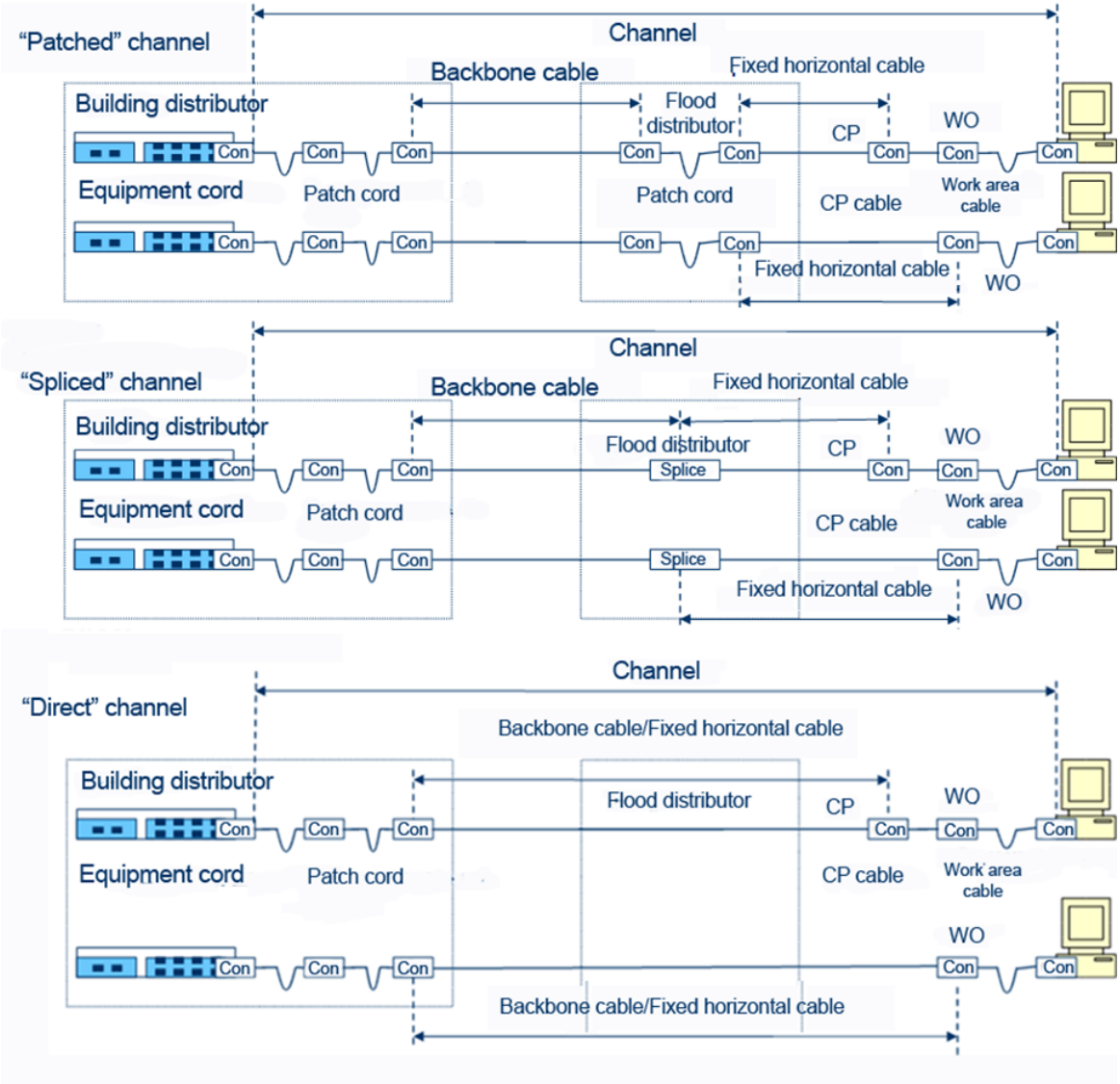
- Implemented a composite scheme (to include two or more permanent links);
- To have at both ends of the cross connect panels.

In backbone permanent links cannot be used consolidation point.

In the channels classes A and B can be applied enclosure of strain and Y-typ.

Backbone channel may be implemented by an inhomogeneous scheme. Optical and balanced segments of the channel connected with Media Converter.

Composite optical channels of the SCS



The configuration of centralized system

8. PECULIARITIES OF REALIZATION OF PERMANENT LINK AND CHANNEL

Permanent link

Permanent link called segment of linear (installation) cable with connection devices (panels and information outlets) on both ends.

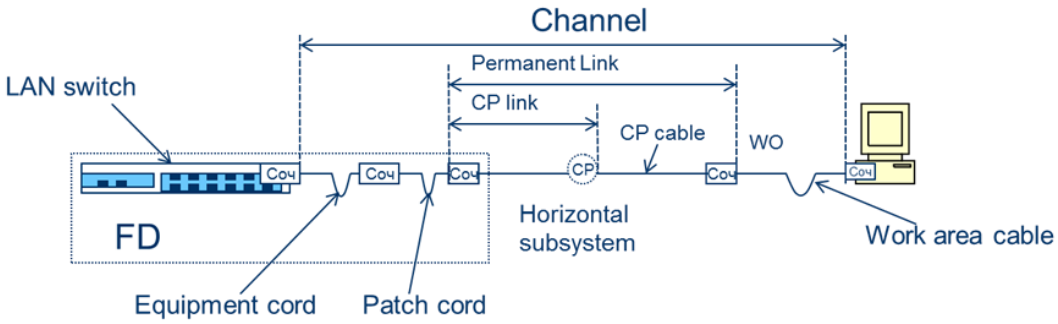
Permanent link may be implemented as symmetrical, and the fiber-optic cable.

The structure of the permanent link may include optional consolidation point.

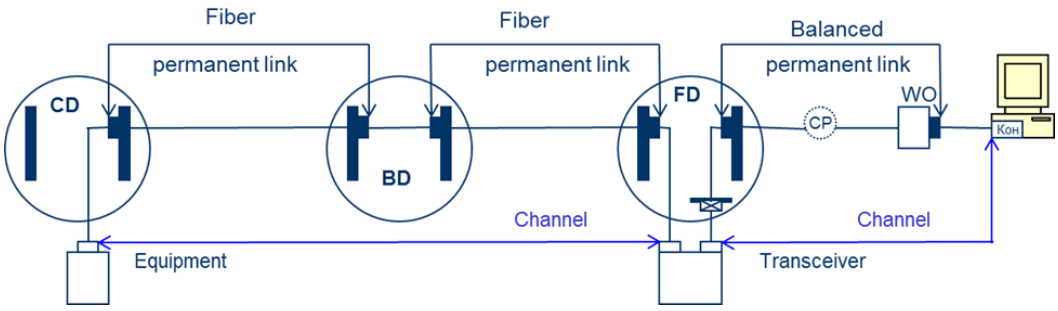
Regardless of the type of fixed cable his maximal length can not exceed 90 m.

Channel

Channel is called a complete way of signal transmission from the connector to the connector on the active network device (for example, from the workstation to the switch LAN).



Ratio channel and permanent link



Features of channel

Tract always includes one or more permanent links and a variety of cords used for connection to active equipment

If you have special requirements at the stage of acceptance tests can be performed selective or complete check of parameters channel and permanent links.

Особенности симметричного тракта

Full performance balanced channel is determined by the characteristics of those components, which are used for its formation

The composition of the channel on the basis of the balanced cable:

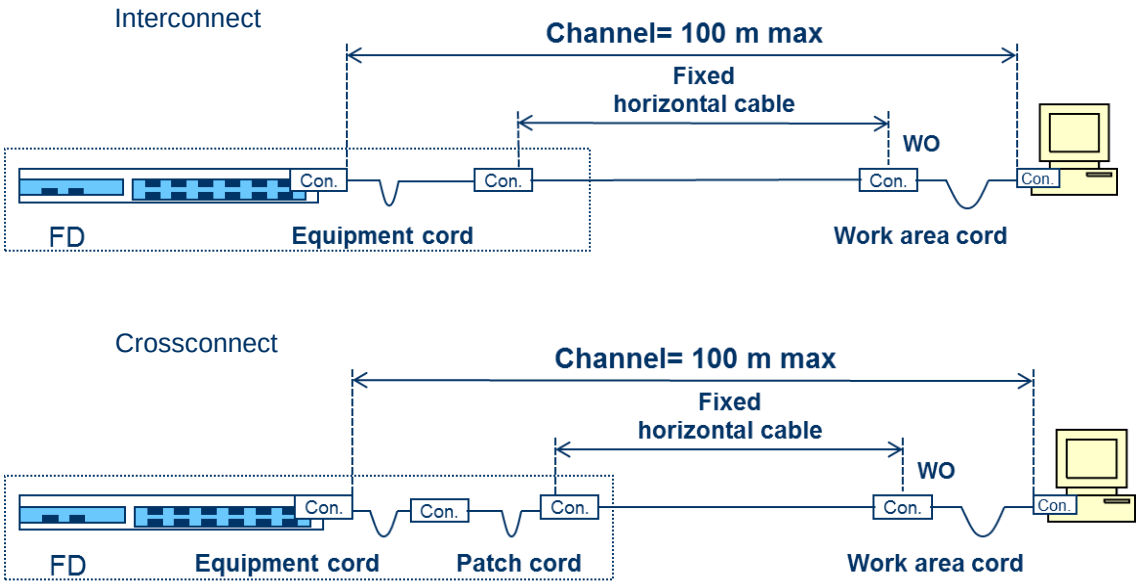
- max 90 m balanced cable with twisted pairs with rigid solid conductors;
- max 10 m diverse cords with flexible stranded conductors of twisted pairs;
- max 3 detachable connector (detachable connectors equipment are not included in the channel)!

The structure of horizontal channel

The structure of horizontal channel described in the normative part of the standards, and the implementation of their provisions ensures the specified parameters of cable communication lines.

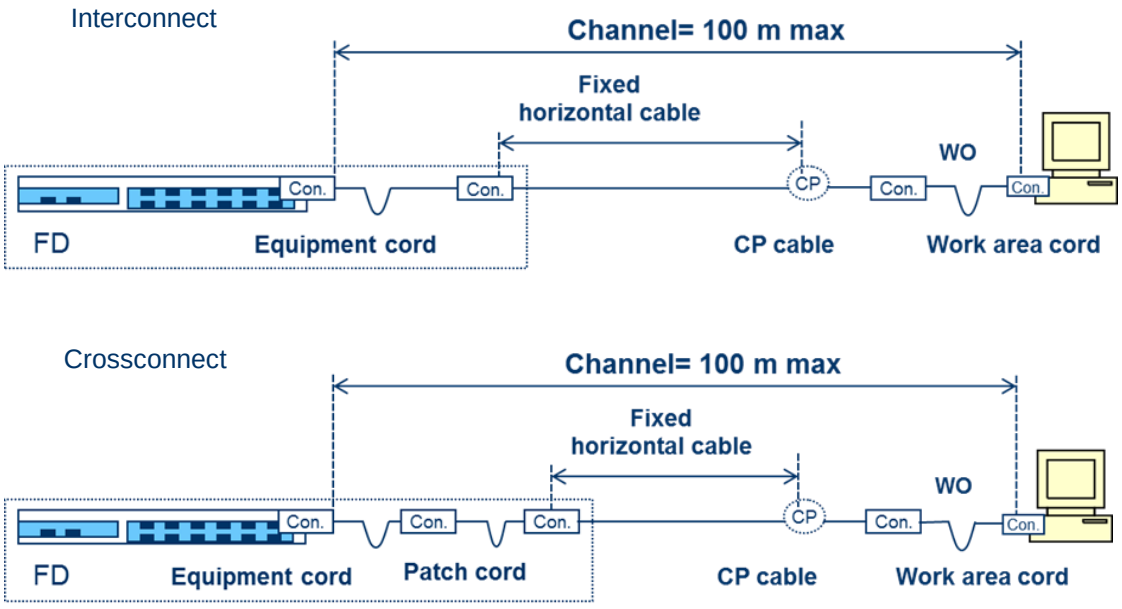
9. THE CANONICAL MODELS OF SCS-SUBSYSTEMS ON BALANCED CABLE

Models of channels of horizontal subsystems without CP



In both cases, stationary horizontal cable with one side is connected to the patch panel in floor distributor, and with another - to-module WO or MUTOA.
Channel includes all cords listed on the slide.
Horizontal subsystem includes internal horizontal cables between panels in the floor distributor, information outlet and patch cords to connect the SCS to the active equipment.

Models of channels of horizontal subsystems with CP



Connection chains of transmission

Cables and components of different categories may be mixed in a line or subsystem SCS, however, you must consider the fact that the performance characteristic of this channel will be determined by the parameters of cable or component of the lowest category.

The standard prohibits the use in the same line of cables and components with different impedance, and in the optical line - of fibers with different core diameter.

In addition, standards SCS prohibit upon termination of cables parallel connection of the conductors.

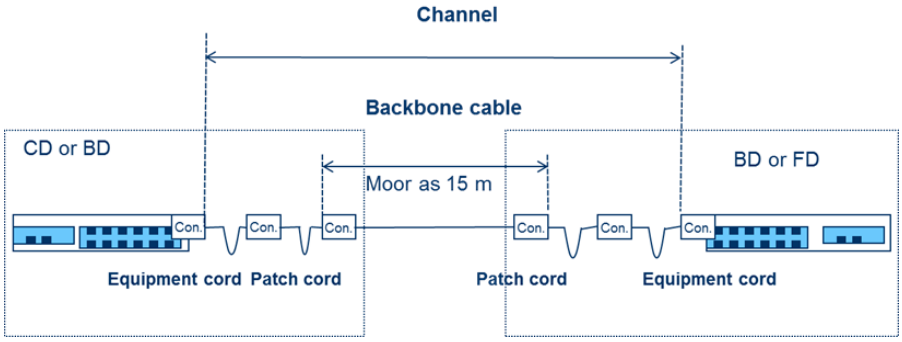
The maximum length of the components horizontal channel, m

Restrictions:
• Physical length not exceeding 100 m;
• The physical length of a horizontal cable: less than 90 m;
• Cable length from CP to WO: not more than 20 m;
• The total length of patch cords in the distribution point: not more than 5 m.

Model features permanent link horizontal subsystem

• The maximum length of the horizontal balanced cable does not depend on the type of element base (shielded or unshielded twisted pair) should not exceed 90 m, regardless of the category applied element base ;
• On the 90 -meter rule limits the total length of the horizontal fixed line is not influenced by the presence or absence of a consolidation point;
• When implementing a horizontal path on the optical element base all of the above restrictions do not lapse.

Model of the balanced backbone channel



The maximum length of the backbone channels, m

Category	Class A	Class B	Class C	Class D	Class E	Class F
5	2000	250 - F*X	170 - F*X	105 - F*X	-	-
6	2000	260 - F*X	185- F*X	111 - F*X	105 – 3 - F*X	-
7	2000	260 - F*X	190 - F*X	115 - F*X	107 – 3 - F*X	105 – 3 - F*X

F – total length of all cords, m; X – coefficient of electrical elongation

Restrictions for classes D, E and F:

- Physical length of channel: not moor as 100 m (skew);
- If both ends of the channel crossconnect used, the maximum length of the backbone cable is reduced to 75 m.

Features rules on the maximum length of the backbone channels, m

- Applications for junior classes (up to C inclusive), the maximum length of channel may differ from those calculated from the table downward.
- Thus, we have direct binding cable system to the application. It is not a violation of the of the canonical principles construction SCS, as versatility cabling declared and guaranteed only at the level of the horizontal subsystem.
- Relevant data on such channels with great lengths are in the informative appendix of the standard ISO/IEC 11801.

10. CONNECTION IN SCS

Connection in SCS

Connection in the SCS is performed:
• In the process of connecting the group and terminal active network equipment to cable system;
• In the process of forming the channels on the horizontal and backbone levels.

Connection to SCS is **always** performed manually with patch cords.

Patch cords are connected to the outlets and panels of SCS.

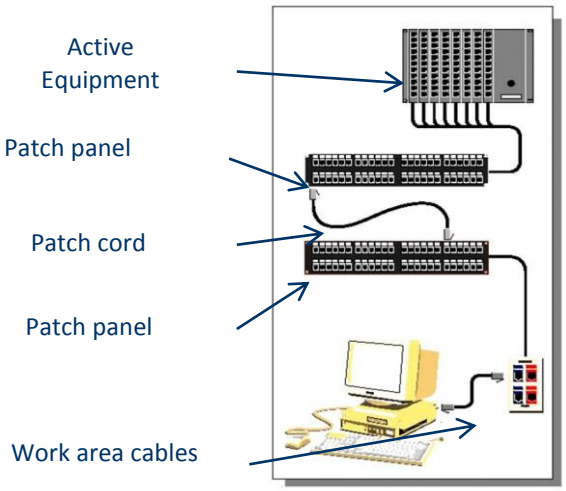
Method of connection

Presence of SCS panels and outlets increases operational flexibility and significantly facilitates procedures MAC (move, add, change).

In SCS used two main methods of connection:
• cross-connect;
• interconnect.

Connection to SCS is always done manually patch cords (jumpers only phone crosses). Therefore, operation of SCS is independent of the power network.

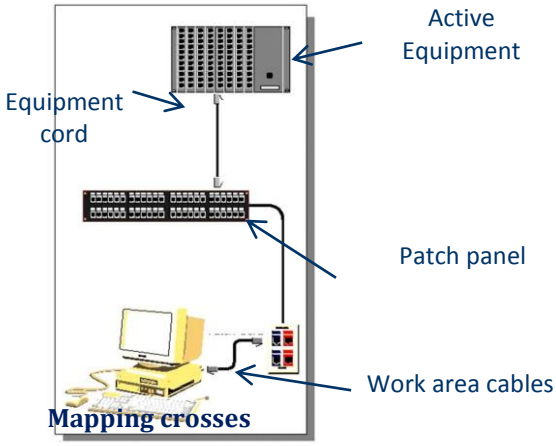
Cross connect



In this case, it is assumed only the patch cord connection to the panels.

Thus, for connecting network equipment in a technical room uses two panels and two connecting cord – patch cord and equipment cord.

Interconnect



In this case, a patch cord is connected directly to the panel and active network equipment without intermediate panel.

