DALHOUSIE UNIVERSITY

Faculty of Computer Science

CSCI 6704 – Advanced Topics in Networks

Name: Arka Ghosh
Banner ID: B00911033
Assignment: 06

Task 1

A.

Abbreviated IPv6 Addresses	Unabbreviated IPv6 Addresses
0::0	0000:0000:0000:0000:0000:0000:0000:0000
0:AA::0	0000:00AA:0000:0000:0000:0000:0000:0000
0:1234::3	0000:1234: 0000:0000:0000:0000:0000:0003
123::1:2	0123: 0000:0000:0000:0000:0000:0001:0002

B.

0::0:

The unabbreviated form of this IPv6 Address is 0000:0000:0000:0000:0000:0000:0000:0000. It is an **Unspecified (Reserved) Address** which is used for IPv6 address lookup.

0::FFFF:0:0

The unabbreviated form of this IPv6 Address is 0000:0000:0000:0000:0000:FFFF:0000:0000. It is **mapped IPv4 address** as the high order 96 bits are used to store the fixed prefix 0000:0000:0000:0000:0000:FFFF.

582F:1234::2222

The unabbreviated form of this IPv6 Address is 582F:1234:0000:0000:0000:0000:0000:2222. It is **Provider Based Unicast address** as the address type prefix is 010 which indicates a unicast address.

4821::14:22

The unabbreviated form of this IPv6 Address is 4821: 0000:0000:0000:0000:0000:0014:0022. It is **Provider Based Unicast address** as the address type prefix is 010 which indicates a unicast address.

C.

Version (4bit) (6)	**Priority (4bit)** (4)	**Flow Label (24bit)** (926)	
Payload Length (16 bit) (140)		**Next HDR (8bit)** (6)	**Hop Limit (8)** (40)
Source IPv6 Address (128 Bits) 582F:1234:0000:0000:0000:0000:0000:2222			
Destination IPv6 Address (128 Bits) 4821: 0000:0000:0000:0000:0000:0014:0022			

D. The low-order 32 bits of IPv6 address are used to IPv4 address, while the high-order 96 bits are used to store the fixed prefix 0000:0000:0000:0000:0000:FFFF. The format has been shown in the following table for the IPv4 address 129.6.12.34:

80 bits	**16 bits**	**32 bits**
0000:0000:0000:0000:0000	FFFF	129.6.12.34

The hexadecimal value of 129.6.12.34 is 8106:0C22. So, the mapped IPv6 address format of the IPv4 address 129.6.12.34 in hexadecimal colon notation is:

Unabbreviated mapped IPv6 Address	**Abbreviated mapped IPv6 Address**
0000:0000:0000:0000:0000:FFFF:8106:0C22	::FFFF:8106:C22

