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Overview of Network Topology in Hospital Management System

Fenska Seipalla[1*], Nadia Liem[1], Deorina Siregar[1], Ardhin Martdana[1], Vip Paramarta[2]

Master of Hospital Management, Universitas Sangga Buana, Bandung, Indonesia
Email : [1]Fenskaledge@gmail.com, [2]Nadialiem02@gmail.com, [3]deorina96@gmail.com, [4]ardhin213@gmail.com, [5]vip@usbypkp.ac.id

Abstract - *Modern hospital administration systems rely significantly on information technology, which includes patient data, medicine inventory management, medical equipment, and more. Understanding network topology is crucial in hospital system management to ensure that the network infrastructure chosen is consistent with the hospital's operational goals and objectives. The method of writing a review of this article is based on the search of the relevant literature to the main problem of the review. The findings compare each network topology's advantages and disadvantages for implementation in a hospital management system. In its network design, hospitals must consider a number of challenges and concerns. First, data integration between a hospital's internal systems must be smooth and seamless in order to provide appropriate and effective patient care. Second, data security must be prioritized, with contemporary security technology such as firewalls and data encryption used. Furthermore, to ensure continuous service availability, network maintenance must be planned and executed effectively. Finally, profit optimization entails selecting the appropriate equipment and employing cost-effective management practices to support long-term hospital operations. In the end, selecting a stable network topology is critical to achieving high patient service satisfaction.*

Keywords*: Hospital Management, Network Topology, Management System, Medical Technology*

1. INTRODUCTION

Hospitals, as medical facilities, treat patients ranging from acute cases through emergencies, polyclinics, and inpatient treatment. Hospital administration entails overseeing resources such as human resources, medical equipment and medicine supplies, financial systems, and security systems, among others. Management systems aid in the planning, monitoring, and optimization of these resources. In general, hospitals continue to seek to improve the quality of work services in order to increase patient satisfaction. With an integrated hospital management system, this can help monitor performance and provide information about hospital service improvements. Modern hospital administration systems, which include patient data, drug inventory management, medical equipment, and more, rely heavily on information technology. Understanding the overview of network topology is critical in hospital system management to guarantee that the network infrastructure chosen is in compliance with the hospital's operational goals and objectives. A computer network's topology is its design. Choosing the correct network topology is critical in management systems, particularly hospital management, because network topology influences the performance, security, availability, and scalability of Information Technology (IT) infrastructure. Aside from that, cost issues must be examined and incorporated into the hospital budget. Choosing the correct network architecture in hospital system management is critical for optimizing operational efficiency, improving patient service quality, and assuring patient data security. In this paper we will discuss the various network topologies that exist and how to choose the right network topology for a hospital system.

2. METHODOLOGY

The method of writing a review of this article is based on the search of the relevant literature to the main problem of the review. Literature comes from textbooks or journals obtained online, then selected according to relevance to the theme and title, and feasibility. The literature search was conducted using Google Database until the latest references in 2023. Reference eligibility categories include discussion about network topology and implementation in hospital management system.

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3. LITERATURE FINDINGS

The physical look of a network that details the positioning of machines in the network and how cables are drawn to connect these computers is referred to as network topology. This is a geometric representation of the relationships between devices (computer terminals, repeaters, and bridges). Choosing the optimal topology for every company's operational model can increase performance while making it easier to discover faults, remedy errors, and allocate resources more effectively over the network. An efficient and well-managed topology can boost energy and data efficiency, lowering operating and maintenance costs.

The topology of a network is separated into two parts:

a. Physical describes the physical connections between equipment (computers, servers, hubs, switches, and network cables) that form a specific pattern.
b. Logical, also known as signal topology, is a description of how one device communicates with another.

