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The Best Multiplexing and Demultiplexing For Single and Multimode Fiber Optics

Eng.Anwar Ahmad
Transmission Department ,The Higher Institute Of Telecommunication And Navigation, Jamal Abdulnaser Street ,Kuwait .

ABSTRACT
Data Traffic Has Increased In Communication Over The Past Couple Of Years By A Hundred Percent, And It Is Expected To Riseby 50 Times In The Next Five Years (Metcalfe & Boggs 1976).Researchers Have Established That To Counter Data Traffic In Communication, Multiplexing And Demultiplexing Have To Be Adopted To Increase Information Transfer Between Users.Also,They Have Discovered That Fiber Optics Have A Great Potential For Reducing The Cost Of Per Bit Transmitted By 40% (Areal,2012).Over The Recent Decade,Fiber Optics Has Increasingly Become The Most Preferred Mode Of Transferring Communication Over Short Distances Due To Its Fastness And Effectiveness. Researchers Have Found Out More Cost-Effective And Efficient Ways Of Increasing The Data Carriage Capacity From A Single Mode Fiberoptic To Multimode Fiber Optic. In This Study, The Researcher Explored The Best Methods Of Multiplexing And Demultiplexing Single And Multimode Fiberoptics. From These Best Methods, The Research Identified The Most Effective And Suggested Them Based On The Cost Effectiveness As Well As The Fastness Used In The Transmission Of Information. This Research Also Gave Potential Multiplexing And Demultiplexing Techniques To Be Used In Future Putting Into Consideration Their Advantages As Well As Their Disadvantages.

Keywords-Demultiplexing,Information Processing, Multiplexing, Single And Multimode Fiber Optics

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I. INTRODUCTION

In Digital Communication, Multiplexing Is A System Thatallows The Interlinking Of Many Data Users Through A Single Optical Fiber Because Itsaves Time And Cost. On The Other Hand, Demultiplexing In Fiber Optic Arises Where Multiple But Unrelated Signal Streams Are Combined Into One Signal Via The Same Medium. Multiplexing And Demultiplexing Methods Are Used To Enhance Transmission Of Information Capacity Over Optical Fiber Transmission (Ruffato, Massari, Parisi&Romanato 2017).

This Research Paper Will Study On The Best Multiplexing And Demultiplex For Single Fiberoptics. Forinformation To Be Transmitted From One Medium To The Other, A Faster Communication Tool Must Be Used. Therefore, Optical Communication Systems Are Used To Carry High Frequencies Since They Travel At A Rate Of 100 Thz. In This Regard, Fiber Optic Communication Is Used Since It Uses Fiberoptical Fibers To Transfer Information (Agrawal, 2012).Several Innovations Have Spurred Growth In The Transmission Of Data For Single And Multimode Fiberoptics. Theseinnovationsinclude; Wavelength Division Multiplexing, Optimal Time Division Multiplexing And Space Division Multiplexing. This Research Will Also Look At Demultiplexing For Single And Multimode Fiberoptics.

The Purpose Of This Study Is To Find Alternate And Cost-Effective Ways Of Information Transmission Through Fiberoptics. Due To The Increase Of Data, Faster And Effective Ways Are Needed For Easy And Less Costly Transfer Of Information. Hence, This Research Will Have A Positive Significant Influence In The Information Technology Sector As Well As Other Industries.

This Research Will Also Contribute In The Reduction Of Power Which Results From Internet Usage. A Study Conducted By Gombiner Reveals That The Internet Remits More Than 2% Of The Carbon Dioxide Emissions($C0_2$) Which Is Emitted By A Human Being(Gombiner, 2011).This,Therefore,Shows That The Internet Has Had A Negative Impact On The Emission Of Carbon Dioxide. To Combat This, Technology Must Be Enhanced So That The Bit Rate Can Be Increased And Information Processing Time Will Be Reduced Thus Enhancing Efficiency As Well As Saving On Energy Costs. Therefore, This Research Will Not Only Benefit The Information Technology Sector, But It Will Also Help In Saving The Environment By Reducing The Emission Of Carbon Dioxide Into The Environment.

1.1 Wavelength Division Multiplexing

Wavelength Division Multiplexing Is A Technology Used In The Transfer Of Infrared Frequencies Simultaneously Over A Single Fiberoptic. It Is Considered Fast Compared To Other Multiplexing Methods Because Every Frequency Channel Carries Unique Information At The Same Time. The Greatest Benefit Of Using Wavelength Division Multiplexing For Single Multimode (WDM) Is Because The Technology Carries Multiple Light Wavelengths At The Same Time (Kiniry 1998).