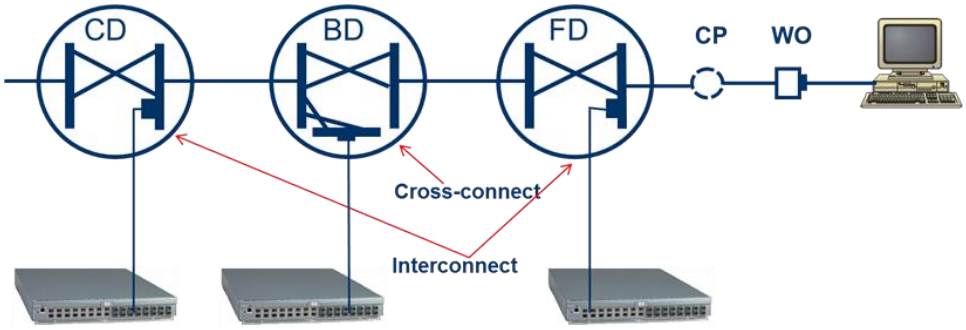
This is the easiest and most common embodiment of SCS.

Mapping crosses

- In situations where both ends of permanent line are panels, said mapping crosses.
- By mapping scheme built backbone lines.
- is commonly used for Class A applications (telephony) or optical trunk lines (different polarity A, B, C).

At the level of the horizontal subsystem cross-mapping scheme is not permitted (three interconnecting constraint violation).

Channel with cross connect and interconnect



cross connect

interconnect

11. SWITCHING EQUIPMENT

Patch-cords

In the SCS used three types of cords:

Work area cords are used in the work area.

Equipment cables are used in the distributors for connect of active equipment.

Patch-cords are used for connections between the panels.

All varieties of cords used in the formation of transmission channels and not included in the SCS.

Patch-panels and crosses

Group switching equipment in distributors, depending on their functionality is divided into:

- Patch panels for connection of line cables;
- display panels used in the crossconnect scheme and connection its linear side ports to active network equipment;
- Crosses (distribution frames), usually operating as a physical interface PBX.

Patch panels

Designed for:

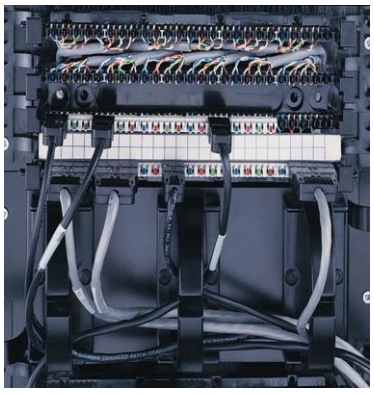
- connected of line cable a different SCS subsystems;
- Manual connection of separate permanent link of cable subsystem with each other patch cords.

Basic requirements:

- Have the highest possible port density per unit height;
- Provide input cables in compliance with the existing rules on the largest bend (stock), tensile stress, and so on;
- Provide ease of installation of individual ports and the panel itself;
- Provide ease of switching process;
- Provide opportunities for effective character and color coding of individual ports and the panel itself entirely.

Switching in the SCS

Use of patch panels gives the following advantages



- increases the flexibility of the whole system;
- for the connection of new users to the network;
- facilitates the movement of various work places;
- provides support for new applications;

12. ADMINISTRATION OF THE SCS

Administration of the SCS

Administration is a collection of methods and means of control system SCS throughout its life.

Operation of SCS involves performing procedures MAC (move, add, change).

The main objective is to simplify administration procedures implementing MAC.

Type SCS administration is fully determined by its topology.

Two types of management: **Singlelevel** and **Multilevel.**

Embodiments of the Administration

Singlelevel

When a sindlelevel administration management process is carried out by switching SCS patch cords in a one distributor only.

Multilevel

In multilevel administration management process is carried out by switching SCS patch cords at several points.

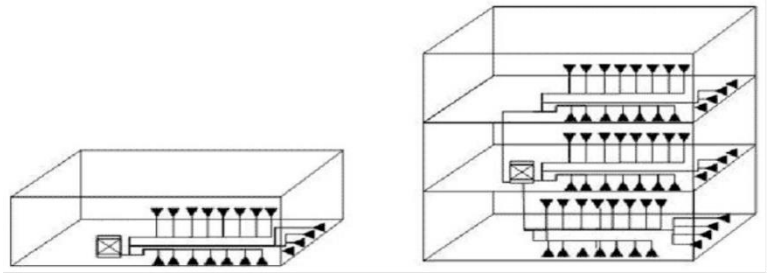
The main symptom of this type of administration - the need to perform switching at least two cords in general configuration changes.

Multilevel administration

Multilevel administration used in the SCS with classical architecture hierarchical star.
The need to perform switching at least two cords in general configuration changes ensures management flexibility and adaptability for new applications SCS.
The advantage of multilevel administration that the number of components that may be damaged, limited. Failure in one of the distributors or on the backbone line does not affect the operation of the network as a whole - only suffering from this part of SCS.

Singlelevel administration

Singlelevel administration is used to create the maximum SCS simplified control type (centralized cabling system). Perhaps only in cable systems with a single technical room.
Centralized system cables are routed from the floor or building distributor directly to the WO, bypassing intermediate distribution points.



Database as part of the system administration

Administration is based on creating and maintaining of the database that is its central element.

Database records are formed by a single template.

The database can be conducted in:

- In paper form;
- In electronic form on the basis of general purpose products;
- A dedicated software.

Database directly or indirectly interact with identifiers, drawings, work orders and reports, as well as files with the test results.

13. THE POE-TECHNOLOGY AND ITS INTERACTION WITH CABLE CHANNELS OF THE SCS

POE-Technology (Power Over Ethernet)

POE technology standardized by the IEEE 802.3af standard and can ensure supply of a direct current in low-power peripherals equipment on cable of SCS.

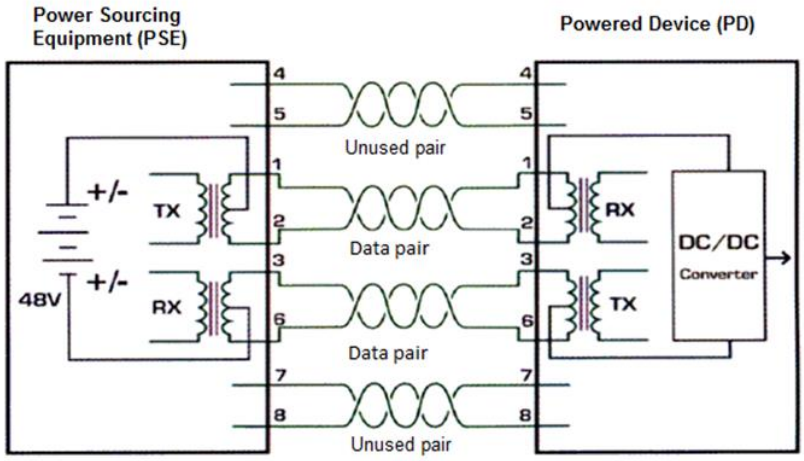
POE technology standardized by the IEEE 802.3af standard and allows for remote DC cable paths SCS low-power peripherals.

Set the maximum settings:

- Resistive asymmetry of one pair - not more than 3%;
- A valid value constant current in the conductor pairs 0.175 A (in the whole temperature range);
- The permissible operating DC voltage between conductors 72 V (all over the temperature range);
- Maximum capacity of the consumer - 12.95 W.

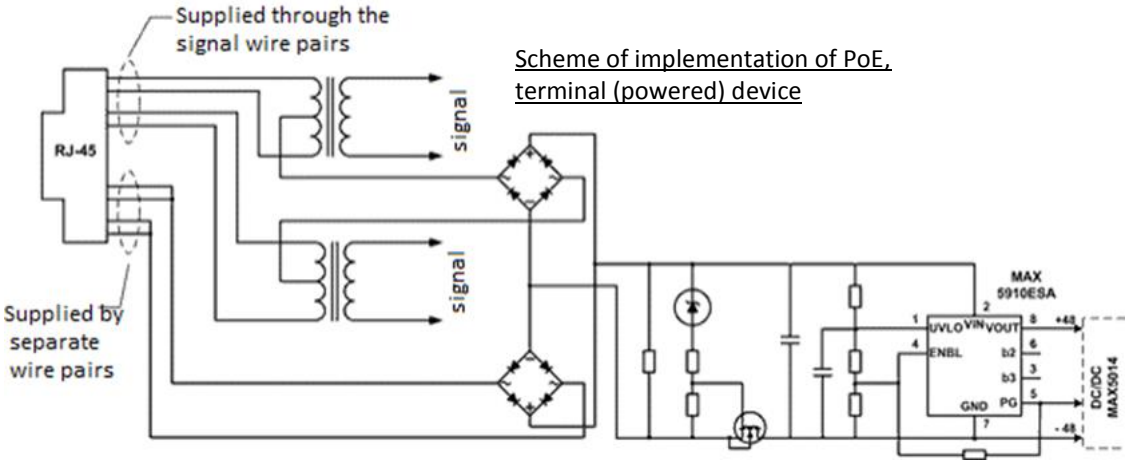
For remote power supply always uses two twisted pairs.

POE-Technology (Power Over Ethernet)



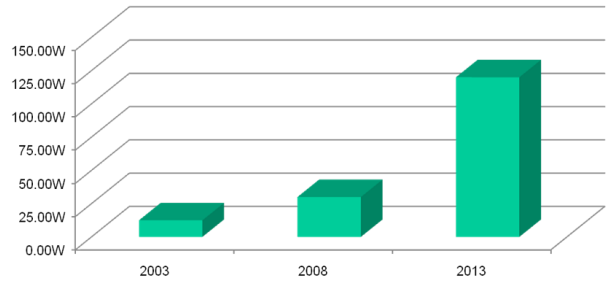
Remote power is exercised by the so-called phantom circuits its supply voltage in the Central branches transformers galvanic separation. This eliminates the mutual influence pairs at each other and at the same time to increase the allowable power consumption of a PD.

Horizontal cables remote power expedient for the twisted pairs that are not used for transmission of signals.



Scheme of implementation of PoE, terminal (powered) device

Standard POE+



Standard IEEE 802.3at DTE Power Enhancements, also known as PoE +, focused on limiting power not less than 26 watts, which will enhance the functionality of existing PoE - devices and stimulates the development of new applications.

Future technology POE/POE+

Compliant PoE + surveillance cameras will be able to pan, tilt and zoom the image, and IP- video phones will be able to easily transfer streaming color video. In addition, the new standard will support PoE + and other devices with high power requirements of food, including WiMAX- transmitters, information kiosks, computer terminals and thin clients .

Appeal to the art, meet the requirements of the new standard, greatly increases the effectiveness of information systems are created.

POE technology and SCS - design features

Remote power supply voltage can be supplied to the terminal devices with a switch or a separate power panel. In the latter case it is reserved for a separate unit in the cabinet.

PoE + class system work only on channels category 6 and above.

At high temperatures, power consumption terminals close to the limit and dense packages horizontal cable loop resistance may be exceeded and disabling sources. Offset by a decrease in the length of the limit permanent link cable up to 80 m or mandatory application on long lines Category 6 with reduced resistance.

DC-Requirements of the ISO/IEC 11801

Many devices connected to the SCS, are essential DC characteristics of channel.

Numerical measure of the loop resistance is DC (Direct Current Loop Resistance), which depends on the class of cannel and normalized to be measured in accordance with IEC 61935-1 for the classes:

A – no more than 560 Ohm;

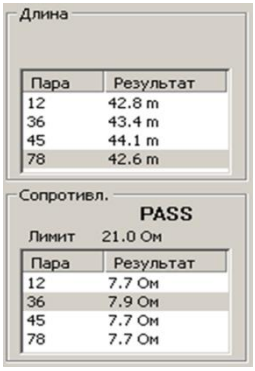
B - no more than 170 Ohm;

C - no more than 40 Ohm;

D - no more than 25 Ohm;

E - no more than 25 Ohm;

F - no more than 25 Ohm.



Important for PoE systems.

14. OPEN OFFICE AND CONSOLIDATION POINT

Open office

Open office - it's a custom workroom large area, which is divided into separate sections furniture or light baffles.

To open offices characteristic frequent redeployment and reconfiguration work areas.

The main features of the SCS for open offices

Horizontal subsystem SCS, which is formed in a typical office environment with corridor-cabinet system and open office, implemented on almost identical hardware components. On the backbone level, such differences do not have the SCS.

As part of the horizontal subsystem actively applied consolidation point and multi user outlets.

Work area cords in an open office on average have significantly greater length.

Consolidation point (CP)

Consolidation point applies to "open office" where you want to arrange free accommodation WO for the employees in the workplace.

Standards do not provide for any differences in all parameters channel of horizontal subsystem with consolidation point and without it.

According to ISO / IEC 11801 CP is the point of administration (this is reflected in the relevant notes), as well as a place to connect test equipment. CP is subject to mandatory testing.

Consolidation point (CP)

Consolidation Point (CP) - this additional compound is therefore associated with it:

- reducing the reliability of SCS;
- deterioration of electromagnetic parameters of the lines;
- an increase in noise.

CP should be used only when necessary!

- CP applies only horizontal subsystem (not more than one for every channel);
- CPs should be placed so that the working groups "open office" can connect to at least one of them;
- One CP can handle a maximum of 12 work places;
- For a balanced cable CP located at a distance of not less than 15 m from floor distributor;
- By CP connects only passive equipment.

Multi user outlet MUTO

Unlike consolidation point MUTO in public offices is available in free access, is a custom component and used mainly for connecting active equipment of workplaces of employees.

MUTO should be placed so that the length of cord that it serves jobs were minimal.

15. CENTRALIZED CABLE SYSTEM

Centralized cable system

Centralized cable system
Centralized cabling system contains only one distribution point, which allows you to perform any switching lines in all the buildings and throughout the enterprise in one place.
Centralized cabling system can go from the main or building distributor to the WO, bypassing intermediate distributors.
Positive features of this solution:

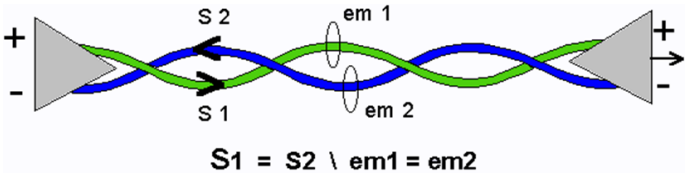
- reduction in the number and range of patch panels;
- the possibility of forming any preassigned working groups on the physical level without the use of virtual networks;
- the concentration of all active equipment in one place, reducing the number of specially equipped technical facilities;
- a significant reduction (or complete elimination) allocated space for floor distributor.

Some properties centralized cabling system

Used primarily for projects class "fiber to the desk".
The decline in the share of such projects encountered in practice the implementation of large networks are rare.
Typically has higher average horizontal length of the cable, i.e. loses hierarchical structures for capital expenditures.
Due to mass adoption of managed switches has no technical advantages, in the absence of specific requirements relating to the treatment of unauthorized access to information.

16. DESIGN FEATURES TWISTED PAIR

Theory of twisted pair



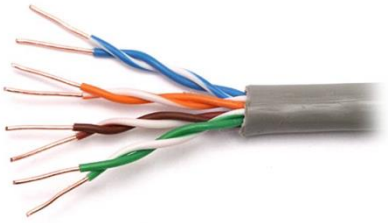
Considered further cable contains one or more twisted pairs with copper conductors under a common sheath.

The ability of the cable to transmit high-frequency signals is determined balanced pair.

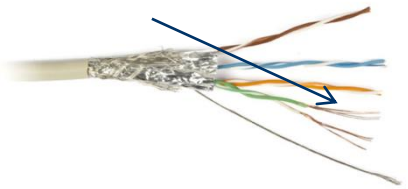
Total radiation "ideal twisted pair" tends to zero.

If the cable contains multiple pairs, then to avoid their mutual influences are twisted with different pitch.

Conductors for installation cables



Only patch cords



To minimize the harmful effects of the proximity effect and scin effect conductors twisted pair line cables are made as solid conductor.

Conductors for cord cables

For reasons of resistance to repeated bending during operation of flexible conductors twisted pairs of cord cables are made as stranded wire.

Stranded conductor made of seven twisted thin wire with a diameter of about 0.2 mm.

Corded cable has higher attenuation. To partially compensate for this undesirable phenomenon overall diameter of the conductor cable recoil increase compared with the installation cable.

17. CROSSTALK PARAMETERS OF TWISTED PAIR

NEXT (Near End Crosstalk)

Electromagnetic radiation produced by balancing imperfection twisted pair is in neighboring pairs induced currents. This effect is called crosstalk, which are a noise to the useful signals.

The difference between the levels of the transmitted signal and it creates interference on adjacent pair is called crosstalk attenuation.
NEXT does not depend on the cable length. Therefore, the measurement of this parameter should be carried out on **both sides** of the line.
Cable is considered to comply with the standard, if in the entire operating frequency range of the real value of NEXT drops below specified standards.

NEXT is frequency dependent (decreases with increasing frequency), but does not depend on the line length.

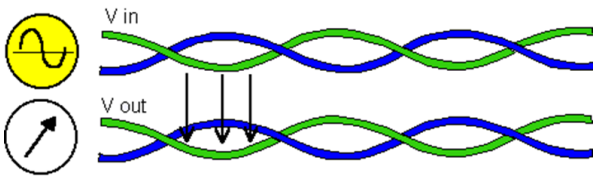
Is the ratio of the signal applied to one pair, induced by a neighbor, the near end of another pair.

NEXT is the more important: than better balanced pair, hence the smaller the level is aiming to neighboring pairs.

The higher the value NEXT, the less interference between the two pairs of conductors.

NEXT should be measured at all frequencies.

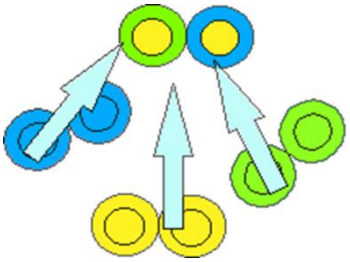
In multi-pair cable measurements shall be made for all combinations of pairs!



PS NEXT (Power Sum Crosstalk)

Taking into account simultaneous cross talk

with all the pairs present in the cable.



Summary indicators have been used in connection with the fact that

new technologies, data is transferred simultaneously in several twisted pairs.

