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WHITE PAPER

High availability without compromises - redundancy concepts in FTTO networks

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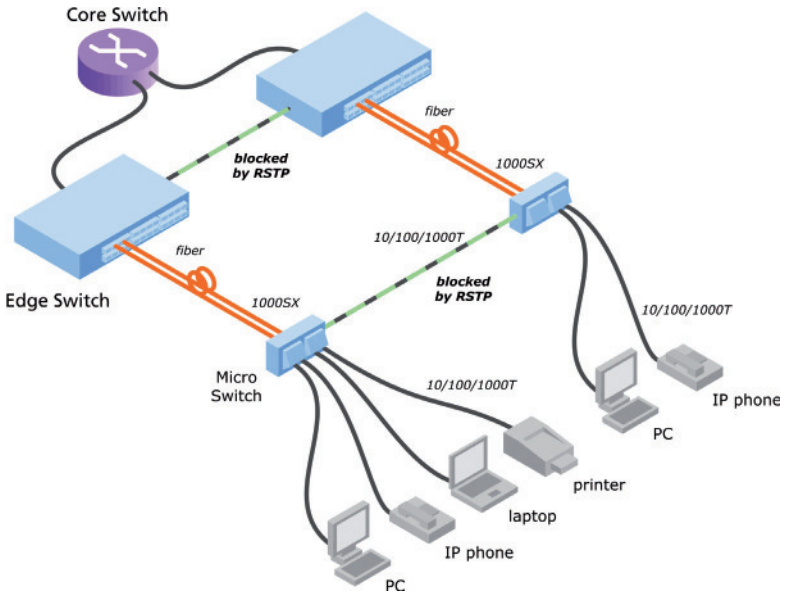
The Fiber To The Office concept from MICROSENS has long since proved its worth for cost-efficient in-house networking in numerous projects

As a cabling concept compliant with the EN 50173-2 standard, it unifies the advantages of fiber optic and copper cabling in an intelligent way and combines both media where they bring the greatest technical and economic benefit: High-performance fiber optic lines are routed consistently in vertical and horizontal cabling right through to the user. This is where a Micro Switch is used as the active element that provides copper access for the terminal devices on a flexible basis.
Intelligent redundancy concepts, which offer a high degree of availability through FTTO, have so far received little consideration, however.

The technical and economical advantages FTTO offers are undisputed. Through longer line lengths, high bandwidth and longer service life compared with conventionally structured cabling, FTTO has proven to be future-proof and optimal in technical and economical terms. A study conducted by WIK Consult has established that FTTO already pays off above a network size of 160 participants. The more participants connected, the clearer the cost benefits turn out - both in setting-up, as well as in operation.
But how does it perform given the demands placed on network accessibility? What about redundancy concepts that are intended to ensure the highest possible availability? Here too, FTTO is in no way inferior and offers no less than four different redundancy solutions.

Variant 1: Classical FTTO with cascading via copper

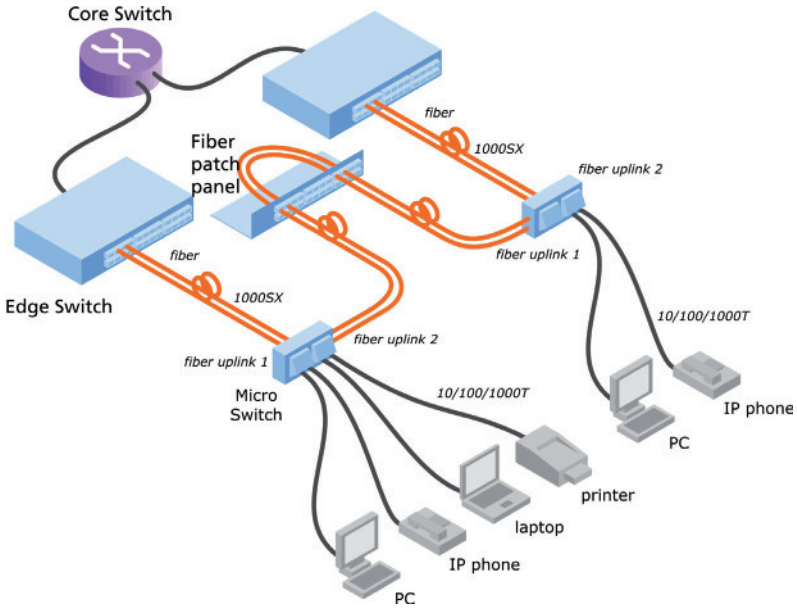
With FTTO, an Micro Switch typically supplies two workplaces. It offers four copper ports for connecting terminal devices and is connected with the core switch via two optical fibers. It also has a copper downlink port on the installation side.
The simplest redundancy solution is to connect two neighbouring Micro Switches together via their copper downlink ports. Only a standard copper patch cable needs to be routed in the cable duct for this purpose. The copper connection is passively connected between the switches by means of the Rapid Spanning Tree Protocol (RSTP). If a fiber optic connection to one of the two Micro Switches fails, the tie line is automatically activated via the copper cable. Both Micro Switches and the terminal devices connected therefore remain accessible in the network. Practically, the neighbouring Micro Switches are connected with different core switches to achieve further redundancy.
With negligible extra cost compared with standard FTTO, this concept can create a redundant solution with enhanced failsafe performance. Only one copper patch cable has to be provided for each pair of Micro Switches . No extra costs arise on the core side.
Redirection of the data traffic is associated with switching times from the RSTP, however. Furthermore, it should be noted that the intake uplink to the core switch then has to transmit the data of both Micro Switches i.e. data from up to 8 terminal devices instead of from four, which can impair the performance of the link.



