Optical Distribution Frames/Patch Panel

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An optical Distribution Frame (ODF) or patch panel is the starting point for optical cables, most commonly found in rack cabinets in Head End (HE)/Central Office (CO)/Point of Presence (POP)/Data Centre (DC) or smaller cabinets or enclosures.

The ODF consists of a metal housing, cable entry ports, splice trays, holders for splice protectors, pigtails, and adapters. Cables are fed into the ODF, where the fusion splicing of cable fibers to the pigtails is performed.

Fig.1. Different ODF models

The standard ducts and microducts that introduce cables to the ODF must be sealed to prevent the entry of water, moisture, gas, rodents, etc. Cables enter from the top via racks or from the bottom through a rectangular opening in the raised floor, fixed at the entry to the ODF.

There are horizontal and vertical plates for fixing cables in the rack cabinet, called breakout plates. This is the point where the sheath, central strength member, Kevlar,

and tubes are secured, after which the cable sheath is removed, and the PVC tubes are directed into the ODF. Afterward, the PVC tubes are fed directly into the splice trays or through special tubes.

In the case of microducts and micro cables, additional racks approximately 300 mm wide with special holders near the ODF are used to provide vertical routing and fixing.

Standard cables with a capacity of 96 fibers have a diameter of about 6-7 mm, while micro cables have a diameter of about 4.5 mm. Fibers are typically arranged in bundles of 12 or 24 fibers in each tube. Color-coded pigtails are used according to ISO, DIN, TIA or other standards. In one ODF, it is possible to immediately introduce, for example, a 96-fiber cable or a more complex variant of first 48 fibers and then another 48 fibers later.

ODFs often come with pre-installed cable entries, splice trays, pigtails, and adapters. However, it is also possible to purchase just the housing and later assemble the necessary configuration – choosing the cable entries, splice trays, holders for protectors, pigtails, and adapters.

ODFs and patch panels generally have vertical rails that allow mounting in standard 19" or 21" rack cabinets. There are also variants for mounting in specially designed cabinets.

ODFs are made with or without doors. Variants with doors increase security and improve aesthetics, with the possibility of quick and easy installation and removal. Doors can be steel, transparent plastic, or perforated. These types of ODFs can have keys, special locks, or cards for unlocking.

The heights of ODFs can vary depending on the need, the number and type of connectors/adapters, and the available space. Height units used are RU or U, which is 44.45 mm. For example, the most common variant of ODF in Europe is 47U, which is 47x44.45 mm, totaling 2089.15 mm, and this is the internal space, with external dimensions being larger depending on the construction.

Depth and width are not standardly defined, but in recent years, constructions with a width of 300 mm have been common. Due to ETSI standards for rack cabinets, ODFs can have widths of 600, 900, 1200, and 1500 mm. However, generally, the need for a depth greater than 600 mm is rare.

When planning an ODF, the width, i.e., the necessary space for fixing and routing patch cords, must be taken into account. For an ODF width of 600 mm, consider an additional two times the width of 300 mm, which means 300 + 600 + 300 = 1200 mm.

In head end or CO buildings, ODFs are usually mounted in rack cabinets, while in point of presence containers, due to limited space, wall-mounted installations are often performed.

Fig.2. Example of ODF in a Data Center – floor-mounted ODF

The construction of ODF can be fixed but is more often able to be dismantled. Fixed constructions are economical to manufacture, but the major drawback is flexibility. A good compromise is achieved by combining fixed with modular parts. Flexible solutions allow for easy extraction of splice trays for inspection or additional splicing.

In cases of a large number of ODFs, special channels outside the rack cabinets are required.

Determining the optimal position of the ODF is also important to avoid fixed obstacles during connections. Additionally, it is crucial to ensure the stability of the rack cabinet with the ODF (to stand firmly on the floor); the floor must not be uneven, or in such situations, adjustments with adjustable screws are made. In raised floors, the rack cabinet should be secured to the concrete floor.

To ensure the stability of the rack, securing the top part of the rack to the wall or adjacent rack cabinet is required.