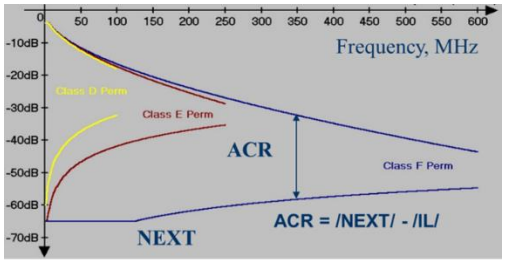
When testing the power sum crosstalk at the near end (PS NEXT) tester measures the impact affecting three pairs on the fourth. This is particularly important for technologies such as Gigabit Ethernet and similar.

Attenuation to Crosstalk Ratio (ACR)

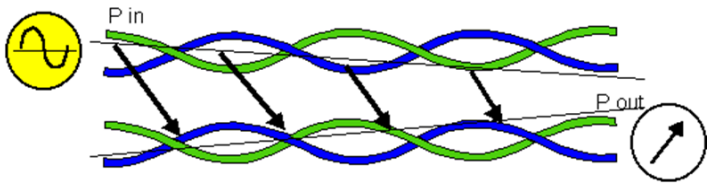
ACR at the near end (ACR-N) is numerically equal to the difference between attenuation and NEXT.

Immunity is a calculated parameter and frequency dependent variable.

Increasing ACR-N increases the signal transmission quality.



FEXT (Far End Cross Talk)



FEXT (Far End Crosstalk) is measured over the entire range of frequencies used and is expressed in decibels.

FEXT - depending on cable length

To compensate for this influence from FEXT subtracted insertion loss: ELFEXT = FEXT – IL

This value is called EL FEXT (Equal Level FEXT) or ACR-F (Attenuation to Cross Talk Ratio - Far End).

Features of impact parameters

Influence parameters are fixed in the normal (without the additional prefix), total (prefix PS) and Alien (prefix A) versions.
FEXT parameter has no independent significance because of the strong dependence on the length.
On the basis of the value of NEXT and FEXT cable scanner automatically calculated ACR values for the near and far end in the usual total Alien and options which are a measure of the signal- to-noise ratio and determine the quality of the functioning of the network interface.
Alien influence parameters are meaningful only in the frequency range above 200 MHz, is for appliances category 6A and higher in the case of its performance unshielded version.

18. METHODS PROTECT THE SYMMETRIC CHANNELS FROM THE EXTERNAL NOISE

External sources of noises

Two major types of external interference:

- Interference and electromagnetic noise

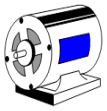
Major sources - mobile phones, transmitters and television broadcasting systems, power sources with high frequency transformation.

- Electromagnetic interference EMI

Major sources - electric motors, starters fluorescent lamps, power cables (AC) and atmospheric phenomena, including lightning strikes.

Standards do not include specific requirements for noise induced by external electromagnetic radiation.

Techniques to reduce the impact of interference



Efficiency of suppression of external interference is achieved by the following methods:

- high degree of symmetry twisted pair;
- ensuring the integrity of the cable shields;
- high-quality shield grounded;
- Increase the distance between the cable and the source of the interference;
- limiting the length of interaction with the source of interference.

Such methods are independent of each other and can be used together.

Distance from sources of interference

Should strictly maintain the minimum distance of the cable from noise sources. Besides the above requirements should also protect the cable from unnecessary stress and the influence of heat sources.

19. BASIC PARAMETERS OPTICAL CHANNELS

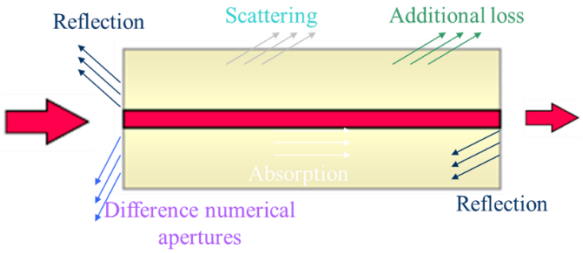
Basic parameters of optical channels

The transmission of information with predetermined quality on a optical channels requires mandatory implementation of a number of norms.
The main parameters responsible for the quality of the transmission are attenuation, broadband, numerical aperture and geometric characteristics of the core.
Broadband, the numerical aperture and the geometrical characteristics of the core type of guaranteed used components.
Attenuation is strongly influenced by quality of installation.

Attenuation

Attenuation - a gradual loss of the optical signal of their energy during propagation along the fiber.
Depends on the magnitude of the attenuation maximum communication range between two transceivers.
Attenuation due to scattering loss and absorption.
The effects of scattering and absorption determine the operating wavelength range of fiber-optic communication.
Attenuation is usually measured in decibels per kilometer.

Parts of optical attenuation

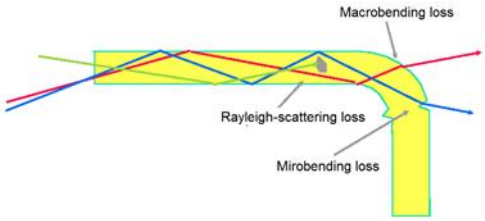


Loss of light in an optical fiber due to scattering and absorption are inevitable.

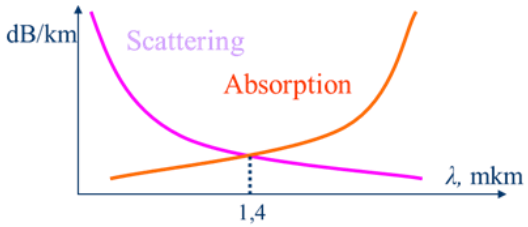
Attenuation in optical fiber

Macrobend - cause great losses at higher wavelengths.
Microbend - appear in the manufacture of fiber.

Shows only core of optical fiber



The lower limit of the fiber loss



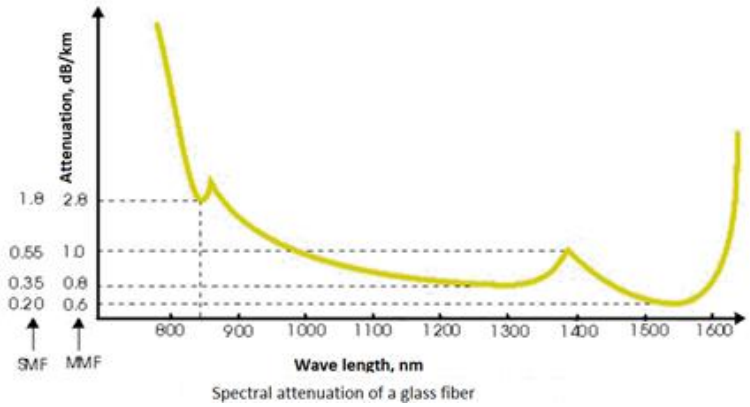
The minimum value of the loss is never reached because:
• Cable losses arising during the manufacture of optical cable.
• impurities contained in the material of the fiber core which leads to a sharp increase in loss at certain wavelengths.

Transparency windows

Fiber-optic communication is not suitable for all wavelengths, but only in certain regions of the spectrum, where the minimum loss is achieved.

Region of minimal losses were named **transparency windows**.

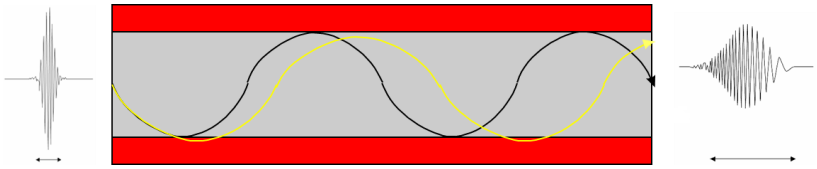
For silica fibers of practical interest are three windows transparency. Most often, this three lengths - 850 nm, 1300 nm and 1550 nm.
Characteristics of semiconductor emitters and photodetectors optimized for these windows.



Spectral attenuation of a glass fiber

20. FREQUENCY PROPERTIES OF THE OPTICAL CHANNELS

Dispersion of electromagnetic radiation

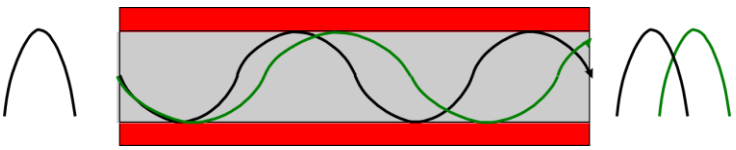


Dispersion is the technical term for the spreading of the pulses of light as they travel along the optical fibre. Dispersion leads to distortion of a form of an impulse.
Dispersion determines the bandwidth of the fiber and arises from the presence of a number of physical processes occurring in the fiber.
There are two main types of dispersion: **chromatic** and **modal**

Chromatic dispersion

Chromatic dispersion caused by the dependence of the signal propagation time along the fiber from the light wavelength (in the presence of the optical signal spectrum of more than one component at different wavelengths).

Multimode dispersion



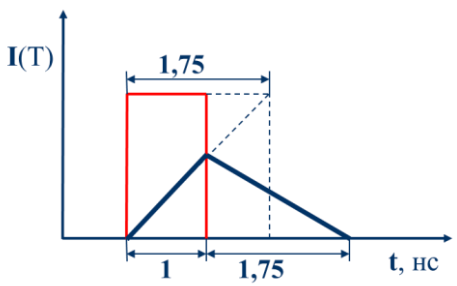
Modal dispersion occurs only in multimode fibers because they contain a large number of modes with different propagation times due to the scatter and reflection angles, respectively, of different lengths of paths that are separate modes in the fiber core.
Has much greater impact on the bandwidth of multimode optical channel than chromatic!

Dispersive coefficient

For single-mode fibers dispersive coefficient has dimension ps/nm x km.
The wavelength λ, above which the material dispersion is positive, and below it - is negative, is called the zero dispersion wavelength.
Frequency characteristics of multimode fiber bandwidth is convenient to estimate the coefficient modal bandwidth having the dimension MHz x km.
The coefficient modal bandwidth is a measure of the bandwidth of multimode fiber and has dimension MHz x km.

Example

Fiber OM1
Modal bandwidth coefficient: 200 MHz x km at wave wavelength 850 nm
Cable length: 1 km



Input impulse: 1 ns (ideal)

Upper frequency limit of the fiber:

$f_{вг}$ = 200 MHz x km / 1 km = 200 MHz

Rise time:

t = 0,35 / 200 MHz = 1,75 ns

21. CATEGORIES AND CLASSES

The need to introduce categories and classes

Various complex objects SCS (permanent lines and channels) are different from each other their related quality parameters.

Guaranteed line and cannels parameters recorded a class.

A similar principle applies to the element base for the formation of lines and channels by specifying categories of cables and patch equipment.

The concepts of class and category are closely related, but not identical.

Categories and classes of balanced cabling

The main feature of the class and category of balanced cabling is the upper frequency limit valuation parameters.

Practically interesting

Class A (Category 1) – up to 100 kHz

Class B (Category 2) – up to 1 MHz

Class C (Category 3) – up to 16 MHz

Class D (Category 5e) – up to 100 MHz

Класс E (Category 6) – up to 250 MHz

Class EA (Category 6A) – up to 500 MHz

Class F (Category 7) – up to 600 MHz

Class FA (Category 7A) – up to 1000 MHz

Class G (Category 8) – up to 2000 MHz (under development)

Match categories and classes balanced techniques

In the balanced technique class guaranteed category corresponds with the mandatory two conditions.

All components of the channel have a category not stated below (the principle of the weakest link).

Performed without exception restrictions standards regarding the lengths of cable elements and structure of the lines.

Categories and classes of optical cabling

Approaches to balanced and optical subsystems are very similar.

At the level of the optical subsystem category distinguish fibers from OM1 to OM4 (multimode technique) and OS1 and OS2 (single-mode technology) and classes channels OF-300 , OF-500 and OF-2000. In the latter case corresponds to a digital code for the maximum channel length in meters.

Each application is assigned its maximum class channel.

Options OM3 multimode optical fibers and OM4 separately normalized for laser and LED light sources and are assigned to different wavelengths of practical interest .

22. TECHNICAL ROOMS

Technical rooms

Technical premises rooms are part of the architectural components of SCS. When deploying SCS uses two types of technical rooms:
Equipment rooms equipped with raised floors, fire suppression systems, air conditioning and access control.
Telecommunications rooms is a room that houses the patch panels of SCS, network equipment and other accessories.
Technical rooms, depending on their destination and accommodation divided into levels.
Each SCS can be only one room for campus distributor, and in each building - only one room for building distributor (if there are no additional requirements for reliability and safety).

Equipment rooms

Equipment rooms is the central technical room not only SCS, but the entire data system of the enterprise. Besides servicing equipment backbone cables SCS It establishes numerous active device group assignment enterprise (central server, backbone switches, the telephone exchange, etc.).
The equipment room is equipped with advanced system engineering, including and fire alarm systems, fire extinguishing system, etc.

Telecommunications room

Telecommunications room - the most massive technical room, which contains elements of the backbone subsystem for communication with the horizontal, as well as active network equipment of workgroup level. Number of telecommunications room is chosen so that each of them served on the floor working area of 1,000 square meters. m. Working area is approximately 2/3 of the total.

Size of technical rooms

Buildings with gross area of 50 000 m2 (500 000 ft2) or less should allocate a minimum of 12 m2 (120 ft2) of floor space for the equipment rooms.
A typical telecommunications room should be sized at 6 m2 (80 ft2).
Recommended dimensions of telecommunications room (standard TIA/EIA-569A).

Serving area, m2	Room size, m
<1000	3,0 x 3,4
<800	3,0 x 2,8
<500	3,0 x 2,2

Environmental conditions in technical rooms

In technical rooms should be appropriate engineering systems when operated by the given conditions on the parameters of the environment.
Controlled by the following parameters:

- temperature (from 18 to 24 C);
- humidity (from 30 to 55 %);
- Illumination (not less than 500 lux);
- vibration;
- electric field (no more than 3 V / m);
- the level of pollutants.

For compliance with the rules on the content of the dust is encouraged to establish technical rooms increased air pressure. Ventilation for this onto a great performance compared with exhaust ventilation.

Additional options architectural realization of technical areas

Besides full technical facilities in the construction of SCS in the case of a small number of service jobs can be used simplified embodiments technical areas in the form of:

- closets (area up to 500 sq. m.)
- Specially constructed areas (distinguished by the presence of closets front and rear doors);
- detached single floor or wall cabinets.

23. 19-INCH MOUNTING CABINETS

Accommodation SCS and LAN equipment in technical rooms

In telecommunication and other technical rooms of low-level equipment is mounted primarily in 19 - inch form factor cabinets.
When the number of WO to 120 applies constructive one.
When the number of WO of over 120 - two cabinets.
In a properly designed SCS more than two 19-inch form factors cabinets in one telecommunication technical room is not required!
In the equipment room of the equipment (usually a telephone exchange) and its cross mounted on the wall, the rest of them active and passive devices - in cabinets.

Classification of 19-inch cabinets

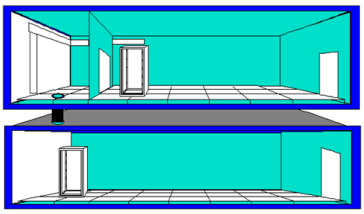
Depending on your performance 19 -inch cabinets divided into:

- floor cabinets;
- wall cabinets;
- open frames.

Wall cabinet supports up to 40 WOs .
The main type of floor cabinets have height 42U.
In the lower level of distribution nodes because of the large number of horizontal cables used mainly 800 mm wide cabinets.
Cabinets with smaller widths (600 mm) are used mainly in equipment rooms.

Rules for the selection of technical rooms and their location in the mounting cabinets

When designing SCS and selecting locations technical rooms should adhere to the following rules:
Avoid neighborhood technical rooms with power plants (transformers, generators, elevators, and so on.), gas, water or power highways in the neighborhood or passing discreetly in the wall.
It is desirable to have the technical rooms centrally with respect to the area they serve as well as closer to the riser as possible.
Constructive assembly should be positioned to be readily accessible to him the technical staff.



If you can not establish constructive mounting in protected areas or areas with limited access should apply lockable cabinets.

Terms location cabinets

By arranging two or more cabinets in a row they have to be mounted aligned horizontally, vertically (at the same height) and bonded with each other to produce a unitary structure.
In the process of vertical alignment allowed to use shims under the mounting feet (height not exceeding 5 mm, the area - not less than 40 m2)

The width of the side passage is chosen to be at least 762 mm, before the front and rear portions of the rack or frame should remain free space of at least 914 mm.

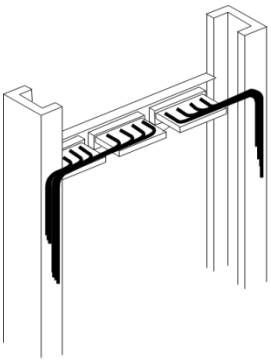
The magnitude of the gap between the top of the cabinet and ceiling elements (False Ceiling) and mounted them on the equipment should be at least 150 mm.

In the case of telecommunication rooms with minimal dimensions when placing cabinet is further controlled quantity of free space in front of the front part. It should be sufficient to free the door opening.

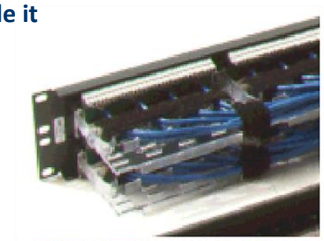
The structure of project documentation in respect of the installation linings included drawings of two types:

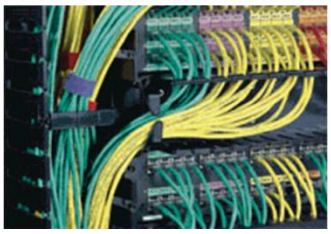
- • The scheme called fronted cabinet indicating mounting locations and varieties installed on each of the active and passive equipment.
- • Layout of cabinets in a technical room with dimensions, making it possible to perform unambiguous binding constructs during installation.

24.TECHNICAL ROOMS – RECOMMENDATIONS



Held horizontally cables to the rear frame, and not inside it





Bundling and fixing cables

In technical rooms, when combined into bundles of cables to the cable tie is better to use Velcro tape (eg VELCRO ®), which are easily added, removed and shall be installed at the new location. Plastic ties better to use only permanent harnesses.

Cable management in the form of rings and clamps are used to correct and accurate laying of cables and harnesses. Use of cable organizers to avoid excessive bending of cables, as well as facilitating their laying. Sagging patch cord is a major contributor to poor organization of cables, their deformation and therefore worsens contact plug socket.

Velcro tape

Parameters:

• Length 1600 mm or 5000, with option to crop;
to the desired length

• Width 20.2 mm;

70V-20-01BU

Used to organize cables into bundles. Ideal for applications requiring frequent moves, adds and changes.

