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There are mainly four types of multiplexers mostly used. Here you will find all types of the multiplexer truth tables and circuit diagrams. There are many important applications of Multiplexer are available which are given in this article. So let's know the Multiplexer Applications, uses.The multiplexer is a device that takes no. of digital inputs at a time but gives only one output at a time. The multiplexer mainly used to transmit two more digital signals over a single transmission line.Multiplexers are classified based on the no. of input. There are mainly four types of Multiplexer mostly used which are,2 to 1 Multiplexer4 to 1 Multiplexer8 to 1 Multiplexer16 to 1 MultiplexerThere are different types of multiplexer that have different truth tables and circuit diagrams. The circuit diagram and truth table of each type of multiplexer are given below.As you see in the below figure, 2 to 1 Multiplexer has two inputs pins(A, B), one output pin(Y), and one select pin(S). This multiplexer takes two digital input signal at a time but gives only one output. We control the output of that multiplexer using the select pin.As you see in the below figure, the 4 to 1 multiplexer has four input pins(A, B, C, D), one output pin(Y), and two select pins(S0, S1). This multiplexer takes four digital input signals at a time but gives only one output. The output behavior can be observed in the truth table.As you see in the below figure, the 8 to 1 multiplexer has eight input pins, one output pins, and three select pins. This multiplexer takes eight digital input signals at a time but gives only one output. The output behavior can be observed in the truth table.Here the 16 to 1 multiplexer is built using five 4 to 1 multiplexers. Each multiplexer has four input pins, so the four multiplexers are used for inputs. The output of the four multiplexers is given to another 4 to 1 multiplexer.1. The main application of multiplexers in thecommunication systemfor data transmission purposes. The multiplexer is used to transmit a huge amount of data from different channels or multiple data packets through a signal transmission line which reduces the data transmission cost, increases efficiency, etc.2. The multiplexer is used incomputer and microcontroller peripherals. For example, a multiplexer in a multiplex keyboard takes different data from the keyboard and sends it to the computer through a single port and wire.3. In thetelevision broadcasting system, multiplexing is used. A lot of different channels come to the cable TV box in our home through a single cable. Television broadcasting system uses frequency division multiplexing system.4.A multiplexing system is used toreduce the no. of pinsof a microprocessor, microcontroller or CPU. We know that the 8085 microprocessor uses a multiplexing system to use the D0 to D7 pins for both address and data transmission.5. Multiplexing system is also used incomputer memory. Using the multiplexing system we can reduce the no of addresses and data pins of a memory chip.6. Insatellite communication, aGPSsystem multiplexer is used.7. The multiplexer is used in Programmable Logic Control or PLC system to maintain a no. input and output devices.8. The multiplexer is used analog circuit when a no. of sensors and transducers are connected in a circuit.Read Also:Thank you for visiting the website. keep visiting for more updates. Skip to content A multiplexer, or MUX for short, is an important building block in digital circuit design. It allows a single device to switch between many different incoming signals, which is very useful when designing complex logic functions. In this article, we will explain what a MUX is, how it works, and why it is useful. We'll also take a look at the 8:1 MUX truth table and equation, and how these are used to define the behavior of a MUX.At its core, a MUX is a digital switch that can be used to direct one out of multiple input signals to an output. A MUX consists of two primary components: a set of input data lines and a select line. The select line is used to determine which input signal should be sent to the output. For example, if the select line is set to 1, then the first input signal will be sent to the output; if it is set to 2, then the second signal will be sent to the output, and so on. The behavior of a MUX is defined by a truth table, which specifies the output values for each combination of the select line and the input data lines.The 8:1 MUX truth table and equations provide details about the behavior of an 8 bit MUX, which means it is capable of switching between up to 8 input signals. In this case, the truth table contains eight columns, one for each of the 8 inputs, and eight columns for the 8 possible select line combinations. Each row of the table represents one of the 256 possible combinations of inputs and select lines. The equations associated with the truth