One of the most common connectors in Europe for FTTH networks is LC, so LC duplex, LC quad, or LC with multiple adapters are often seen on the ODF. They can be oriented on the front or side or at an angle.

There are several types of ODF, which can be categorized by mounting location:
- wall-mounted ODF – applicable in small, confined spaces.
- rack-mounted ODF – the most common variants for HE/CO/POP/DC.
- floor-mounted ODF – often used in HE/CO/POP/DC, and
- enclosure-mounted ODF – various variants exist, with different dimensions depending on the application.

According to access, ODFs are divided into two groups:
- front-facing patch fields, and
- side-facing patch fields.

Initially designed ODFs were designed so that the cable entry was on the back of the panel, while patch cords and adapters were on the front. Such solutions did not allow for high densities within rack cabinets. As the demand for higher density grew, modifications were made.

The mentioned early versions of ODF allowed only front access. Installation and maintenance were enabled only from the front side. As adapters were facing the technician, they were easily visible and accessible. A problem can arise if patch cords are routed from the front as they can hide unused ports or make access or removal of existing patch cords difficult. The next problem is access to pigtails and splice trays in case of issues. The last problem is the risk to the technician's eyes in case of direct viewing into the adapter with a signal.

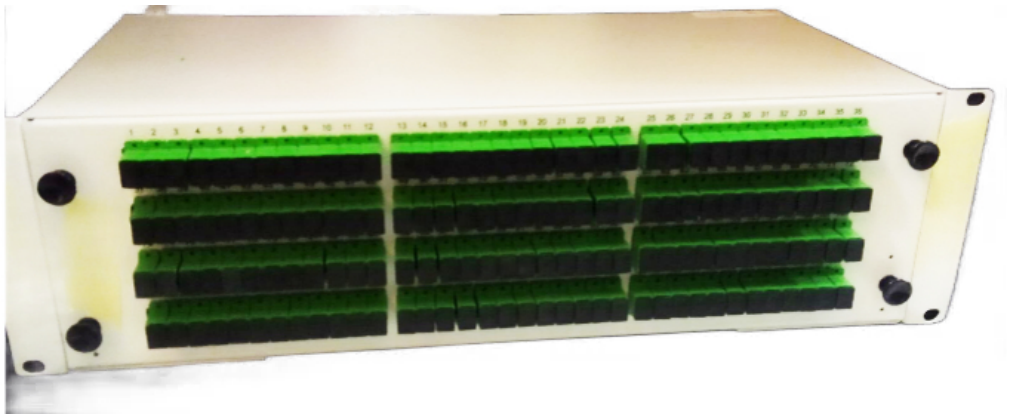

Fig.3. Front-facing patch field ODF

Side-facing access solutions have their advantages, such as significantly reduced risk of laser light and the use of the front side for marking and identification. Arranging patch cords is more complicated.

High-density ODFs can be achieved using LC connectors, particularly the new types of multi-fiber connectors. Additionally, the diameter of patch cords is reduced from 2 mm to 1.6, 1.4, or even 1.2 mm (but mechanical protection is also reduced simultaneously). Of course, G.657 standard fibers are used.

Density should not be overdone; a compromise should be found between cost-effectiveness, density, and ease of use, especially concerning FTTH solutions. High-density front-access ODFs for 96 fibers used in FTTH networks can be 1 U. However, issues arise regarding access for connecting, labeling, testing, and maintenance.

To reduce or solve these problems, the front side of the door is used for labeling. As LC connectors are smaller than SC and with an increase in the number of patch cables being hard to access, the introduction of new connector variants with specially designed extraction elements is used, or special pliers for LC connectors are used for this purpose.

According to flexibility, i.e., the ability to open and access the interior of the ODF, they can be divided into:

- pivoting (patch) panels,
- sliding (patch) panels, and
- ODF (sub-racks) with vertical or horizontal modules.

Panels with pivoting capabilities are very common in FTTH networks. Fast and safe access to connectors and internal elements is enabled by moving the patch field. It is possible to add additional cables later.

