High Performance of Plastic Optical Fibers within Conventional Amplification Technique in Advanced Local Area Optical Communication Networks

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***Abstract*— Plastic optical fibers (POF) are the most promising solution for the short transmission distance range in data communication. The combine the inherent benefits of all optical fibers such as high bandwidth, total electromagnetic immunity with additionally amazing simplicity in handling. This paper has proposed the investigation of plastic optical fibers within conventional Raman amplification technique in advanced local area optical communication networks. Plastic optical fiber links are deeply studied over wide ranges of the affecting parameters. Two multiplexing methods are applied, ultra wide space division multiplexing (UW–SDM) and ultra wide wavelength division multiplexing (UW–WDM), where 4000 and 6000 channels are processed to handle the product of transmission bit rate and repeater spacing for cables of multi-links (20 to 120 links per plastic fiber cable core) with employment of transmission and conventional amplification techniques are investigated namely soliton propagation and Raman amplification techniques. The transmission bit rate and bandwidth distance product per optical channel) are treated over wide ranges of the affecting parameters.**

***Keywords*—** Plastic Fibers, Conventional Raman Amplification, Space Division Multiplexing, and Local Area Network

I. INTRODUCTION

In principle, Plastic optical fiber (POF) is similar to the standard 'glass' optical fiber (GOF) which is now in common use for data & telecommunications [1]. All optical fiber cables work by transmitting pulses of light along the length of the fiber and then reading the signal at the other end. In order to receive a good signal over a long distance the transparency of the fiber needs to be very high, which means using very pure materials and clean processes. Until recently limitations in the quality of plastic materials and processes meant that the high signal attenuation of POF restricted its use to lighting applications. However, the latest advances in technology have now proved POF capable of delivering over 10 Gbit/s for more than 100 m, which makes it a potential competitor to both copper and GOF for high data requirements in both commercial and domestic LANs and network interconnections [2]. POF are the most promising solution for the "last 100 m" in data communication. The combine the inherent benefits of all optical fibers such as high bandwidth, total electromagnetic immunity with additionally amazing simplicity in handling [3]. This is mainly due to their relatively large diameter and acceptance angle (or numerical aperture NA). In spite of the outer diameter being in the range of typically 1 mm, the fiber remains flexible because of the polymer material used, mainly acrylics like Polymethyl methyl metha acrylate (PMMA). These benefits make POF attractive for a wide variety of applications and their applications in the area of data communication. For sensor applications we refer to [4, 5]. The application of POF for data communication over short distances has a fairly long history. Well known are cables in industrial production lines where the main reason was the complete immunity to electromagnetic interferences [6]. Real progress was made in the last century, where low loss plastic materials had been developed and drawn into fibers, starting with a step-index profile, followed by first attempts to produce graded index profiles [7].

In the present study, we have managed plastic optical fibers in local area optical communication networks due to their economical and easy-manageable advantages, plastic optical fibers (POFs) are going to replace traditional communication media such as copper and glass step by step within short distance communication systems. POFs are used in various fields of optical communication, e.g. the automotive sector or in-house communication. Though single channel communication systems are state of the art technology, using of only one channel/wavelength for communication limits the bandwidth. Moreover POFs combine the advantages of an optical After the introduction of POF in car networks the use in building networks will be the next big market. Inter device data links and sensor networks communication medium with the availability of low cost components and extremely easy installation are additional applications, that is suitable for local area network applications.

II. MODELING ANALYSIS

The effective refractive index n of plastic optical fiber can be expressed in empirical equation as [8]:

$$n=\sqrt{\frac{k_1\lambda^2}{\lambda^2-k_2^2}+\frac{k_3\lambda^2}{\lambda^2-k_4^2}+\frac{k_5\lambda^2}{\lambda^2-k_6^2}}\quad, \tag{1}$$

The set of parameters of empirical equation coefficients of plastic fiber material are recast as [8]: k1=0.4963, k2= 0.0718(T/T0)2, k3=0.6965, k4=0.1174 (T/T0)2, k5=0.3223, and k6=9.237 (T/T0)2. Where T is the ambient temperature and T0 is the room temperature. Where the result of the first and second differentiation of Eq. (1) with respect to operating signal wavelength λs yields as in Ref. [8]. Therefore the total pulse broadening Δτ due to total dispersion coefficient in system can be expressed as:

$$\Delta\tau = D_t\,\Delta\lambda\,L_m \quad , n\sec \tag{2}$$

Where the total dispersion coefficient (nsec/nm.km) in the system is given by:

$$D_t = \left(M_{md} + P\right) \quad , \tag{3}$$

In which both material and profile dispersions were taken into account as Mmd and P respectively [9]:

$$M_{md} = \left(-\frac{\lambda^3}{c}\left(\frac{dn}{d\lambda}\right)^2 - \frac{2\lambda}{c}\left(\frac{d^2n}{d\lambda^2}\right)(N_1\Delta n)C_1\left(\frac{2\alpha}{\alpha+2}\right)\right)^{0.5} \tag{4}$$

$$P = \left(\left(\frac{N_1\Delta n}{c\lambda}\right)^2\left(\frac{\alpha-2-\varepsilon}{\alpha+2}\right)^2 \times \frac{2\alpha}{3\alpha+2}\right)^{1/2} \tag{5}$$