table provide a mathematical description of the behavior of the MUX. The 8:1 MUX truth table and equations provide a convenient way for engineers and designers to define complex logic functions for digital circuits. By combining the select line and input data lines, engineers can specify precisely which signal should be sent to the output in any given situation. This makes it easier to design digital circuits that can process large amounts of data quickly and accurately. Furthermore, as MUXs can have different configurations, engineers can use the truth table and equations to design a custom MUX that meets their specific needs. As a result, the 8:1 MUX truth table and equations are an invaluable tool for digital circuit design. Digital Circuits Multiplexers Block Diagram Of A Single Bit 8 1 Multiplexer Its Truth Table Is Given Scientific Cse370 Final Exam Solution Answered Implement The Following Boolean Bartleby 4 1 Mux Graphical Symbol A Truth Table B Scientific Diagram Multiplexer What Is It And How Does Work Electrical4u Combinational Circuits Multiplexers Decoders Programmable Logic Devices Lecture 1 To 8 Demultiplexer Plc Ladder Diagram Instrumentationtools Synthesis04 Gif What Is Multiplexer Draw The Truth Table And Logic Diagram Of An 8 1 Sarthaks Econnect Largest Online Education Community How Do Implement An 8 1 Line Multiplexer Using Two 4 Multiplexers Quora Synthesis06 Gif Multiplexer In Digital Electronics Fun Multiplexer And Demultiplexer Types Differences Their Applications Multiplexer In Digital Electronics Fun Multiplexer In Digital Electronics Javatpoint What Is Demultiplexer Diffe Types Of Demultiplexers Using 8 1 Multiplexers To Implement Logical Functions Eeweb Data Processing Circuits And Flip Flops Ppt Multiplexer What Is It And How Does Work Electrical4u Related How can financial brands set themselves apart through visual storytelling? 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Explore our latest gallery of EditorsPicks.Browse Editors' Favorites Share copy and redistribute the material in any medium or format for any purpose, even commercially. Adapt remix, transform, and build upon the material for any purpose, even commercially. The licensor cannot revoke these freedoms as long as you follow the license terms. Attribution You must give appropriate credit , provide a link to the license, and indicate if changes were made . You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use. ShareAlike If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. No additional restrictions You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits. You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation . No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material. Imagine sending HD video, music, emails, phone calls, and internet all down one wire! Multiplexing is the magic trick, and multiplexers (MUX for short) are the tiny wizards behind it. In this guide, learn what is a Multiplexer, different types of multiplexers like 2 to 1, 4 to 1, 8 to 1 and 16 to 1 Multiplexer, commonly available Multiplexer ICs and some important applications of Multiplexers. What Is Multiplexing?Multiplexing is the process of combining one or more signals and transmitting on a single channel. In analog communication systems, a communication channel is a scarce quantity, which must be properly used. For cost-effective and efficient use of a channel, the concept of Multiplexing is very useful as it allows multiple users to share a single channel in a logical way.The three common Types of Multiplexing approaches are: Two of the best examples of Multiplexing Systems used in our day-to-day life are the landline telephone network and the Cable TV.The device which is responsible for Multiplexing is known as Multiplexer. Multiplexers are used for both Analog and Digital signals. Let us focus on digital signals in this tutorial, to keep things simple. A multiplexer is the most frequently used combinational circuit and it is an important building block in many in digital systems.These are mostly used to form a selected path between multiple sources and a single destination. A basic multiplexer has various data input lines and a single output line. These are found in many digital system applications such as data selection and data routing, logic function generators, digital counters with multiplexed displays, telephone network, communication systems, waveform generators, etc. In this article we are going to discuss about types of multiplexers and its design.What Is A Multiplexer?The multiplexer or MUX is a digital switch, also called as data selector. It is a Combinational Logic Circuit with more than one input line, one output line and more than one select line. It accepts the binary information from several input lines or sources and depending on the set of select lines, a particular input line is routed onto a single output line.The basic idea of multiplexing is