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A Case Study on Network Enhancement from Copper to FIBER in PTCL

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Abstract: Pakistan Telecommunication Company Limited (PTCL), is a company that is ready to explore its boundaries and achieve out of the box solutions that will hopefully change the face of the telecommunication market in the years to come. In today's day and age there are many different ideas and products that the nation has direct or indirect access to PTCL is known to have its exchanges located in different key localities all over Pakistan to provide users with easy access for queries and concerns that may arise along with service solutions that can people have direct access to. One such that is under discussion for this research is the Pakistan Employees Cooperative Housing Society, better known as PECHS. The PECHS exchange is serving 45000+ subscribers both, residential and corporate, under their respective domain. Currently the exchange is functioning under the copper network, however, there is a complete plan to change this network to new Fibre versions. The main purpose of the Network Transformation Project (NTP) pilot project is to overcome the limitations of copper network and to rehabilitate this old network (i.e. copper) by new network of MSAGS (i.e. Fibre) that will ultimately end up making the PECHS exchange a model exchange with a complete Fibre network and as well as an increase in the PECHS exchanges subscriber base. This NTP Pilot project is basically named as 'PECHS Network Transformation'.

Keywords: VoIP, NTP, ICT, Hybrid Network

1. INTRODUCTION

The introduction to application of copper wires followed by the application of fibre optics and how it works. The advantages and disadvantages of the same followed by new and improved technologies that are present. It also shares a brief about Pakistan Telecommunication Company Limited (PTCL) that currently applies copper wires. It goes on to share the problem statement, research objective and research question *(Fiber-optic communication*. 2017)

With more and more inventions coming forth for the development of communication systems, it was in the 1920's that two separate people from two separate nations got together for a patent to bring forward the concept of having groups of muffled tubes or simple see-through shafts that allow Figures to be sent for television communication or fax machine systems. These two inventors where namely John, (from England) and Clarence Hensel (from the United States) *(History of fiber optics*. 2017).

Nearly 34 years later, Abraham V. Heel and Harold H. Hopkins both from Dutch and British nationalities respectively stated in two different main articles of the methods of Figure bundles and how they could be used. The concept of having Figure bundles revolved around the application of unclad fibres as per the understanding of Hopkins, whereas Heel stated the usage of clad fibres for the same.

Previously the fibre optics that were used were mostly uncovered and everything was visible as per clear viewing of the glass-air interface. With the covering of the fibre be it glass or plastic of a lower refraction, it managed to protect the surface of the fibres from not only cross talk and overall distortion but also from adulteration or merging as well (*Disadvantages of copper*. 2017).

With the passage of time glass clad fibres were developed and were being utilized for clearer more concise forms of communication. It was in 1960 that it was noted that with the usage of glass fibres there was a reduction of about 1 decibel (dB) per meter (Attaa 2017). This article along with the proposal that was submitted was accepted for medical research where it could be used to see the internal organs of patients. However, here the loss of 1 dB per meter still remained as an issue to be resolved (Attaa 2017).

It was in the year 1964 that Dr. Charles managed to recognize a major requirement for the application of long distance communication devices, that is the process of managing the light that is lost at a total of 10 or 20 dB per kilometre. He presented the theory with the fact that purer form of glass could be used to aid in the reduction of the light loss that was being incurred. Thus by 1970 there was a complete team of research that began working with silica, an extremely pure material that had a high breaking point and low measurement of light index (Conductors.2017).

2. SYSTEM WORKFLOW

To make the move within the PECHS exchange a proper workflow was formulated and applied to have a smooth execution within out limitations. The workflow that shall be applied for the transformation, that is old to new network, will be done so in the following steps. The steps shall have:

1. Identification
2. Methodology
3. Testing
4. Secondary network
5. Secondary routes
6. Network planning
7. Bill of quantities
8. Replacement of existing ONUs/MSAGs
9. Placement of new MSAGs
10. Soft Migration
11. Network Rehabilitation

3. METHODOLOGY

The methodology for this transformation was based on testing the switch. The phase involved extensive testing to take place. This testing for the 20 MB data rate was carried out in a number of scenarios at different distances from the MSAGs. Looking at these tests the results that were derived showed that transformation of the existing network could be applied in such a way that maximum distance of within ONE km would allow the working of 20 MB data rate. Here the changes that could be applied were as follows:

- Replace all ONUSs copper cabinets with MSAGs
- Additional new MSAGs to cater for demand in dry areas
- Additional new MSAGs for loop length control
- All MSAGs with combo cards to work both with ADSL and VDSL
- Ensure 100% ring protection of all MSAGs
- Upgradation of backhaul for 20 MB enabled each MSAGS port
- Rehabilitation of all Secondary network
- New network in dry areas

Fig1: Overview of the location where Transmission has happened

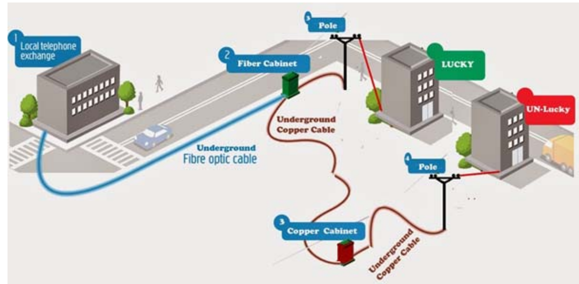

Fig. 2: Graphical Representation of Exchange Transformation

4. BEFORE TRANSFORMATION

The numbers were working from Exchange through Primary cable feed in Cabinets. Capacity of One MSAGS doesn't fulfil its old ring was of 2.5 G which was in sufficient to provide the required bandwidth. The main disadvantage of this 2.5 ring was that bandwidth was assigning manually.