Recommended for organizations Category 6 cabling and up to prevent excessive tension.

25. GROUNDING AND POTENTIAL EQUALIZATION

Grounding and potential equalization

Quality grounding and potential equalization are important for all types of systems.
As telecommunications grounding line (TGL) can not use the internal water pipes building.
If there are multiple vertical inventory to combine them on the top floor and at least every 3 floors.
The effectiveness of the screen depends on the "purity" of the earth, that is, from the constancy of its potential throughout.
The standard requires that the potential difference between two points connecting ground less than 1 V.
Resistance separate grounding device must meet the requirements of the enterprise - manufacturer of equipment or departmental standards, but should not exceed 4 ohms.
Existing regulations operation of electrical and metal structures for various purposes for its installation require that all parts of the ground conductive materials.
Grounding equipment relate to the standard 19-inch element constructs.
The cable trays must be grounded (contact with the ground every 15-20 m, formed trays circuit must be continuous) and if the tray is smaller, then the two sides.
According to EN 50174-2 distance between power and telecommunication cables shall be not less than 20 cm.
Cables from different systems should intersect at right angles.

26. ELEMENTS FORMING CONDULET

Channels for SCS cable - General Requirements

When implementing SCS horizontal subsystem uses the following types of channels:

- Boxes;
- Trays;
- Mortgages pipe.

When implementing internal subsystem highways SCS crossings covering and wall channels are used following varieties:

- Slot;
- Sleeve;
- Mortgage pipe.

Channels of any type must ensure compliance with permissible bending radius of cables laid on him and should not have sharp edges.

Cable Trays

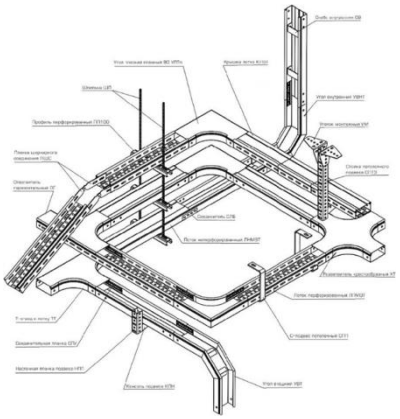
Cable trays must not damage the shell lay cables.
Issued the following types of metal trays
(depending on the application):


Unperforated (solid);


perforated;


wire;


Stair.



Wire Cable Trays

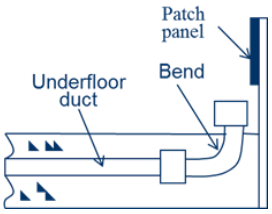
The easiest way to install - wire trays. They do not require special accessory - only two or three fastening elements, all of the compounds twists and branches bend during installation. In this case there is no need to count the number of turns, the taps and so on.
However, these trays are quite expensive because of the complexity of their production, so installation costs and the highest (of appropriate quality).
Provide direct visibility of the cables in the road. Connectors should not be placed directly over the supports for trays and forbidden to go.

Stamped trays

Most economical - stamped or perforated trays solid. They are easy to implement, subject to availability accessory turns, branches, inlets, etc. Possible that when all these elements are made "on the spot" grinder, with sharp edges may remain and sustain the minimum bending radius of cables is very easy.

Stamped trays - enough flexible solution: using the same grinder experienced installers "bypass" tray any obstacle cable routing.

Conduits



The pulling force applied to the cable during his broach is one of the main criteria for selecting the size and configuration of the cable channel.
The magnitude of the force of attraction is significantly affected by the bending radius and their number, as well as the diameter and the number of laid cables with a specific cross-sectional area.
Network embedded metal or plastic pipes of different diameters similar underground channels with a rectangular cross section is set to intermediate floor structure before the "clean fill" sex.
Such a network can be divided into two subsystems: **the main and distribution.**
The network of embedded tubes according TIA/EIA-569 standard is so designed that, in the general case it out sections having more than two bends at a right angle between the points of cable drawing or intermediate suction boxes, and with a length exceeding 30 m.
The magnitude of the bending radius of a circular duct is chosen taking into account the diameter of the pipe and the type of laid cables in them. Meaning bend radius of 400 mm is preferable for the organization of vertical pins.
Neither inserts pipes must not have more than two bends at an angle of rotation not more than 90 degrees.

Conduit sizing for horizontal cables

Conduit sizing for horizontal cables - the number of cables that can be placed in it, and therefore depends on the size of the cables and the tube itself.
Not recommended lay cables with low and high signal levels in a single pipe.
The table on the next slide is taken from ANSI/EIA/TIA-569-A, approved by National Electrical Code (NEC, USA), and the diameters were calculated for 40% filling tube cables. This table contains information about the capacity of horizontal tubes, having no more than two right angles, and no longer than 30 meters.
Each turn of the tube at right angles to the friction force increases by an amount equal to 10 emerging meter straight section of pipe.

Conduit sizing for horizontal cables

Internal diameter, mm	Maximum numbers of cables					
	4.6 mm	5.6 mm	6.1 mm	7.4 mm	7.9 mm	9.4 mm
19 (0,75”)	5	4	3	2	2	1
25 (1”)	8	7	6	3	3	2
32 (1,25”)	14	12	10	6	4	3
38 (1,5”)	18	16	15	7	6	4
50 (2”)	26	22	20	14	12	7
63 (2,5”)	40	36	30	17	14	12
76 (3”)	60	50	40	20	20	17
102 (4”)						30

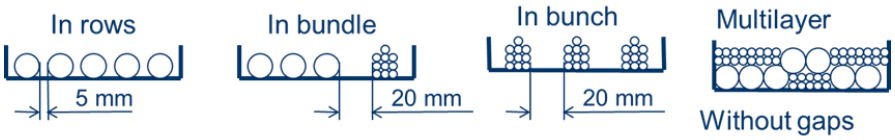
27. TERMS OF LAYING CABLE CHANNELS IN GUTTER TYPE

Terms of cables in the channels trough-type

Cables and harnesses are laid in rows of trays, bundles and packages.
Single-layer routing distance between the individual cables shall not be less than 5 mm, while laying beams - not less than 20 mm.
And laying the individual cables are formed parallel to the sides of the package and is made symmetrically with respect to the central axis of the trays.

Occupancy of trough-type channels

In boxes wires and cables may be routed to the multi-layered structured and random (bulk) mutual arrangement. Sum of cross sections of wires and cables suitable for their outer diameter including insulation and outer sheath shall not exceed: for deaf boxes (trays), 35% in light box section, for boxes (trays) with an openable cover 40%.



Terms of cables in the channels trough-type

If a tray at the same time laid fiber optic cables and twisted pair cables, first in tray stacked heavier balanced cables and then top them with fiber optic cables.
At the same laying itself must be carried out so that the fiber optic cables do not fall between the balanced cables and compressed them.
This is especially true for indoor optical cables, strengthening coatings which provide a minimum level of protection of the core pieces of compressive forces.
Power cables and SCS is desirable to lay on various cable channels. If such a solution is not possible, in different sections of a single box. Spatial partition ensures their continuous spatial separation.
Should be possible to more (not less than 125 mm) to organize cables SCS from fluorescent light ballasts, which are point sources of interference.
Prohibited any distortion when laying cable.

28. VERTICAL PATHWAY

Vertical pathway

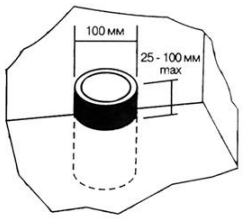
Vertical channels should be placed one above the other on each floor of the building.
Include at least three 100 mm pipes or hoses.
Before installation should be completed all preparatory work.
Before installation, install all the necessary equipment (chutes, rollers, winch).
Installation is carried out between the floors from the top or bottom of the track marks.

Cable can not hang freely, it must necessarily be fixed (otherwise its properties can change).

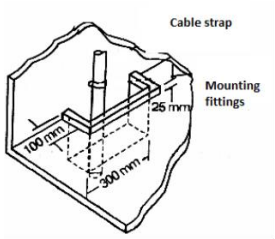
Vertical pathway

Slots, short and long sleeves elements embedded passage intermediate floor.

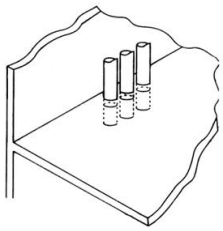
Sleeve



Slot

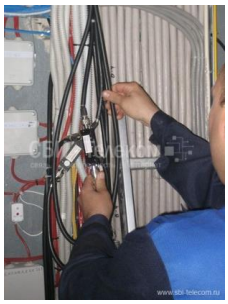


Long sleeve (tubes)



Interbilding backbone cable fixing highway

Backbone cables passing through the slot, attached to the wall placing special technical fittings, made in the form of clamps and brackets of various kinds.



Slot

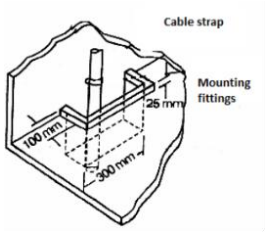
Slot necessarily supplied border that prevents the flow of water and protects the opening from being hit by foreign objects. Upon completion of work should be embedded plug of refractory material.

Advantages :

- flexibility;
- good dimensions and weight.

Disadvantages:

- high cost of implementation;
- reduces the mechanical strength of the overlap;
- complexity of the fire safety regulations.



Sleeve

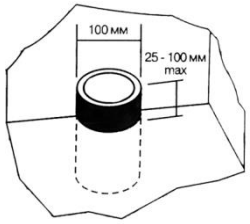
Sleeve is a short length of pipe diameters up to 100 mm, mounted in a suspended ceiling. Sleeved over similar slots set for fixing the various components of the individual cables and beams.

Advantages:

- ease of practical implementation;
- Easy installation in them delaying fire plugs in accordance with the requirements of fire safety.

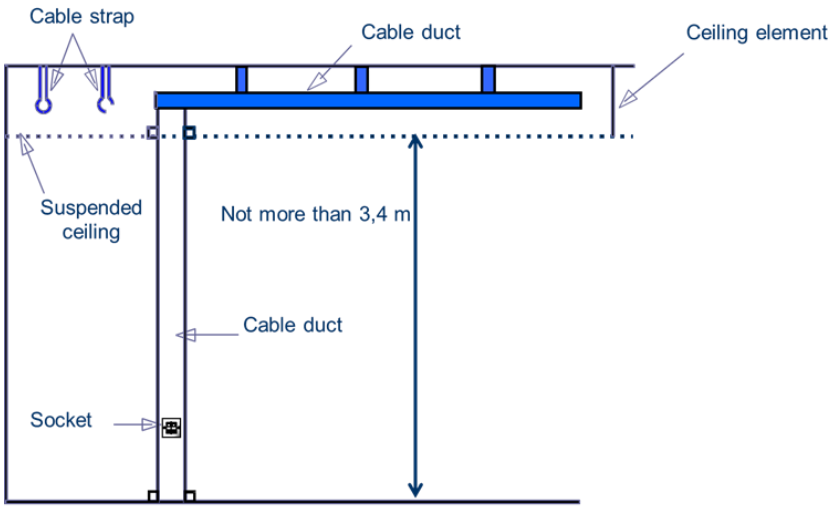
Disadvantages:

• provide a lower capacity and flexibility compared with slots.



29. WIRING FOR FALSE CEILINGS IN THE RAISED FLOOR

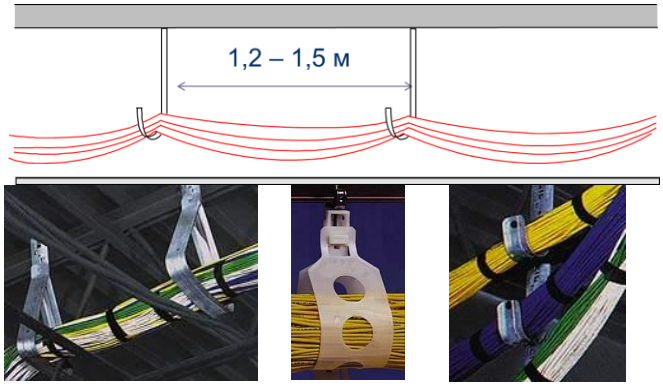
Suspended ceiling



Suspended ceiling - the rules of cabling

Laying cable channel must respect the recommended duty cycle.
You should begin with styling long cable lengths. First, it is more convenient. If you later find that you make a mistake, add a short section is always easier than long. Second, for short segments can use what is left on the coils after styling long.
Marking - mandatory and important procedure. The cable must be marked on both sides. This operation is always preceded by stacking and not vice versa - never cut the cable laid from the residue on the coil, if not installed near the site of the label pruning.

Hooks for hanging cables



Laying underfloor

The most economical in terms of fuel cable option - laying lines inside the floor.
If used in an office mobile partitions, cable can be laid under the floor just by mounting sockets in hatches.

Raised Floor

The raised floor is a floor covering consisting of removable plates that are mounted on a strut-type supports.

Raised floors provide:

- easy access;
- ease of upgrade;
- Easy to install new and removal of obsolete cables;
- conversion of buildings for other needs.
- optimal solution when laying a large number of cables.

Design issues raised floor

- Common tasks in the design:
- Installation of grazing plates;
- ensuring good ground;
- Protection against electrical interference.

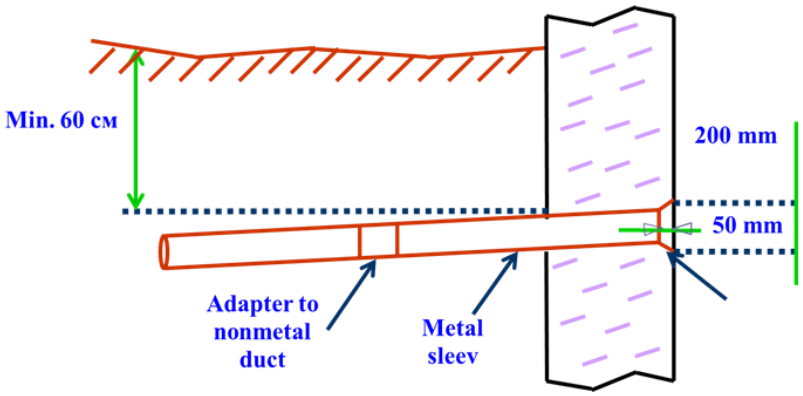
You must make sure that:

- there is enough powerful air conditioning system to cool all the equipment;
- take into account
- Check whether there is enough free space to install the equipment available, and take into account margin development. He limitations of mechanical load on the raised floor and the floor, which is the basis;

30. BUILDING ENTRANCE

Building entrance - standard EIA/TIA 569

External backbone cables, if they are not universal, entered the building on the maximum length of 15 meters, and then be routed internal cables that meet fire safety requirements.

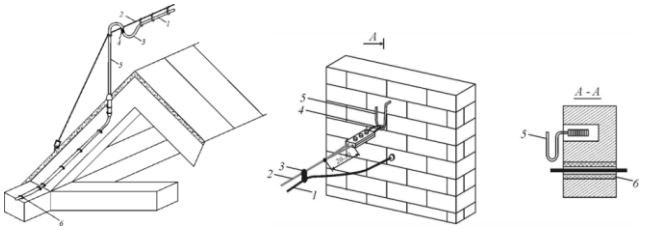


Encased entrance conduit termination

Underground entrance the building is realized on asbestos cement, metal or plastic pipes.
Packing depth introduction pipe in the ground should be at least 600 mm.
Pipe is installed with a bias towards the street or well to prevent water from entering the building. The magnitude of the slope is selected to be not less than 25 mm per 1 m length of pipe.
The outer end of the pipe should extend beyond the line of the wall or retaliation by not less than 600 mm.
Height of the lower row of tubes introductory unit should be at least 200 mm above the floor.
Unoccupied input pipes must be seale.

Air entrance conduit

Air cable entrance into the building is organized in two main ways: through the roof and through the wall.



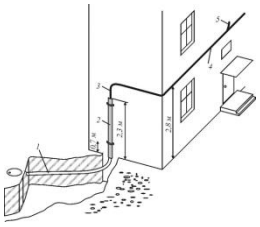
Features of construction air entrance conduit

Air cable entrance to the building should be considered as an exception because of its relatively low operational reliability and complexity of implementation.
Air input can be performed through the wall and through the roof.
When entrance the organization through the wall into the inlet hole should be required to set the tube of polymeric material with a slope of not less than 12 mm outside.
It is forbidden to enter the cable into the building through a hole in the window frames.
When entrance through the roof to protect from moisture in the attic, must necessarily be applied with a curved down tube end.

Installation of the cable on the outside wall of the building

Installation of the cable on the outside wall of the building conforms RD 120-2000 conducted between the first and second floors.

Direct output to the wall under the ground is performed by a curved pipe
Vertical section of the cable on the wall be sure to protect metal area at a distance of not less than 2.1 m from the ground.



31. HORIZONTAL CABLE INSTALLATION

Velcro tape

Velcro tape is often used in practice

Velcro tape used to secure the cable bundles on cable trays and for mounting on a wall or instrument rack.

Velcro tape made of durable

not stretch material and may be white or colored

Grouping cables

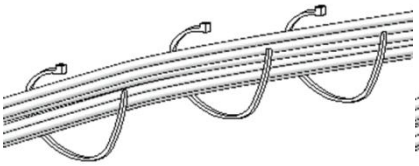
When forming bundles should observe the following rules:

• the maximum number of cables in a bundle no more than 24 pieces;

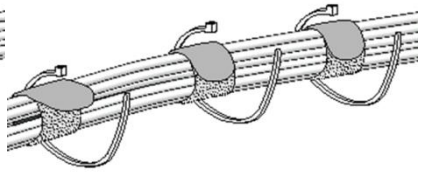
• for horizontal cabling should be installed tape or ties every tie of 1 meter;

• for vertical cabling should be installed tape or ties every tie of 1 meter;

• detaching force should not deform the cable.



No for Xot 6



For cat 6 and higher

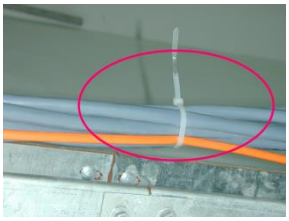
Examples of groups of cables

Correct

Wrong

. When excessive tightening the fastening clamps begins derating cables.

Typical error during installation



Excessively strong tightening fixing ties

Bending radius

Minimum bending radius - is limiting radius to which the cable can be bent without mechanical damage or deterioration of its characteristics.