shown in figure below in which data from several sources are routed to the single output line when the enable switch is ON. This is why, multiplexers are also called as many to one combinational circuits.The below figure shows the block diagram of a multiplexer consisting of n input lines, m selection lines and one output line. If there are m selection lines, then the number of possible input lines is 2m. Alternatively, we can say that if the number of input lines is equal to 2m, then m selection lines are required to select one of n (consider 2m = n) input lines.This type of multiplexer is referred to as 2n 1 multiplexer or 2n-to-1 multiplexer. For example, if the number of input lines is 4, then two select lines are required. Similarly, to select one of 8 input lines, three select lines are required.Generally, the number of data inputs to a multiplexer is a power of two such as 2, 4, 8, 16, etc. Some of the most frequently used multiplexers include 2-to-1, 4-to-1, 8-to-1 and 16-to-1 multiplexers.These multiplexers are available in IC forms with different input and select line configurations. Some of the available multiplexer ICs include 74157 (Quad 2-to-1 MUX), 78158 (Quad 2-to-1 MUX with inverse output), 74153 (4-to-1 MUX), 74152 (8-to-1 MUX) and 74150 (16-to-1 MUX).Also Read: What Is A Demultiplexer2 to1 MultiplexerA 2 to 1 multiplexer consists of two inputs D0 and D1, one select input S and one output Y. Depending on the select signal, the output is connected to either of the inputs. Since there are two input signals, only two ways are possible to connect the inputs to the outputs, so one select is needed to do these operations.If the select line is low, then the output will be switched to D0 input, whereas if select line is high, then the output will be switched to D1 input. The figure below shows the block diagram of a 2:1 mux which connects two 1-bit inputs to a common destination.21 Multiplexer Calculator21 multiplexer truth table is shown below. Depending on the value of the select input, the inputs i.e., D0, D1 are produced at outputs. The output is D0 when Select value is S = 0 and the output is D1 when Select value is S = 1.SD0D1Y00X001X11X001X11X in the above 2:1 multiplexer truth table denotes a dont care condition. So, ignoring the dont care conditions, we can derive the MUX Boolean Expression of a typical 2:1 Multiplexer as follows:Y = SD0 + SD1From the above output expression, the logic circuit of 2-to-1 multiplexer can be implemented using logic gates as shown in figure. It consists of two AND gates, one NOT gate and one OR gate. When the select line, S=0, the output of the lower AND gate is zero, but the output of upper AND gate is D0. Thus, the output generated by the OR gate is equal to D0.Similarly, when S=1, the output of the upper AND gate is zero, but the output of lower AND gate is D1. Therefore, the output of the OR gate is D1. Thus, the above given mux Boolean expression is satisfied by this circuit.In order to efficiently use the Silicon, IC Manufacturers fabricate multiple Multiplexers in a single IC. Generally four 2 line to 1 line multiplexers are fabricated in a single IC. Some of the popular ICs of 2 to 1 multiplexers include IC 74157 and IC 74158.Both these ICs are Quad 2-to-1 Multiplexers. While IC 74157 has a normal output, the IC74158 has an inverted output. There is only one selection line, which controls the input lines to the output in all four multiplexers.The output Y0 can be either A0 or B0 depending on the status of the select line. Similarly, Y1 can be either A1 or B1, Y2 can be either A2 or B2 and so on. There is an additional Strobe or Enable control input E/Strobe, which enables and disables all the multiplexers, i.e., when E=1, outputs of all the multiplexer is zero irrespective of the value of S.All the multiplexers are activated only when the E / Strobe input is LOW.4 to 1 MultiplexerA 4 to 1 multiplexer consists four data input lines as D0 to D3, two select lines as S0 and S1 and a single output line Y. The select lines S0 and S1 select one of the four input lines to connect the output line. The figure below shows the block diagram of a 4:1 multiplexer in which, the multiplexer decodes the input through select line.41 Multiplexer CalculatorThe 41 multiplexer truth table is shown below in which four input combinations 00, 10, 01 and 11 on the select lines respectively switches the inputs D0, D2, D1 and D3 to the output. That means when S0=0 and S1 =0, the output at Y is D0, similarly Y is D1 if the select inputs S0=0 and S1= 1 and so on.S0S1D0D1D2D3Y000XXX0001XXX101X0XX001X1XX110XX0X010XX1X111XXX0011XXX11From the above 4:1 multiplexer truth table, we can write the output expressions as follows:Y = S0 S1 D0 + S0 S1 D1 + S0 S1 D2 + S0 S1 D3From the above expression of the output, a 4-to-1 multiplexer can be implemented by using basic logic gates. The below figure shows the logic circuit of 4:1 MUX which is implemented