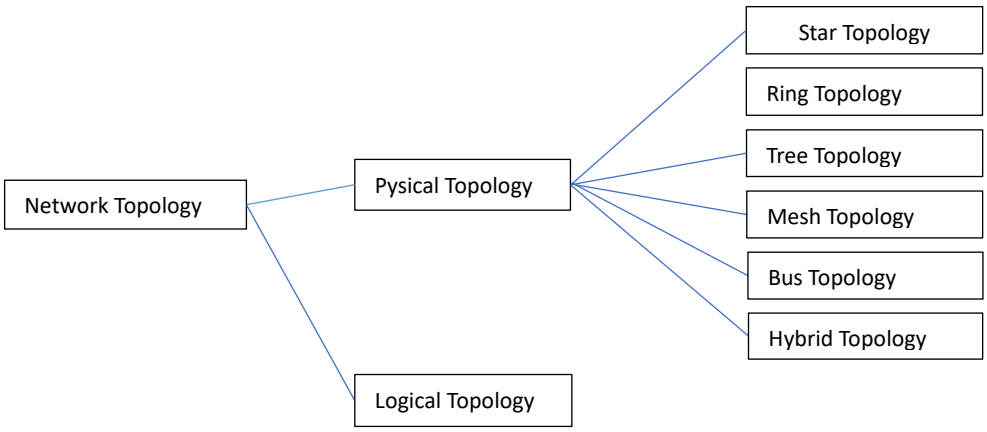

Figure 1. Illustration of Several Types of Network Topology Used For System Management.

a. Bus Topology

A network configuration in which each computer and network device is connected to a single cable is known as line topology. This type is appropriate for tiny networks (such as those set up in small offices).

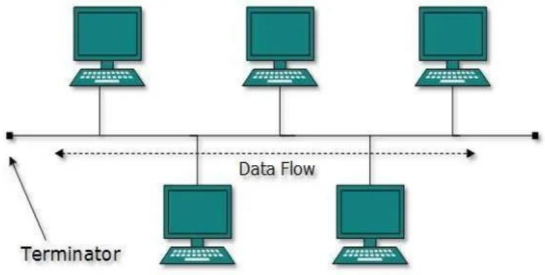

Figure 2. Bus Topology (Source: https://vidumibandara23.medium.com/network-topologies-8d6a09d43acd)

b. Star Topology

This is the most popular topology. Each network device is connected to a central hub, which is the host computer, in this topology, and at the end of each connection is a terminal. Each node (computer workstation) in a star architecture is linked to a central node known as a hub or switch.

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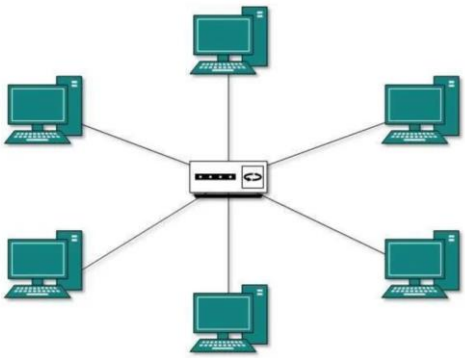

Figure 3. Star Topology (Source: https://vidumibandara23.medium.com/network-topologies-8d6a09d43acd)

c. Ring topology

Every node or device is linked to every other device on both sides. A ring topology is a network topology that connects two computers in a circular circuit, much like a ring. Typically, this topology just employs a LAN card to connect one computer to another.

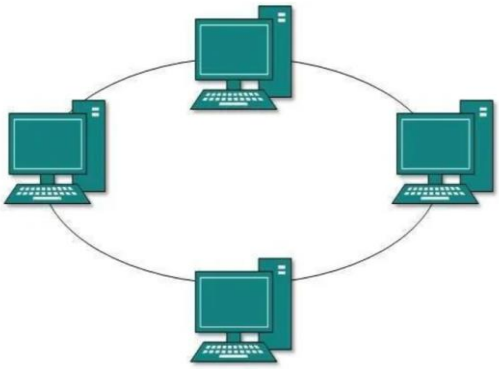

Figure 4. Ring Topology (Source: https://vidumibandara23.medium.com/network-topologies-8d6a09d43acd)

d. Mesh topology

In terms of multiple route selection, this is an excellent topology. When other paths fail, this serves as a backup path; any device can connect to any device in the network.

