

**TITLE : UNDERSTANDING THE CONCEPT OF FTTO  
(FIBER TO THE OFFICE/OUTLET)**

**AUTHOR : CLIFFORD C. WALKER**

**SPONSOR: EUROMICRON**

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

WHITE PAPER

### TABLE OF CONTENTS

INTRODUCTION .....	3
THE BASIC COMPONENTS .....	5
COSTING COMPARISON .....	7
CASE STUDY .....	8
CONCLUSIONS .....	13

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

#### INTRODUCTION.

**About the Author :** Clifford C. Walker has had a checkered career spanning from 14 years in the British Army, as a Control Technician, before leaving in 1979 and eventually entering the Computer Industry in 1981. His first few companies were associated with Main Frame Computer Installations for both Manufacturers and for a Third Party Maintenance Company. In 1985 he left the shores of England and headed to the Middle East. Initially he spent 14 years in the Sultanate of Oman rising from a computer engineer to Country Manager with a small Maintenance Company. In 2002 he finally landed in Dubai. For the first 2 ½ years he was unemployed and managed to earn some money building and selling PCs. Towards the end of 2004 he was asked to design the Structured Cabling System for a tender on Dubai Airport Expansion T3/C2/CP. Eventually, in 2008, he joined ADPi as the SCN Design Engineer overseeing the Installation on T3/C2/CP. During his time with ADPi, he was able to re-design the SCN for the new Concourse 3 of Dubai International Airport. This was revolutionary as it was a purely Fiber Optic cable based system.

When specifications are calling for a compliant, cost effective and up-to-date system, including future proofing, then Fiber Optic Cable solutions are the definitive answer. With the falling cost of both Fiber Optic Cable, including Connectivity, and the rising cost of Copper, then a compelling case is made to go directly for a Fiber Optic Cable solution for the horizontal runs as well as the back bone. The system designer must remember that the majority of End Users still require a RJ45 connection to the network. To do this effectively the horizontal cable must be turned back from Fiber Optic to copper. This would necessitate the use of media conversion at each RJ45 outlet. These days there are a number of companies that have developed an Intelligent Micro Switch, with POE (Power Over Ethernet) capability, to do just this. This Paper will endeavor to help the reader understand this new technology without going into the inside workings of these switches.

Designing a Fiber Optic solution is easier than designing a Copper solution as there is no 90m restriction on the length of the horizontal runs. With the lifting of this restriction, less Technical Rooms (with everything that that entails, i.e. UPS Power and cooling being the most important), housing the Connectivity, are required.

Intrinsically Fiber Optic Cable solutions are more reliable than Copper Cable solutions, due to the aggregation layer being core to core. This system is easier to work with both for Installation and later for Maintenance.

Performance wise, the Fiber Optic solution gives a true Gigabit transmission rate and with greater bandwidth.

All installed points using a Fiber Optic solution are both active and capable of supporting POE at every outlet.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

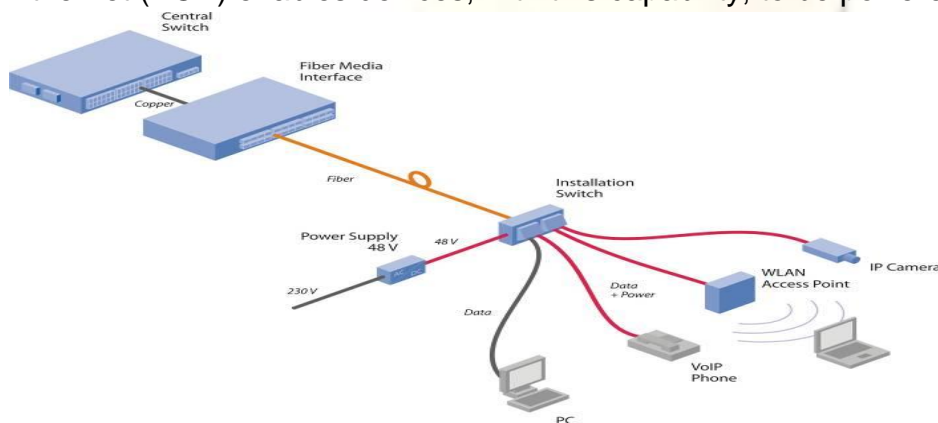
When would you use the FTTO Concept? The answer lies with the needs of the End Users. If they are looking for a State of the Art system that also has major future proofing inbuilt, then you would automatically think Fiber.