by four 3-inputs AND gates, two 1-input NOT gates, and one 4-inputs OR gate.In this circuit, each data input line is connected as input to an AND gate and two select lines are connected as other two inputs to it. Additionally, there is also an Enable Signal. The output of all the AND gates are connected to inputs of OR gate in order to produce the output Y.Generally, this type of multiplexers is available in IC with dual mode i.e., there will be two 4-to-1 Multiplexers in a single IC. The most common and popular 4-to-1 line multiplexer is IC 74153 which, is a dual 4-to-1 line multiplexer. It consists of two identical 4-to-1 multiplexers. It has two separate enable or strobe inputs to switch ON or OFF the individual multiplexers. But the Select lines are common to both the Multiplexers.Usually, the enable input or strobe can be used to cascade two or more multiplexer ICs to construct a multiplexer with large number of inputs. Each multiplier is supplied with separate inputs. The figure below shows the pin diagram of IC74153.8 to 1 MultiplexerAn 8 to 1 multiplexer consists of eight data inputs D0 through D7, three input select lines S0 through S2 and a single output line Y. Depending on the select lines combinations, multiplexer selects the inputs.The below figure shows the block diagram of an 8-to-1 multiplexer with enable input that can enable or disable the multiplexer. Since the number data bits given to the MUX are eight, then 3 bits (23 = 8) are needed to select one of the eight data bits.81 Multiplexer CalculatorThe 8 to 1 multiplexer truth table is given below with eight combinations of inputs so as to generate each output corresponds to input.For example, if S2= 0, S1=1 and S0=0 then the data output Y is equal to D2. Similarly the data outputs D0 to D7 will be selected through the combinations of S2, S1 and S0 as shown in below figure.S0S1S2D0D1D2D3D4D5D6D7Y0000XXXXXXX00001XXXXXXX1001X0XXXXX0001X1XXXXX1010XX0XXXX0010XX1XXXXX1011XXX0XXXX0011XXX1XXXX1100XXXX0XXX0100XXXX1XXX1101XXXXX0XX0101XXXXX1XX1110XXXXXX0X0110XXXXXX1X1111XXXXXXX00111XXXXXXX11From the above 8:1 multiplexer truth table, the Boolean equation for the output is given as:Y = S0 S1 S2 D0 + S0 S1 S2 D1 + S0 S1 S2 D2 + S0 S1 S2 D3 + S0 S1 S2 D4 + S0 S1 S2 D5 + S0 S1 S2 D6 + S0 S1 S2 D7From the above Boolean equation, the logic circuit diagram of an 8-to-1 multiplexer can be implemented by using 8 AND gates, 1 OR gate and 7 NOT gates as shown in below figure. In the circuit, when enable pin is set to one, the multiplexer will be disabled and if it is zero, then select lines will select the corresponding data input to pass through the output.IC 74151 is a popular 8-to-1 multiplexer IC with eight inputs and two outputs. The two outputs are active low and active high outputs. It has three select lines A, B and C and one active low enable input. The pinout of this IC is given below.8 to 1 Mux Using 4 to 1 Mux And 2 to 1 MuxIf you observe the Boolean Expression of 8-to-1 Multiplexer shown above, we can re-write it as follows:Y = S0 S1 S2 D0 + S0 S1 S2 D1 + S0 S1 S2 D2 + S0 S1 S2 D3 + S0 S1 S2 D4 + S0 S1 S2 D5 + S0 S1 S2 D6 + S0 S1 S2 D7Y = S0 (S1 S2 D0 + S1 S2 D1 + S1 S2 D2 + S1 S2 D3) + S0(S1 S2 D4 + S1 S2 D5 + S1 S2 D6 + S1 S2 D7)The expression in the first bracket i.e., S1 S2 D0 + S1 S2 D1 + S1 S2 D2 + S1 S2 D3 is similar to the multiplexer Boolean Expression of a 4-to-1 Multiplexer with D0, D1, D2 and D3 as inputs and S1 and S2 as Select Lines. Let this expression be P1.Similarly, the expression in the second bracket i.e., S1 S2 D4 + S1 S2 D5 + S1 S2 D6 + S1 S2 D7 is similar to the multiplexer Boolean Expression of another 4-to-1 Multiplexer with D4, D5, D6 and D7 as inputs and S1 and S2 as Select Lines. Let this expression be P2.Now, replacing the above expressions with P1 and P2, we get,S0 P1 + S0 P2This expression is similar to a 2-to-1 Multiplexer with P1 and P2 (where, P1 and P2 are outputs of respective 4-to-1 Multiplexers) as Inputs and S0 as Select Signal. So, finally, we can deduce that an 8-to-1 Multiplexer can be implemented using two 4-to-1 Multiplexers and one 2-to-1 Multiplexer. The block diagram of the same is shown below:16 to 1 MultiplexerAll the higher order Multiplexers like 8-to-1, 16-to-1, etc. can be implemented using lower order multiplexers. But none the less, let us take a quick look at 16-to-1 Multiplexer. IC 74150 is a popular 16-to-1 Multiplexer IC. The inputs to a 16:1 MUX are D0, D1, D2 and so on up tp D15. Since it has 16 input lines, there will be 4 select lines namely S0, S1, S2 and S3.The following image shows the block diagram of a typical 16 to 1 Multiplexer.Simplified truth table for 161 Multiplexer is shown in the following table.S0S1S2S3Y0000D00001D10010D20011D30100D40101D50110D60111D71000D81001D91010D101011D111100D121101D131110D141111D15The Boolean Expression of a 16-to-1 Multiplexer is as follows:Y = S0 S1 S2 S3 D0 + S0 S1 S2 S3 D1 + S0 S1 S2 S3D2 + S0 S1 