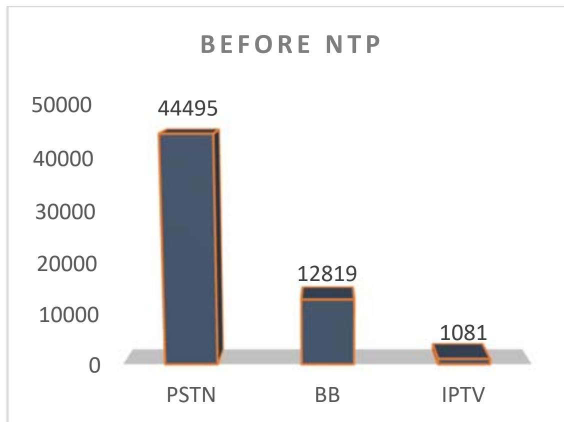

Fig 3: Before Transformation

The **(Fig. 3)** shows the in PECHS exchange before the network transformation. It shows that before the transformation the PSTN were 44495, BB were 12819 & 1081.

a. Current Data Rate of ONU Mehdi

Table 1: Current Data Rate of ONU MEHDI

Row Labels	Count of Telephone No
1 MBPS	2
2 MBPS	3
4 MBPS	4
8 MBPS	4
only pstn	47
(blank)	
Grand Total	**60**

(Table 1) shows the existing numbers of connection in ONU Mehdi and how much data. This data is very useful to us because later on it will help to compare the results of before & after transformation effects.

b. Current Data Rate of BLT 27

Table 2: Current Data Rate of BLT 27

Row Labels	Count of Telephone No
0 Kbps	2
1 MBPS	9
2 MBPS	7
4 MBPS	18
8 MBPS	5
ONLY PSTN	96
(blank)	
Grand Total	137

(Table 2) shows the existing numbers of connection in BLT 27 & how much data.

c. Current Data Rate of PTC 61

Table 3: Current Data Rate of PTC 61

Row Labels	Count of Exchange Name
0 Kbps	1
4 MBPS	2
ONLY PSTN	8
Grand Total	**11**

(Table 3) shows the existing numbers of connection in PTC 61 & how much data rate every is using

A grand total of the numbers working from cabinets which will later on be called as MSAG 207 = 208

d. Current Data rate of BLT 26

Table 4: Current Data rate of BLT 26

Row Labels	Count of NE User Name
0 Kbps	1
1 MBPS	8
2 MBPS	4
4 MBPS	6
ONLY PSTN	52
Grand Total	**71**

(Table 4) shows the existing numbers of connection in BLT 26 & how much data rate.

A grand total of the numbers working from cabinet which will later on be called as MSAG 208 = 71

5. AFTER TRANSFORMATION

This section consists of the data used to transform MSAGS into hybrid MSAGs.

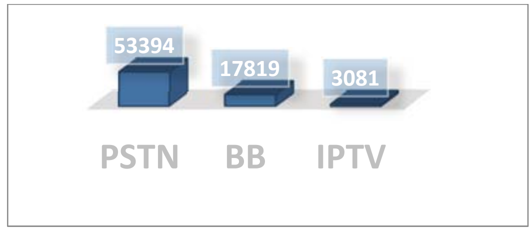

Fig 4: After NTP

(Fig. 4) shows the increase after implementing the project. The PSTN customers which 44495 before the transformation have been increased to 53395 after the transformation and similarly with BB & IPTV.

6. RESULTS OF MSAGS AFTER TRANSFORMATION

Table 5: MSAGS 208 Versus MSAGS 207

MSAGS 208		**MSAGS 207**	
Row Labels	**Count of Telephone No.**	**Row Labels**	**Count of Telephone No.**
0 Kbps 1MBPS 2 MBPS 4 MBPS Only PSTN	1 8 4 10 51	0 Kbps 1MBPS 100 MBPS 12 MBPS 2 MBPS 20 MBPS 4 MBPS 50 MBPS 8 MBPS Only PSTN	3 18 1 1 15 1 44 1 15 291
Grand total	**74**	**Grand total**	**390**

(Table 5) shows the increase the MSAGs. Before in MSAG 207 numbers working were 208 and now it has increased to 390 and similarly with MSAG 208.

