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"Pneumatic Effect On Fibre Optic Transmission Line; Analysis And Survivability Strategy, With Bias To Nigerian Situation'

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Abstract: *Optic fibre has a good advantage over other data transmission medium for haulage over long distance communication. Its characteristic fidelity has endeared it to the world providers of broadband as backbone for telecommunication. When articulated planning and installation are carried out, its durability cannot be paralleled by any other medium. Pressure and temperature are two critical external forces that impedes its transmission capability, hence adequate planning and standard ethics must be followed in system installation. Periodically, attenuation, dispersion, power budget cuts must be monitored and measured to ascertain when fibre degradation sets in.*

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I. BACKGROUND

In this dynamic digital age, there is very high demand for numerous services for signals to be transmitted to operators through optic fibre, this brings about the need for installation of wave length division multiplex (WDM). Gerd K.(2000) This also creates its own problem; known as dispersion which is the premise for this work. The work is primarily aimed at reducing problems caused by pneumatic insurgence on optic fibre cable carrying traffic. The motivation, of this work hinges on the fact that our network is bedevilled with call droppings, poor call completion rate (CCR),answer seizure ratio (ASR), attenuation, bending losses etc ,hence it is observed that individuals carry more than one SIM card at a time. Some have as many as four network SIM CARD, to ensure that they are in constant communications .these are as a result of inadequate planning and damaged by heavy duty trucks and vehicles running over the routes. Also the construction of roads by companies /Governments agents pay no respect to the routes due to lack of identification marks; such as the use of cable Markers, Fig 1.1 gives detail of the information under discussion.

Figure 1.1 Uprooted Optic fibre cable along a major road in Nigeria.

However, this should not be so in a good Telecommunication environment that has no distortion. The word distortion engulfs many areas of errors such as noise, attenuation, dispersion etc. Various types of dispersions exist in transmission lines such as pulse mode dispersion (PMD), group velocity dispersion (GVD), intramodal /intermodal dispersion and chromatic dispersion. (CD) .Since dispersion is the broadening of signal, Pressure is a catalyst to aggravating the process as well as causing the flatting of the fibre thereby severing the through-put of signals as shown in Fig 1.2.

Fig 1.2 Pulse spreading causing information distortion as a result of pressure on fiber optics

Summary of related works:
To achieve this aim, many works were reviewed. Despite the presence of extensive works on optic fibre, it was observed that a gap existed in addressing the specific problem of pneumatic effects and that is the academic lacuna this work intends to fill. This forms the scope of this work, the limitations are that the thesis has to use case studies as a result of limited resources and was limited to Nigeria.

II. MATERIALS AND METHOD:

The fibre optics cable has to be tested and necessary parameters measured for authenticity hence the necessary tools/materials were employed. These includes but not limited to, Optical Time Domain Reflectometer (OTDR),Splicing machine ,Doped Fibre Amplifier (EDFA),Fibre Fly Head (PIG TAIL): to link the frame to the fibre under test),Power Meter, Methylated spirit, Organizer, cotton wool ,Industrial Tissue, cutters and Pressure gauge analyser A hybrid experimental and case study methodology approach were adopted in addressing this problem. Two private telecommunication operators (PTOs) which had been acutely affected by the problem under review were systematically chosen that had an adequate presence of the problem. This was to ensure consistency and reliability of results. Hence, these two PTOs were used as case studies to resolve the transmission problem established. To establish this fact the fiber optic route Asaba-Okpanam was taken as a test–bed, a route for one of the Private Telephone Operators (P.T.Os). Adequate experiments and measurements were carried out and categorically analyzed for implementations.