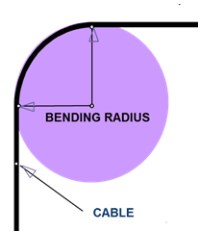
The minimum bending radius is normalized separately for installation and after installation (operation).

The recommended bend radius for installation is usually larger than after installation.

Before installing the need to consult with the manufacturer of the cable. Small radii of curvature degrade NEXT (balanced cables) or loss (optic), and can also damage the cable.

Minimum bending radius for a balanced cable for operation is its four outer diameters.

Bending radius



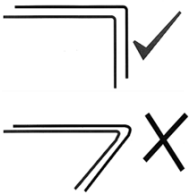
The bending radius of the cable is indicated with respect to its outer diameter.

Typically, the minimum bend radius is:

• Four external cable diameters, for cables with six pairs and less;

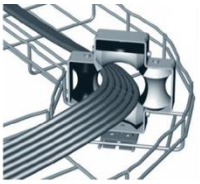
• ten cable outer diameter, for cables with the number of pairs of more than six.

By increasing the radius of curvature decreases mechanical stress and deformation of the cable when passing angles during its mounting.



Tension

Recommended maximum force of tension for 4-pair unshielded balanced horizontal cable is 110 N, for shielded - 220 N.



Terms of cable installation

Compliance with these rules will help avoid stretching the wires when installing or deterioration of throughput characteristics caused by excessive stretching of the cable.
Basic errors that increase mechanical stress on the cables:
twist the cable during pulling or installation;
tension on the suspended sections of the route ;
tighten the cable clamps ;
too small bending radii .
Cable laid out on the floor before tightening the channel, you can not walk.
The process begins with laying all the major trunk and internal cables.

Next laid horizontal cables must be have smaller diameter.
Unacceptable to lay telecommunications cables in the same conduit with power cables.
If the system has more than two channels turns at 90 degrees or pipe length exceeds 30 m - should provide lingering box.
Applying grease cables during broaching increases the degree of filling (not recommended).

32. WORKING WITH BACKBONE CABLES SCS

Installing backbone cable

Installing trunk cable is different from the horizontal cable installation due to its greater linear mass and less flexibility.

Working with master cable requires much more technological devices.

Special attention should be organization laying backbone cables on vertical sections, which is practically ubiquitous in the SCS projects with a hierarchical topology.

Laying backbone cable from the top down

Requires less equipment.

Requires lifting cable drum tracks on the upper mark.

Need a place for drums and equipment.

Requires compliance with the following rules:

- drum must be placed at some distance from the inlet;
- must be used or roller guide groove for cable feed into the inlet;
- ensure that the necessary measures required braking;
- reel cable drum should be slow;
- cable fixing should be implemented immediately after installation, should start from the bottom.

Laying backbone cable from the down top

Typically, a more complicated procedure.

Requires compliance with the following rules:

- at the inlet roller must be installed and the device that produces the pulling force (winch);
- must be lowered from the top rope broaching;
- ensure that the necessary measures required braking;
- ensure strong attachment of the cable to the cable broaching;
- Cable should be stretching at a predetermined rate;
- where appropriate, should include provision of cable.

Maintain the bending radius and pulling effort

Bending radius of the indoor backbone cables must be supported by at least 10 outside diameter of the shell at no load and at least 15 with outer diameters dragging with the force of maximum permissible values.

Bending radius of outdoor backbone cables must be maintained for at least 10 outer cable diameters in the absence of load (after installation) and not less than 20 external diameter with dragging with the force of maximum permissible values.

Routing of cables and stocks on the laying

When routing the backbone cables on the track in the intermediate inspection carried out by its computation devices along the walls, where such an operation envisaged design of the device.

The need to take into account the introduction of reserves calculations for the length of the cable.

In determining the reserves taken into account:

- stacking irregularities;
- end cutting.

Stocks forming the cable length in the form of rings in the duct and inspection devices are not allowed.

Additional requirements for fiber-optic backbone cables

ANSI/ICEA S-83-596

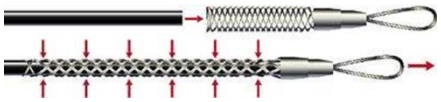
2 - and 4 - fiber cables that are part of the horizontal or centralized optical fiber system must have a bending radius not less than 25 mm (1 inch) in the absence of load (after installation).
Bending radius of 2 - and 4 - fiber cables at broach through horizontal routes must be kept at least 50 mm (2 inches).
Bending radius of all other cables inner liner must be maintained for at least 10 outer diameter shell at no load and at least 15 with outer diameters dragging with the force of maximum permissible values.
Requirements for the work with optical and balanced outdoor cables are equal.

Attaching the cable to the broaching rope

In the case where the applied force is small (smaller segments to Install thin cables) cable connection to broaching rope can be done directly for the strength member of the cable.
In all other cases should mount exercise for the cable fixed to the tip.
Tips are of two types:

- Disposable (crimped);
- Reusable (collapsible).

The most reliable and safe way of fixing is fixing with a cable stocking. The most reliable and safe way of fixing is fixing with a cable stocking.
It is a braided sleeve made from metal wire or polymer fibers of various thicknesses.
Upon application of longitudinal force and a stretchable sleeve decreases in diameter, firmly fixing the cable.
Allows equally reliably fix single cables or bundles of cables of any design without damaging the capture.



Winches

Gate - a simple tool for retracting cable.
Does not allow significant efforts to develop and creates uniform feed.
Manual or electric winch control and do not allow limit the developed force.

33. CONNECTION OF BALANCED CABLES TO THE PATCH PANELS

Rules of termination

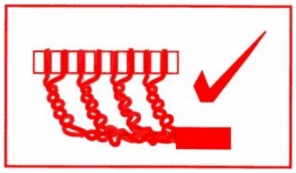
Connecting twisted pair of balanced cable to IDC-contacts called termination.

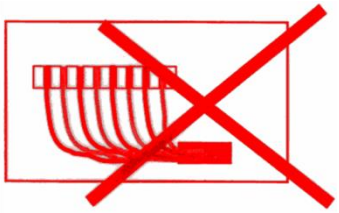
Basic rules for the implementation of termination.

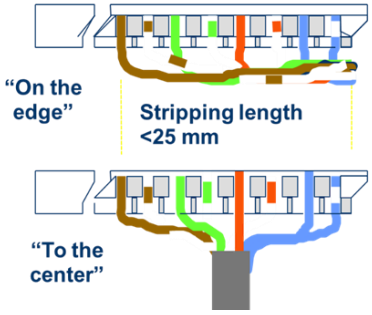
For a given value NEXT maximum length untwisted of twisted pair Category 5 and above should not be more than 12.7 mm.

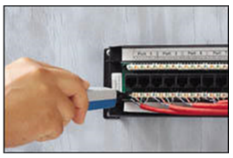
The cable sheath is removed exactly as long as necessary to terminate on a connector.

Connecting twisted pair of balanced cable to IDC-contacts

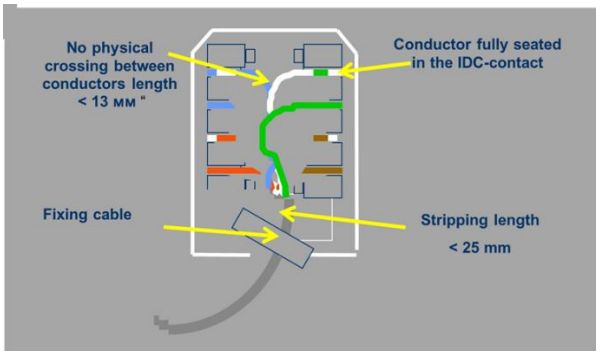








Termination of cables



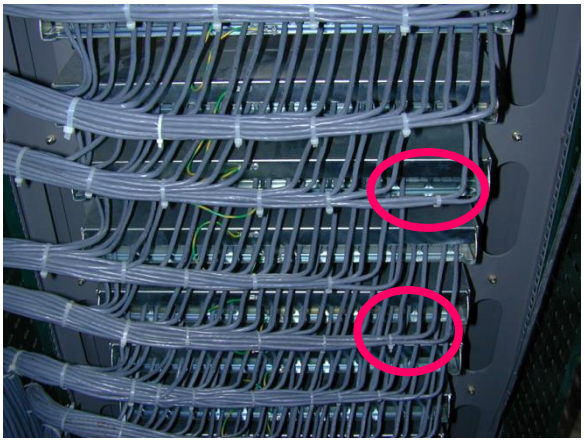
Installation rules

Saving factory lay twisted pair is critical.

End fitting with the restriction minimum bending radius

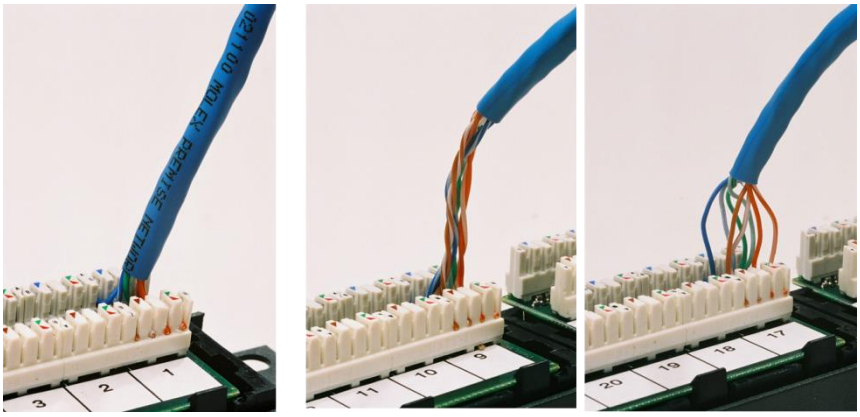
Installation rules

First impression: The cable is laid gently but …



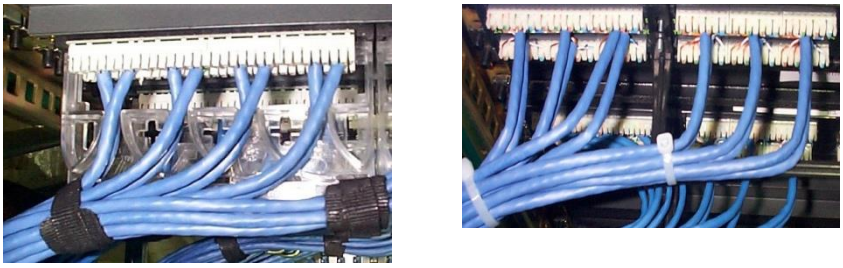
Cable connection to panel

Correct **Wrong**



Cable connection to panel

Correct **Wrong**



34. PATCH PANELS AND CORDS

EUROLAN patch cords

Variants:

- Patch cords U / UTP, F / UTP category 5e, 6;
- Patch Cords S / FTP Category 6A.

Features patch cords:

- Plug RJ45 8-way, 8-pin, category 5e, 6 or 6A;
- Number of cycles connection/disconnection at least 1000;
- Contact material bronze alloy doped with phosphorus;
- Contact protection against corrosion through:
  - Nickel plating thickness of 2.54 microns;
  - Gold plating thickness of 1.27 microns.
- Mounting on cable cord - plug flooded plastic shank;
- The color of the outer sheath of a cord: white, red, blue, green, yellow.

Features RJ45 patch cords

Wire diameter of U/UTP-5e flexible cable is 0.98 mm and the diameter of the mounting hole plug 1.01 mm, which allows you to install manually.
In shielded cable wire diameter exceeds 1.01 mm, which does not allow to install the plug in the field.
For equipment category 6 and above achievement of the required parameters for manual installation cords impossible.

Eurolan Company strongly recommends the use prefabricated cables with better parameters and more reliable!

Variety of patch cords

Patch cords Eurolan different:

- Design: Shielded - unshielded;
- Category: 5e of up to 6A;
- Length: 0.5 to 10 m;
- The type of plugs: RJ45 and 110 (may be combined cords);
- cords with plug type 110 have 1, 2 or 4 pairs.

Important: The minimum bend radius of the 4-pair cable is 20 - 25 mm.

Some rules for the application of patch cords

Patch cord is made from cable with stranded conductors that have high attenuation. Therefore, patch cords must have a minimum length.
The minimum length of patch cords not only improves the quality of the functioning of the cable channel, but also improves the conditions of administration, because loop cords do not overlap marks.
Cable patch cord must necessarily be laid to organizer and not affect its weight on the plug.

Crossing wire EUROLAN

Jumper wire (19A-U3-01-R500) is used to patch panels with 110-type formation lines to transmit telephone signals.

Parameters:

- Number of pairs - 1;
- Conductor 0,51 mm, copper, solid;
- PE insulation;
- Packing - a hank of 500 m;
- No cover;
- Gross weight 2.6 kg.

Patch panels

Patch panels are generally mounted in the cabinets in technical rooms and as an exception, directly on the wall.
Patch panels are used to connect the cables to them the various subsystems SCS and for manual connections of subsystems of a cable system and active equipment with patch cords or jumpers.
Patch panels Eurolan allow cables terminate the conductors of which have a diameter of from 0.45 to 0.65 mm.
Patch panels are available in monoblock and typesetting versions and are offered in style and with 110 and outlets RJ45.

Installing the patch panels

Patch panels are mounted only in the places provided by the project construction SCS.
When you change the setting on the local conditions, this fact is necessarily reflected in the executive documentation.
Before connecting cables to the panel their technological marking changes the finish marking. Application finish marking is mandatory according to the requirements of SCS administration.
Panel installation on standard working space is performed before or after connecting to it line cables depending on the installation technology.
The type of mounting elements depends on the installation location and characteristics of the wall.

35. WORK AREA OUTLET

Work area outlet

Information outlets, which are an integral part of the horizontal subsystem of the SCS, are used to connect the equipment to the SCS by work area cords.


According to the standard ISO/IEC 11801 contains one information outlet for at least two modules 5e/6/7 categories, one of which can be replaced with an optical connector. Such WO should serve about 10 m^2 working area.

Housing information outlets are divided into: **external** and **internal**.
Outer casing closes jack module on all sides, and the inner is made as a decorative front panel or other mounting base and leaves open the back (cable) part jack module.
Inner casing sockets installed into the seat using latches.
Landing sizes of sockets type Mosaic 45 Mosaic 45 correspond to a system of Legrand (22,5 x45 mm).
Wall outlets are mounted directly onto the surface.

Jack module UTP / FTP Category 3, 5e Keystone



- Performs style Keystone or Mosaic 22,5 × 45,0 mm;
- Modular jack RJ45, 8-wires, T568A/B;
- Available in shielded and unshielded versions with categories from 5e to 6A;
- The number of cycles connection/disconnection at least 750;
- Contact outlet: Phosphorus doped tin bronze;
- Protective nickel plating thickness of 2.54 micron and 1.27 micron thick gold plating;
- IDC-contacts: Phosphor Bronze;
- Protective coating nickel (thickness of about 2.54 microns); Colors: black, white, red, yellow, green, blue.

36. INSTALLATION OF OPTICAL CABLES

Installation of optical cables

Essential to adhere to the procedure process installation cabling (styling, cutting, connection and installation of connectors).
Error is quite expensive - from replacing spoiled connector before installing the coupling in place of the damaged cable.
Cutting cable can be performed:

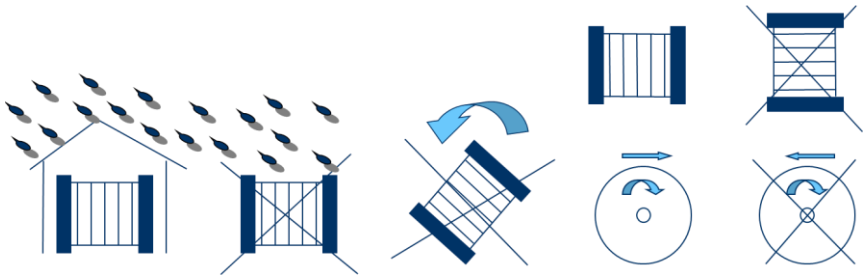
- for mounting plug connectors;
- Splice (welding or assembly one-piece connectors).

Features installation of optical cables

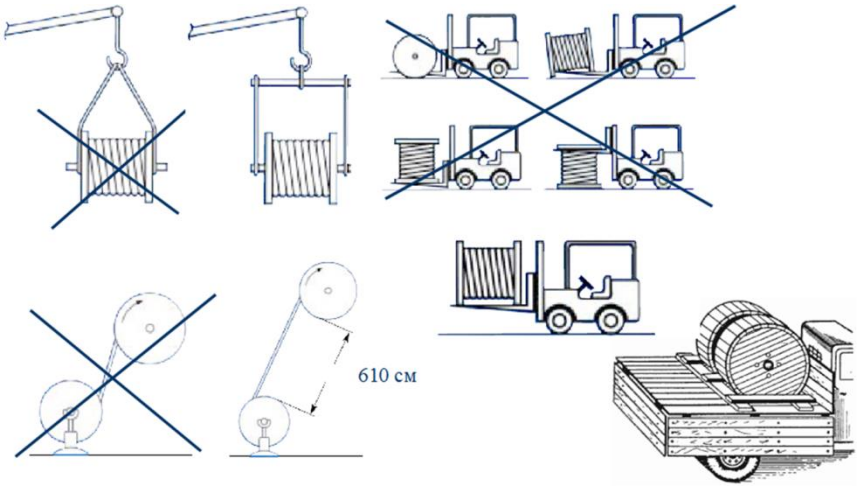
Allow lower tensile loads than the cables with metal conductors.
Particular attention should be when installing long lengths of cable.
Necessary to follow restrictions permissible tensile load.
If you violate the process may appear internal injuries that will emerge over time.

Storage and transport of fiber optic cables

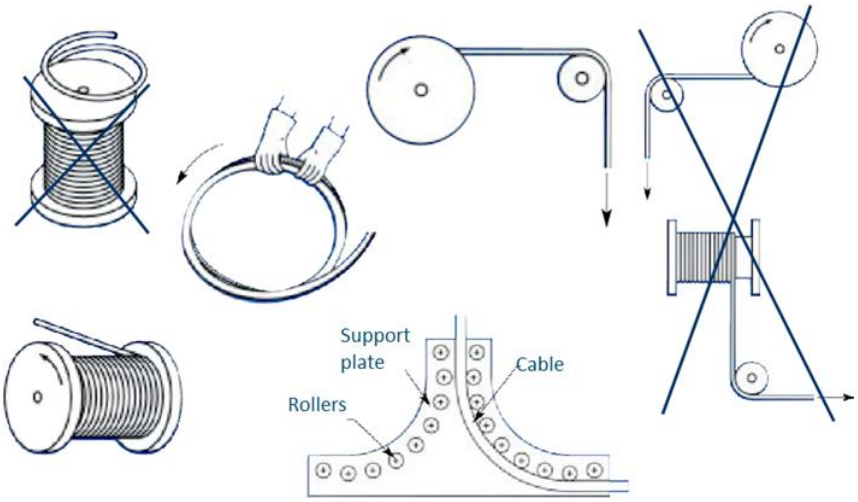
Do not store the cable in the street in the clear. The cable ends must be closed leakproof caps.
Transportation must be done in their original packaging.