7. DATA INTERPRETATIONS

a. T-Test

Paired Samples Statistics

Table 6: Paired Sampling

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Q6	1.3000	50	.64681	.09147
	Q10	1.2800	50	.64015	.09053
Pair 2	Q7	1.9600	50	.72731	.10286
	Q11	1.8800	50	.71827	.10158
Pair 3	Q8	1.9400	50	.84298	.11922
	Q12	2.9400	50	1.15016	.16266
Pair 4	Q9	1.9200	50	.75160	.10629
	Q13	2.9200	50	1.10361	.15607

The mean that has been derived is noted to be 2.94 over a sample of 50 respondents. Based on the highest mean that has been noted the Standard deviation for the same is 1.15 with the mean error of 0.16. This states true that the bandwidth has increased with the application of fibre optics as compared to that of copper. Comparatively is has also shown a high positive reaction to the speed of the internet. The data presented shows a mean of 2.92 and standard deviation 1.104. The standard mean error is 0.156.

Thus the question has been held as agreeable to the point that both bandwidth and internet speed has had a positive impact.

Paired Samples Correlations

Table 7: Paired sample Correlations

		N	Correlation	Sig.
Pair 1	Q6 and Q10	50	.631	.000
Pair 2	Q7 and Q11	50	.733	.000
Pair 3	Q8 and Q12	50	-.383	.006
Pair 4	Q9 and Q13	50	-.451	.001

The **(Table 7)** presents the results that for both Q6 and Q10 along with Q7 and Q11, the results have a positive co-relation (0.631 and 0.733) with a balanced significance value of 0.000. This shows that the new users have felt a difference within the usage of bandwidth network and an increased level of satisfaction with the same. Comparatively Q8 and Q12 and Q9 and Q13 have a negative correlation that has been established. Here the results are -0.383 and -0.451 with a significance of 0.006 and 0.001, that the statement holds true or positive at a higher rate of deviation that is 1.666 and 1.591.

b. Frequencies

Q1

Table 8: Age representation on percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18-23	12	24.0	24.0	24.0
	23-27	13	26.0	26.0	50.0
	28-35	5	10.0	10.0	60.0
	36-45	13	26.0	26.0	86.0
	46-55	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

Q1 focused on the age bracket that were within the ranges for 18 to 55 years. From a total of 50 interviews that were conducted the most amount of target audience totalled to 26%. This 26% were from the age ranges of 23 – 27 years and 36 – 45 years of age.

Q2

Table 9: Location representation in percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Commercial	26	52.0	52.0	52.0
	Residential	24	48.0	48.0	100.0
	Total	50	100.0	100.0	

The **(Table 9)** presents the percentage split between commercial and residential. Commercial were noted to have a higher ratio that is 52% as compared to that of residential that being 48%. Here majority thus were centred to the commercial zone.

Q3

Table 10: User representation in percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1.00	5	10.0	10.0	10.0
	2.00	4	8.0	8.0	18.0
	3.00	7	14.0	14.0	32.0
	4.00	5	10.0	10.0	42.0
	5.00	6	12.0	12.0	54.0
	6.00	7	14.0	14.0	68.0
	7.00	4	8.0	8.0	76.0
	8.00	3	6.0	6.0	82.0
	9.00	2	4.0	4.0	86.0
	10.00	3	6.0	6.0	92.0
	11.00	1	2.0	2.0	94.0
	12.00	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

The **(Table 10)** presents the data for the number of users that were present within each household. The highest frequency here was noted to be at 3 and 6, having a frequency of 14 and a total percentage of 14% and 14% or a cumulative percentage of 32% and 68% respectively. This is followed by the number of 5 users within a frequency of 6 with a percentage of 12% and cumulative percentage of 54%.

Q4

Table 11: Gender representation in percentage

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	43	86.0	86.0	86.0
	Female	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

The **(Table 11)** presents the results for males and females that were interviewed. The frequency here was a total of 43, that is a majority of males as compared to females. The total percentage here was thus 86% males and 14% females for the same.

Q5

Table 12: Internet usage in hours per day

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1-2 hours	8	16.0	16.0	16.0
	2-4 hours	9	18.0	18.0	34.0
	4-8 hours	19	38.0	38.0	72.0
	8 - more hours	14	28.0	28.0	100.0
	Total	50	100.0	100.0	

As per the **(Table 12)** for the number of hours spent online, majority stated a frequency total of 4 – 8 hours 19. The total percentage here is thus noted to be 38%. 8 and more hours have a frequency 14. The total percentage here is thus noted to be 28%.

8. CONCLUSIONS

Overall it can be said that before the addition of fibre optic cables within the PTCL P.E.C.H.S exchange the system was not only considered slow but the broadband connection was evaluated to be weak with many issues that ultimately created a churn effect for most clients. The list of complaints was literally high from issues such as connectivity and speed to lines being stolen or 'disappearing' during the night. To counter this, the idea of implementing fibre optics within the P.E.C.H.S exchange came about, labelling it as the model exchange.

9. ACKNOWLEDGEMENTS

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