Operational procedure for testing:
The fibre to be tested is best operated from the optical frame, one end is connected to the optical frame and the other end, classified as dark or light fibre or the pigtail is equally connected to the optical frame and is also connected to the OTDR. The readings taken from the OTDR screen terminal. The measurements were taken from both terminal ends A and B to ascertain the actual location of the fault, be it cut, attenuation or dispersion (Harus A 1986). The readings at Asaba test-bed were the direct readings. These measurements show the fault that primed the two companies were majorly pneumatic. The Optical Time Domain Reflectometer (OTDR) being an integrating instrument, measured, compared and by analysis produced on a trace the loss of signal energy between the two points on the fibre cable. Its ability to handle our major task was first confirmed therefore by using it to obtain the signal loss along some communication routes. In the process, it was now possible to locate fault that could occur along any route precisely

As a result of the report tests were conducted and it was discovered that there was a flat out at kilometer 12 causing the OPTICAL TIME DOMAIN REFLECTOMETER (OTDR) signal failure at that point. This was the result after the tests and confirmed with the Fibre Optic Test Procedure (FOTP) documentation.. These instruments enable a variety of statistical measurements to be made at the push of a button, after the user has keyed in the parameters to be tested and the desired measurement range.

Table 2.1: Fibre Optics Dispersion Test Result, due to pressure

Fibre	Event1 2Km	Event 2 4Km	Event 3 6Km	Event4 8Km	Event 5 10Km	Event6 12Km	Event7 14Km	Event8 16Km	Event9 18Km	Event 10 20KM
1	0.26	0.26	0.28	0.34	0.96	3.61	0.52	0.32	0.33	0.34
2	0.25	0.29	0.31	0.36	0.86	3.71	0.58	0.38	0.32	0.24
3	0.22	0.26	0.29	0.33	0.87	3.21	0.52	0.32	0.30	0.22
4	0.21	0.27	0.28	0.32	0.87	3.42	0.56	0.35	0.28	0.25
5	0.25	0.27	0.31	0.38	0.72	3.12	0.49	0.33	0.22	0.24
6	0.25	0.27	0.29	0.32	0.81	3.32	0.52	0.38	0.25	0.22
7	0.24	0.28	0.30	0.34	0.78	3.31	0.58	0.33	0.26	0.23
8	0.23	0.28	0.34	0.39	0.92	3.61	0.56	0.35	0.23	024
9	0.21	0.29	0.29	0.30	0.92	3.63	0.57	0.30	0.24	0.25
10	0.22	0.26	0.29	0.32	0.82	3.27	0.59	0.31	0.22	0.27
11	0.25	0.27	0.28	0.33	0.85	3.48	0.60	0.35	0.23	0.28

12	0.26	0.29	0.31	0.26	0.87	3.66	0.58	0.33	0.26	0.26
13	0.26	0.27	0.29	0.31	0.88	3.28	0.52	0.36	0.27	0.26
14	0.27	0.29	0.33	0.34	0.87	2.32	6.53	0.38	0.26	0.24
15	0.22	0.26	0.32	0.31	0.87	3.21	0.54	0.34	0.25	0.24
16	0.23	0.27	0.29	0.32	0.88	3.44	0.55	0.35	0.20	0.26
17	0.24	0.26	0.34	0.36	0.85	3.48	0.56	0.32	0.24	0.22
18	0.26	0.29	0.32	0.38	0.87	3.62	0.57	0.36	0.20	0.21
19	0.27	0.29	0.36	0.38	0.88	3.59	0.59	0.37	0.23	0.23
20	0.22	0.26	0.34	0.37	0.82	3.57	0.54	0.38	0.22	0.20
21	0.24	0.25	0.32	0.34	0.82	3.56	0.53	0.37	0.24	0.25
22	0.22	0.26	0.29	0.32	0.83	3.61	0.52	0.34	0.26	0.26
23	0.24	0.27	0.34	0.39	0.88	3.72	0.88	0.33	0.23	0.27
24	0.22	0.28	0.29	0.32	0.87	3.22	0.56	0.32	0.22	0.28

Fig 2.1 Damages on fibre optics cable

As a result of the reports and the situation in fig 2.1 the fault occurred and the test result on table 2.2 indicates that the fault occurred at kilometer 12.