Terms of cable drums



Handling fiber-optic cables



Terms repair and replacement of the optical cable

Fiber optic cables are used in the construction of the backbone subsystems, characterized by a large length and a greater risk of mechanical damage.

For small lesions can be performed for its shell repairs in order to restore its integrity.

Splicing damaged cable runs through the enclosure.

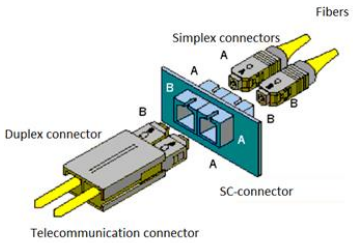
Enclosure must be use, if set at the damaged area is more than 400 m, in other cases, changing the entire segment as a whole.

37. OPTICAL SHELVES, PATCH CORDS AND PRE-TERMINATED CABLES

Basic parameters of optical connectors

	ST	SC	LC	MT-RJ
Performances Insertion loss, dB Return Loss, dB	 0,3 55	 0,2 55	 0,08 55 (SM) 20 (MM)	 0,2 55 (angled)
Version	Standard Singlemode Angled Multimode		Singlemode Multimode	
Ferrule	2,5 mm, round		1,25 mm, round	2,5 mm

Coding of optical connectors and adapters



Connector labeled "A" must always be connected to the adapter with the same label, and vice versa.
Duplex SC connector standard should have a different marking their halves.
Connector labeled "A" always is the source and adapter
the same label - the receiver and vice versa.

Optical patch cords EUROLAN

Features:

- Ferrule material - ceramics;
- Temperature range from -40 to +85 ° C;
- Number of connections ≥ 1000 cycles.

Types of connectors: SC, LC, FC, ST
Standard lengths: 0,5; 1; 1,5; 2; 3; 5; 7; 10 m
Colour coded connectors:

- Multimode – Beige;
- Singlemode – blue;
- Singlemode APC 8°/9° – green.

Possible combination cords SC-LC, ST-SC, etc.
Patch cords can be ordered in any length.

Pigtails

Features:

- Ceramic ferrule;
- Temperature range from -40 to +85 ° C
- Number of connections ≥ 1000 cycles

Types of connectors: SC, LC, FC, ST
Standard lengths: 1,5; 2; 3 m
Colour coded connectors:

- Multimode – Beige;
- Singlemode – blue;
- Singlemode APC 8°/9° – green.

Pre-terminated cables

Parameters:

- It is ready to install the system;
- No welding or installing fiber connectors;
- The number of fibers of 2 to 48;
- Termination with one or both sides;
- Cables performed with tight-buffered fiber or fiber free buffer;
- 100% tested.

38. SPLICING TECHNIQUES FIBERS

Necessity splicing of fibers

Necessity splicing of fibers occurs:

- in the case of certain varieties of technologies of connector mounting;
- the repair of the damaged backbone cables.

When installing the splitter enclosures used two varieties of matching:

- a semi-permanent (using a mechanical splice);
- permanent (using a fusion splice).

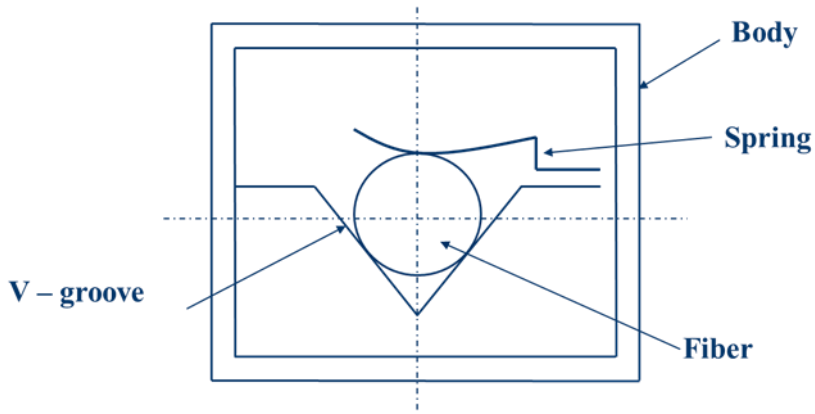
Mechanical splice

Mechanical splices intended for the connection of optical fiber connectors without setting of connectors.

Provides normal contact of fibers with physical contact end surfaces and additional mechanical fixing.

Apply to both permanent and temporary splicing.

Scheme of mechanical splice



Mechanical splice KeyQuick

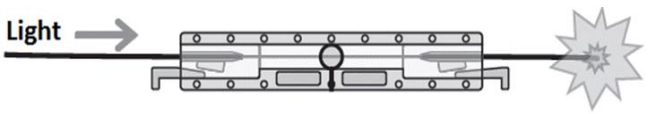
Parameters:

• Installation time 30 sec;

• Typical loss less than 0.1 dB;

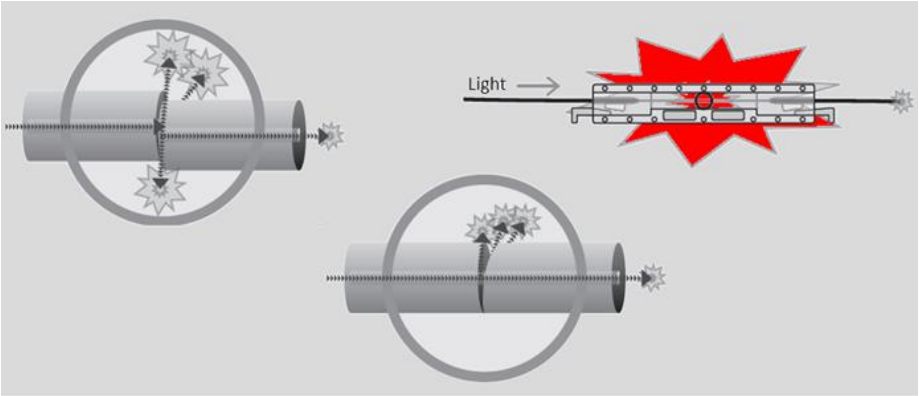
• Temperature range from -40 º to +75 º C;

• Compliant with international standard IEC 61753-1.



Feature mechanical splice KeyQuick

Connect with heavy losses observed bright luminescence module KeyQuick *



* - When connecting the test light source

Fusion splicing of optical fibers

Fusion splicing of optical fibers based on reflow fibers in the arc followed by convergence and fusion.

This technology involves the use of a pigtail.

This technology provides the best performance for all major parameters (loss, backscattered, reliability).

For fusion splicing involved specialized automatic and semiautomatic fusion splicing apparatus .

When you work with multimode fiber is possible to use devices of all types, for single-mode fiber are preferred automatic fusion splicing apparatus.

Fibers are connected with no space between them.

Loss is 0.02 to 0.1 dB (depending on the type of fusion splicing equipment).

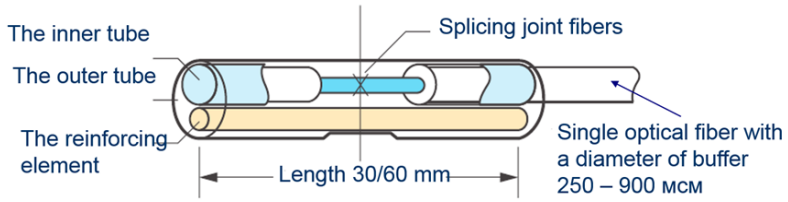
Long-term reliability of the connection.

Low cost for a large number of matching operations.

The place of contact fiber protected Fusion Splice sleeve.

This sleeve is the only one consumable components.

Fusion Splice sleeve



39. DESIGN OF SCS

The process of implementation of SCS in the facility

Implementation of SCS standardized international standard ISO / IEC 14763-2 (2012).
Implementation of SCS is divided into four main phases:

- Preparation of project documentation;
- Preparation of specifications and supply of equipment;
- Installation;
- Operation.

Each phase for reasons of convenience is divided into separate stages.

The need for planning design and construction process of SCS

The success of the project construction SCS is largely determined by careful planning.

Scheduling is performed for all phases and stages and comprises:

- Planning for quality assurance;
- Scheduling of installation works in the SCS proper and related systems;
- Planning documentation and management of SCS;
- Planning the testing process;
- Planning of additional measures (grounding, lightning protection, etc.).

Need for reserves

A properly designed and installed SCS should have provisions for increasing the number of users served and the list of supported applications, including promising.
This advice applies not only to the channels and permanent links, but also to adjacent systems (electricity, cable routes, grounding, lightning protection, etc.).

Measures to ensure the quality

Appointment of responsible experts from the contractor, subcontractors and customers.
Execution (where appropriate) of the input control of physical, electrical, mechanical and other parameters of components.
Checking mutual compatibility of the individual components of the cable system.
Testing for compatibility with pre-existing SCS cabling.
Identifying the need for adapters in the corps and corded versions.

Interaction with related subsystems

- Select the element base in accordance with the concept of MICE;
- Planning for the interaction with the power cables (choice of the distance, the use of screening separators, etc.);
- Planning architectural components technical rooms of SCS (including their size and placement of cabinets based on free zones around them).

Elements for cable laying

Monitored compliance structure SCS:

- The maximum number of stacking cables (number of ports + 40% margin);
- Minimum bending radius;
- The thickness of the package of cables;
- Distance to the sources of electromagnetic interference;
- The maximum distance between the point of fixing elements and support.

Laying line cables

In the process of laying is controlled by:

- Compliance with the magnitude of pulling effort and lack of twist;
- Minimum bending radius;
- No mechanical damage due to the efforts of squeezing;
- No mechanical damage to the shell by the sharp edges of cable routes.

On the cables shall be technology marked.

Administration system

Administration system advantageously implemented in electronic form.
Standard ISO / IEC 14763-2 provides for three levels of administration. Levels differ mainly a list of components included in the scope of the system.
As the level of administration in the region include a large number of components.
For the level of influence:

- The number of lines of SCS;
- Installation area (office, data center, industrial building, etc.).

In the process of developing a system of administration be commit identifier formats, labels and records administered components.

40. GENERAL DESIGN PRINCIPLES TELECOMMUNICATION PARTS OF SKS

The design process of SCS

Design process, for convenience, divided into a series of individual steps performed sequentially. By number of WO and the structure of the object with the involvement of floor plans:

- determined by the overall structure of the SCS and the number of distribution points.
- fixed type of element base of subsystems ;
- is the total number of WO serviced with their distribution on separate premises;
- calculated total length horizontal cable;
- determines the type of performances and calculated total length backbone cables;
- formed switching field distribution of individual nodes ;
- calculated the number of patch cords.

SCS structure

In determining the structure of the SCS as starting the following postulates:

- Choice of structure depends largely on the architectural features of the setting area of SCS ;
- When designing the SCS in a building with 4 floors and more a hierarchical structure is used with a dedicated indoor subsystem;
- When designing several buildings SCS uses a hierarchical structure with a dedicated outdoor subsystem;
- The diameter of the workspace (the distance between the most distant outlets) served one floor distributor is not recommended to increase more than 70 m;
- It is advisable that even if technically feasible, one floor distributor served no more than one adjacent to her floor (top and bottom).

The main types of linear cables

In the bulk of cases for the construction of the linear part of the individual subsystems, must be use the following kinds of cables:

- Horizontal subsystem – balanced horizontal cable category 5e or 6. Cable category 6A must be use primarily in data centers

Building backbone subsystem:

- Mulimode optical cable - LAN signal transmission
- Multipairs balanced cable – analog or digital PBX signal transmission;
- Main backbone subsystem – singlemode optical cable.

41. WORKAREA SUBSYSTEM DESIGN

The main task of designing

During work area subsystem design solves the following main tasks:

- selected configuration information outlet typical user workplace as its design;
- calculated the number of work outlets;
- selected the category of jacks and cords;
- calculated the total number of user cords and their length distribution.

Work outlets

Work outlets, which are part of the permanent link of horizontal subsystem, used to connect the active terminal equipment to SCS by equipment cords.

According to the standard ISO / IEC 11801 contains one work outlet for at least two modules 5e/6/7 categories, one of which can be replaced with an optical connector. Such WO should serve about 10 m2 working area.
Housing work outlets are divided into: **external** and **internal**.
Outer housing closes jack module on all sides, and the inner is made as a decorative front panel or other mounting base and leaves open the back (cable) part jack module.
Inner housing sockets installed into the seat using latches.
Landing sizes of sockets type Mosaic 45 correspond to a Mosaic 45 system of Legrand (22,5 x 45 mm).
Wall sockets are mounted directly onto the surface.

Calculation of the number of modules information outlets

Number of modules work outlets depends on the circuits of the SCS horizontal subsystem, including

- the availability of solutions "fiber to the workplace";
- category applied element base;
- requirements for subsystem configuration workplace SCS.

It is believed that one work place:

- 4 square meters of event space to accommodate users in office buildings;
- 6 square meters of event space in the design offices and similar facilities;
- in the case of open offices expected density of work place increased by 10%.

Total area associated with a work area ratio of 0.66 (0.8 with an upper estimate).
When calculating the number of work place the result is always rounded up to the nearest whole top. Additional outlets provide operational flexibility and are used to connect devices such as the group of printers, scanners, etc.
This calculation is performed for each user's premises.
In a typical configuration of cable system, the number of modules bush twice the amount of user information outlets.
Category determined by the category of modules bush horizontal subsystem.
Design user work outlet depends on the method of its installation in the workplace (in the box on the box next to the duct in the wall, etc.).

Calculation work area cords

Total number of work area cords is calculated in accordance with one of the four principles:

- the number of work places;
- requirements for design of WO;
- on the initial number of users;
- number of ports of workgroup switches.

The provision, which increases the scope of delivery, usually 10% of the total number of cords

Taking into account only the work area cords to connect workstations. Unless otherwise stated, the cord to connect a conventional analog or digital telephone is considered within the set of its delivery.

The most common work area cords 3 m.

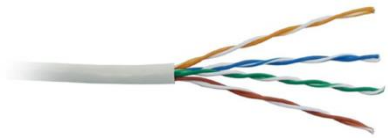
Category and type of work area cords pinch screen coverage coincides with the same parameters most horizontal subsystem.

42. CALCULATION OF HORIZONTAL CABLE

Horizontal subsystem SCS

During the design of the linear part of the horizontal subsystem SCS solved a number of problems:

- determined by the design and the category of horizontal cable;
- determined by the fire parameters of the horizontal cable;
- determine the desired length of horizontal cable;



Horizontal cable

Horizontal cable gets its name because of the way laying on the track.
Designed for use primarily in the horizontal subsystem between the floor equipment room and work outlet.
Current revision of standards allow the use of horizontal cables with a characteristic impedance of 100 ohms only.
Horizontal cable always contains 4 pairs.

The outer jacket

The outer jacket are usually made of polyvinylchloride (PVC).
Application jacket of non-combustible materials (LSZH, LSHF, LS0H, LSNH) increases the price of the cable at 20 - 30%, and compounds that do not contain halogens, have low fire resistance.
Adding to the feedstock chalk provides the necessary cables in the process of cutting the fragility of the outer jacket (provides accurate and reliable cut to the desired location).

Shielded and unshielded cables

ISO / IEC 11801 standard in Annex E (informative) introduces the format identifier constructing symmetrical cable designs.

The identifier allows explicitly indicate the presence or absence of additional shielding coatings separate twisted pairs and / or the core in general.

Identifier has the form - XX / YZZ, where:
XX - overall screen
F - foil;
S - braid screen.
Y – element screen:
U - unscreened;
F (foil) – foil screened.
ZZ – balanced element:
TP – (twisted pair);
TQ – (twisted quad).

Select design horizontal cable

The main variation of the horizontal cable is unshielded 4-pair U/UTP cable.
Shielded design used in the following cases:

- special requirements to ensure the confidentiality of transmitted information;
- when working in difficult noise conditions at least part of the cable route.

Used primarily Cat5e providing speeds of up to 1 Gbit / s, category 6 is used in special requirements for the quality of the channel.

Depending on the design of the linear part of the cable route using cables:

- sheathed with non-combustible, Low Smoke Zero compound LSZH - when laid in the plenum-areas;
- a budget cable with PVC jacket - while laying in closed conduits of non-combustible material.

Algorithm for calculating the required length of the horizontal cable

When calculating the expected length of the horizontal cable, using the following five-step procedure.

- The expected average length of the line:

$$\overline{L} = \frac{L_{\max} + L_{\min}}{2} \times 1{,}1 + b$$

where: Lmax and Lmin - the length of the longest and the shortest cable lines.

b - stocks for cutting a cable (usually 0.6 - 0.8 m).

- Dividing the length of the horizontal cable package on the average length of the line, rounded to the nearest whole number of lines from the bottom we find the one package.
- Multiply the number of work outlets to find the total number of lines.
- Dividing the number of lines by in Step 2, rounded to the nearest integer, find the number of packages.
- Multiply the number of packages on the length find of the total cable length.

Features and limitations of the algorithm implementation

When specifying values Lmax and Lmin in step 1 we consider all ascents, descents and turns. Moreover, the greatest and least over the length of cable route must necessarily have the same structure.
Need to monitor the implementation of the "rules of 12/70."
All cable lines having a length of less than 12 meters are not counted in the total number of cable lines.
Consumption cable to implement all cable lines with a length of over 70 m (SCS properly designed they should not be more than 5%) is determined separately using the same algorithm. These lines are also not counted in the total number of cable lines.

Methods to accelerate calculations

When calculating the length of the horizontal cable can be employed some techniques to save some time for the implementation of the algorithm due to loss of precision.

- As an estimate Lmin can use the value of 12 m.
- As an estimate Lmax can use the value of the field installation semiperimeter horizontal subsystem.
- The average value of the length of the permanent link on the full set of projects (including waste) is approximately 45 m.
- The last at the most popular in practice 305 -meter carton box allows you to apply an assessment form " 7 ports - a box".