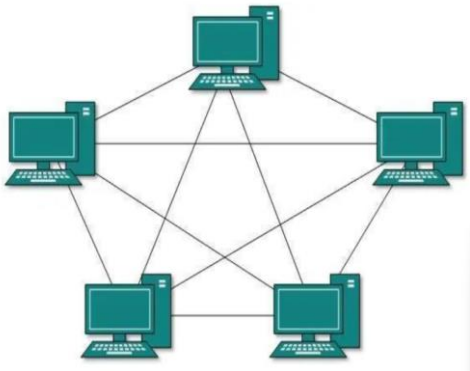

Figure 5. Mesh Topology (Source: https://vidumibandara23.medium.com/network-topologies-8d6a09d43acd)

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e. Tree Topology

A hybrid topology that combines star and bus topologies. This network topology is typically used to connect centers with distinct hierarchies. There are tiers in the network. The system is connected at the lowest level, which is access. The network center is the highest level. Like a bus topology, point-to-point connections exist between all adjacent hosts; if the root fails, the entire network is affected.

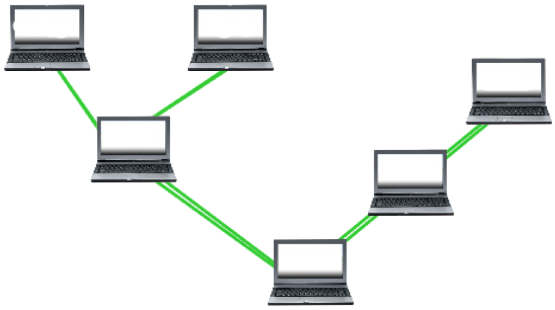

Figure 6. Tree Topology (Source: https://www.jatikom.com/pengertian-topologi-jaringan-komputer/)

f. Hybrid Topology

It can be said to be a combination of several topologies. Usually used in large companies where there is a personalized topology for each department.

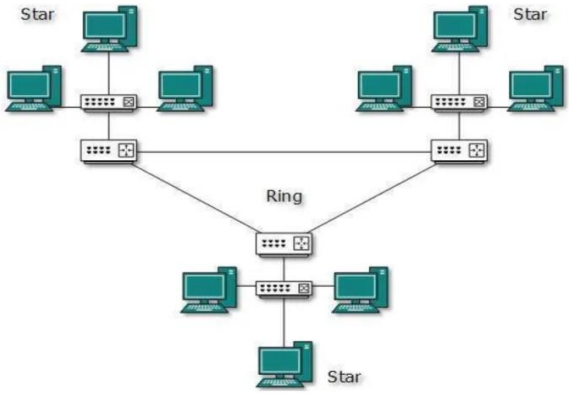

Figure 7. Hybrid Topology (Source: https://www.jatikom.com/pengertian-topologi-jaringan-komputer/)

The network topology chosen in a hospital must be based on the demands of the hospital, as well as budget and maintenance considerations, as well as the benefits and drawbacks of each network topology.

Table 1. Advantages, Disadvantages and Implementation of Network Topology in Hospital

Bus Topology	
Advantages	Installation costs can be said to be very cheap because it only uses a few ca bles. Adding new clients/workstations can be done easily. The topology is v ery simple and easy to apply.
Disadvantages	If one of the cables in the bus network topology breaks or has a problem, thi s can disrupt other workstation/client computers. The process of sending (se