The FTTO concept has three (3) major Elements.

1. The Passive components
2. The Active components
3. The Power Supply (for POE, Power over Ethernet)

Following is a more detailed account of these three elements and their part in the concept.

1. The Passive Components consist of the Fiber Optic Cables, both for backbone and for horizontal, and the connectivity components (Patch Panels, Splice Enclosures etc.). There are many Manufacturers of such equipment and cables. The designer would have to choose which is best for their particular needs taking into account which is most cost effective and fully compliant with the specifications.
2. The Active Components are made up of Core (central) Switches and the Intelligent Micro Switches which carry the outlets (RJ45). The Core (central) Switches are the drivers for the system. The Intelligent Micro Switches are the means of converting the media transporting data, from Fiber Optic cable to Copper Cable and the means of transferring the data from light to electrical pulses.
3. The power Supply is applicable to the Intelligent Micro Switches and enables the switch to give POE over all connectors (RJ45). The power system is +48VDC and is carried to the switch either from a local mains-to-DC convertor or by a Centralized Power System. Power over Ethernet (POE) enables devices, with this capability, to be powered without an outside source.



This figure displays the basic concept including the power injection for POE.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

In the following sections there will be a more detailed description of the three elements and their position in the design of the Fiber Optic Solution known as FTTO.

### THE BASIC COMPONENTS

#### The Passive components

There are many well known Manufacturers of Fiber Optic Cables, so the choice is wide and varied. The smaller manufacturers will try to push Multimode Cable. With this there are many standards to consider. OM1, OM2, OM3 and OM4. Each standard has different characteristics, but even OM4 will only give 700-800m for 20GHz bandwidth.

With Single mode Fiber, the price difference is now well balanced, and with only two (2) standards, is easy to choose. OS1 and OS2 are the standards and the differences are mostly in the performance. OS2 can easily carry a signal of 100GHz band width up to 5Km.

#### The Active components

The active components are the distribution layer, traditionally comprising of 24/48 port Edge Switches, with or without POE capability, which are patched, via RJ45 patch leads, to Patch Panels connected, by copper cable, to the RJ45 outlets.



Three different models of FTTO from three different Manufacturers of the FTTO Switches.

The active components of the FTTO concept are distribution switches but in the location once taken by the RJ45 outlets. This switch gives the possibility of 4 RJ45 outlets that are already active. Each of the 4 outlets are fully capable of delivering POE to the end user devices. Again in this section there are many manufacturers of these switches, some are shown above.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

WHITE PAPER

### *The Power Supply (for POE)*

The power required to be available to the FTTO Switch has to take into account that all four RJ45 Outlets will have permanent POE (Power over Ethernet) of the value 15.2 watts. This Power, and the minimal required to run the switch is of the order of 65watts. A 48VDC Power Supply is needed to achieve the required levels. There are two ways of achieving this. Firstly from a local power adapter which powers one switch. Secondly by a Centralized Power System which can power a number of switches at the same time.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

#### Costing Comparison between Copper and FTTO based Solutions

<b>Copper Solution based on Cat 6a</b>		<b>QTY</b>	<b>QR</b>
1	Cat6A UTP cable 305m reel	609	1,360,646.07
2	Cat6A Patch Panel	115	109,826.15
3	Cat6A Dual outlets	1,325	49,435.75
4	42U cabinet	42	370,278.72
5	Cat6A UTP Patch cord, 1m (at TR)	2,650	63,626.50
6	1U Cable Management	120	12,601.20
Approximate cost (Not Active) :			<b>1,966,414.39</b>