Where N_1 is the group index for the mode which is given by:

$$N_1 = n - \lambda\frac{dn}{d\lambda} \quad , \tag{6}$$

Where C_1 is a constant related to index exponent and profile dispersion and is given by:

$$C_1 = \frac{\alpha-2-\varepsilon}{\alpha+2} \quad , \tag{7}$$

Where α is the index exponent, and ε is the profile dispersion parameter and is given by:

$$\varepsilon = -\frac{2n}{N_1}\frac{\lambda}{\Delta n} \quad , \tag{8}$$

Δn is the relative refractive index difference and is defined:

$$\Delta n = \frac{n - n_{clad}}{n} \quad , \tag{9}$$

The idea of soliton transmission is to guide the nonlinearity to the desired direction and use it for our benefit. When soliton pulses are used as an information carrier, the effects of dispersion and nonlinearity balance each other and thus don't degrade the signal quality with the propagation distance. Moreover, because of the high quality of the pulses and return-to-zero (RZ) nature of the data the soliton data is suitable for all-optical processing. Dispersion on one hand and non linearity of the refractive-index on the other hand produce infinitesimal modulation angles which exactly compensate reciprocally. In the sense that their sum is an irrelevant constant phase shift. Under such conditions the pulse shape is the same everywhere. All this provided that a soliton waveform be used with a peak power [10]:

$$P_0 = \frac{\lambda_s^3\,D_t\,A_{eff}}{12.7\,c\,n_{nl}\,\Delta\tau^2} \quad , \tag{10}$$

Where nnl is the nonlinear Kerr coefficient, 2.6 x 10-20 m2/Watt, λ is the operating signal wavelength in μm, P0 is the soliton peak power in watt, Aeff is the effective area of the plastic fiber in μm2, c is the velocity of light (3x108 m/sec). Then the total pulse broadening can be expressed in another form from the above equation as the following:

$$\Delta\tau = \sqrt{\frac{\lambda^3\,D_t\,A_{eff}}{12.7\,P_0\,n_{nl}\,c}} \quad , n\sec \tag{11}$$

Then the Soliton bit rate per channel is given by [11]:

$$B_r = \frac{1}{10\,\Delta\tau} = \frac{0.1}{\Delta\tau}\,,\; Gbit/\sec/channel \tag{12}$$

III. AVERAGE REPEATER SPACING MODEL

Plastic, as all organic materials, absorb light in the ultraviolet spectrum region .The mechanism for the absorption depends on the electronic transitions between energy levels in molecular bonds of the material.Generally the electronic transition absorption peaks appear at wavelengths in the ultraviolet region, and their absorption tails have an influence on the POF transmission loss.According to urbach's rule, the attenuation coefficient αe due to electronic transitions in plastic material is given by [12]. In addition, there is another type of intrinsic loss, caused by fluctuations in the density, orientation, and composition of the material, which is known as Rayleigh scattering.. This phenomenon that gives rise to scattering coefficient αR that is inversely proportional to the fourth power of the wavelength, i.e., the shorter is λ the higher the losses are. In the same way, the estimated total loss coefficient factors for plastic optical fibers (POFs) as:

$$\alpha_{total}\left(PMMA\right) = 1.10\times10^{-5}\exp\left(\frac{8}{\lambda}\right) + 13\left(\frac{0.633}{\lambda}\right)^4,\; dB/km \tag{13}$$

Where λ is the operating signal wavelength of the plastic material in μm. The Raman gain coefficient for plastic fibers link can be expressed as:

$$g = \frac{B\,\Gamma\,\upsilon_s}{\left(\upsilon_p - \upsilon_s\right)n_s\,\Delta\upsilon_N} \tag{14}$$

Where υs is the stokes frequency in Hz, υp is the pump frequency in Hz, $\Delta\upsilon_N$ is the half width of maximum intensity in Hz, and ns is the refractive index of the plastic material. Where B is a constant and is equal to 3.0776 x 10-4 and Γ can be expressed as a function of T as follows:

$$\Gamma = 0.15905 - 0.48102\times10^{-3}\,T - 0.15606\times10^{-6}\,T^2 \tag{15}$$

In the fiber link media, the interaction between the pump and stokes waves should be considered. The interaction ruled by the following set of two coupled equations [13] .

$$\frac{dP_P}{dZ} = -\alpha_p P_P - \frac{\omega_P}{\omega_S}\frac{g}{A}P_P P_S \quad , \tag{16}$$

$$\frac{dP_S}{dZ} = -\alpha_S P_S + \frac{g}{A}P_P P_S \quad . \tag{17}$$

Where αs is the absorption coefficient representing fiber loss at stokes frequency in dB/km, αp is the absorption coefficient representing fiber loss at pump frequency in dB/km , and A is the effective POF core area in μm2. Eqns. (16) and (17) can be solved by numerical method .To evaluate the Raman threshold in POF, the pump detection can be neglected. For step index (SI) POF and grade index (GI) POF , the deduced equations become that [13]:

$$A^S = \frac{6.28\,a^2}{\ln\left(2\,a\,\Delta n^2\,k_0^2\right)} \quad (SI) \quad , \tag{18}$$

Where a is the plastic fiber core radius in μm, n is the refractive index of plastic core fiber, and k0 is the vacuum wave number in m-1, and is defined by :

$$k_0 = \frac{2\pi}{\lambda_0} \quad , \tag{19}$$

Equations (16) and (17) can be solved by mathematical method to evaluate repeater spacing as [14]:

$$P_{si}(Z)=\frac{\left(C\sum_{i=1}^{N}\frac{\lambda_R}{\lambda_s}\right)e^{-\alpha_s Z/4.343}}{1+\left[\frac{C}{U_0}\sum_{i=1}^{N}\frac{\lambda_R}{\lambda_s}-1\right]e^{-\frac{4.343\,A\,C}{\alpha_R}\left(1-e^{-\alpha_R Z/4.343}\right)}} \qquad (20)$$

Where C is a constant and is found from the initial conditions, and is equal to:

$$C=W+\sum_{i=1}^{N}U_s\frac{\lambda_s}{\lambda_R} \qquad (21)$$

Where Psi (z) is the optical signal power at distance Z, λR is the pumping (Raman) signal wavelength in μm, λs is the optical signal wavelength in μm, αR is the Raman spectral losses in dB/km, αs is the signal spectral losses in dB/km, U0 is the output signal power in Watt, Z is the repeater spacing in km, and A is the effective POF core area in μm2 [15].