The simplest form of redundancy:
Two Micro Switches are connected via a copper patch cable.

Variant 2: Classical FTTO with cascading via fiber optics

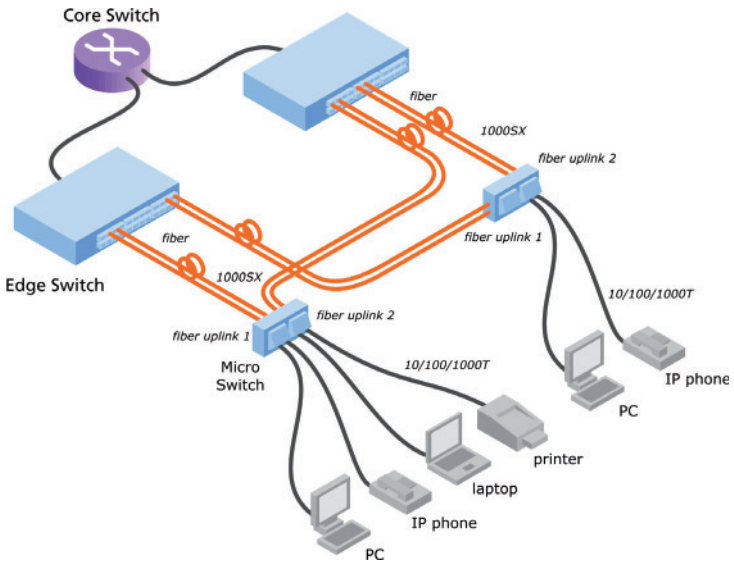
In this variant, each Micro Switch is equipped with two fiber optic ports. As an office with two workplaces usually has four fibres installed, the Micro Switch uses the fibers routed as a reserve for connection to a further Micro Switches. Rather than routing a copper patch cable in the cable duct to the next Micro Switch as in Variant 1, the optical fibers used for cascading are simply shunted through passively at the patch panel. The advantage of this solution is that the optical fibers are used consistently as cabling medium and the copper and glass mix of cabling media to the Micro Switches therefore no longer applies. The decentral side is already designed for full redundancy, the central side can be converted little by little by providing redundant ports by converting the passive connection to active fiber optic ports.



Cascading via via fiber optics: One port of an Micro Switch is connected with a core switch, the second with another Micro Switch

Variant 3: Dual homing - double optical fiber connections

Also in this concept, each Micro Switch has two mutually independent fiber optic ports, but is connected directly with two independent core switches - preferably via separate paths to achieve in increase in security. If a link to a core switch drops out, the data traffic simply runs via the other.
In this variant, everything is implemented twice, apart from the Micro Switch. In the event of failure of a link, the full link performance of the Micro Switch is maintained, as the second link to the other core switch is activated.
However, dual homing also comes at a price: Every Micro Switch is equipped with two fiber optic ports (SFPs) and therefore has twice as many as a standard FTTO solution. In addition, twice the number of ports also has to be provided on the core side.