43. CALCULATION OF BACKBONE CABLES

Features perform calculations

On the backbone level, separate cables SCS clearly broken down by applications. Therefore, the number of individual groups of cables is very dependent on the type of information system technologies used in a particular project.
In the process of calculating separately controlled necessarily limit the length of channel to specifically given application.
On the flow rate of the cable a certain influence applied technology panel installation and type of transmission medium. The main means of accounting for these features are stocks for installation and the coefficient of elongation.
Ceteris paribus due to the large specific mass in the backbone part of SCS easier and more convenient to work with several smaller capacity cables.
Advisable to use cables with the same number of chains of transmission (pairs and fibers).

Calculation of balanced multi-pair cable

At every work outlet considerations support not only conventional telephony, but also system telephones allocated two pairs.
Category cable should be selected taking into account the fact that its main customer will telephony (application class A with the minimum requirements in relation to the bandwidth).
Stock up on installation set numerically equal to 1 m at each end.
The linear part is taken equal to the length of the cable channel.
Elongation in the linear part is taken equal to 4%.
Number of cables depends on:

- the total number of transmission lines;
- the availability of backup channels;
- the number of panels.

Selection of fiber optic cable on a design

When choosing a case design takes into account:

- area of operation;
- fire safety requirements ;
- applied technology terminating fibers.

To implement outdoor subsystem used outdoor cables protected the fibers from moisture (eg, an external buffer).
To implement the indoor subsystem used cable in fiber buffer coating of 0.9 mm in diameter (eg, a tight buffer).
Inside the building, it is recommended to use fiber optic cables with LSZH jaket.

Calculation of indoor backbone optical cable

For every 10 - 15 work outlets on the basis of statistics of completed projects in the indoor subsystem given one pair of fibers.
The basis of the linear part of the indoor subsystem are multimode fiber optic cables.
Category multimode fiber depends on the maximum transmit data rate and the expected length of the channel in typical operating conditions.

Length of channel, m	Category
2 - 82	OM2 and higher
2 - 300	OM3 and OM4
2 - 550	OM4

Calculation of indoor backbone optical cable

Provision for cable termination at each end set numerically equal to 3 m from the installation of optical shelves (feature applied technology using pigtails that requires work on the table).

The linear part is taken equal to the length of the cable channel.

Elongation in the linear part is taken to be 10%.

Number of cables depends on:

- the total number of transmission lines;
- the availability of backup channels;
- the number of panels.

Calculation of outdoor backbone optical cable

To implement outdoor subsystem used primarily single-mode cable with fiber ITU-T G.652
Optimal cable is the 16 - 24 fibers.
The need to increase the number of channels used technology known spectral and time multiplexing (WDM and SDH).
Stock up on cutting a cable at each end set numerically equal to 3 m from the installation of optical shelves (feature applied technology using pigtails that requires work on the table).
The linear part is taken equal to the length of the cable channel.
Elongation in the linear part is taken to be 10%.
Number of cables depends on:

- the total number of chains of transmission;
- the availability of backup channels.

44. FEATURES DESIGN OPTICAL SUBSYSTEM

Main parameters of the fiber-optic lines

The transmission of information on a predetermined quality optical channels requires mandatory implementation of a number of norms.
The main parameters responsible for the quality of the transmission are: attenuation, bandwidth, numerical aperture and geometric characteristics of the core.
Bandwidth, the numerical aperture and the geometrical characteristics of the core are guaranteed type of used components.
Attenuation is strongly influenced by quality of installation and cleanliness.

Requirements for optical connectors

Products must meet the basic specifications:

- Adding the minimum attenuation combined to give high optical return loss;
- Provide long-term stability and reproducibility when connecting - disconnecting;
- High mechanical strength with minimal size and weight;
- Easy to install on the cable.

Basic parameters of optical connectors

	ST	SC	LC	MT-RJ
Performances Insertion loss, dB Return Loss, dB	 0,3 55	 0,2 55	 0,08 55 (SM) 20 (MM)	 0,2 55 (angled)
Version	Standard Singlemode Angled Multimode		Singlemode Multimode	
Ferrule	2,5 mm, round		1,25 mm, round	2,5 mm

Kinds of the fiber end face polishing

Форма и качество полировки определяют:

- Optical insertion loss;
- Optical return loss.

Depending on the achievable optical return loss connectors are divided into the following classes:

- PC < - 30 dB;
- Super PC (SPC) < - 40 dB;
- Ultra PC (UPC) < - 50 dB;
- Angled PC (APC) < - 60 dB.

Kinds of the fiber end face polishing

Class return loss determined mainly by quality of polishing the end face and core fiber.

Single-mode optical connectors are usually issued with classes polishing UPC and SPC.

After several cycles of connection and disconnection class return loss falls to PC.

APC Polishing is necessary only for analog cable television systems and SCS irrelevant.

Multimode fiber optic connectors enough polishing PC.

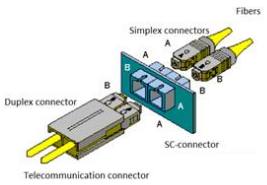
Marking of optical connectors

Plug labeled "A" must always be connected to the adapter with the same label, and vice versa.

Dual SC connector plug standard should have a different marking their halves.

Plug labeled "A" always is the source and adapter.

the same label - the receiver and vice versa.



Basic types of optical connectors

As the basic type of optical connector is recommended to use small form factor optical connector type LC.
SC type connector is regarded as optional and may be used in the practical implementation of the circuit structural heterogeneity.
In the optical subsystem Data Centre widely used group type optical connectors MPO / MTP.
For visual distinction singlemode and multimode connector options apply standardized color coding.

Optical patch cords EUROLAN

Features:

- Ferrule material - ceramics;
- Temperature range from -40 to +85 ° C;
- Number of connections ≥ 1000 cycles.

Types of connectors: SC, LC, FC, ST
Standard lengths: 0,5; 1; 1,5; 2; 3; 5; 7; 10 m
Colour coded connectors:

- Multimode – Beige;
- Singlemode – blue;
- Singlemode APC 8°/9° – green.

Possible combination cords SC-LC, ST-SC, etc.
Patch cords can be ordered in any length.

Pigtails

Features:

- Ceramic ferrule;
- Temperature range from -40 to +85 ° C
- Number of connections ≥ 1000 cycles

Types of connectors: SC, LC, FC, ST
Standard lengths: 1,5; 2; 3 m
Colour coded connectors:

- Multimode – Beige;
- Singlemode – blue;
- Singlemode APC 8°/9° – green.

Calculation of patch cords and pigtails

Number of patch cords is selected by number up-link-port switches in technical areas.
In stock laid typically 1/10 of the working cords.
For most projects, it is enough patch cord length of 2 - 3 m
Given the need for termination of all optical fibers optic cable pigtails number coincides with the number in each distribution point.

45. OPTICAL SHELVES AND WALL CABINETS

Design features

Optical shelves and wall cabinets is designed for:

- connect the network equipment directly to SCS using terminal cords or adapters;
- connect various fiber permanent links together using patch cords;
- creating inside their body permanent connection (splicing) with each other various fiber backbone or horizontal cabling;
- mechanical protection of fiber connections.

Optical shelves

Designed for installation in 19-inch mounting enclosure systems. Used for mounting with the mounting brackets.

Front panel has cutouts for mounting removable straps with locking snap them. Straps are designed for installation of the optical adapters;

Shelves are divided into: fixed and sliding.


Wall cabinets

Used to move from the outdoor to indoor backbone cables not far from enters to the building.

Most comfortable when the active and passive network equipment mounted without closed cabinets.

Task of designing optical cross

In the design process of optical cross solve the following main types of problems:

- determined by the type of optical cross;
- capacity of the switching device is consistent with the number of fiber of terminated optic cables.

Additionally, fixed type and design outlets

When designing optical cross in SCS with singlemode and multimode backbone advisable to use as much as possible the principle of constructive heterogeneity through the use of different types of optical adapters.

46. POLAR OPTICAL CHANNELS

The need to ensure the polarity of optical channels

For trasmissions rates up to 10 Gbit / s used 2-optic scheme of the optical cannels.
Compliance ensures that the correct polarity connection transmitter and receiver optical interfaces at different ends of the line.
To ensure proper polarity is applied:

- crossed wiring diagram outlets duplex connectors at opposite ends of the fixed line;
- crossed wiring diagram duplex patch cords.

The main project activities to ensure the polarity

Crossed wiring diagram of all the components used because any path regardless of its structure always contains an **odd** number of components.
In optical shelves devices polarity is provided:

- installation of outlets under the scheme "key up - key down";
- fixing of wiring diagrams of individual fibers line cables.

In case of appeal to first solve the problem of selecting the reception layout of keys on different levels.

47. ACCOUNTING FEATURES TECHNOLOGIES OF FIBER TERMINATION

Variety of technologies mounting connectors

The EUROLAN system uses two kinds of technologies terminating optical fibers cables: by fusion splicing and mechanical splices.
Both technologies are universal and do not depend on the design of optical cables.
Both technologies are based on the use of prefabricated pigtails.
For terminating a single fiber using pigtails + protection sleeve in case of fusion splicing technology and pigtails + spice KeyQuick in case of semi permanent mechanical connection.
Taking into account the requirements of all optical fibers terminating number of such pairs is numerically equal to the number of optical fibers introduced into the technical room.

Variety of technologies mounting connectors

Given the number of possible technological marriage protection sleeves is permissible to increase by 1 - 2 pieces for each optical panel.
Due to the fact that the mechanical splices KeyQuick are removable and reusable increase their number is not required.
Type fiber of pigtails and line cable must be consistent.
Connector type of pigtails consistent with the type of adapters optical patch panel.

48. PATCHING FIELD CONSTRUCTION

Patch panels

Patch panels are mounted directly on the wall or cabinets or frames in telecommunication and equipment rooms.
Patch panels are used to connect the cables to them the various subsystems and SCS for manual connection of separate permanent links cable system with each other patch cords or jumpers.
Patch panels are divided into:

- Cross panels type 110;
- Cross panels type 110, 19" Category 5e;
- Patch panels 19” RJ45 Category 5e/6;
- Patch panels 19” RJ45 phone style;
- Patch panels 19” modular.

Calculation of the number of patch panels

When calculation the number of patch panels take into account that one panel should not serve the cables related to various functional sections.
Total number of patch panels of specific functional section calculated by dividing the total number of circuits on transmission capacity of a single panel with rounding the result to the nearest integer from above.
Data required to calculate are taken from the linear part of the horizontal and backbone subsystems.
Category and execution of the connector panel should coincide with the same parameters of linear cables and cords.

The principle of constructive unhomogeneity

The principle of constructive unhomogeneity used as a means of increasing the effectiveness of the administration and simplifies the operation SCS. It is based on the fact that functionality sections of the cross area implemented on visually perfect type of equipment:

- Horizontal subsystem - monoblock panel with jacks RJ45;
- Redundant internal subsystem lines – the panel with separate jacks RJ45;
- Telephone part - panel 110 or double row of high density panel with jacks RJ45;
- Optical part subsystem indoor backbone – optical shelves (in addition to the color-coded outlets is recommended to use different types of connectors for single-mode and multimode fibers).

Principle of continuity

The principle of continuity is used as a means of increasing the efficiency of the administration system and simplifies the operation of SCS.
The principle of continuity is based on the fact that the work outlet modules in the equipment room are also located directly next to each other on patch panels.
Impact: The partition patch panels horizontal subsystem on the computer and telephone impractical due to reduced flexibility SCS.
The introduction of continuity necessary for the horizontal part of SCS was not only universal in individual lines and circuits, but also in terms of the system.

49. APPROACH TO THE FORMATION OF PATCHING FIELD

Approach to the formation of patching field

When selecting the location of the equipment in the 19-inch cabinets recommended adhere to the following order of their installation:

- At the bottom of the cabinet is placed unattended heavy equipment such as local servers, UPS and similar to them;
- Directly above unattended equipment located LAN switches;
- Over LAN switches are panel horizontal subsystem;
- Above the horizontal subsystem panels are arranged telephone panel;
- Panels and shelves of the optical indoor subsystem mounting in the highest position of cabinet.

The main and the alternative configuration of the patching field

Placing it in the two cabinets certainly applies in the case of service and more than 120 two-port information outlets.
In this situation, can be used the main and the alternative scheme.
The basic scheme is characterized by symmetrical arrangement and on the principle of placing the equipment is no different from the case of a single cabinet.
In an alternative scheme uses asymmetric arrangement of the equipment. In one cabinet (usually the left) are located panel horizontal subsystem and a telephone line, the second cabinet is used for the installation of LAN switches and shelves of the optical part of indoor subsystem.

The main and the alternative configuration of the patching field - some features

Main and alternative configurations are roughly equivalent on a broad set of criteria.
The basic configuration is considered more natural, while it allows a little easier to build the capacity of SCS.
An alternative configuration is more adapted to the division of areas of responsibility between crew individual divisions.
An extremely congested alternative switching network configuration has a lower average length of cords.
Responsible for the selection of the type of configuration is the author of the project.

50. TERMS OF USE OF ORGANIZERS

Organizers

Cable organizers are designed for stacking excess lengths of patch cords, avoiding confusion and loops and also provides good visibility of the markings patch panels.
Organizers additionally protect patch cords from sagging under its own weight, which is accompanied by the danger of losing contact in the connector.
Divided into horizontal and vertical.

Installation rules of the horizontal organizers

It is recommended to mount the horizontal organizers between each patch panels and additional top and bottom functional section. This approach allows us to enter immediately into cable patch cord organizer that improves the conditions of reading labels and reduces the mechanical load on the plug connector.
Fixing the organizers is the same as the mount patch panels.

Selecting the type of organizer and features their installation

The choice of design the organizers depends on:

- scheme of switching field;
- features supply patch cord's cables to the ports of the active equipment ;
- the number of patch cords.

With a large number of patch cords should be used organizers with large rings.
When installing cabinets row to facilitate inter-row switching is recommended to have horizontal organizers in different cabinets at the same height.
Vertical organizers are recommended to install the entire height of the cabinet on both sides of the switching field.

51. COMPONENT MARKING

Features of application of labeling

Labeling individual components of SCS and related infrastructure is an indispensable component of the administration system and the relevant section of the profile is normalized standard (ISO / IEC 14763-2).

Administration system are divided into levels, depending on the level used varies list of labeling components.

Marking is further divided into: technological and finish.

Labeling elements characteristic of technological applications for linear cable. After finishing the construction and connection of the panels are replaced by finishing.

Drafting identifiers

Applied on the labeling elements unique identifiers.
Identifier has standardized structure and contains a mandatory benchmark elements and optional suffixes and prefixes of arbitrary length and nesting.
IDs are divided into: one-point and two-point (last - for cables).
In compiling the identifiers are not used letters I and O, as well as widely used different delimiters as hyphens, points, slash etc.
Develop a system of identifiers lies with the author of the project.

52. MEASUREMENTS IN SCS

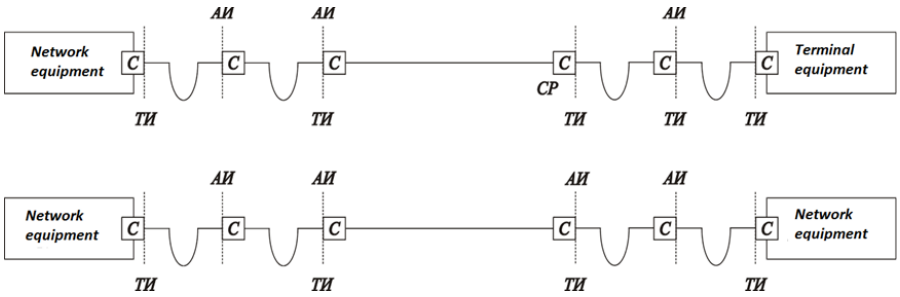
Variety of measurements

Measurements are performed in the SCS over the whole lifetime.
These measurements have different purposes and are used to a certain life cycle of the system.

Installation	Certification	Operation
Entrance test	Routine testing	Preventive testing
Installation testing	Certification testing	Emergency testing
		Verification testing

Equipment and test SCS interfaces

Due to the nature of construction of permanent links and channels, as well as the existence of certain prohibitions SCS separately isolated Equipment and test interfaces (EI and TI, respectively). They are not the same in all cases.



Basic types of Test Equipment

For measurements can be used all types of cable scanners certified by their manufacturer to work with SCS.

Test Equipment for field testing of balanced cabling:

- Fluke DTX-1xxx, DSX-5000;
- Ideal Industries LANTEK II/6/6A/7;
- Fiber WireXpert.

Optical subsystem: all of the above in the case of the corresponding module. When testing at the Tier 1 - any optical tester, corresponding to the requirements of accuracy provided a basic standard ISO / IEC 14763-3.

53. ORGANIZATION MEASUREMENTS IN SCS

Organization of acceptance and certification tests

Organization of different kinds of tests involves the following basic procedures:

- Prepare the necessary set of measuring and test equipment;
- performance verification and calibration of measuring and test equipment;
- compilation of a list of monitored parameters and models used lines;
- compilation of plan a measurements and tests;
- planning for the analysis and correction of errors identified.

Preparing for measurement

Before performing measurements active network equipment must necessarily be disconnected from the channels and permanent links.
Controlled settings meet instrumentation and parameters of the tested objects.
Separately verified by setting the parameters related to the measurement of length (NVP or refractive index).
Controlled correctness of the relevant fixed and variable fields protocols.
Verified that there is sufficient amount of free internal and external storage of test equipment for recording measurements.

Documenting the results of measurements

When making the test results it is recommended to use a standard template of automatic meters. When measuring protocol is recommended to include in it the following information:

- the date of the measurements;
- the basic parameters of the measuring equipment, including date of calibration;
- method of measurement;
- identifiers test objects;
- personal information specialists;
- direction of measurement and other additional information (where applicable).

Main activities with negative test results

Check the correctness of the applied measurement configuration.
Re-calibrate the measuring equipment.
Repeat the process to eliminate the occasional glitches.
Perform a visual inspection of the accessible parts of the test lines to detect the causes of not passing the tests.
Enable these options and \ or build appropriate scheme for measuring localization of a possible error.
Change the measurement range, the accumulation time results and perform other actions to increase the accuracy of the data.
After troubleshooting is necessary to repeat the measurements.