S2 S3 D3 + S0 S1 S2 S3 D4 + S0 S1 S2 S3 D5 + S0 S1 S2 S3 D6 + S0 S1 S2 S3 D7 + S0 S1 S2 S3 D8 + S0 S1 S2 S3 D9 + S0 S1 S2 S3 D10 + S0 S1 S2 S3 D11 + S0 S1 S2 S3 D12 + S0 S1 S2 S3 D13 + S0 S1 S2 S3 D14 + S0 S1 S2 S3 D15The following image shows the logical circuit of a 16-to-1 Multiplexer.Similar to an 8-to-1 Multiplexer, we can implement 16-to-1 Multiplexer using lower order multiplexers like 8-to-1, 4-to-1 and 2-to-1. The following image shows the block diagram of a 16-to-1 Multiplexer implemented using two 8-to-1 Multiplexers and one 2-to-1 Multiplexer.Further, we can implement the individual 8-to-1 Multiplexers in the above image using two 4-to-1 Multiplexers and one 2-to-1 Multiplexer.Application of MultiplexerIn all types of digital system applications, multiplexers find its immense usage. Since these allows multiple inputs to be connected independently to a single output, multiplexers are found in variety of applications including data routing, logic function generators, control sequencers, parallel-to-serial converters, etc.Multiplexers are used in telecommunications for data routing, in computer memory to select data lines, in broadcasting to combine multiple audio or video signals, and in various electronic devices for signal processing.Data RoutingMultiplexers are extensively used in data routing applications to route the data to a one particular destination from one of several sources. One of the applications includes the displaying of two multidigit BCD counters, one at a time. In such application, 74157 multiplexer ICs are used to select and display the content of either of two BCD counters using a set of decoder and LED displays.Logic Function GeneratorIn place of logic gates, a logical expression can be generated by using a multiplexer. It is possible to connect the multiplexer such that it duplicates the logic of any truth table. In such cases it can generate the Boolean algebraic function of a set of input variables.This abruptly reduces the number of logic gates or integrated circuits to perform the logic function since the multiplexer is a single integrated circuit. In this kind of applications, multiplexers are viewed as logic function generators.For example consider the below logic diagram to implement the ex-OR function of three inputs. A 74151A 8-to-1 multiplexer is used in this logic generator. This multiplexer works exactly similar to the set of logic gates implementing the same function.The output F is 1 for data inputs D1, D2, D5 and D6 which are selected by making selection lines to 001, 010, 100 and 111 respectively.Parallel to Serial ConversionA multiplexer circuit can be used to convert the parallel data to serial data in order to reduce the number of parallel buses by converting them to serial signals. This type of conversion is needed in telecommunication, test and measurement, military/aerospace, data communications applications.Mostly in digital systems, data is processed in parallel for achieving higher speeds. But for transmission of the data signals over long distances, we need more number of lines. In such cases, parallel data is converted into serial form using multiplexers.The figure below shows the parallel to serial data conversion using an 8 input multiplexer. Parallel data from the data in or some other register is applied to the 8 input lines of the multiplexer.The selection codes for the multiplexer are generated by a 3-bit counter. With the application of each clock pulse to the counter the data is serially out from the multiplexer.Other applications of multiplexers include control sequencers, pulse train generators, encoders, register to register data transfer, waveform generators, etc.ConclusionComplete tutorial on Multiplexer (MUX) and Multiplexing. You learned the basics of Multiplexing, multiplexer, different types of commonly used multiplexers like 2:1 MUX, 4:1 MUX, 8:1 MUX and 16:1 MUX, their multiplexer Boolean Expressions, logic circuits and also couple of important applications of Multiplexers.FAQs: Multiplexers And MultiplexingHow does a multiplexer differ from a demultiplexer?A multiplexer (MUX) combines multiple input signals into one output signal, while a demultiplexer (DEMUX) takes a single input signal and routes it to one of several outputs.What are the key factors to consider when selecting a multiplexer for a project?Key factors include the number of input channels, signal type (analog or digital), speed requirements, power consumption, and compatibility with the rest of the system.How does a multiplexer improve the efficiency of data transmission?A multiplexer allows multiple signals to be transmitted over a single channel, reducing the need for multiple communication lines and improving bandwidth efficiency.How do multiplexers affect signal integrity?Multiplexers can introduce signal degradation due to factors like crosstalk, noise, and propagation delay. Proper design and shielding can mitigate