IV. SIMULATION RESULTS AND DISCUSSIONS

At the set of controlling parameters {operating optical signal wavelength λ_s, number of channels N_{ch}, number of links N_L}, the performance of plastic optical fibers in advanced local area optical communication network is processed based on the soliton product: transmission bit-rate x average repeater spacing, i.e,

$$P_r = B_r \times Z \qquad (22)$$

The assumed parameters ranges of operation are: 1.45 ≤ operating signal wavelength, λ_s, μm ≤ 1.65, Spectral linewidth of the optical source, $\Delta\lambda_s$=0.2 μm, Number of transmitted channels, N_{ch} =4000 and 6000 channels, Number of links in the fiber cable core, N_L = 40 –240 links, Plastic fiber radius, a =50 μm, Raman pumping power, P_R=2 Watt. Based on specially designed software, the variations of the following effects: (Soliton product/channel, average repeater spacing of plastic optical fibers, Soliton transmitted bit rate/channel) against the variations of the following conditions: {optical signal wavelength λ_s, total number of transmitted channels N_{ch}, number of links in the fiber cable core N_L}, thses variations are deeply investigations for the Soliton transmission technique. We have investigated the basic soliton transmission technique to transmit 4000 and 6000 channels based on ultra wide wavelength division multiplexing (UW-WDM), in the interval of 1.45 up to 1.65 μm wavelengths. For the reality from the points of view of the spectral dependences of the different fiber characteristics [14-16], we have employed also the ultra wide space division multiplexing (UW-SDM) where 4000-6000 channels are divided into subgroups each subgroup has its own spectral characteristics. With total number of links, N_L= {20, 21, 22,…. 50, 51, 52, … 90, 91, 92,………………….120} Links. With JS={1, 2, 3, 4, 5,………........………N_L}.

Where: $\Delta\lambda_L = \Delta\lambda_s / N_L \equiv Link\ spacing$ (23)

$$\delta\lambda_s = \Delta\lambda_s / (N_{ch}\,.\,N_L) = \Delta\lambda_L / N_{ch} \qquad (24)$$

Where N_{ch} is the number of transmitted channels per optical link, N_L is the total number of optical links per plastic fiber cable core, and $\Delta\lambda_s = \lambda_f - \lambda_i$ = 1.65 – 1.45 = 0.2 μm.

$$\lambda_s(initial)/\,link = 1.45 + (JS-1)\delta\lambda_s \qquad (25)$$

Also, the number of transmitted channels per optical link can be expressed as:

$$\Delta N_{ch} = N_{ch} / N_L \qquad (26)$$

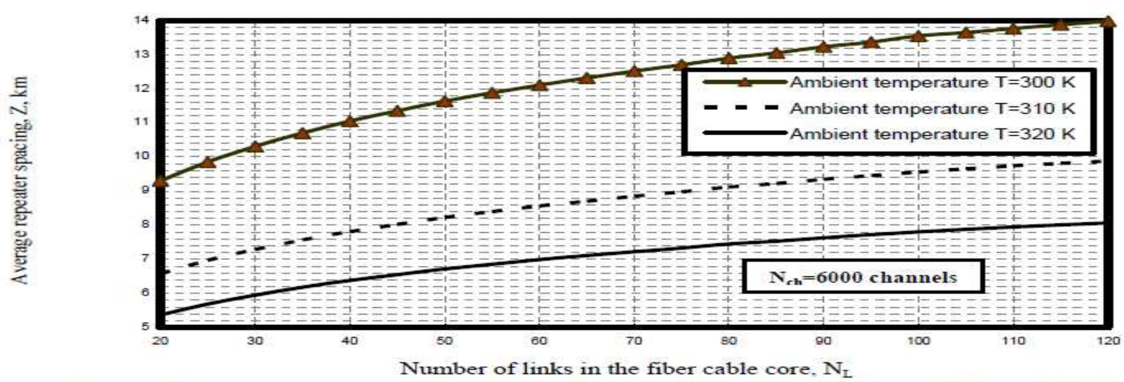

Fig. 1. Variations of repeater spacing versus number of links in the fiber cable core at the assumed set of parameters.

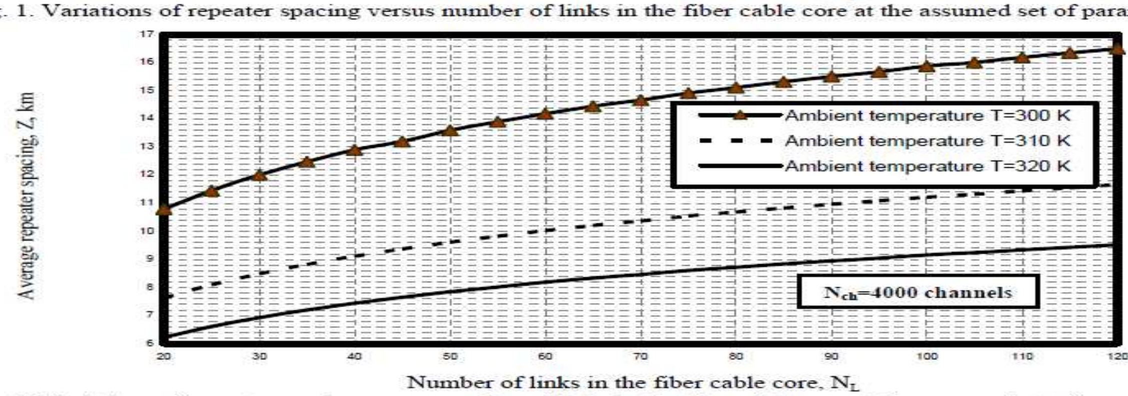

Fig. 2. Variations of repeater spacing versus number of links in the fiber cable core at the assumed set of parameters.