E. The IPv6 loopback address in hexadecimal colon notation is 0:0:0:0:0:0:0:1 or ::1.

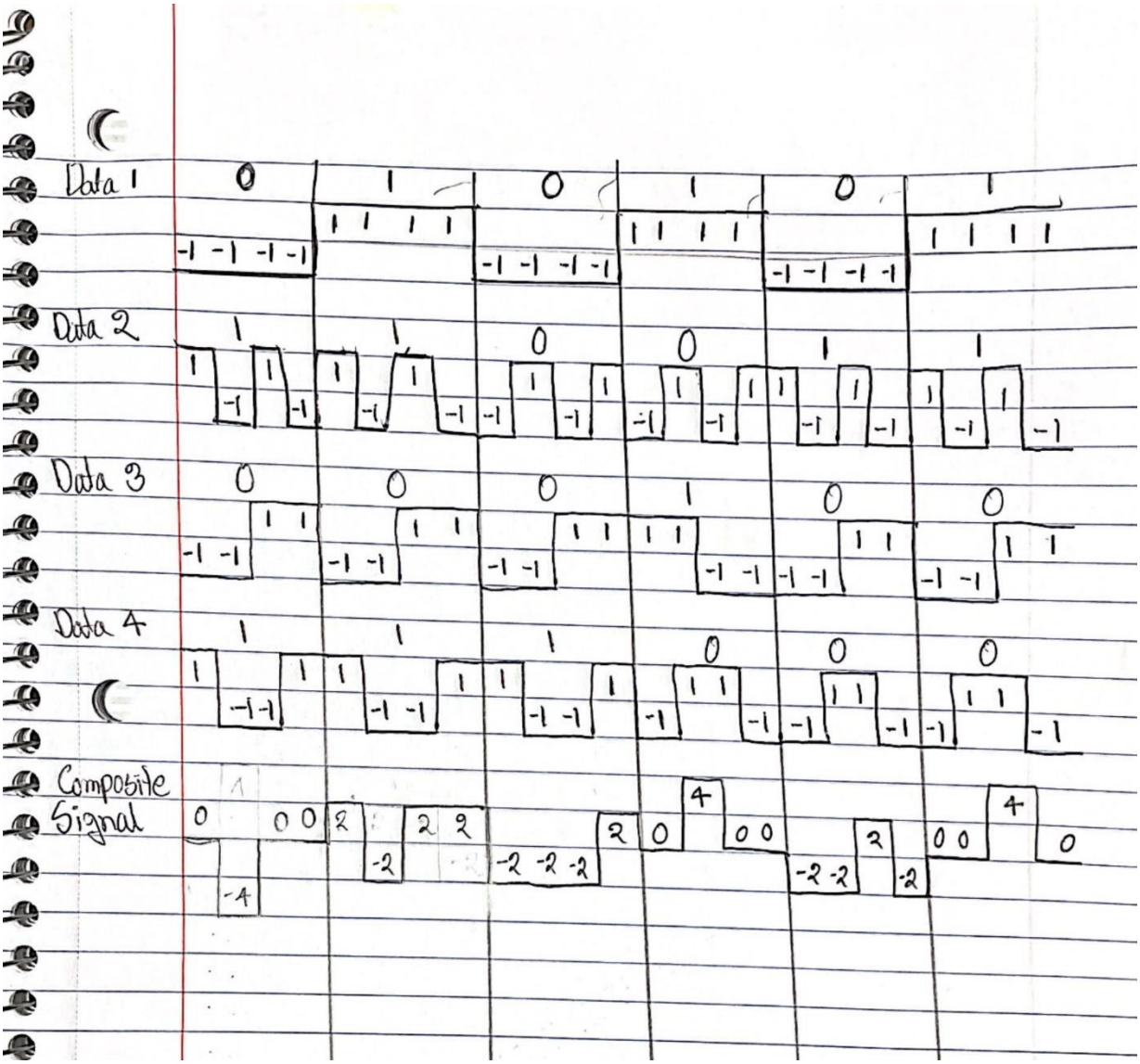
Task 2

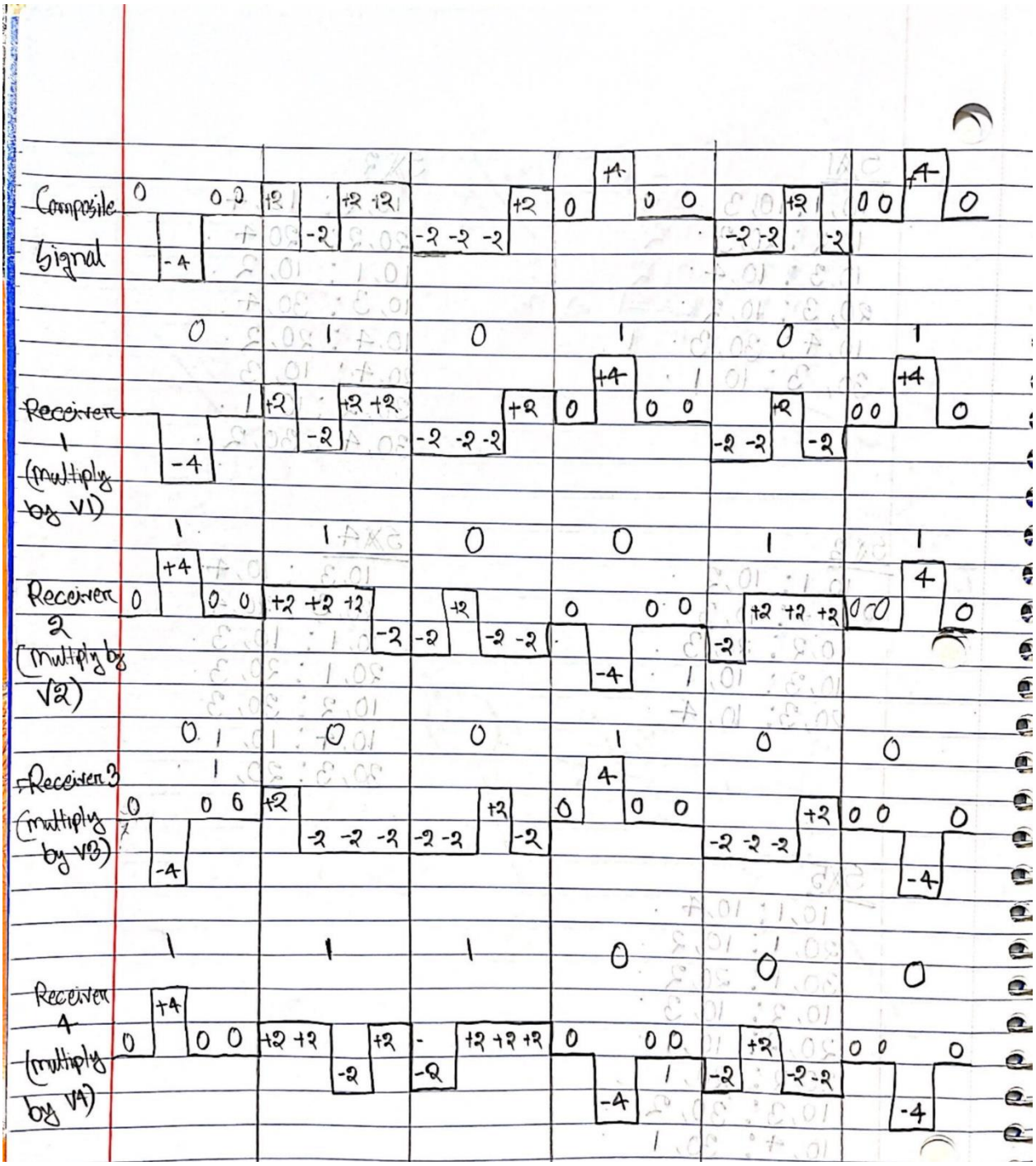
Data Encoding for Data 1: (-1,-1,-1,-1), (1,1,1,1), (-1,-1,-1,-1), (1,1,1,1), (-1,-1,-1,-1), (1,1,1,1)