these effects.Are there software-based multiplexers?Yes, software-based multiplexers exist and are used in applications like operating systems and networking software to manage multiple data streams and virtual channels. Have you ever heard of Multiplexer truth tables and circuit diagrams? Maybe in your engineering class or on a complex electronic device? If so, you may have wondered what all the fuss is about.Multiplexers, also known as MUXs, are electronic components that allow multiple signals to pass through them in a single channel. The main function of these components is to increase the amount of data that can be transmitted in a given time period. They can be used in a variety of applications, including computer networks, audio and video signals, and even in digital circuits.A Multiplexer truth table is a logical table that shows the expected results for each possible combination of inputs. Basically, it's a way to quickly determine whether two or more signals will produce a certain output. In addition, a Multiplexer circuit diagram is a schematic diagram that visually displays how a multiplexer is connected to other components in an electronic system.If you're unfamiliar with the details of how a Multiplexer works, you're not alone. With its complex electrical connections and mathematical equations, it can be difficult to understand the inner workings of a multiplexer. Fortunately, there are many tutorials and resources available online that can help you gain a comprehensive understanding of this highly important electronic component. In addition, there are several professional tools available that allow engineers to design multiplexers for specific applications. These tools are incredibly powerful and can significantly reduce the time taken to design multi-channel systems. No matter whether you're an engineer or simply an electronic enthusiast, having a good understanding of Multiplexer truth tables and circuit diagrams can be invaluable. With their versatility and efficiency, multiplexers are essential components in many areas of electronic engineering, and understanding them can help you improve your work and achieve better results. In this article we will go through the multiplexer, we will first define what is a multiplexer then we will go through its types which are 2x1 and 4x1, then we will go through the Implementation of the 2x1 mux and higher mux with lower order mux, at last we will conclude our article with some applications, advantages and some FAQs. What Are Multiplexers? A multiplexer is a combinational circuit that has many data inputs and a single output, depending on control or select inputs. For N input lines, log2(N) selection lines are required, or equivalently, for 2n input lines, n selection lines are needed. Multiplexers are also known as "N-to-1 selectors," parallel-to-serial converters, many-to-one circuits, and universal logic circuits. They are mainly used to increase the amount of data that can be sent over a network within a certain amount of time and bandwidth . Multiplexer Types of Mux The Mux can be of different types based on input but in this article we will go through two major types of mux which are 2x1 Multiplexer The 2x1 is a fundamental circuit which is also known 2-to-1 multiplexer that are used to choose one signal from two inputs and transmits it to the output. The 2x1 mux has two input lines, one output line, and a single selection line. It has various applications in digital systems such as in microprocessor it is used to select between two different data sources or between two different instructions. Block Diagram of 2:1 Multiplexer with Truth Table Given Below is the Block Diagram and Truth Table of 2:1 Mux. In this Block Diagram where I0 and I1 are the input lines, Y is the output line and S0 is a single select line. Block Diagram of 2:1 Multiplexer with Truth Table The output of the 2x1 Mux will depend on the selection line S0, When S is 0(low), the I0 is selectedwhen S0 is 1(High), I1 is selected Logical Expression of 2x1 Mux Using the Truth Table ,the Logical Expression for Mux can be determined as Y=\overline{S_0}.I_0+S_0.I_1 Circuit Diagram of 2x1 Multiplexers Using truth table the circuit diagram can be given as Circuit Diagram of 2x1 Mux41 Multiplexer The 4x1 Multiplexer which is also known as the 4-to-1 multiplexer. It is a multiplexer that has 4 inputs and a single output. The Output is selected as one of the 4 inputs which is based on the selection inputs. The number of the Selection lines will depend on the number of the input which is determined by the equation log_2n ,In 4x1 Mux the selection lines can be determined as log_4=2 ,slo two selections are needed. Block Diagram of 41 Multiplexer In the Given Block Diagram I0, I1, I2, and I3 are the 4 inputs and Y is the Single output which is based on Select lines S0 and S1. The output of the multiplexer is determined by the binary value of the selection