Sliding panels allow panel extraction from the front and access to connectors and internal elements. However, the problem arises when a larger number of patch cords are connected; thus, pivoting panels are preferred.

ODFs with vertical or horizontal modules are very popular. They consist of a housing where modules with a capacity of 12 or 24 fibers are inserted from the front. The possibility of adding new cables and accessing all elements is very simple, fast, and safe. ODFs with vertical modules are most commonly used.

Fig. 4. ODFs with vertical modules

For patch cords, special horizontal and vertical managers are required. Active equipment is connected to the ODF using patch cords. It is desirable that the distance between rack cabinets with active equipment and rack cabinets with ODF or splitters for PON networks is a few meters. This allows for quick and easy cable installation and connection. Then it is possible to use standard patch cords of lengths 3, 5, and 7 meters.

Proper routing and labeling of patch cords are very important. This enables further expansion and quick and easy identification of existing cables in case of interventions. Training is required for technicians, but also a document with instructions on the inside of the ODF.

It is necessary to clearly define and adhere to patch cord paths to avoid tangling. This is especially problematic when multiple technicians are involved in these tasks.

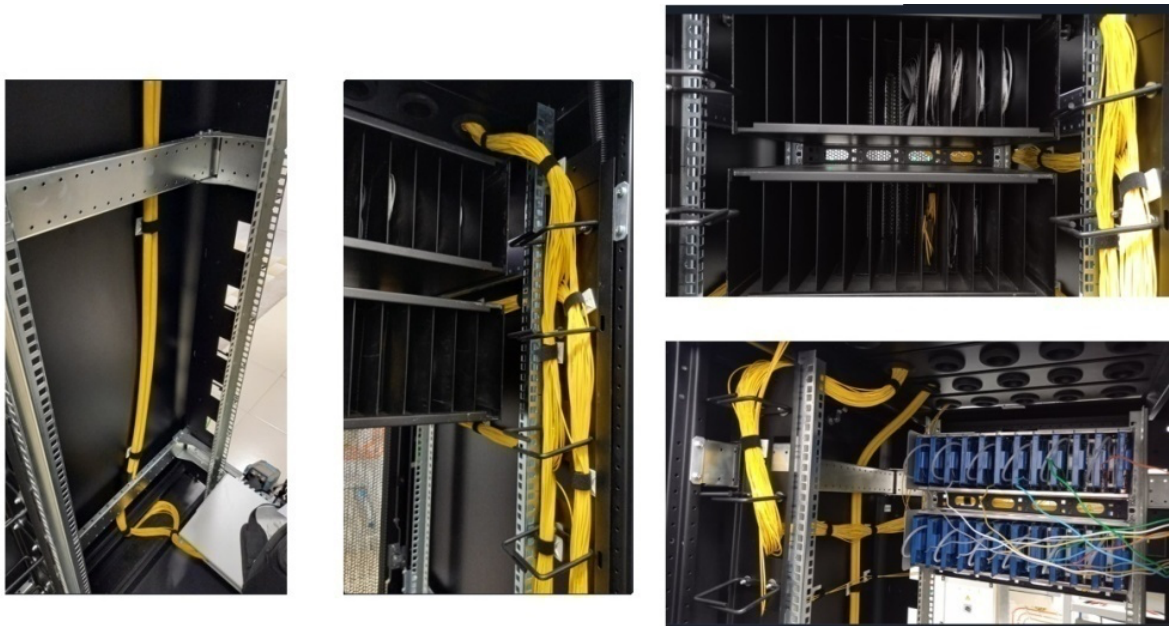

Fig. 5. Managing patch cords

Proper labeling of patch cords is very important for later maintenance. The label should be unambiguous to quickly and easily identify the required patch cord. Various labels are possible, but they must be clear and logical. For example, patch cords may have PON port labels or more detailed labels can be used, including geographical locations of the first splitter and exact locations on the ODF and OLT, which include: settlement, street, building or house number, rack cabinet number in DC/HE/CO/POP, patch panel position in that cabinet, and port number.

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