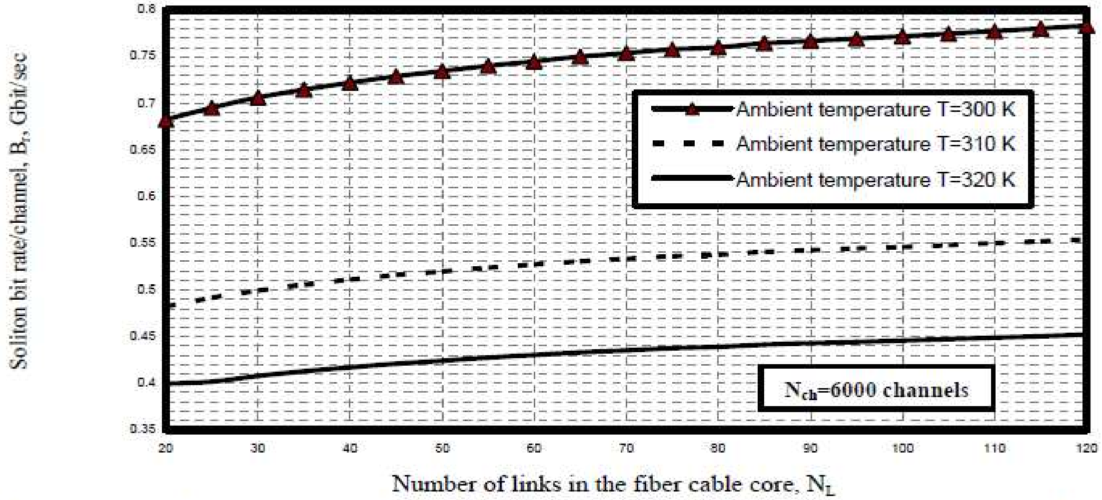

Fig. 3. Variations of soliton transmission bit rate against number of links in the fiber cable core at the assumed set of parameters.

Based on the clarified variations of the parameters in the series of Figs. (1–13), the following facts are assured:

i) As shown in Figs. (1, 2) have assured that as the number of links in the fiber cable core increases, this leads to increase in average repeater spacing at constant ambient temperature. As well as ambient temperature increases, this results in decreasing average repeater spacing at constant number of links for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in average repeater spacing at the same operating conditions of both number of links and ambient temperature.

ii) Figs. (3, 4) have demonstrated that as the number of links in the fiber cable core increases, this leads to increase in soliton transmission bit rate per channel at constant ambient temperature. As well as ambient temperature increases, this results in decreasing soliton bit rate per channel at constant number of links for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in soliton bit rate per channel at the same operating conditions of both number of links and ambient temperature.

iii) As shown in Figs. (5, 6) have demonstrated that as the number of links in the fiber cable core increases, this leads to increase in soliton product per channel at constant ambient temperature. As well as ambient temperature increases, this results in decreasing soliton product per channel at constant number of links for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in soliton product per channel at the same operating conditions of both number of links and ambient temperature.

iv) Figs. (7, 8) have demonstrated that as the number of links in the fiber cable core increases, this leads to increase in soliton transmission bit rate per channel at constant relative refractive index difference. As well as relative refractive index difference increases, this results in decreasing soliton bit rate per channel at constant number of links for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in soliton bit rate per channel at the same operating conditions of both number of links and relative refractive index difference.

v) As shown in Figs. (9, 10) have demonstrated that as the number of links in the fiber cable core increases, this leads to increase in soliton product per channel at constant relative refractive index difference. As well as relative refractive index difference increases, this results in decreasing soliton product per channel at constant number of links for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in soliton product per channel at the same operating conditions of both number of links and relative refractive index difference.

vi) Figs. (11, 12) have assured that as number of links in the fiber cable core increases, this leads to increase in both average repeater spacing and soliton product per channel with amplification compared to its values without amplification.

vii) As shown in Fig. 13 has indicated that optical signal power decreases within increasing transmission distance, with amplification, the optical signal power is increased compared to its values without amplification.

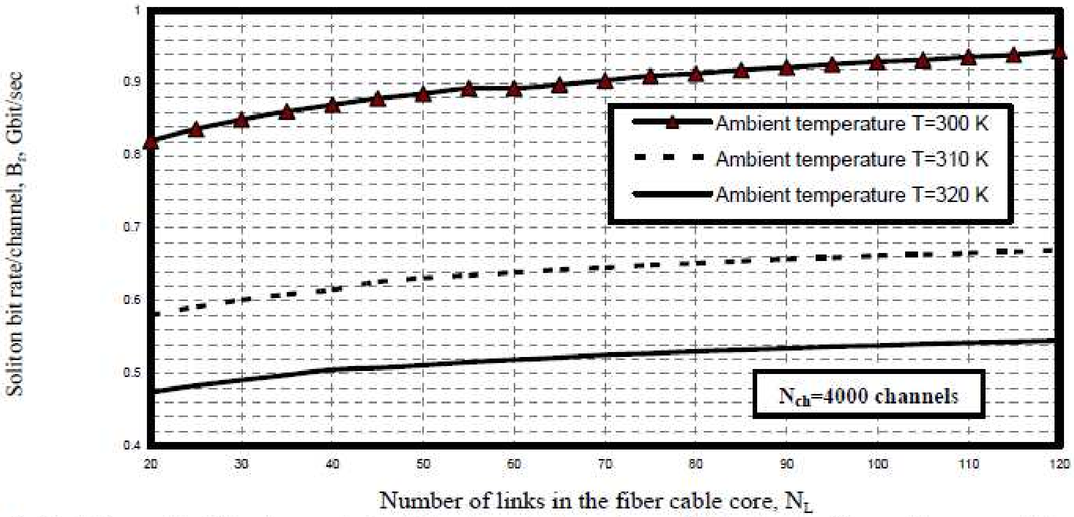

Fig. 4. Variations of soliton transmission bit rate against number of links in the fiber cable core at the assumed set of parameters.