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	nding) and receiving (receiving) data is less efficient, usually data collisions often occur in this topology.
Implementation in Hospital	Hospitals can use this topology for small and isolated networks such as spec ific departments such as laboratories or small clinics.
Star Topology	
Advantages	If one computer experiences a problem, the network in this topology contin ues to run and does not affect other computers. Being flexible, the level of s ecurity can be said to be quite better than a bus topology. The ease of detect ing problems is quite easy if there is damage to the network.
Disadvantages	If the switch/hub which is actually the central point experiences problems, t hen all the computers connected to this topology also experience problems. It just requires a lot of cables, so the costs are quite expensive. The network is highly dependent on the central terminal.
Implementation in Hospital	Can be applied to the hospital administration section to make management a nd monitoring easier.
Ring Topology	
Advantages	Has better performance than bus topology. Easy to implement, reconfigurati on and installation of new devices can be said to be quite easy, because addi ng or removing devices only requires moving two connections. Ring networ ks can also cover longer distances compared to other types of networks. Unl ike bus topology.
Disadvantages	Communication performance in this topology is assessed by the number of points or nodes. Troubleshooting can be said to be quite complicated. If one connection breaks, the other connections also break. In this topology, collis ions (data collisions) usually occur, moving, adding and changing devices c an affect the system.
Implementation in Hospital	This topology can be applied in the ICU in installing patient monitoring dev ices to ensure consistent data access.
Mesh Topology	
Advantages	There are many data transmission paths used, so there is no need to worry a bout data collisions. The bandwidth is quite wide. Security in this topology can be said to be very good.
Disadvantages	The network installation process in this topology is very expensive, because it requires a lot of cables.
Implementation in Hospital	Can be implemented in hospital data centers because of excellent security. This topology can also be applied to critical life- support systems because network services will not be interrupted if one devi ce is interrupted or disconnected.
Tree Topology	
Advantages	Hierarchical centralized data arrangement, a combination of star and bus top ologies. This makes data management better and easier. Easy to develop int o a wider network. Errors in the network can be detected. Network installati on and configuration is easy.
Disadvantages	If the computer at the highest level experiences a problem, then the comput ers below it also have problems, network performance in this topology is co nsidered slow. Using lots of cables and the bottom cable (backbone) is the c

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	enter of this technology. The budget required is also quite expensive to insta ll and maintain this type of network topology because it is quite complex.
Implementation in Hospital	Can be applied in hospitals with many departments. For example, the admin istrative data center is the backbone ensuring centralized control and sharin g of resources. Each branch of the tree represents an isolated department wit h its own network. For example, the radiology department is separate from t he surgery department so that if there is network disruption in the surgery d epartment it will not affect the radiology department.
Hybrid Topology	
Advantages	Adding other connections is very easy. Combines several topologies so it is flexible. Suitable for hospitals that require a lot of complex networks.
Disadvantages	Management of this network is very difficult. The development costs for thi s topology are also expensive. Network installation and configuration on thi s topology can be said to be quite complicated, because there are different t opologies.
Implementation in Hospital	Implemented in large hospitals where a star topology can be combined for t he administrative part, a ring topology for monitoring patients in certain roo ms, and a mesh topology for the hospital data center.

In hospital system management, designing a dependable network architecture is critical to ensuring hospital integrity and operating efficiency. Several significant factors must be considered in order to reach this goal. First, data integration between a hospital's internal systems must be smooth and seamless in order to provide appropriate and effective patient care. Second, data security must be prioritized, with contemporary security technology such as firewalls and data encryption used. Furthermore, to ensure continuous service availability, network maintenance must be planned and executed effectively. Finally, profit optimization entails selecting the appropriate equipment and employing cost-effective management practices to support long-term hospital operations.

4. CONCLUSION

Choosing the correct network architecture in hospital system management is critical for a variety of reasons. The key to enabling quality patient care, protecting data security, and running hospital operations efficiently is a combination of availability, security, maintainability, efficient system integration, and prudent cost management. Before constructing a computer network in a hospital, the importance of thorough design must be considered. In its network design, hospitals must consider a number of challenges and concerns that can effect performance, data security, and patient privacy. Hospitals must integrate their information systems well to enable smooth data flow between multiple systems such as inventory management systems, finance systems, and electronic medical records. Choosing a dependable network topology is critical to guaranteeing high service availability for patients. Network disruption or failure can have a serious impact on patient care and their satisfaction.

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