Data Encoding for Data 2: (1,-1,1,-1), (1,-1,1,-1), (-1,1,-1,1), (-1,1,-1,1), (1,-1,1,-1), (1,-1,1,-1)

Data Encoding for Data 3: (-1,-1,1,1), (-1,-1,1,1), (-1,-1,1,1), (1,1,-1,-1), (-1,-1,1,1), (-1,-1,1,1)

Data Encoding for Data 4: (1,-1,-1,1), (1,-1,-1,1), (1,-1,-1,1), (-1,1,1,-1), (-1,1,1,-1), (-1,1,1,-1)




Composite signal
Receiver 1 (multiply by V1)
Receiver 2 (multiply by V2)
Receiver 3 (multiply by V3)
Receiver 4 (multiply by V4)

Task 3

Overview of Zigbee

Zigbee is a wireless technology that was established as an open worldwide connection standard to meet the special requirements of cost effective and low-power wireless IoT data networks [1]. The IEEE 802.15.4 physical board radio specification underpins the Zigbee connection standard, which runs in unlicensed radio frequencies such as 2.4 GHz, 900 MHz, and 868 MHz [2]. The idea of Zigbee emerged in the late 1990s [3] when many developers and engineers came up with the fact that both Wi-Fi and Bluetooth would be inadequate for a wide range of applications. A lot of engineers were particularly interested in creating ad hoc network of digital radios that could arrange themselves without the need for network administration or external setup. After being conceived in 1998, Zigbee was standardized in 2003 and revised in 2006 [4].

Architecture and Operation of Zigbee

The architecture of the Zigbee is based on two blocks among which the upper layer the data link layer placed at the bottom forms a bridge between the top and lower layers, whereas the application layer in the upper layer has nodes to connect the end device [5]. This architecture is known as a stack and Zigbee stack has four major components (Appendix A) which are described below:

- Application Layer: Application layer in Zigbee has two sublayers which are Application Support Sub Layer and Application framework. This layer filters packets for end devices and looks for duplicate packets, which are frequent in networks with automated retries. When the sender requests an acknowledgement, it automatically retries the transmission to increase the likelihood of success [6].
- Network Layer: The interface between the application layer and the MAC layer is provided by the network layer. It oversees routing and constructing the Star, Mesh, and Tree topologies of the Zigbee network. To route data from source to destination, it also offers routing features that enable RF data packets to go via many devices [7].
- Medium Access Control (MAC) Layer: The layer oversees managing the connection between the physical layer and the network layer [8]. PAN ID as well as network discovery via beacon requests are also handled by the MAC layer.
- Physical Layer: The Physical Layer establishes the physical and electrical features. Data reception and transmission are handled by this layer. The primary function of the physical layer is to map informational bits and allow them to move through the air via modulation and spreading techniques.