Table 2,2 Fibre Optics Dispersion Test Result ,under normal operation (FOTP STANDARDS)

Fibre	**Event1 2Km**	**Event 2 4Km**	**Event 3 6Km**	**Event4 8Km**	**Event 5 10Km**	**Event6 12Km**	**Event7 14Km**	**Event8 16Km**	**Event9 18Km**	**Event 10 20KM**
1	0.24	0.24	0.25	0.27	0.24	0.25	0.22	0.23	0.26	0.27
2	0.26	0.24	0.27	0.23	0.31	0.27	0.28	0.30	0.24	0.23
3	0.24	0.27	0.25	0.22	0.24	0.26	0.28	0.26	0.25	0.22
4	0.21	0.24	0.22	0.26	0.27	0.28	0.23	0.25	0.24	0.26
5	0.22	0.21	0.23	0.24	0.26	0.28	0.23	0.26	0.27	0.24
6	0.19	0.22	0.21	0.20	0.27	0.28	0.25	0.27	0.28	0.20
7	0.22	0.24	0.27	0.23	0.26	0.29	0.24	0.22	0.26	0.23
8	0.21	0.24	0.22	0.26	0.27	0.28	0.25	0.21	0.27	0.26
9	0.22	0.25	0.26	0.28	0.25	0.26	0.28	0.26	0.24	0.28
10	0.25	0.22	0.23	0.28	0.24	0.27	0.22	0.24	0.26	0.28
11	0.27	0.24	0.25	0.26	0.24	0.28	0.23	0.26	0.23	0.26
12	0.24	0.24	0.25	0.27	0.24	0.25	0.22	0.23	0.26	0.27
13	0.26	0.24	0.27	0.23	0.31	0.27	0.28	0.30	0.24	0.23
14	0.24	0.27	0.25	0.22	0.24	0.26	0.28	0.26	0.25	0.22
15	0.21	0.24	0.22	0.26	0.27	0.28	0.23	0.25	0.24	0.26
16	0.22	0.21	0.23	0.24	0.26	0.28	0.23	0.26	0.27	0.24
17	0.19	0.22	0.21	0.20	0.27	0.28	0.25	0.27	0.28	0.20
18	0.22	0.24	0.27	0.23	0.26	0.29	0.24	0.22	0.26	0.23
19	0.21	0.24	0.22	0.26	0.27	0.28	0.25	0.21	0.27	0.26
20	0.22	0.25	0.26	0.28	0.25	0.26	0.28	0.26	0.24	0.28
21	0.25	0.22	0.23	0.28	0.24	0.27	0.22	0.24	0.26	0.28
22	0.27	0.24	0.25	0.26	0.24	0.28	0.23	0.26	0.23	0.26
23	0.21	0.24	0.22	0.26	0.27	0.28	0.23	0.25	0.24	0.26
24	0.22	0.21	0.23	0.24	0.26	0.28	0.23	0.26	0.27	0.24

The above result on table 2.2 showed that the fault has been restored, hence the following maintenance schedule from April to August were used to monitor the development processes for future invents,. During this period, monitoring statistical reading view from table 2.3 showed that the fault was gradually coming back until August 2013 when the attenuation rose to 0.3 dB per kilometres.

Tables 2.3 a-f Summary Sheet of Attenuation Test Result on Optics fibre involving Measurement from Point A to B Location Asaba-0kpanam

- Measurement from Point A to B, Date: April-July,

Time (week)	Length of Cable	Attenuation (dB) 1	2	3	a (dB) Mean	Attenuation dB/KM
1	59	15.68	15.67	15.66	15.57	0.27
2	59	15.88	15.82	15.11	15.60	0.27
3	59	16.02	16.03	16.01	16.05	0.28
4						