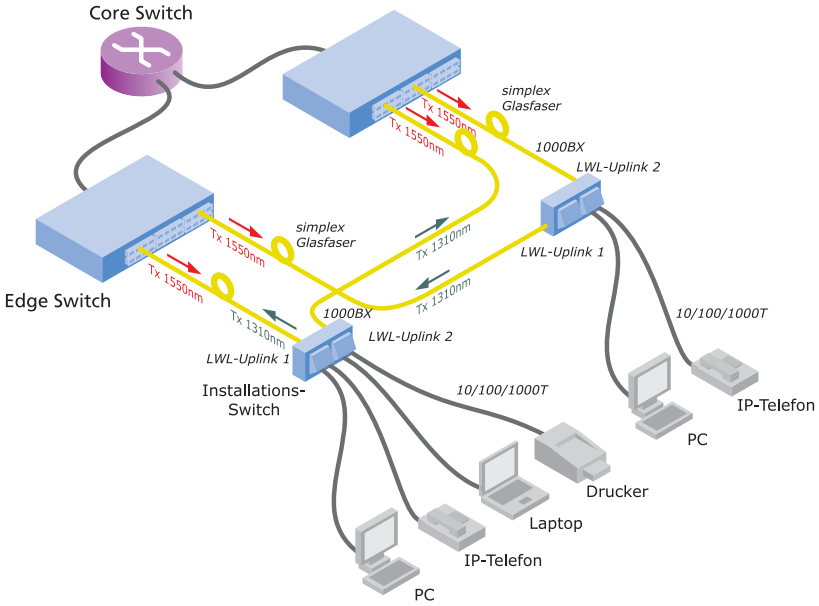
Dual homing: Micro Switch with two mutually independent fiber optic connections, connected with two separate core switches

Variant 4: Dual homing with single fiber

As with classical dual homing, the Micro Switch for dual homing with single fiber has two mutually independent fiber optic connections. However, in this concept only a single fiber is required for a link. So-called BiDi-SFPs send and receive via the same fiber at different wavelength, a technique that has long become established in long-distance traffic technology.

Through the use of just one fiber rather than two for a link, only half the optical fibers are needed compared with classical dual homing, so the overall cabling work is halved. Fibers, splices and patch panels - everything is only needed half as often, which has a positive effect in the filling level of cable ducts and cable routes. With the single fiber concept, the existing mono-mode cabling can be migrated to a fully redundant topology without major cabling work.

In place of two BiDi-SFPs, a so-called Compact SFP (CSFP) can also be used. With a Compact SFP, expressed in simple terms, two BiDi-SFPs are combined in a common housing. Instead of plugging two individual BiDi-SFPs for each fiber into two Standard SFP slots, a dual-fiber compact SFP can be used, which only occupies one slot. This halves the number of SFP slots required in the core switches. With CSFPs, dual homing with single fiber offers double the port density in the core area.



Dual homing with single fiber: Switches with BiDi-SFPs

BiDi and CSFP technology come from the Fiber to the Home market on which favourable prices are achieved though large volumes. If the Micro Switch is compatible with both Standard SFP, as well as BiDi/CSFP, it can be used flexibly for redundant and non-redundant applications.
Whereas variants 1 to 3 can be realised optionally with multimode or monomode fibers, in case of variant 4, monomode fibers are absolutely necessary.

SFPs each with a fiber per link: BiDi-SFP (left) and Compact SFP (right)

A question of investment

Redundant concepts can always be expanded and refined. The concept you ultimately decide on is a question of the investment you wish to make. With FTTO, the user has three different variants available with which the redundancy options this technology offers can be flexibly adapted to needs. Even with a low investment, the availability of the network can be significantly enhanced - an advantage that cannot be offered as such by classically structured cabling.

	Variant 1: Classical FTTO with cascading via copper	Variant 2: Classical FTTO with cascading via fiber optics	Variant 3: Dual homing - double optical fiber connections	Variant 4: homing with single fiber
Installation expenditure	low	low	high	medium
Cabling work	low	low	high	medium
Fiber type	optionally multimode or monomode	optionally multimode or monomode	optionally multimode or monomode	only monomode
Number of optical fibers per Micro Switch	2 (1 link)	4 (2 links)	4 (2 links)	2 (2 links)
Space requirement in the cable duct	low, but with additional copper patch cable in the cable duct	medium	medium	low
Consistency of the cabling medium	no	yes	yes	yes
Required SFP slots in the core switch per Micro Switch	1	1	2	1 (with CSFPs) 2 (with BiDi-SFPs)
Fully redundant solution	yes	yes	yes	yes
Performance-influencing of the link to the core switch in the event of a fault	yes	yes	no	no