<b>FTTO Solution based on Fiber Optic Cable SM OS2</b>		<b>QTY</b>	<b>QR</b>
1	FO cable 96 core SM OS2	1,800	184,000.00
2	FO Cable 2 core SM OS2	22,000	161,520.00
3	FO Patch Panels 96-fiber SC	20	48,400.00
4	FO Splice Enclosures	8	3,792.05
5	Splice Trays for Enclosures	192	2,377.96
6	FO Patch Cord LC-SC, SM, 3m	220	52,272.00
7	FO Patch Cord SC-SC, SM, 3m	480	66,960.00
8	FTTO Switches	220	220,000.00
9	Power Supplies for FTTO Switches	4	240,000.00
10	Cisco Core Switch	2	650,000.00
11	42U cabinet	4	35,264.64
12	1U Cable Management	20	2,100.00
Approximate cost (Active) :			<b>1,666,686.65</b>

This comparison is for a single level of an Airport other than the case study. Prices for Cat6a cable are taken from the winning bid. The FTTO prices are taken from the case study. All prices and quantities are approximate but realistic for this study.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

#### CASE STUDY

The Case Study is the design of the SCN infrastructure of a new Concourse for an International Airport in the Middle East. The original design was drawn up using CAT6a U/FTP cable. The Client was persuaded to look at an FTTO solution. A cost comparison was done to show the saving between continuing in Cat6a and going for fiber optic cabling solution utilizing FTTO.

A pictorial representation of the comparison is shown below. As can be seen, there is a substantial difference between the two layouts. In the copper design, a number of Technical Rooms are required, whereas in the FTTO solution, only Fiber Optic Splice Enclosures are required. A saving in cost is made, not just for the building of the rooms, but of power and cooling for those same rooms which are no longer required.

During the course of the design, it was realized that a new discipline was being formed. This discipline required engineers who were well versed in the three elements of the basic design, namely, Passive, Active and Power.

This White Paper is issued purely for the understanding of the concept of FTTO. Full Technical and Financial details will be covered in a further White Paper once the initial installation has been completed.



# UNDERSTANDING THE CONCEPT OF FTTO

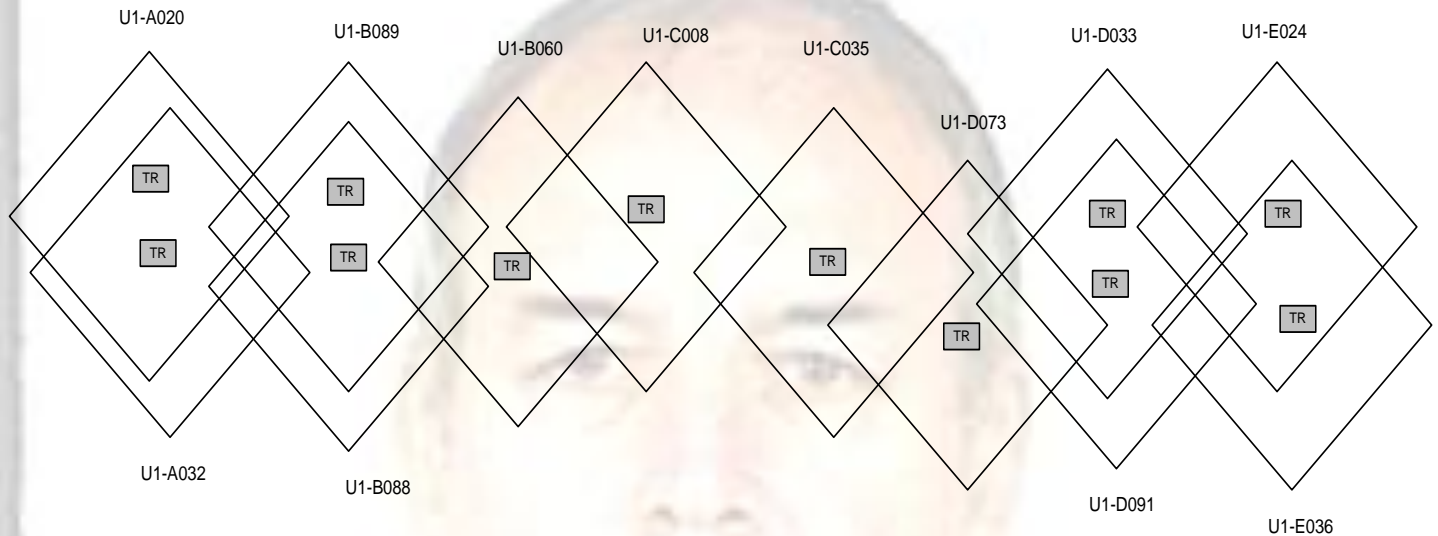
## (Fiber to the Office/Outlet)