- Measurement from Point A to B, Date: August-Oct,

Time (week)	Length of Cable	Attenuation (dB) 1	2	3	a(dB) Mean	Attenuation dB/Km
1	59	17.01	16.72	16.65	16.79	0.29
2	59	16.02	16.03	16.81	16.28	0.29
3	59	17.02	17.04	17.11	17.05	0.30
4						

c) Measurement from Point A to B, Date: Nov- Jan

Time (week).	Length of Cable	Attenuation (dB) 1	2	3	a (dB) Mean	Attenuation dB/Km
1	59	17.12	17.11	17.01	17.08	0.30
2	59	18.12	18.11	18.10	18.11	0.32
3	59	19.10	18.92	18.16	18.72	0.33
4						

d) Measurement from Point A to B, Date: Feb-March,

Time (week)	Length of Cable	Attenuation (dB) 1	2	3	a (dB) Mean	Attenuation dB/Km
1	59	19.20	19.21	19.11	19.17	0.34
2	59	19.10	19.18	19.91	19.12	0.34
3	59	19.12	19.16	19.20	19.16	0.35
4						

- Measurement from Point A to B, Date: April-June,

Time (week)	Length of Cable	Attenuation (dB) 1	2	3	a (dB) Mean	Attenuation dB/Km
1	59	20.11	19.23	19.34	19.28	0.35
2	59	20.10	20.11	19.34	19.85	0.35
3	59	21.64	21.61	21.44	21.50	0.38
4						

f) Measurement from Point A to B, Date: July-Aug

Time (week)	Length of Cable	Attenuation (dB) 1	2	3	a (dB) Mean	Attenuation dB/Km
1	59	21.82	22.72	22.65	22.39	0.39
2	59	22.61	22.62	22.60	22.61	0.40
3	59	22.40	22.71	22.48	22.43	0.40
4						

It will be observed that the Measurement Summary gives the value: (0.27-0.28) db/km for the Wave length: 1550 nm

- Secondly there was pulse spreading as stated earlier which is the dispersion and will be fully treated subsequently. The dispersion was fully ascertained when the faults resurfaced after 8 months and necessary tests confirmed dispersion without cut on the fiber cable. The OTDR never indicated any cut or breakage. At this point it was duly confirmed that pressure was the cause of failure hence the pressure confirmatory tests

Data Measurement Results
Data Presentation and Analysis
Data from the four major investigations carried out are presented, with the corresponding analysis, these tests (i) and (ii) were used for confirmation.

- Crush/Impact Destructive test result
- Power budget Test Result

The observations of the measurements and their analysis are presented here, for better results measurements were taken several times, (however because of the cost, some, especially the near destructive tests were taken once). Measurements were taken to obtain the attenuation of the signal as the distance increased over some routes. The measurements were also taken over a period. The dispersion measurements were also taken over several fibre lengths.(Eke J 2006} The near destructive test using pigtails were carried out once. (Table 2.1)

2.2 SIMPLE LOAD VARYING SYSTEM TEST TO DETERMINE THE EFFECT OF PRESSURE ON FIBRE (CRUSH IMPACT TEST)

After the continuity/attenuation tests which identified where the faults were located, all the buried optic fibre cable were excavated, and replaced with dispersion compensated fibre (DCF), re-spliced, re-coupled and reconnected. The problem resurfaced. So this time after the above-mentioned tests revealed same problem as before, the researcher had to critically by observe the physical location of these fibres; to check and see if they are under any direct crush or impact pressure. Cable crush and impact are very important but rarely do operators understand details of it on optic fibre cables. The IEC794-1-E3/ EIA-RS-455-41/FOTP41 and IEC794-1-E4/ EIA-RS-455-45/FOTP45 standards (FOTP) detail. The crush and impact test methods of optic fibre cables to ascertain how well the cable may withstand or recover from a slow crushing or compressive action or repeated impact loads. These problematic routes happen to be in areas, where they were exposed to crush and impact strain from heavy vehicles, so the crush and impact tests were carried out immediately as they contributed to chromatic dispersion in optic fibre.

Neguty T. (2001) had solved a related problem by using a silicon micro machined pressure sensor to obtain the microbending induced in an optical fibre. In the present work, instead of the silicon micro-machined pressure sensor, a simple load varying system was adopted. The flow diagram is shown in Fig 2.3 while the setup of the work is shown in Fig 2.4 the applied force came through varying loads and the spreading broadly came as a result of the increased pressure on the fibre.