The WDM Method Is Also Preferred Because It Reduces The Coast Of Setting Up Fiberoptics. Forinstance, To Increase The Bandwidth Of A Fiberoptic, Severalfibers Are Needed So That Information Can Transfer Separately In All The Fibercables.However,This Is Different In Wavelength Division Multiplexing Method Because Multiple Wavelengths Can Travel Using A Single Fiber.This Significantly Reduces The Number Of Fiber Optic Cables To Be Bought Because Only A Single Cable Is Needed.

The WDM Mode Is Also Advantageous Because It Saves On Time Which Is Needed To Transfer Information From One User To The Other. If A User Needs To Transfer Information From One Person To Another, They Would Need To Send Multiple Information Through Several Fiber Optics Cables. Since The WDM Method Only Requires One Cable, The Information To Be Transferred Is Sent From One End To The Other Which Takes A Very Short Time And This Causes Inconveniences. This Can Be Demonstrated Because A Single Strand Of The Fiber Optic Cable Transmits Between 10 And 80 Gigabytes Of Data Which Is Super-Fast.

Most Services Providers Desire To Provide Most Services To The Clients. For Services Providers To Produce Quality And Fast Services, They Must Have A Faster Method Of Transmitting Information From One User To Another. Forinstance, In An Office Set-Up, Information Must Be Quickly Transmitted From A Junior Officer To The Manager And The Rest Of The Team. Therefore, If A Service Provider Uses Wavelength Division Multiplexing In Transmitting Information, The Clients Are Assured Of High Bandwidth Of Transmitting Information Hence This Technology Is Preferable.

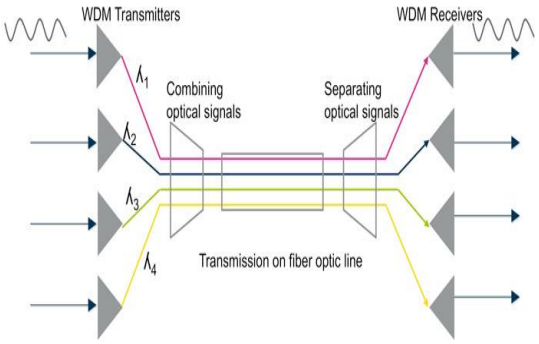

Figure 1: Wavelength Transmission

1.2 Optimal Time Division Multiplexing

The Optical Time Division Multiplexing Technology Is An Advancement From The Wavelength Division Multiplexing Technology. The Optical Time Technology Integrates Several Signals Into A Fixed Period Hence Forcing Many Signals To Be Transferred Over A Single Or Multimode Fiber Optic Cable Over A Defined Period.

The OTD Technique Limits The Electronic Bandwidth Components Using The Time Domain Approach Thereby Having A Critical Impact On The Signal Bit Rate Transmission [60, 61, 62, And 63].The Optimal Time Division Multiplexing Method Transfers The Binary Signal Information By Using Pulses Known As Short Return-To-Zero (RZ) Pulses. The Energy From The RZ Pulses Is Concentrated Over A Short Duration Of Time Compared To The Bit Period I.E [73, 74].Multiplexing Ensures That More Data Will Be Transmitted Over A Short Period. On The Other Hand, When The Pulse Width Are Short, Many Data Streams Can Be Combined Hence Accelerating Information Transfer From The Source To The User.

To Obtain An Optimal Time Divisional Multiplexing Signal, A Combination Of Fiberoptics Is Done Which Results In An Aggregated Bit Rate Which Is Higher Than The Original Bit Rate. Forinstance, Information Can Be Processed At A Rate Of Gigabit Per Second Which Escalated The Number Of Input Channels.

In Summary, The Optimal Time Divisional Multiplexing Technique Works Using The Synchronization Mode Whereby Any Channel Operating In Low Speed Is Synchronized And Then Proceeds To The Next Channel. This Mode Has Proved To Be Effective And Efficient In The Fast Delivery Of Data Using Fiberoptic. Thetransmission Speed Increases Over Time Because Of More Multiplexing Of Several Channels. Nonetheless, This Method Is Preferred Compared To The Wavelength Division Multiplexing Because It Separates Different Wavelengths According To The Time.Also,It Is

Preferred Because It Allows More And Faster Transmission Of Data Compared To The Wavelength Division Multiplexing Technique.