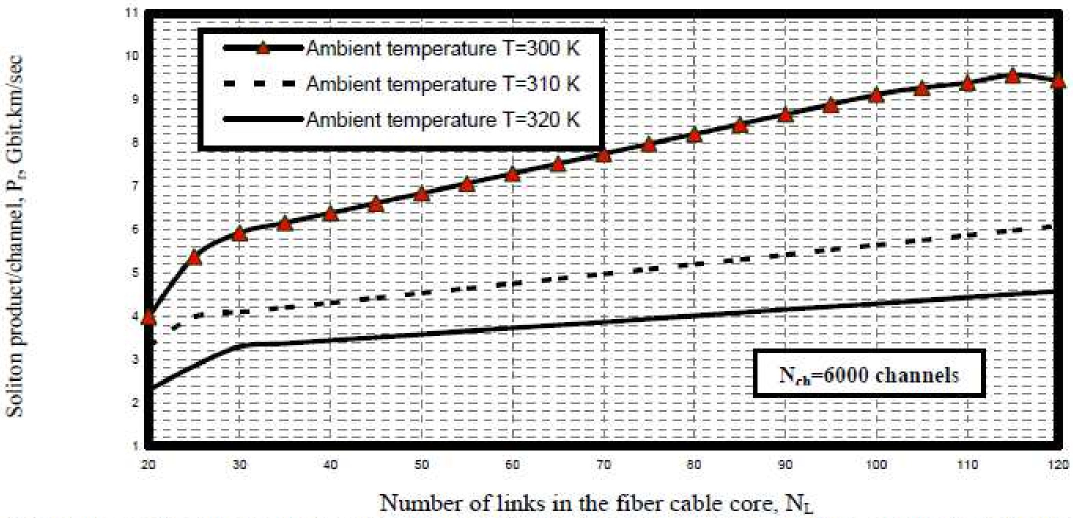

Fig. 5. Variations of soliton product against number of links in the fiber cable core at the assumed set of parameters.

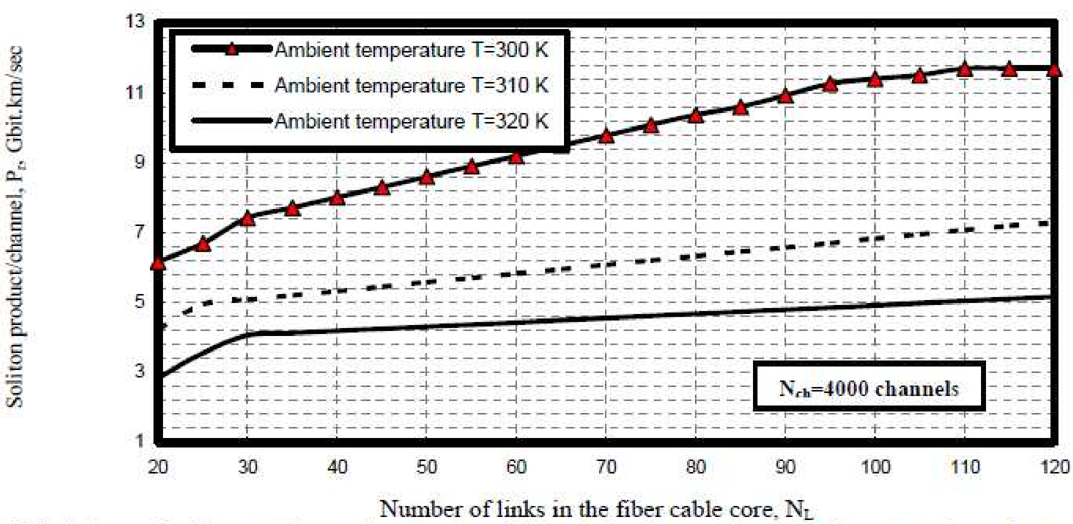

Fig. 6. Variations of soliton product against number of links in the fiber cable core at the assumed set of parameters.

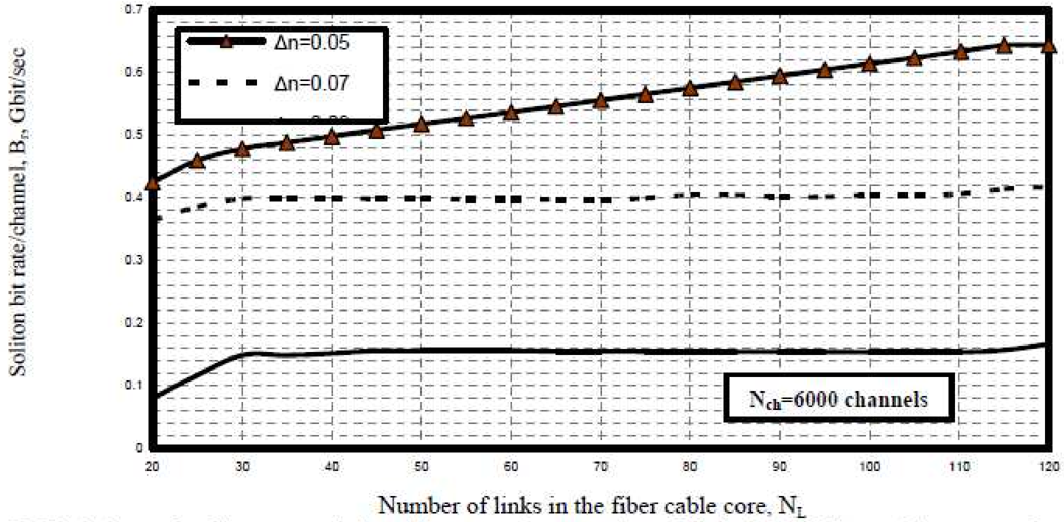

Fig. 7. Variations of soliton transmission bit rate against number of links in the fiber cable core at the assumed set of parameters.