Fig 2.2: Crush Impact Test flow chart

Fig 2.3: Measurement of Pressure Effect in Optical Fibre
The OTDR was used to monitor the signal variation

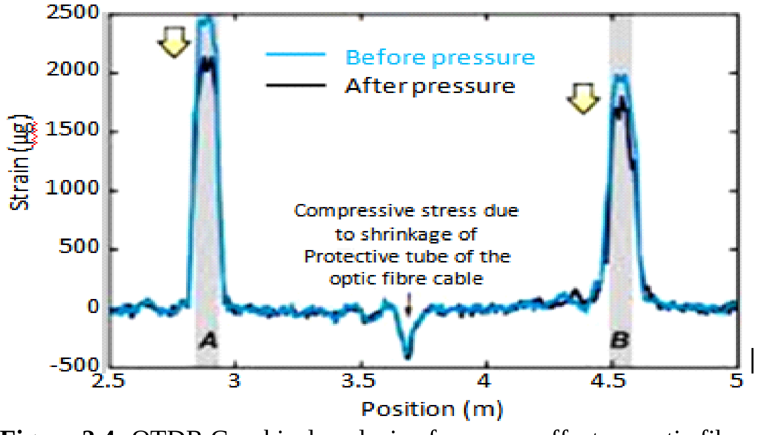

Figure 2.4: OTDR Graphical analysis of pressure effect on optic fibre

The cable was crushed between two plates while measuring optical power loss see Fig 2.6, the results of the tests were compared with the manufacturer's data sheet.

Fig 2.5: Destructive test on an Optical Fibre Cable

Optical power meter was used when testing power loss attenuation. Several weights where applied on the crushing apparatus and then the fibre tested to see the maximum weight at which no output would be received at the end point. The varying loads weights used are 500N, 1000N, 1,500, 2,000N, 2,500, and 3,000N, the cut-off point was discovered to be at 3,000N.
This confirmed that crush and impact pressure where also sources of chromatic dispersion i.e. the pulses at the affected locations experienced signal spreading such that the signals were indistinguishable at the receiver end.
Apart from the bending loss experiment using varying loads, the researcher also carried out a near destructive testing of the fibre using single mode optical pigtails.
The essence was to obtain a near sharply flat fibre and the attenuation level that could cause them. In this respect, the objective is to obtain the effect of attenuation (over the range of 3.0dB – 34.0dB) on an optical signal. Instruments used include:

- 1.1 xWavetek MTs 5100 Optical Time Domain Reflectometer (used as an optical source).
- 2.1 x Siemens optical variable attenuator with d.c. power source.
- 3.1 x Siemens optical power meter with d.c. power source.
- 4.2 x signal mode optical pigtails.

The investigation involved:

- The optical time domain reflectometer (OTDR) configured to work as an optical source.
- Using a single mode (SM) optical pigtail, and linking it up with an optical variable attenuator (OTDR output to attenuator input)
- Linking the attenuator output to the power meter input using another optical pigtail.
- Transmitting at 0.48mw of optical energy in the 1555nm wavelength with the attenuator and power meter on.
- Adjusting the value of the attenuator downwards until the received level on the display in the optical meter started changing.

III. RESULT ANALYSIS AND IMPLEMENTATION

As regards results, adequate standards and measures were used to certify potency of results. The Enugu -Onitsha fiber optics idle route and Fiber Optics Test Procedures (FOTP) documentation standards were used as reference sources to produce the desired result, a credible improvement.

Crush/impact test results

Sequel to the test of loading and results obtained from fig 2.5 the graphical effect of distance and strain in fig2.6 clearly shows the effect of pressure on optic fiber. Similarly the setup of fig 2.6 and 2.7 confirms the assumptions.