1.2.1 Optimal Time Division Demultiplexing

In OTDM Demultiplexing, The Original Signal Is Separated Using A Non-Linear Fiber. To Ensure That Multiple But Unrelated Signals Are Combined, The Single Channel Is Enlarged And Introduced To The Non-Linear Optical Mirror. This Mirror Separates The Original Signals Into Two; One Rotating Clockwise And The Other One Rotating Anti-Clockwise. In This Step, An Important Step Known As Cross-Phase Modulation Occurs Where Different Signals Are Multiplexed Into One Which Contains A Higher Pulse Rate Hence An Effective Control Signal. These Signals Are Recombined And Later Are Used To Transfer Information And Data In A More Faster And Accurate Way Than The Previous Occasions.

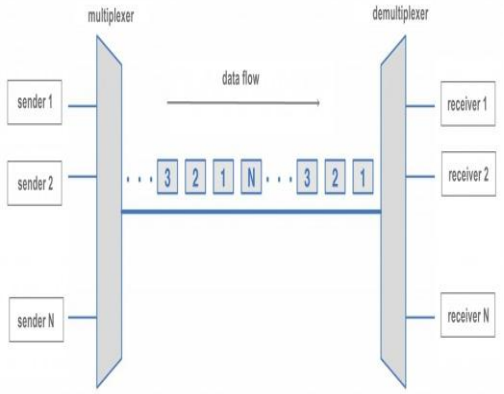

Figure 2:Optimal Time Division Multiplexing And Demultiplexing

1.3 Space Division Multiplexing

The Space Division Multiplexing Technology Identifies Channels Along The Data Streams Through The Same Fiber Optic Cable (Richardson, Fini& Nelson 2013).In This Method, Antennas Are Used In The Transmission Of Data In The Fibercables. Therefore, This Method Applies The Multiplexing Technique Which Increases The Antennas Relaying The Information. The Antennas Receive Data Through Receivers Whose Pivotal Role Is To Receive And Digitize The Signals And Process The Signals Using A Method Known As Digital Signal Processing (DSP).

To Equalize The Mode Crosstalk, The Space Division Multiplexing Uses The Multi-Input Multi-Output (MIMO) Equalization Method To Equalize The Crosstalk. Various Studies Conducted Have Indicated That Space Division Multiplexing Technology Has Contributed To A Faster Data Transmission Rate Of 5-8 Petabit/Second. This Is Higher Compared To The Wavelength Division Multiplexing And The Optimal Time Division Multiplexing. The Method Used Mimowhich Works By Placing Two Antennas On The Sender'sside (Output) And Two Antennas At The Receiving Side (Input).Then, Data Is Transmitted Very Fast And At A Cheaper Cost Compared To The Other Methods Above. For Space Division Multiplexing To Occur Efficiently, A Multi-Core Fiber Amplifier Is Used To Transmit Data From The Sender's Antenna To The Receiver's Antenna. The Multi-Core Fiberamplifiers Are Vital In Increasing The Amplitude Of A Signal From One End To Another.

Sometimes, There Can Be Challenges Which Are Faced When Using The Multi-Input Multi-Output (MIMO) Techniques. For Instance, Data May Take A Longer Time To Be Transferred From The Sender's Antenna To The Receiver's Antenna And The Data Or Information Transmitted May Not Be Of A Higher Quality. However, New Improvements Have Been Made Which Have Enhanced The Usefulness Of The Space Division. Weak Transmissions Can Employ The Use Of MDM Transmission Hence Reducing The Multi-Input Multi-Output Difficulties On The Receiver's Side. When There Is A Technological Hitch, Data May Not Reach The Receiver On Time Or The Information May Reach There When It Is Distorted. Therefore, To Combat This Menace, A Mode Known As MUX/DEMUX Method Is Used As It Reduces The Complexity Of The Technique.

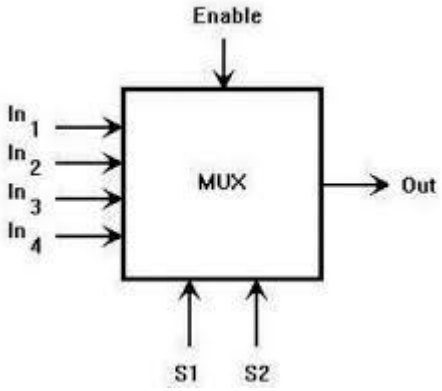

Figure 3: MUX

A MUX Is Used To Select Data And Send It To The Output. The Major Function Of A MUX Is To Increase The Accuracy Of The Information Or Data Which Is Sent From The Sender To The Receiver At A Particular Time As Well As Bandwidth. The MUX Technology Can Be Used In Various Places Such As Transmission Of Information And Data, Communication Purposes And In The Telephone Industry. It Simplifies Everything And It Is Fast Because It Aides In The Conversion Of A Large Volume Of Data Into Meaningful And Required Information.