Applications of Zigbee

Numerous industries, including home automation, healthcare, and material tracking, use Zigbee technology. A communication link continuously monitors numerous parameters and crucial equipment in the manufacturing and production industries. Therefore, Zigbee significantly lowers this communication cost while also streamlining the control procedure for increased dependability. Today's digital giants are placing a lot of money on home automation services with their products like Google Home, Amazon Alexa, and others [9]. Zigbee wireless technology is ideal for remotely managing household appliances as part of security systems, lighting controls, appliance controls, safety controls, and other applications. Between the healthcare gateway and the vital sign monitoring devices such as ECG BPO2 etc. [10], data is sent using the Zigbee module.

References

[1] J. Morales, “What is zigbee and how does it work?,” *MUO*, 20-Oct-2022. [Online]. Available: https://www.makeuseof.com/what-is-zigbee/. [Accessed: 02-Dec-2022].

[2] “What is Zigbee Protocol Wireless Mesh Networking?,” *What Is Zigbee Protocol Wireless Mesh Networking? | Digi International*. [Online]. Available: https://www.digi.com/solutions/by-technology/zigbee-wireless-standard.

[3] R. Kay, “Zigbee,” *Computerworld*, 15-May-2006. [Online]. Available: https://www.computerworld.com/article/2554497/zigbee.html?page=2. [Accessed: 02-Dec-2022].

[4] “Zigbee,” *Wikipedia*, 26-Nov-2022. [Online]. Available: https://en.wikipedia.org/wiki/Zigbee#:~:text=Zigbee%20has%20a%20defined%20rate,2003%2C%20and%20revised%20in%202006. [Accessed: 02-Dec-2022].

[5] “Zigbee Technology Architecture,” *FreeWimaxInfo.com*, 14-Aug-2016. [Online]. Available: https://freewimaxinfo.com/zigbee-architecture.html. [Accessed: 02-Dec-2022].

[6] L. Ashrit, “Zigbee architecture (Zigbee stack) - all layers and its functions,” *electricalfundablog.com*, 08-Dec-2018. [Online]. Available: https://electricalfundablog.com/zigbee-architecture-zigbee-stack-layers/. [Accessed: 02-Dec-2022].

[7] “Introduction to zigbee: Architecture, networks and at commands,” *What is ZigBee? Zigbee Architecture, Networks and AT Commands*. [Online]. Available: https://circuitdigest.com/article/zigbee-introduction-architecture-at-commands. [Accessed: 02-Dec-2022].

[8] “Introduction of zigbee,” *GeeksforGeeks*, 07-Jun-2022. [Online]. Available: https://www.geeksforgeeks.org/introduction-of-zigbee/. [Accessed: 02-Dec-2022].

[9] J. Chakraborty, “Zigbee and its significance in IOT applications,” *IoTEDU*, 12-Dec-2020. [Online]. Available: https://iot4beginners.com/zigbee-and-its-significance-in-iot-applications/. [Accessed: 02-Dec-2022].

[10] K. Al Sharqi, A. Abdelbari, A. A. Elnour, and M. Tarique, “Zigbee based wearable remote healthcare monitoring system for elderly patients,” *International Journal of Wireless & Mobile Networks*, vol. 6, no. 3, pp. 53–67, 2014.

Appendix

Appendix A

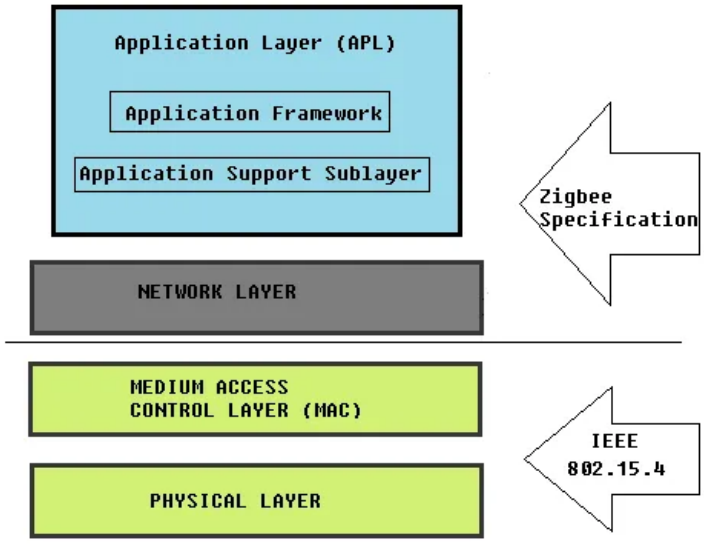


Figure: Architecture of Zigbee [6]