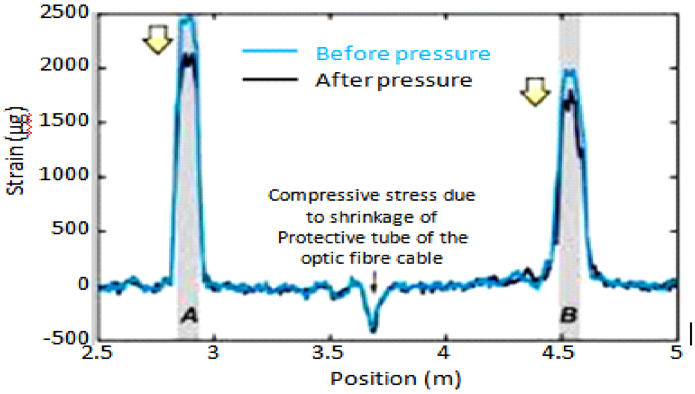

Figure 2.6: OTDR Graphical analysis of pressure effect on optic fibre

Fig 2.7 The details for the measurement of the near destructive test

This new measurement confirms that pressure has very great effect on the propagation and spreading of pulse alone the Fibre due to implementation WDM. This was discovered from crushing test carried out in Table 2.4. Essentially, the crushing test on fibre death zone included:

- Fibre – 24 core
- Length – 60 kg/km
- Max. stressed diameter - 110mm
- Crushing resistance (pressure) - 2000N

Table 2.4: Crushing Test – Maximum stressed guage and Load

Cable Weight/length kg/km	Maximum Bend Diameter (mm)	Maximum Load (N)	Crushing Load (N)
60	110	1200	2000
85	130	1800	2000
100	148	2,200	2500
130	160	2700	2800
205	200	4,000	2000

Fig 2.8: Cable length vs maximum bend diameter graph for Abuja NsaAso Drive - Nsa Zone4 route

Fig 2.9: Cable weigth/Lenght vs Maximum & Crushing Load for Abuja Nsa Aso Drive - Nsa Zone4 route

The purpose of this experiment is to monitor the effect of pressure on the optic fibre cable irrespective of cable diameter and natural aperture see table 2.5. It is established that as the pressure increases, dispersion value increases linearly as shown in Fig 2.8 and 2,9. Dispersion and Attenuation vs Crushing Load.

Table 2.5: Crushing Test – Attenuation and Dispersion

Crushing loading (N)	Attenuation dB	Dispersion dB/Km
500	0.20	16.65
1000	0.20	16.68
1500	0.21	16.72
2000	0.21	16.92
2,500	0.3	20.21
3,000	0.8	22.74

Figure 2.10: Crushing Load Vs Attenuation for Abuja NsaAso Drive - Nsa Zone4 route

Fig 2.11: Crushing Load Vs Dispersion for Abuja NsaAso Drive - Nsa Zone4 route.

From the analysis increase in crushing load is directly related to rise in dispersion as shown Fig 2.10 and 2.11. The next step was calling on the federal Ministry of Works to visit construction sites and observe the operation and construction guide lines.

2.2.1 Effect of Pressure on Power Budget Data Test Results and Analysis

These tests were used to calculate the losses along the trunk route irrespective of the topology of the route. This research work treats these trunks as bus topologies, since these were major trunk routes that carry heavy traffic. Power budget deals with power injected into the system from the input to output power together with the losses incurred from the splices, connectors, couplers etc.

Fig 2.12 Power budget test

Optical Power Level Measurement (Power Budget) Data

The optical power level as the signal transmitted over a given distance was measured see Table 2.6. To measure the optical loss, a known level of light is transmitted from the light source directly to a power meter without the system or any of its components in place. The power meter then references out this known level which becomes the reference level. Once this reference is known, the light source is then connected to the system under test and reference levels correspond to the loss of the link. In the present work the OTDR was used. As an integrating system it handled all the process (received, analyzed and sent out the result plotted) thus the reading of the power level as the signal transmitted was recorded by the OTDR automatically.