lines When S1S0=00, the input I0 is selected.When S1S0=01, the input I1 is selected.When S1S0=10, the input I2 is selected.When S1S0=11, the input I3 is selected. Truth Table of 41 Multiplexer Given Below is the Truth Table of 4x1 Multiplexer Circuit Diagram of 4x1 Multiplexers Using truth table the circuit diagram can be given as Multiplexer can act as universal combinational circuit. All the standard logic gates can be implemented with multiplexers. Implementation of Different Gates with 2:1 Mux Given below are the Implementation of Different gate using 2:1 Mux Implementation of NOT gate using 2 : 1 Mux The Not gate from 2:1 Mux can be obtained by Connect the input signal to one of the data input lines(I0).Then connect a line (0 or 1) to the other data input line(I1)Connect the same input line Select line S0 which is connected to D0. Given Below is the Diagram for the Logical Representation of NOT gate using 2 : 1 Mux Implementation of AND gate using 2 : 1 Mux The And gate from 2:1 Mux can be obtained by Connect the input Y to I1.Connect the input X to the selection line S0.Connect a line(0) to I0. Given Below is the Diagram for the Logical Representation of AND gate using 2 : 1 Mux For further more on the Implementation of AND gate using 2 : 1 Mux Implementation of OR gate using 2 : 1 Mux The OR gate from 2:1 Mux can be obtained by Connect input X to the selection line S0.Connect input Y to I1.Connect Line(1) to I1. Given Below is the Diagram for the Logical Representation of OR gate using 2 : 1 Mux Implementation of NAND, NOR, XOR and XNOR gates requires two 2:1 Mux. First multiplexer will act as NOT gate which will provide complemented input to the second multiplexer. Implementation of NAND gate using 2 : 1 Mux The NAND gate from 2:1 Mux can be obtained by In first mux take inputs and 1 and 0 and y as selection line.In Second MUX the Output from mux is connected to I1.line(1) is given to the I0.x is given as selection line for the second Mux. Given Below is the Diagram for the Logical Representation of NAND gate using 2 : 1 Mux For further more on the Implementation of NAND gate using 2 : 1 Mux Implementation of NOR gate using 2 : 1 Mux The Nor gate from 2:1 Mux can be obtained by In first mux take inputs and 1 and 0 and y as selection line.In Second MUX the Output from mux is connected to I0.line(0) is given to the I1.x is given as selection line for the second Mux. Given Below is the Diagram for the Logical Representation of NOR gate using 2 : 1 Mux For further more on the Implementation of NOR gate using 2 : 1 Mux Implementation of EX-OR gate using 2 : 1 Mux The Nor gate from 2:1 Mux can be obtained by In first mux take inputs and 1 and 0 and y as selection line.In Second MUX the Output from mux is connected to I1.y is given to the I0.x is given as selection line for the second Mux.Given Below is the Diagram for the Logical Representation of EX-OR gate using 2 : 1 Mux Implementation of EX-NOR gate using 2 : 1 Mux Given Below is the Diagram for the Logical Representation of EX-OR gate using 2 : 1 Mux The Nor gate from 2:1 Mux can be obtained by In first mux take inputs and 1 and 0 and y as selection line.In Second MUX the Output from mux is connected to I0.y is given to the I1.x is given as selection line for the second Mux. Implementation of Higher Order MUX using Lower Order MUX Given Below are the Implementation of Higher Order MUX Using Lower Order MUX 4 : 1 MUX using 2 : 1 MUX Three 2: 1 MUX are required to implement 4 : 1 MUX. 4 : 1 MUX using 2 : 1 MUX Similarly, While an 8:1 MUX requires seven (7) 2:1 MUX, a 16:1 MUX requires fifteen (15) 2:1 MUX, and a 64:1 MUX requires sixty-three (63) 2:1 MUX. Hence, we can draw the conclusion that an 2^n:1 MUX requires sixty-three (63) 2:1 MUX. Hence, we can draw the conclusion that an2 n :1MUX requires(2n1)2:1 MUX (2 n 1)2:1 MUX. 16 : 1 MUX using 4 : 1 MUX Given Below is the logical Diagram of 16:1 Mux Using 4:1 Mux In general, to implement B : 1 MUX using A : 1 MUX , one formula is used to implement the same. B / A = K1, K1/ A = K2, K2/ A = K3 KN-1 / A = KN = 1 (till we obtain 1 count of MUX). And then add all the numbers of MUXes = K1 + K2 + K3 + ... + K N . To implement 64 : 1 MUX using 4 : 1 MUX Using the above formula, we can obtain the same. 64 / 4 = 16 16 / 4 = 4 4 / 4 = 1 (till we obtain 1 count of MUX) Hence, total number of 4 : 1 MUX are required to implement 64 : 1 MUX = 16 + 4 + 1 = 21. f(A, B, C) = \sum (1, 2, 3, 5, 6) with don't care (7) Using A and B as the select lines for 4 : 1 MUX, AB as select: Expanding the minterms to its boolean form and will see its 0 or 1 value in Cth place so that they can be placed in that manner. AC as select : Expanding the minterms to its Boolean form and will see its 0 or 1 value in Bth place so that they can be place in that manner. BC as select: Expanding the minterms to its boolean form and will see its 0 or 1 value in A th place so that they can be place in that