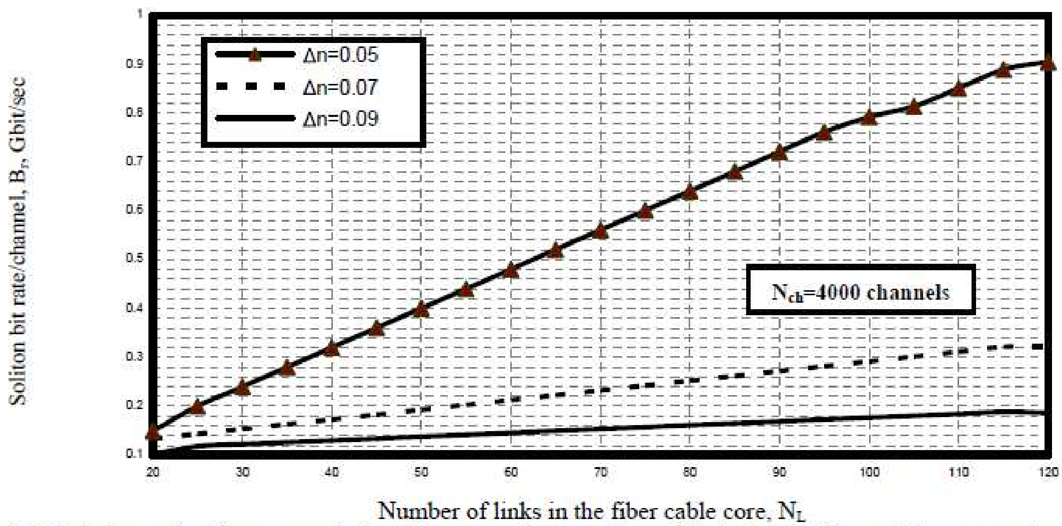

Fig. 8. Variations of soliton transmission bit rate against number of links in the fiber cable core at the assumed set of parameters.

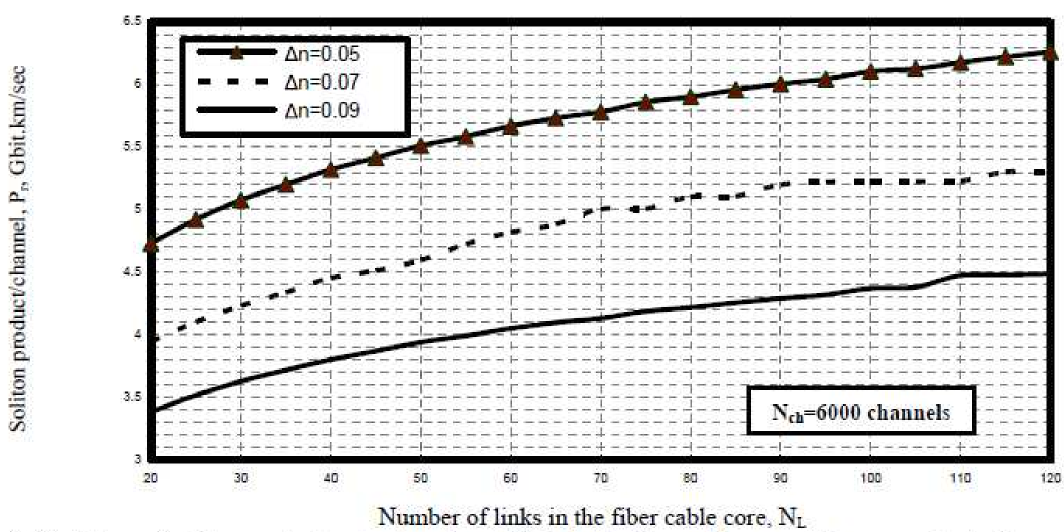

Fig. 9. Variations of soliton product against number of links in the fiber cable core at the assumed set of parameters.

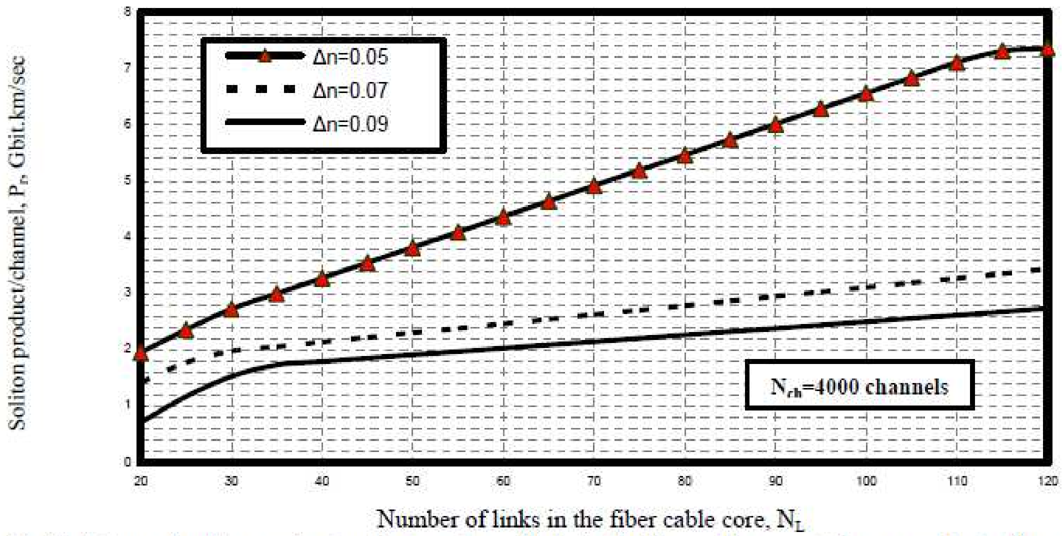

Fig. 10. Variations of soliton product against number of links in the fiber cable core at the assumed set of parameters.