Table 2.6: Power Level as Signal is Transmitted Through the Fibre

Fibre Pair in zp(km)	**T= 0.1**	**T= 0.2**	**T= 0.3**	**T= 0.4**	**T= 0.5**	**T= 0.6**	**T= 0.7**	**T= 0.8**	**T= 0.9**
1.0	-92.30	-81.10	-68.10	-61.40	-50.90	-39.80	-31.40	-22.30	-11.20
2.0	-44.80	-43.10	-38.10	-29.10	-26.10	-21.10	-16.30	-10.90	-5.30
3.0	-31.20	-27.20	-22.20	-14.40	-17.30	-14.10	-11.10	-7.30	-3.50
4.0	-23.40	-21.10	-18.10	-11.90	-12.90	-11.20	-8.20	-5.90	-2.70
5.0	-19.50	-17.10	-14.30	-11.10	-11.10	-9.10	-6.80	-5.10	-2.10
6.0	-14.60	-14.10	-12.60	-9.20	-9.20	-6.90	-6.10	-3.60	-1.70
7.0	-13.80	-12.30	-11.10	-7.90	-8.10	-6.10	-4.90	-3.10	-1.30
8.0	-12.40	-10.10	-8.90	-7.10	-7.20	-5.30	-3.60	-2.40	-1.20
9.0	-11.40	-8.30	-7.40	-6.91	-6.80	-4.70	-3.30	-2.20	-1.10
10.0	-8.60	-8.10	-7.10	-6.30	-5.20	-4.20	-2.90	-1.90	-1.10

Zp= Fibre per Distance. T locations of testing point

Fig 2.13: Time VsZp for Abuja NsaAso Drive - Nsa Zone4 route

IV. SUMMARY OF FINDINGS

Based on the findings of the study, the researcher made the following contributions:

i) The research has shown that the pneumatic insurgence is catalytic to signal broadening in fibre optics.

ii) That adequate planning is required for its optimum performance in eliminating fibre optic attenuation and dispersion.

iii) Equally, pointed out is that beside the signal broadening, Chromatic Dispersion has limitations on other signal characteristics such as gain, bandwidth, power penalty and losses

Developing the Best Fit for Network Planning and Implementation Network Restoration/Repair
Maintenance and testing are required to provide high reliability and quick response to faults for optical fibres in access metro long-haul networks (Ihekweaba, et al, 2012). There are several ways commonly used to implement the functions listed:

- OTDR testing;
- loss testing with the measurement of the level of a specific wavelength injected into the fibre outside the wavelengths of the data signal;
- monitoring a proportion of the data signal power (power monitoring);
- Identification light detection.

The OTDR-based monitoring systems are capable of periodic measurements of the fibres' attenuation coefficient and, when integrated with transmission equipment alarms, they are capable of immediate reporting fault location data in case of cable damage.
Loss testing and power monitoring, through the continuous monitoring of a power level received at the end of the optical fibre (just before the receiving equipment), are able to collect and store power-level data and provide an immediate detection of fibre faults through the activation of an OTDR function when the monitored power decreases below a certain level.
All these systems are designed to minimize the service outages. To signal to the operator, the immediate location of failures through alarm generation and, at different degrees., Also to predict failures due to the degradation of fibre while carrying traffic due to ageing or external influence. pressure and temperature. (Ihekweaba C.2010)

In planning and installation the local authority must be consulted, especially the works department to take the route of the fibre off the shoulders of the road, as well as taking cognizance of future expansion. The trench for fiber laying must be at least 1.5meters deep with earth stry cable laid one meter from the surface, warning tape, point five meter above the earth wire. Finally cable markers placed along the route at intervals of about one hundred meters a part Fig 2.14 is typical of survey road plan from ministry of works