Monitored parameters

Testing is performed in accordance with the requirements of IEC 61935-1
Controlled parameters are divided into three main categories:

- Basic (wire map, shorts, opens, the continuity of the screen, etc.);
- return loss, attenuation of business, various types of NEXT and ACR, loop resistance, propagation delay and skew;
- different types of ANEXT and AACR;

Recommended test model is Permanent Link.
Tested 100% lines.

Features measurement

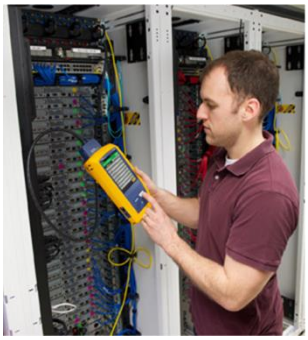
Recommended test model is Permanent Link.
The channel's model used to test only in cases stipulated separately.
Tested 100% lines in classes D and above.
Class (category) of the line, the level of accuracy and range of the tester's measurements should be consistent with each other.
For junior classes of backbones lines measurement program as agreed with the customer can be reduced up to verify the wiring absence of discontinuities of individual wires and loop resistance.

Features testing alien crosstalk

Testing is performed on a sample scheme.
Minimum sample size:

Number of lines	Number of tests
3 - 150	3 или 0,1 x N
151 - 3200	33
3201 - 35000	126
35001 – 150 000	201
150 001 – 500 000	315

Testing of balanced lines



Installers should not be used during testing walkie-talkies and mobile phones, as these systems may cause radio interference and result in incorrect measurements.

54. TESTION OF FIBER OPTIC SUBSYSTEM

Measured parameters

According to international standard ISO / IEC 14763-3 at the optical subsystem is generally controlled by the following parameters:

- Continuity and maintenance of polarity
- Propagation delay
- Length;
- Optical attenuation
- Optical rerurn loss

The main parameters for fiber-optic lines are:

- Attenuation (A);
- Multimode modal bandwidth
- Numerical aperture.

In the field the attenuation measured only!

55. LOSS MECHANISMS IN OPTICAL CONNECTIONS

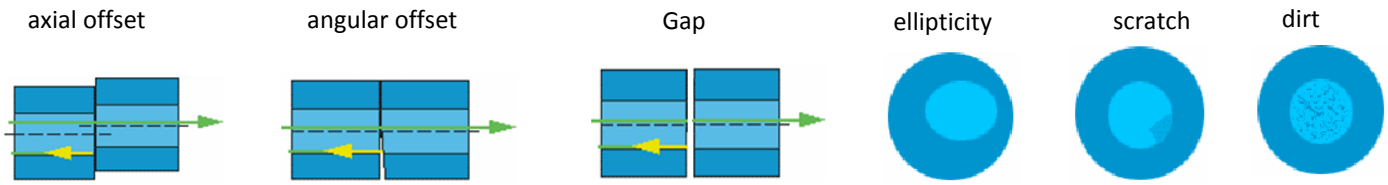
Loss mechanisms in optical connections

Loss in the connection depend on:

- The quality of the fiber used;
- Qualifications installer performing compound;
- Technological equipment capabilities for connecting fibers.

The main reasons for the insertion loss:

- dimensional tolerances of fibers;
- the quality of the individual elements of the connector and its manufacturing tolerances;
- reflections and scattering;
- pollution.



Methods for minimizing losses in optical fiber connections

Loss in optical connectors depend on a number of different internal, external and technological factors.

Losses depending on internal factors, minimize the use of element base of leading manufacturers, manufactured with guaranteed compliance with standards.

The influence of external factors reduced to negligible quantities compliance with the rules of the fiber and the implementation rules for cleanliness technical premises.

Technological factors are eliminated using the appropriate tools and the implementation of all process steps.

Not permitted to use the immersion gel to minimize Fresnel losses (except for mechanical splices, where it is a technological design element).

Test parameters of the optical subsystem

Maximum allowable attenuation, dB

Wavelength, nm	Class of channels		
	OF-300	Of-500	OF-2000
850	2,55	3,25	8,5
1300	1,95	2,25	4,5
1310	1,8	2,0	3,5
1550	1,8	2,0	3,5

Maximum length of channel

Class	OF-300	OF-500	OF-2000
Length, m	300	500	2000

Calculation limit attenuation of the optical path of arbitrary length

This procedure is necessary to determine the maximum allowable attenuation channel and permanent link.

The basic equation:

$$A(\lambda) = \alpha(\lambda)L + n_c \times 0{,}75 + n_s \times 0{,}3 \quad \text{(dB)},$$

where α (λ) - the attenuation coefficient of the optical cable at the operating wavelength λ (see Table);

L - total length of all linear and the cord cables;

nc - number of plug connectors in the path;

ns - number of one-piece fusion and mechanical connectors in the channel.

Features of the calculation procedure

Data on the attenuation coefficients of optical cables are given in the table.

Wavelength, nm	Multimode fiber		Singlemode fiber	
	850	1300	1310	1550
Attenuation coefficient	3,5	1,5	1,0	1,0

Because of the relatively large quantities of the individual components of the optical channel, subject to compliance with the rules of installation technology standards largest loss is not big problems.

56. ATTENUATION MEASUREMENTS USING OPTICAL TESTER

Attenuation measurements using optical tester

Attenuation measurement is performed according to the standard ISO / IEC 14763-3 by the method of insertion loss in the following modifications:

- One jumper method (permanent link attenuation measurement.
- Three jumper method (attenuation measurement patch cords).

Should be used only LED light sources. The use of special reference cords and normalizing mandrels modal filters is mandatory!

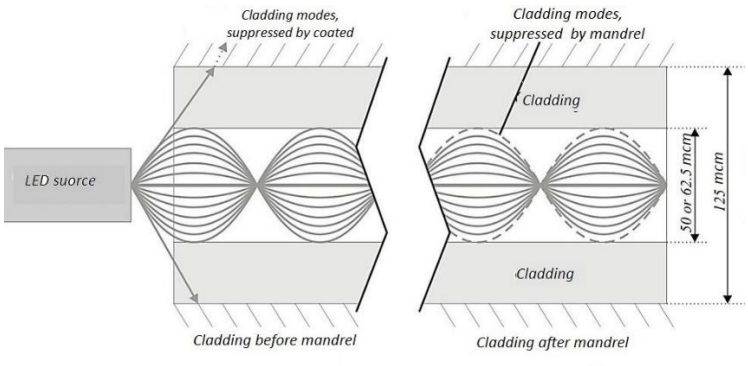
Measurements are performed in the following sequence:

- setting the reference optical power ;
- measurement of the actual attenuation.

After setting the reference power forbidden to disconnect the launch cord from the source!

Application of the mandrel

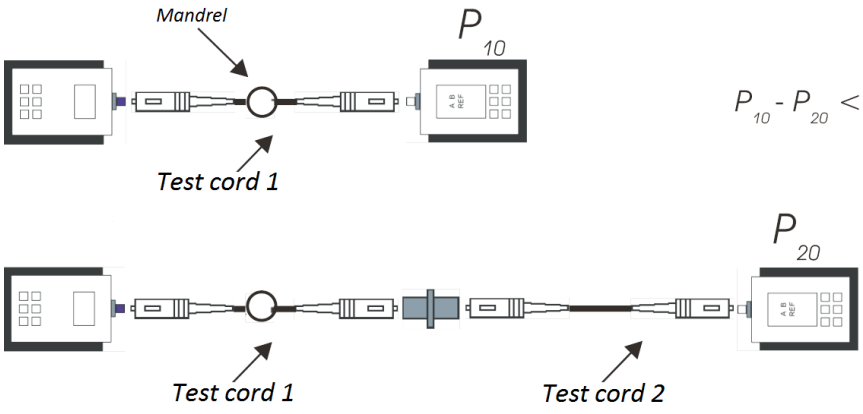
Mode filter is used to bring the forced mode composition of the LED light source to the steady-state value due to suppression of high-order modes. Consists of a mandrel, which is wound 5 turns cable cord connected to a source of light.



Use of the mandrel is a must!

Verification procedure of reference cords

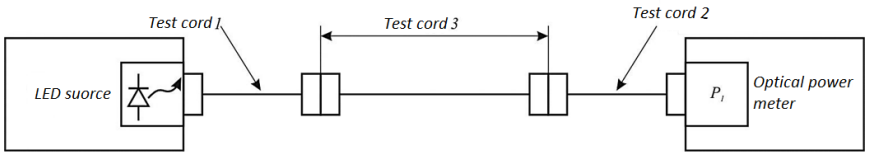
Verification procedure needed to implement the method of one jumper (second measuring cord is not involved in the calibration and setup of the reference values).



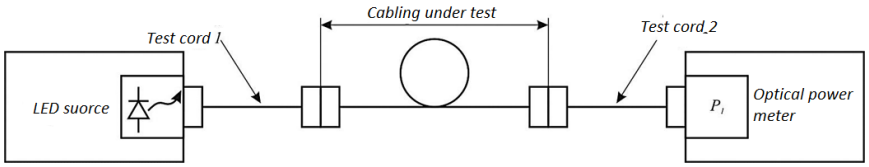
$$P_{10} - P_{20} < 0{,}5\,dB$$

Setting the reference value and the measurement

1-jumper method



2-jumpers method

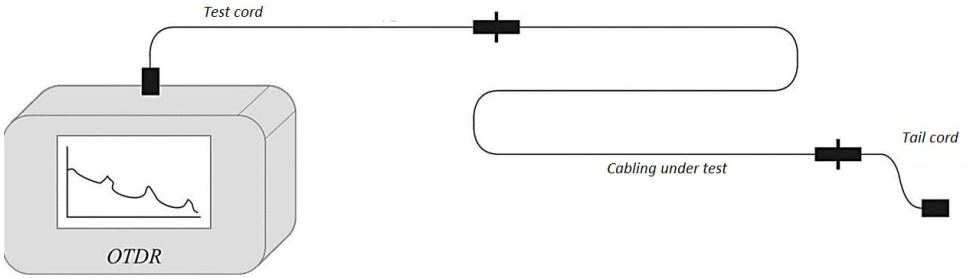


3-jumpers method

57. USE OF THE OTDR

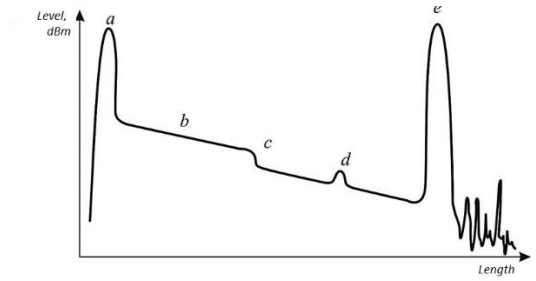
The operating principle of OTDR

Using the OTDR provides standard ISO / IEC 14763-3 in the implementation of measurements by level 2. Device implements the method of Rayleigh scattering.
OTDR can measure not only the distribution of the total attenuation, but also its distribution along the length of the line, including point in the components of its length and reflectance of different types of connectors.



Features of the OTDR
OTDR as a measuring device is extremely sensitive to the quality of the input probe light into the fiber, is input connector before starting measurements must be thoroughly cleaned of dirt.
The timing of the accumulation result is determined by a compromise between resolution and the duration of the test run.
On short lines set the minimum duration of the light pulse (maximum resolution).
To properly study the input and output connectors to them must be connected normalizing and lengthening coil, respectively, of at least 100 m
It is recommended to perform reflectometry at two wavelengths.

Reflectogram and its analysis



Major events are logged OTDR:
a - pulse Fresnel reflection from the input end;
b - fiber without irregularities;
c - mechanical or fusion one-piece connector;
d - optical connector;
e - pulse of the Fresnel reflection from the far end.

Channel length measurement with an OTDR

Measurement is performed in the following order:

- Fits the refractive index of the core (in the absence of such information, use the table of average data);
- The method of visual analysis of trace excluded so-called phantom or ghost (if available);
- The path is marked on the trace installation of two markers on start and end points. Reflectometer is doing other calculations automatically.

Wavelength, nm	850	1300	1310	1550
SM fiber 9/125	-	-	1,467	1,468
MM fiber 50/125	1,490	1,480	-	-
MM fiber 62,5/125	1,496	1,491	-	-

Determination of the coefficient of reflection on the event

The reflection coefficient is usually calculated OTDR automatically and read out by set a marker on the event.
In the absence of such an option, use the following formula:

$$RL = -10\lg\left(\frac{10H}{5} - 1)\right) - 10\lg d + k \text{ (dB)}$$

where:

d - the duration of the probe pulse in ns;

k - backscatter coefficient in dB.

The resulting value is compared with the norm.

58.VERIFICATION OF CONNECTORS WITH MICROSCOPE

Fiber Inspection Microscope

Used for visual inspection of the end surface of the ferrule plugs with installed in them fiber

The need for a microscope due to small linear dimensions of the fiber, which makes it impossible to control the naked eye.

The main purpose of microscopes:

- detection of defects (chips, cracks, calving);
- verification of the polishing quality fiber;
- control the purity of the fiber end face and centering tip connector.

Basic requirements for microscopes

Magnification:

- not less than 100 for a multimode fiber;
- at least 200 for single-mode fiber.

Ability to perform end and side (corner) backlight.
Having an effective system adjustment.
Providing the possibility to work with different types of optical connectors (usually achieved by using interchangeable heads).
The built-in filter cutoff wavelength suppression of more than 1 micron to protect the operator's eye.

Picture rating

Field of the shell is divided into two zones:

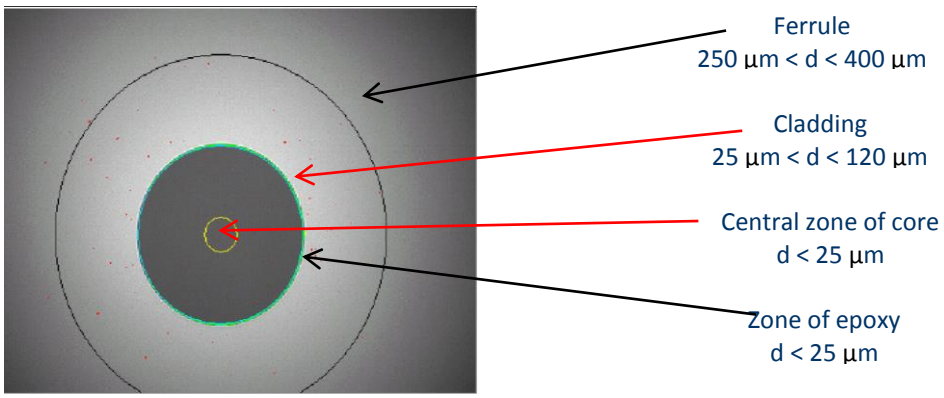
- Internal diameter 58 mm;
- the outer diameter of 125 microns.

Defects are classified as:

- scratches (up to 3 - 5 microns);
- chipped (size up to 10 microns).

Number of scratches can not exceed 10 pieces.
The presence of large defects (chips), even in the interior of the cladding is not allowed.

Zones of ferrule



59. PARTICULAR SPECIALIZED SCS

Industrial SCS

These are described in the standard ISO / IEC 24702
Element base carefully monitored for compliance with the requirements of MICE, depending on the application (office area, light and heavy industrial environments).
Cupper subsystem
Preference for Category 6 (6-Connector model channel!).
Ability to implement the linear part solely on flexible cables with stranded conductors.
Optical subsystem includes quartz-polymer and plastic fiber with less allowable length channel.
Added a fourth additional level in the topology (accounting departments of large linear dimensions).

SCS for open offices

The construction of such cable systems can be used full-time element base and standards of normal office SCS.
The main difference - widespread use of consolidation points.
Consolidation points shall be located not less than 15 m from the floor distributor.
Consolidation point serve typically 36 m2 office area (square 6 x 6 m).
Permissible increase in the total length of the cords for various purposes over 10 m, with each additional meter of excess offset by lower maximum length linear cable 1.5 m

SCS for Data Centre

At the international level is normalized by ISO / IEC 24764.
Number of hierarchy levels reduced to two (American Standard ANSI/TIA-942-A allows large data centers in a two-tier backbone subsystem).
Separately provides office part, which is implemented by the standard ISO / IEC 11801 and is directly connected with the wiring equipment room.
Developed system of reserve lines including between different levels.
Minimum recommended category 6A balanced cables and optical fiber OM3.
In the optical subsystem is regulated by the use of LC-Duplex connector and MPO / MTP (for lines with the number of fibers greater than 2).

SCS for Data Centre – feature of optical subsystem

Due to the high data rates used in data centers significantly large amounts of fiber optics.
Economically viable use of multimode fiber (small transmission range).
Support data rates 40 and 100 Gb / s over a parallel transmission scheme (so-called parallel optics).
The use of only two types of optical connectors MPO / MTP (12 and 24 Fiber - variants) for speeds of 40/100 and LC for speed 10 Gbit / s, respectively.
Widespread use of cluster modular solutions that do not require installation of connectors on the installation.
Ease the transition from dual fiber cannels to the multifiber cannels (cassette adapter panels and harness fan-out cords - MTP-LC) without changing the panel.

SCS in homes and cottages

SCS has a predominantly single-level solution in the form of a simple star.
Symmetrical and coaxial cables using, optical solutions are possible, but much less possible.
Symmetrical cable category 5e support computer and telephone networks, as well as home automation, coaxial cable used to connect televisions.
Mounting constructive - is narrower fastening field.
In organizing television wiring is advisable to use an additional amplifier.
User information outlets located mainly due to the planned placement of furniture

60. SPECIAL TYPES OF CABLE SYSTEMS

The need for special types of cable systems

SCS are widely used to support the operation of a number of specialized equipment.
The most often used in practice next specialized systems:

- master clock system;
- Wi-Fi access to the network;
- System access control;
- CCTV system.

For such equipment is not designed separate SCS and allocated special line comprising a conventional cable system office type.
A characteristic feature of this part of the project is very rigid adherence to the architectural features of the placing equipment.

SCS for Wi-Fi-network

Using of the Wi-Fi-system increases the number of ports cable systems. For wireless access points used 1-port outlets.
One Wi-Fi access point is planned:
• in open offices on the basis of calculating the diameter serviced workspace in 22 m;
• in the office with cabinet system - one Wi-Fi-point for a room.
To support the functioning of a modern radio access point enough channels category 5e.
Outlet for connecting a Wi-Fi access point located mainly near the equipment.
To Wi-Fi access point recommended to use PoE.