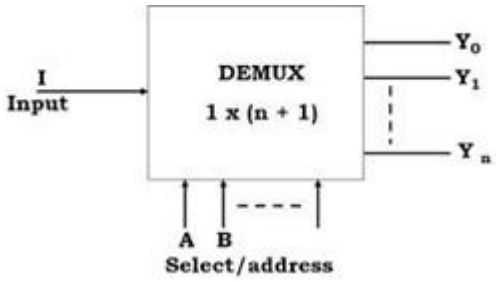

Figure 4: DEMUX

A DEMUX On The Other Hand, Receives Data Signals At The Entry Side (Input) And Then Sends That Data To A Parallel Data Centre. The Major Function Of A DEMUX Is To Distribute Data. It Takes Data From The Input And Then It Re-Converts Them Back To Their Original Form Then Distributes That Data To The Various Outputs. It Is Used In Many Places Such As Generators And Decoders.

II. CASE STUDY

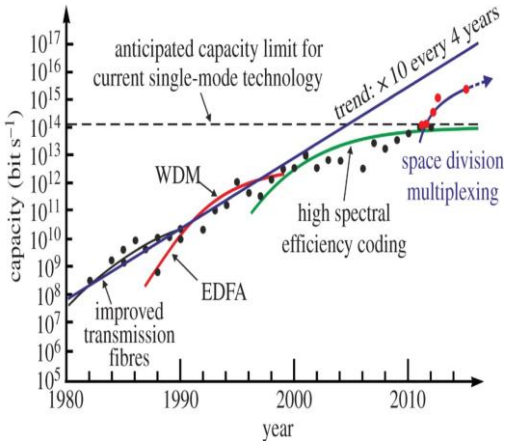

Fig 5:The Evolution Of Transmission Capacity In Optical Fibers As Evidenced By State Of The Art Laboratory Transmission Demonstrations Over The Years. The Data Points Shown Represent The Highest Capacity Transmission Numbers (All Transmission Distances Considered) As Reported In The Postdeadline Session Of The Optical Fiber Communications Conference Held Each Year In The USA.

III. CONCLUSION

Nowadays, The World Is Evolving Into An Information Technology- Driven Society. It Is Therefore Paramount For Fiber Optics To Be Adopted To Increase Efficiency In The Transmission Of Data And Information.

This Study Has Looked At Various Multiplexing And Demultiplexing Used For Single And Multimode Fiber Optics. Some Of The Technologies Include; Wavelength Division Multiplexing, Optical Time Division Multiplexing And Space Division Multiplexing.

Wavelength Division Multiplexing Transmits Data Faster By Increasing The Bandwidth Of The Single And Multimode Optical Fiber.It Does This By Allowing Any Communication Passing By Either Side To Be Transported And Transmitted Over A Single Optical Fiber. This Reduces The Time Taken To Wait For Communication Travelling On One Side To Reach The Other End For It To Be Transmitted. Another Benefit Of This Method Is That It Saves Of The Transportation Cost As It Allows Information To Be Transported Via A Single Fiber Optic.

Also, The Researcher Has Looked At Optical Time Division Multiplexing Technology. The Approach Combines Several Transmission Channels And Transports The Data Over A Fixed Period. This Enables A Large Chunk Of Information To Be Transported, Saves On Time And Is Also Cost-Effective. The Multiplexer And Demultiplexer Work In Synchronization To Deliver Better And Effective Results Compared To Other Methods.

The Research Also Explored Space Division Multiplexing Method Whereby Multiple Channels Can Relay Information Over Long Or Short Distances And At A Very Fast Speed. The Method Is Also Suitable Because It Maintains Robustness As Well As Reducing The Cost. Forinstance, Data Is Relayed With Increased Speed Over A Single Fiber Optic Cable. Therefore, The Service Provider Will Save On The Cost And Time Which Could Be Used To Purchase Several Fiber Cables To Be Used To Transport The Data. This Method Also Greatly Reduces The Amplifying Costs As There Are Alternatives To Cheaper And Adequate Amplifying Material. Furthermore, Amplifying Materials Also Offer A Great Integration.

In Summary, Wavelength Division Multiplexing Is The Most Suitable Method To Use Since It Carries Multiple Wavelengths At The Same Time And The Signals Are Dependent On Each Other And Very Fast. Various Technologies Have Been Innovated But This Technique Has Bypassed All Of Them Regarding Of Efficiency, Effectiveness And Cost.

This Research Paper Has Also Concluded That Multiplexing An Demultiplexing For Single And Multimode Fiber Optics Has A Positive And Significant Influence In Signal Processing And Transmission. Technology Also Saves On Cost And Time.

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