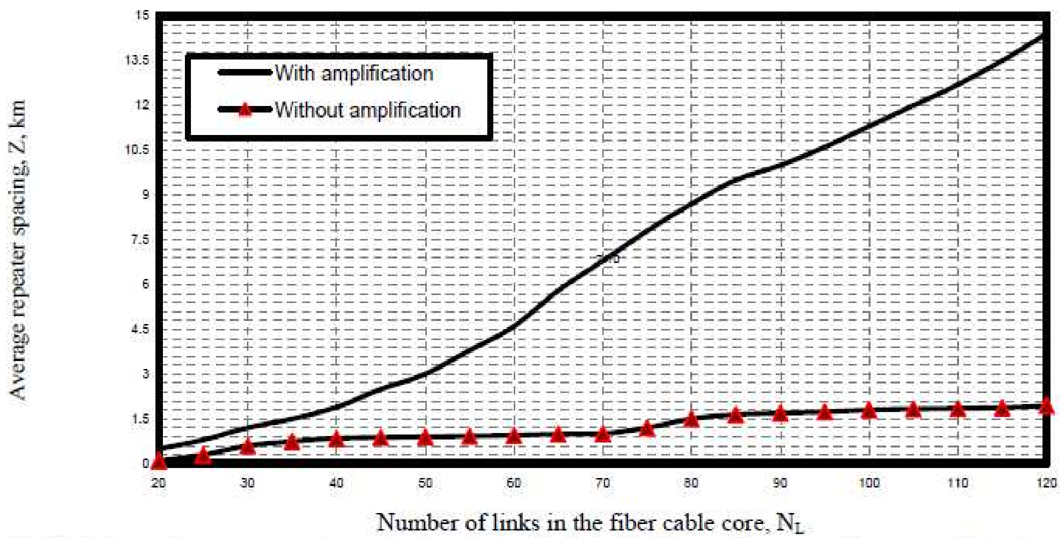

Fig. 11. Variations of repeater spacing against number of links in the fiber cable core at the assumed set of parameters.

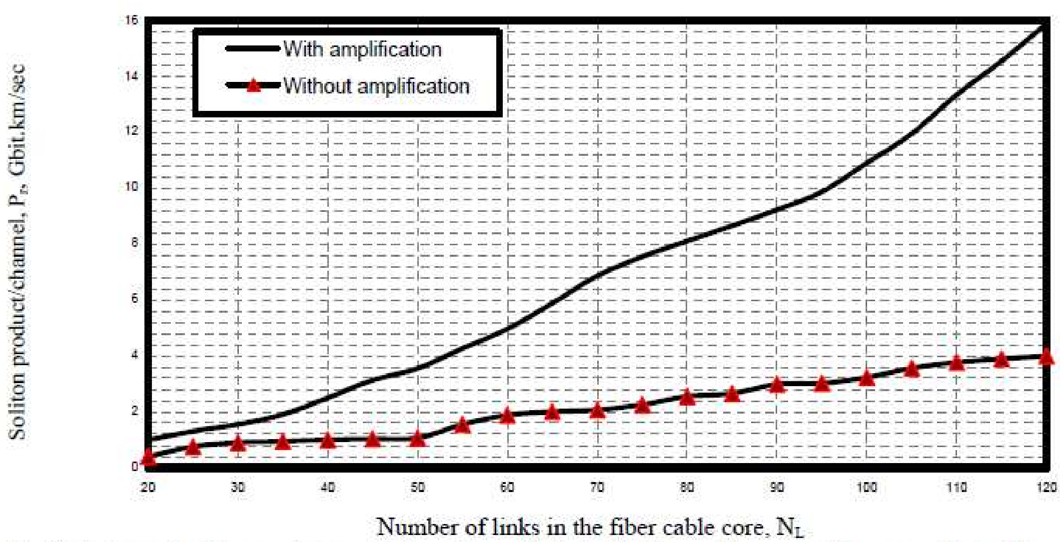

Fig. 12. Variations of soliton product against number of links in the fiber cable core at the assumed set of parameters.

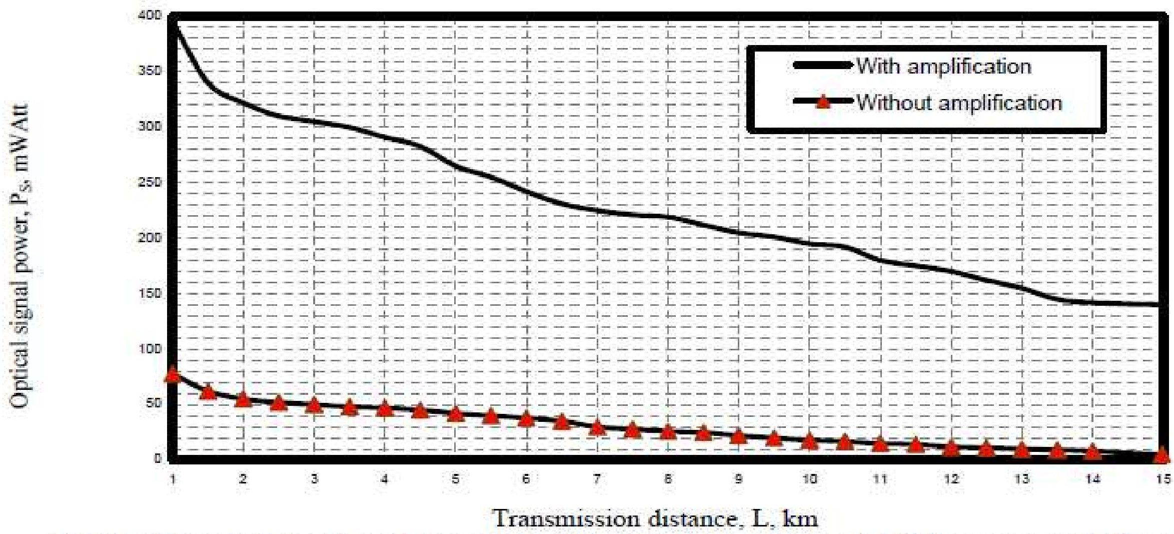

Fig. 13. Variations of optical signal power against average repeater spacing at the assumed set of parameters.

