

Sudan University of Science and Technology (SUST)

College of Graduate studies

**Performance Evaluation of Optical Networks
Using Erbium Doped Fiber Amplifier**

**تقييم أداء شبكات الألياف الضوئية باستخدام المكبر الضوئي خليط
أربيوم**

**A Thesis Submitted in Partial Fulfillment of the Requirement
for the Degree of Master of Science in Electronics Engineering
(Communication Engineering)**

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Dedications

This project is dedicated to my parents who have been a constant source of support and encouragement during the challenges of life since day one , I would never forget how they always loved me unconditionally and taught me that even the largest task can be accomplished if it is done one step at a time specialization my mother AMEERA HALAL .

I also like to dedicate this project to all my family for their support with Allah's blessing to achieve my goal specialization my sister AZZA ,and my brother MOHAMMED (WGEE) .

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Abstract

Fiber optic in communications today is one of the most important cables to use for sending and receiving data and is used for protection and safety and also for long distance transmission and high speed .

Some of the factors that limit the use of optical fibers, for example, are the loss problems, the weakness of the data being transmitted within the optical fiber cable. These problems affect the reception of data clearly, which increases the length of the fiber optic cable. There are some ways to compensate for this loss, which occurs in the data when sent in cables, including the use of amplifiers. The use of optical amplifier Erbium dope fiber amplifier between transmitter and receiver is one of the most effective ways to compensate for data loss.

In this research, the optical amplifier was used to solve the problem by placing it in different places and then comparing the data obtained in all cases to know the importance of using optical amplifier .The search also includes the number of optical amplifiers that are determined according to the length of optical fiber cables. The greater the distance, the greater the number of amplifiers used. Therefore, the standard was two cases of transmission at 80 kilometers and 120 kilometers transmission .

Opti System was used to analyze through eye diagram, bit error rate, quality factor, and height eye

The results showed that the optical amplifier (Erbium doped fiber amplifier) showed better results than the transmitter in fiber optic cables without the optical amplifier .

المستخلص

أصبحت الألياف الضوئية في مجال الاتصالات اليوم من أهم وأكثر الكابلات استخداماً لإرسال واستقبال البيانات لتمتعها بالحماية والأمان وبالأضافة للإرسال لمسافات طويلة وبسرعة عالية رغم المميزات الكثيرة التي تتمتع بها الألياف الضوئية إلا أن هنالك بعض العوامل التي تحد من استخدام الألياف الضوئية منها الفقد الذي يحدث للبيانات أثناء إرسالها داخل كابل الليف الضوئي وتؤثر هذه المشكلة في استقبال البيانات بصورة واضحة حيث تزيد بزيادة طول كابل الليف الضوئي ، هناك بعض الوسائل لتعويض هذا الفقد الذي يحدث في البيانات عندما ترسل في كابلات ومنها استخدام المكبرات ويعتبر استخدام المكبر الضوئي خليطاً أريبوم بين المرسل والمستقبل من أكثر الطرق الفعالية في تعويض الفقد في البيانات ، وفي هذا البحث تم استخدام المكبر الضوئي لحل المشكلة وذلك بوضعه في أماكن مختلفة وهي بوضعه قبل كابل الليف الضوئي ووضعه بعد كابل واخيراً وضعه بين كابل الليف الضوئي ثم المقارنه بين البيانات المستقبلة في جميع الحالات لمعرفة تأثير استخدام المكبر الضوئي على حسب موضعه في الشبكة وايضا شمل البحث عدد المكبرات الضوئية التي تحدد على حسب طول كابلات الألياف الضوئية كلما زادت المسافة زاد عدد المكبرات المستخدمه لذلك كان المعيار في حالتين حاله الإرسال في مسافه 80 كلم ثم الإرسال في مسافه 120 كلم والمقارنه بين معارين الإرسال والاستقبال ، وتم استخدام برنامج أوبيتي سيستم لتحليل من خلال شكل العين ، أقل معدل للأخطاء ، عامل الجوده ، وارتفاع العين ، وظهرت النتائج استخدم المكبر الضوئي خليط الأريبوم في الشبكة الضوئية يعطي نتائج أفضل من الإرسال في كابلات الألياف الضوئية بدون استخدامه.

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LIST OF ABBREVIATIONS

APD	Valance Photodiodes Detector
AR	Antireflection
ASE	Amplified Spontaneous Emission
BER	Bit Error Rate
CATV	Cable Television
CDM	Code Division Multiplexer
CW	Continues Laser
EDFA	Erbium Doped Fiber Amplifier
GUI	Graphical User Interface
ILD	Injection Laser Diode
LAN	Local Area Network
LED	Light Emitting Diode
MAN	Metropolitan Area Network
MMF	Multi Mode Fiber
NRZ	Non Return to Zero
OSD	Sample Optical Design
PD	Photo Detector
P_{in}	Power Input
PON	Passive Optical Networks

Pout	Power Output
PRMS	Pseudo Random Binary Sequence
Q-factor	Quality Factor
RZ	Return to Zero
SLAs	Semiconductor Laser Amplifiers
SMF	Single Mode Fiber
SNR	Signal Noise Ratio
SOAs	Semiconductor Optical Amplifiers
TDM	Time Division Multiplexer
WDM	Wavelength Division Multiplex

LIST of Symbols

L	Length
LOSS _{Actu}	Actual loss
LOSS _{accep}	Acceptable loss
N	Number
G	Gain
P _{in}	Power Input
P _{out}	Power Output
λ	Wavelength
ΔE	The difference in energy levels
h	The Planck's constant.
N	Number of Amplifier
G	Gain
C	Velocity
F _n	Figure noise