manner. Advantages of MUX Efficiency : The Mux has good efficiency in routing multiple input signals to a single out signal based on control signals. Optimization : The Mux helps to conserve resources such as wires, pins and integrated circuit (IC). Different Implementation: The Mux can be used to implement different digital logic functions such AND,OR etc. Flexibility: Mux can be easily configure according to the requirements and accommodate different data sources, enhancing system versatility. Disadvantages of MUX Limited number of data sources: The number of input that can be taken by a multiplexer is restricted by the number of control lines, which can cause limitations in certain applications. Delay: Multiplexers can have some delay in the signal path, which can have impact on the performance of the circuit. Complex control rationale: The control logic for multiplexers can be complex, particularly for bigger multiplexers with an large number of inputs. Power utilization: Multiplexers can consume more power compared with other simple logic gate, particularly when they have a large number of inputs. Applications of MUX Data Routing : The Mux is used for data routing in the digital system where they select one of the several data lines and re-route it the output. Data Selection : The Mux is used for data selection where they select data source according to the select lines. Analog-to-Digital Conversion : The Mux are used in ADC to select different analog input channels. Address Decoding : The Mux are used in Microprocessors or memory for address decoding. Logic Function Implementation : Mux can be used to implement various logic functions. In this article we will go through the multiplexer, we will first define what is a multiplexer then we will go through its types which are 2x1 and 4x1, then we will go through the Implementation of the 2x1 mux and higher mux with lower order mux, at last we will conclude our article with some applications, advantages and some FAQs. What Are Multiplexers? A multiplexer is a combinational circuit that has many data inputs and a single output, depending on control or select inputs. For N input lines, log2(N) selection lines are required, or equivalently, for 2n input lines, n selection lines are needed. Multiplexers are also known as "N-to-1 selectors," parallel-to-serial converters, many-to-one circuits, and universal logic circuits. They are mainly used to increase the amount of data that can be sent over a network within a certain amount of time and bandwidth . Multiplexer Types of Mux The Mux can be of different types based on input but in this article we will go through two major types of mux which are 2x1 Multiplexer The 2x1 is a fundamental circuit which is also known 2-to-1 multiplexer that are used to choose one signal from two inputs and transmits it to the output. The 2x1 mux has two input lines, one output line, and a single selection line. It has various applications in digital systems such as in microprocessor it is used to select between two different data sources or between two different instructions. Block Diagram of 2:1 Multiplexer with Truth Table Given Below is the Block Diagram and Truth Table of 2:1 Mux. In this Block Diagram where I0 and I1 are the input lines, Y is the output line and S0 is a single select line. Block Diagram of 2:1 Multiplexer with Truth Table The output of the 2x1 Mux will depend on the selection line S0, When S is 0(low), the I0 is selectedwhen S0 is 1(High), I1 is selected Logical Expression of 2x1 Mux Using the Truth Table ,the Logical Expression for Mux can be determined as Y=\overline{S_0}.I_0+S_0.I_1 Circuit Diagram of 2x1 Multiplexers Using truth table the circuit diagram can be given as Circuit Diagram of 2x1 Mux41 Multiplexer The 4x1 Multiplexer which is also known as the 4-to-1 multiplexer. It is a multiplexer that has 4 inputs and a single output. The Output is selected as one of the 4 inputs which is based on the selection inputs. The number of the Selection lines will depend on the number of the input which is determined by the equation log_2n ,In 4x1 Mux the selection lines can be determined as log_4=2 ,slo two selections are needed. Block Diagram of 41 Multiplexer In the Given Block Diagram I0, I1, I2, and I3 are the 4 inputs and Y is the Single output which is based on Select lines S0 and S1. The output of the multiplexer is determined by the binary value of the selection lines When S1S0=00, the input I0 is selected.When S1S0=01, the input I1 is selected.When S1S0=10, the input I2 is selected.When S1S0=11, the input I3 is selected. Truth Table of 41 Multiplexer Given Below is the Truth Table of 4x1 Multiplexer Circuit Diagram of 4x1 Multiplexers Using truth table the circuit diagram can be given as Multiplexer can act as universal combinational circuit. All the standard logic gates can be implemented with multiplexers. 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