V. CONCLUSIONS

In a summary, we have processed soliton transmission technique to handle the soliton product, soliton transmission bit rate, and Raman amplified repeater spacing in plastic optical fibers under two multiplexing configurations (UW-WDM+UW-SDM). It is observed that the increased number of links in the fiber cable core, the increased average repeater spacing, soliton transmission bit rate and product per transmitted channel. As well as the decreased of both ambient temperature, T and relative refractive index difference, Δn, the increased soliton transmission bit rate and product per channel for different number of transmitted channels. Moreover as the number of transmitted channels increases, this leads to decrease in soliton transmission bit rate and product per channel at the same operating conditions of number of links, relative refractive index difference, Δn and ambient temperature, T. We can conclude that within conventional Raman amplification in plastic fiber media link, the higher optical signal power, average repeater spacing, soliton bit rate and product per channel that is suitable for maximum transmission distance in Local area optical communication networks.

REFERENCES

[1] A.M.J. Koonen, H.P.A. van den Boom, A. Ng'oma, M. Garcia Larrode, J. Zeng, G.D. Khoe, "POF Application in Home Systems and Local Systems", Proc. POF 2005, Hong Kong, Sep. 19-22, pp. 165-168, 2005.

a. M. J. Koonen, X. Li, J. Zeng, H.P.A. van den Boom, "High Capacity Data Transport over Plastic Optical Fiber Links Using Quadrature Modulation", Proc. ICAT 2006, Cambridge (UK), June 21-22, pp. 69-72, 2006.

[2] D. Càrdenas, A. Nespola, R. Gaudino, S. Abrate, C. Lezzi, "FTTH in Italy: the Fast Web Access Infrastructure and Its Possible Evolution With New PMMA-SI-POF Media Converters", IEE Conference on Access Technologies, 21-22 June 2006, Abington Hall, Cambridge, UK.

[3] O. Ziemann. H. Poisel: "Short Distance Optical Connections for Home Networks, Sensing and Mobile Systems", OFC, Anaheim USA, Invited paper, 2007.

[4] S. C. J. Lee, A. M. J. Koonen, S. Randel, J. Vinogradov, O. Ziemann, B. Offenbeck: "10 Gbit/s over Large Diameter

[5] Polymer Optical Fibers using Discrete Multitone Modulation", POF'2007, Torino, pp. 71-74, 2007.

[6] S. Schöllmann, C. Wree, A. Joshi, W. Rosenkranz: "First Experimental Transmission over 50 m GI-POF at 40 Gb/s for Variable Launching", ECOC'2007, Berlin.

[7] F. Breyer, S. C .J. Lee, S. Randel, N. Hanik, "1.25 Gbit/s Transmission over up to 100 m Standard 1 mm Step-Index Polymer Optical Fiber using FFE or DFE Equalisation Schemes", ECOC 2007, Berlin.

[8] Abd El-Naser A. Mohammed, Abd El-Fattah A. Saad, and Ahmed Nabih Zaki Rashed, "Applications of Arrayed Waveguide Grating (AWG) in Passive Optical Networks," IJFGCN International Journal of Future Generation Communication and Networking, Vol. 2, No. 2, pp. 25-36, June 2009.

[9] Farag Z. El-Halafawy, Abd Elnaser A. Mohamed, Abd Elfattah A. Saad, and Ahmed Nabih Zaki Rashed, "Performance of Polymer and Germania Doped Silica Optical Fibers in Advanced Communication Systems", Menoufia Journal of Electronic Engineering Research MJEER, Vol. 15, No. 2, pp. 99-112, July 2005.

[10] B. Biswas, and S. Konar, "Soliton To Solitons Interaction With Kerr Law Non Linearity," Journal of Electromagnetic Waves and Applications, Vol. 19, No. 11, pp. 1443–1453, 2005.

[11] S. Sawetans, and S. Konar, "Propagation of a mixture of Modes of Laser Beam in A medium With Securable Nonlinearity," Journal of Electromagnetic Waves and Applications, Vol. 20, No. 1, pp. 65–77, 2006.

[12] J. T. Ahn, S. Park, J. Y. Do, J.-M. Lee, M.-H. Lee, and K. H. Kim, "Polymer Wavelength Channel Selector Composed of Electrooptic Polymer Switch Array and the Two Polymer Arrayed Waveguide Gratings," IEEE Photon. Technol. Lett., Vol. 16, No. 6, pp. 1567–1569, Jun. 2004.

[13] S. Alabady, O. Yousif, "Design and Simulation of an Optical Gigabit Ethernet Network," Al-Rafidain Engineering, Vol. 18, No. 3, pp. 46-61, June 2010.

[14] Abd El-Naser A. Mohammed, Abd El-Fattah A. Saad, and Ahmed Nabih Zaki Rashed, "High Channel Arrayed Waveguide Grating (AWG) in Wavelength Division Multiplexing Passive Optical Networks (WDM-PONs),"

IJCSNS International Journal of Computer Science and Network Security, Vol. 9, No. 1, pp. 253-259, Jan. 2009.

[15] Abd El-Naser A. Mohammed, Abd El-Fattah A. Saad, and Ahmed Nabih Zaki Rashed and Mahomud M. Eid, "Characteristics of Multi-Pumped Raman Amplifiers in Dense Wavelength Division Multiplexing (DWDM) Optical Access Networks," IJCSNS International Journal of Computer Science and Network Security, Vol. 9, No. 2, pp. 277-284, Feb. 2009.

[16] D. Janner, M. Belmonte, and V. Pruneri, "Tailoring the Electrooptic Response and Improving the performance of Integrated LiNbO3 Modulators by Domain Engineering," Journal of Lightwave Technology, Vol. 25, No. 9, pp. 2402–2409, 2007.

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