### WHITE PAPER

#### Schematic of Structured Cabling System

Level U1

Cat6A



#### Level U1 Summary

No. of TR's : 12

No of outlets: 3600

#### Network and Cabling Componets

Copper Cables, Cat6A UTP 4 pair @ 50m/point approx:  
Cat6A Outlets RJ45: 3600  
Cat6A 24-port Patch Panels: 156  
Cat6A UTP Patch Cords: 7200  
42U Cabinets: 12  
24-port Ethernet Switches: 156  
1U Cable Management: 156  
Fiber Optic Patch Panels: 12  
Fiber Optic Patch cords: 156

The drawing above depicts a single level (U1) of an airport designed to be installed with a copper solution (Cat6a). It shows the number of Technical Rooms that are required and also shows the maximum coverage zoning for the outlets.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

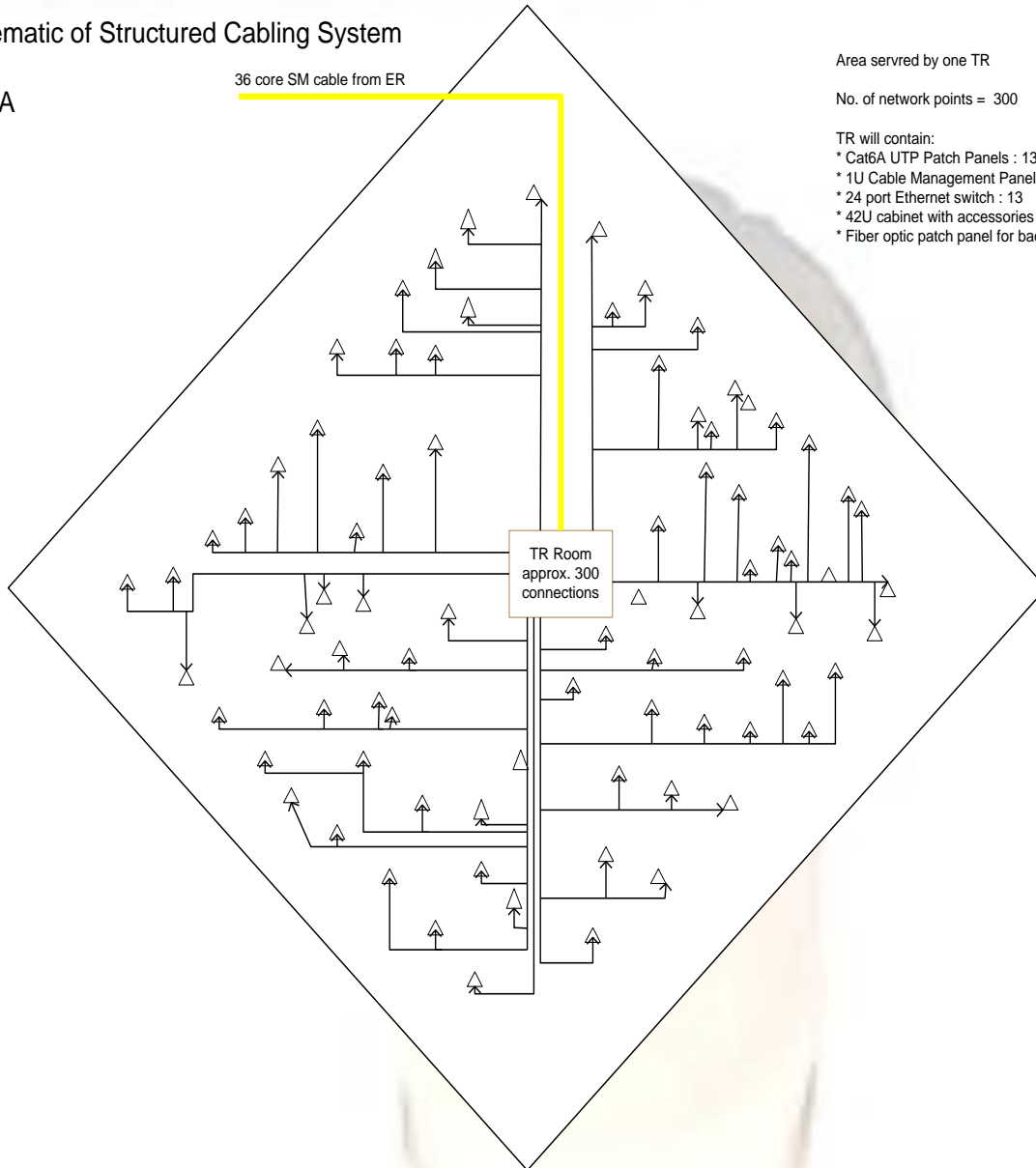
WHITE PAPER

Schematic of Structured Cabling System

Level U1

Cat6A

36 core SM cable from ER



Area served by one TR

No. of network points = 300

TR will contain:

- \* Cat6A UTP Patch Panels : 13
- \* 1U Cable Management Panel : 13
- \* 24 port Ethernet switch : 13
- \* 42U cabinet with accessories
- \* Fiber optic patch panel for backbone link

With this drawing, the layout inside the Coverage Zones is shown. The distance from the TR Room to the outlet is a maximum of 70m due to the requirements of spare loops of cable at each end for any required re-positioning.

# UNDERSTANDING THE CONCEPT OF FTTO

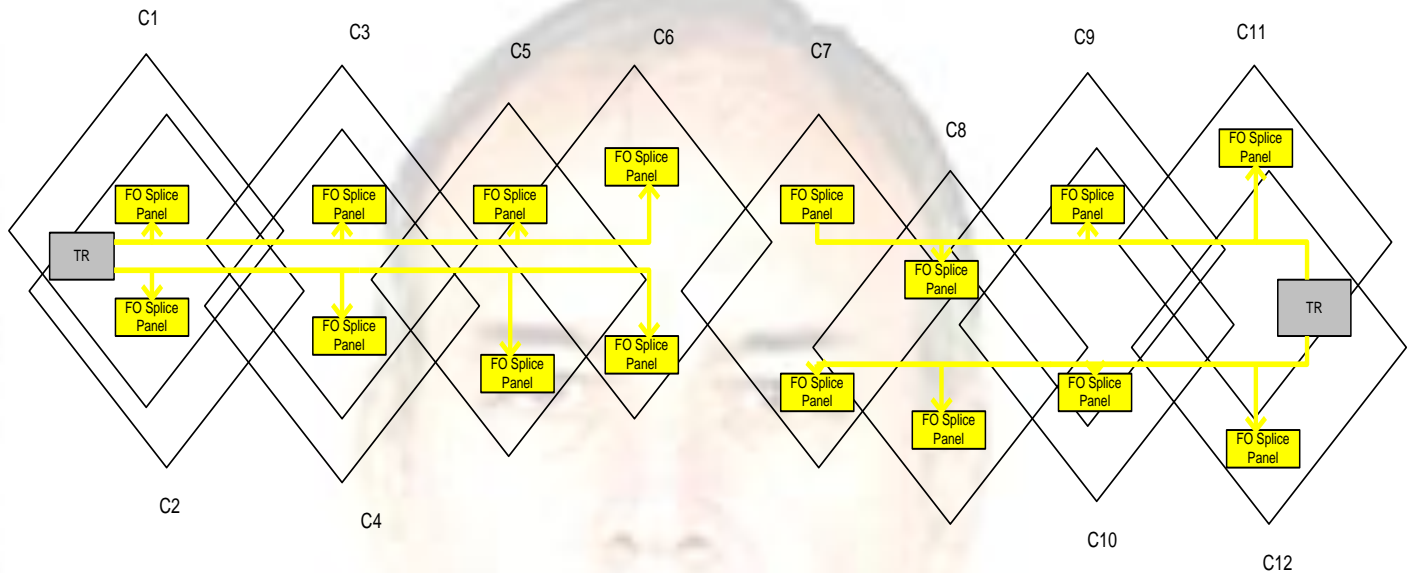
## (Fiber to the Office/Outlet)