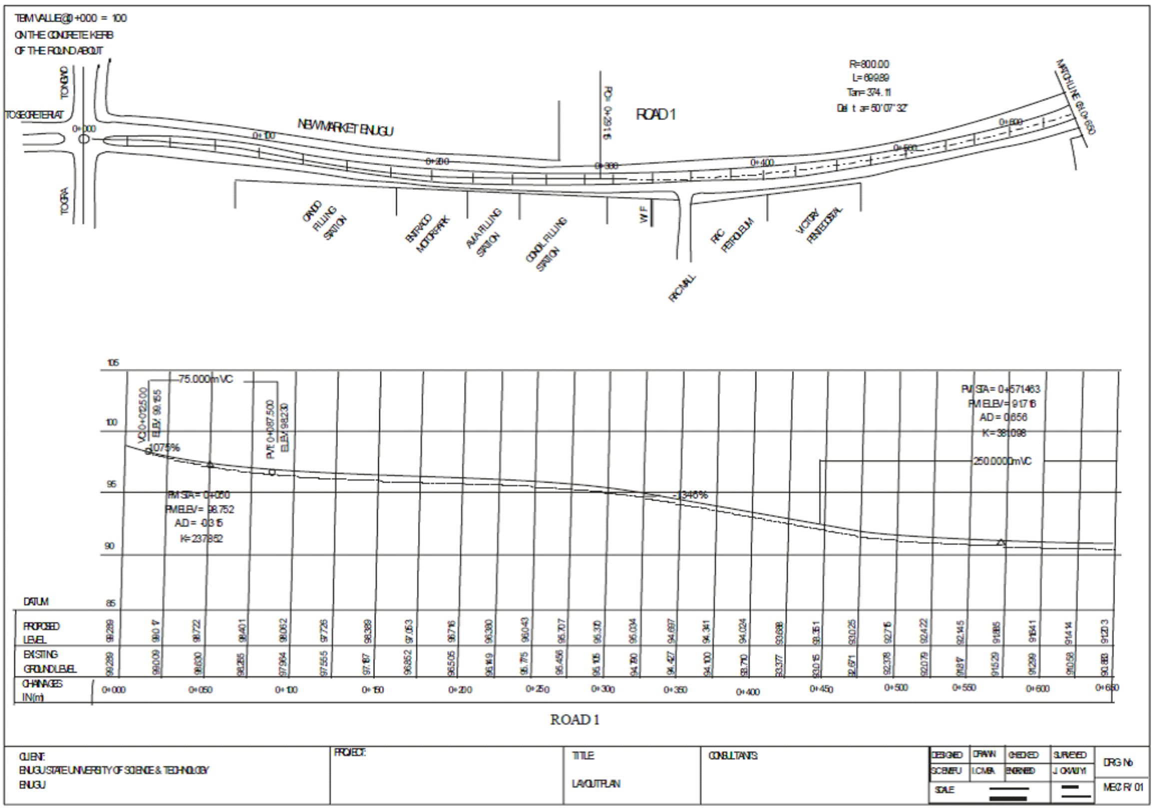

Fig 2.14 Typical planning survey for optic fibre Installation route along existing road.

It equally recommended that tractors be used for excavations of trenches along the route.

AREAS FOR FUTURE ATTENTION

The role of temperature and hydro ingress in and around optic fibre duct needs more researcher's attention. In this country the Nigerian Communication Commission has to step-up installation standards in terms of materials and qualitative man-power. There is the need to adopt share path protective system with self-healing to achieve good network system devoid of poor Grade-Of-Service (GOS)

V. CONCLUSION

The Nigerian Communications Commission and Nigerian Society of Engineers must constitute a monitoring committee to ensure that the ethic and standards are maintained during the installation of optical Fibre systems as pointed out in this work.

REFERENCES

[1]. Eke, J. (2006). *Emperical Determination of Bending Loss in Optic Fiber.* Enugu State University of Sciene and Technology.Doctorial thesis`
[2]. FOTP-526-4, T. (1995). *Optical Eye Pattern Measurement Procedure.*
[3]. Girattan, k., & Maeggitt, B. T. (1995). Optic fibre sensor technology.
[4]. Harus, A. (1986). Bend Loss Measurement. *Aparatus operation journal Vol.12*, 2506-2512.
[5]. Ihekweaba C., Onoh G. Ekeh J.N.,2012 "optical fiber installation and maintenance, best practice case study. An Anambra Nigeria fiber optical link". International computer and electronic engineer. Vol 5 No 2 (2012) Pp 137-142

Ezeagwu "Pneumatic Effect On Fibre Optic Transmission Line; Analysis And Survivability Strategy, With Bias To Nigerian Situation'." American Journal of Engineering Research (AJER), vol. 6, no. 11, 2017, pp. 258-267.