### WHITE PAPER

#### Schematic of Structured Cabling System

Level U1

#### FTTO



#### Level U1 Summary

No. of TR's : 2

No of network points : 3600

#### Network and Cabling Components

2 core SM Fiber Optic Cables @ 30m/FTTO switch approx: 27000 m

96 core SM Fiber Optic Cables @ 100/splice panel : 1600 m

4 port Gigabit FTTO switch w/ power supply : 900+

Cat6A UTP Patch Cords: 3600

42U Cabinets: 4

Cisco 6509 switch (w/ blades + 2 x 10 Gig XENPAK + 225 SFPs): 4

Fiber Optic Splice Panels: 16

Fiber Optic Patch Panels for backbone (12-fiber) : 4

Fiber Optic Patch Panels at TR (for FTTOs) (96-fiber) : 16

Fiber Optic Patch cords: 924+

1U cable management panels : 38

Here is shown the same level, but for the FTTO Concept shows Fiber Optic Splice Enclosures in place of Technical Rooms. The two Technical Rooms remaining are for control and redundancy.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

WHITE PAPER

### Schematic of Structured Cabling System

Level U1

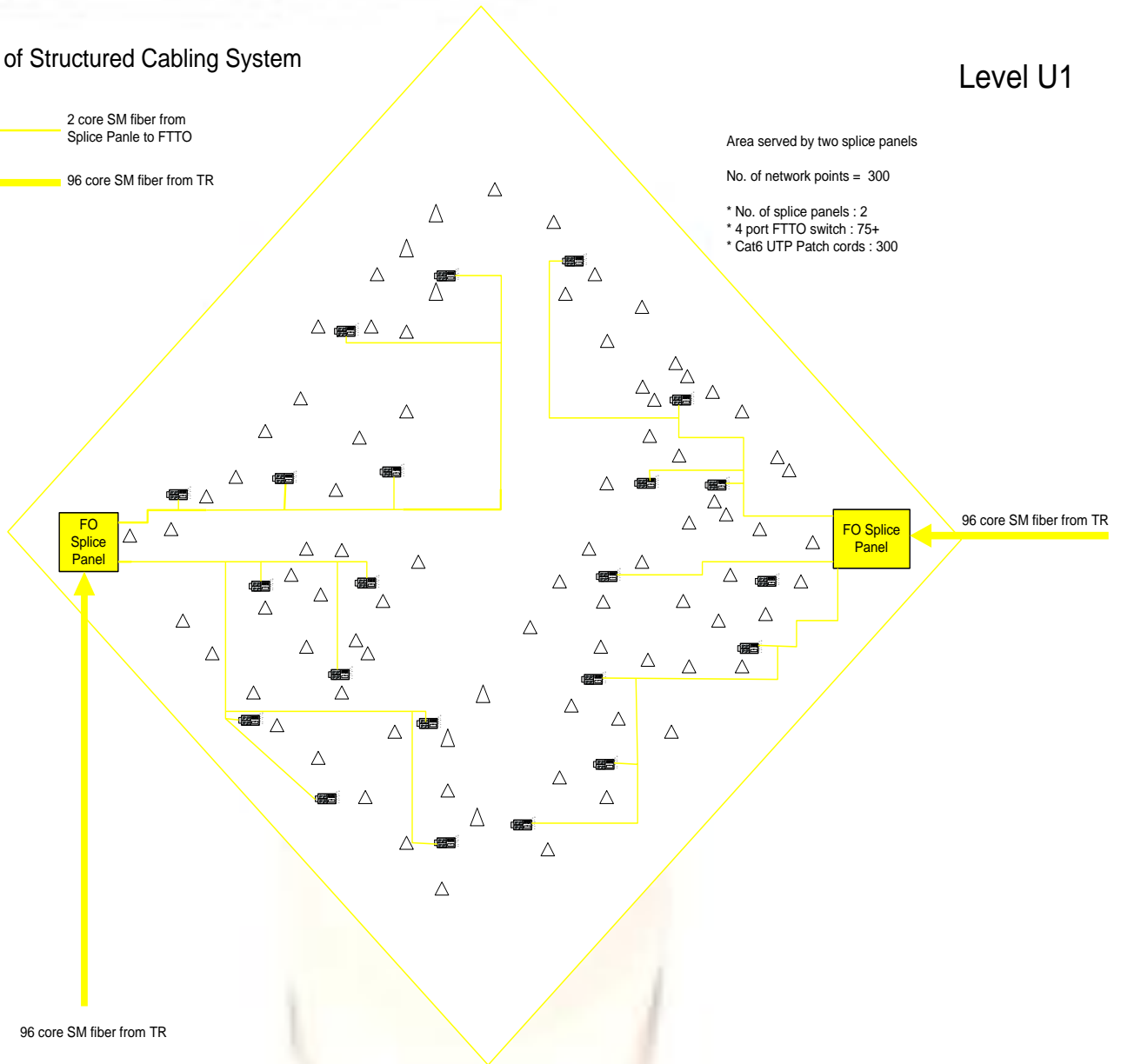
FTTO

- 2 core SM fiber from Splice Panel to FTTO
- 96 core SM fiber from TR

Area served by two splice panels

No. of network points = 300

- \* No. of splice panels : 2
- \* 4 port FTTO switch : 75+
- \* Cat6 UTP Patch cords : 300



Inside a coverage zone, showing the Ratio of FTTO switches to Outlets. This is a direct comparison of the same zone utilizing splice enclosures and FTTO switches in stead of TR Room.

# UNDERSTANDING THE CONCEPT OF FTTO

## (Fiber to the Office/Outlet)

### WHITE PAPER

## CONCLUSIONS

Savings are not immediately visible, in fact because the SCN now includes core switches in the TRs the cost of the passive and active part of the overall project rises slightly.

### **FTTO significantly reduces the CAPEX and OPEX of a network.**

To compare the cost of different network types it is essential not to compare individual costs, but to look at the total cost of ownership (TCO).

#### **Lower CAPEX through:**

1. Less network ports required on the central switch, resulting in less network segments to be installed in the building.
2. Less number of equipment rooms for sub-distribution required, less investment in floor space, safety measures, control equipment, climatic systems etc.
3. Lower cabling cost, as fiber optic cable is cheaper than both Cat6a and Cat.7.
4. Prolonged investment cycles, as fiber optic cabling has long-term lifespan compared to copper cabling.

#### **Lower OPEX through:**

1. Lower port count on central equipment reduces consumption of power and cooling.
2. Reduced number of equipment rooms save power, cooling and maintenance.
3. Distributed installation of Micro Switches reduces power density, additional cooling not required in normal office environment. Micro Switches are power optimized, consuming less than 1W per active network port.
4. Reduced maintenance, as Micro Switches can be exchanged quickly without specialized tools.

**Final conclusion will be the subject of a further White Paper, once the initial installation is completed and more detailed information is available.**