HAPTER 1

INTRODUCTION

1.1. **Background**

The Huge of Data need suffer the Access Network existing, so the fiber network become the promises Technology to compete the needs and demands. Fiber to The Home (FTTH) Access Network base on Giga bit Passive Optic Network (GPON) Technology represent a Great Solution for Triple Play Services. GPON connected Optical Line Termination (OLT) at the Central Office to the Customer Premises Optical Network Terminal (ONT) via Optical Distribution Cabinet (ODC), Cables and Splitters.

Designing of FTTH requires consideration of several factor: Dimension of Splitter, Power loss allowance from OLT to ONT, Numbers of Demand, Coverage Area, and Clustering. The growth of the City usually getting bigger and wider, spreading to the Suburb area because of space or limitation area in the city itself. Availability fiber optic network existing due to the existing Network Topology that possible to be gain or enhanced to the full FTTH. These requirements are combined with the difficulty to reach efficiency to reach the efficiency, In other words double cost, double investment, the worst is the design itself cannot accommodate the future needs. Some other effect happen on the Operation and Maintenance cost, and asset depreciation. It is important to create a design that is able to minimize development costs and to accommodate potential customers.

The spreading demand in the suburban area becomes new challenge in the Development Program. To match the Implementation and demand, in this case TSP Modeling being chosen to solve the problem. However, network designs are usually created by network planners based on their expert domain knowledge. The designs are often produced in tight time scales and the quality of designs varies with the planners' experience. Time constraints imposed to the planners make it impossible for them to evaluate different scenarios to achieve lowest cost. In general, as soon as the design satisfies all the planning rules, he/she will then submit the design and move on to another area. In addition, different planners may produce different designs even for the same networks. The variations are due to the experience of planners and the complexity of the given networks.

The author chose ACA and GA due to the advantage of both and in this case to determine the extent of the strengths and weaknesses of each algorithm to provide the optimized solution for the needs of design comparing to the results of manual FTTH design planner Implemented, in

several parameters namely: attenuation distribution as small as possible (within the distribution as short as possible) and meet the criteria of choosing development pathways of distribution of ODC to ODP (as a representation of demand).

1.2. **Design Concept of FTTH**

FTTH technology provides residences with high speed broadband access to digital services and the Internet. The FTTH networks have now established their economic competitiveness by providing significantly reduced operating expenses and enhanced revenue opportunities for carriers. In addition, a FTTH solution based on Wavelength Division Multiplexing (WDM), or a λ - based structure, allows for additional flexibility and adaptability to support future services. FTTH network has very useful property it is the distributed architecture in manner of several varieties of splitters located at different strategic places in the network.

In Economic aspect of projects and/or solutions in telecommunication networks is discussed and the authors found that the GPON is the more suitable to implement FTTH than other networks. In a comprehensive cost modeling of FTTH was presented, which includes outside plan, head end, and premises equipment and labor with enhanced reach and split ratio and estimate cost as associated with passive and active equipment and components for the typical FTTH PON. The aim of is to enhance the quality of service offered by standard passive optical networks with reduced network costs. To that extent, a dynamic multi-wavelength protocol has been developed to increase the network upstream bandwidth and introduce multiple service levels to a Fiber To The Home-based through a Gigabit Passive Optical Network (GPON). Cost optimization is introduced for feeder cables, distribution cables and total cost of FTTH network through the GPON technology with respect to the number of optical distribution point.

1.3. **Consideration of Topic Selection**

The Era of Fiber Optic becomes more reliable to implement in a wide area in the need of Broadband Technology. The combination trick to achieve the future as soon as possible with consideration to the existing fiber optic Networks, with the basic need for the FTTH Network. Passive Optical Network (PON) is one alternative that could replace copper for broadband technology and PON networks can be integrated with a network of copper (copper). With a Passive Optical Network (PON) performance can be improved and operating costs can be reduced. With fiber optic technology several services such as telephony, data, and video can be through a single channel. Optical fiber transmission in PON networks using three wavelengths to carry communication signals by utilizing the WDM (Wavelength Division Multiplexing).

Development especially FTTH fiber optic network in Indonesia is relatively inexpensive compared with 5 years ago, however, the main obstacle is the FTTH network development process include:

1. Provision of data of potential customers who have a high validity value
2. Constrains geographic and demographic region outside of Java where islands and spacious and distribution of the population.
3. Licensing liberation and or land use
4. There are no attractive incentives for partners or investors, especially outside Java.

Having regard to the points 1, 2 and 4 mentioned above have implications for a significant increase amount of the costs for the construction of FTTH networks in Indonesia (especially outside Java).

1.4. **The Gap of the Real Condition and the Future**

Design is currently relying on the ability and experience of the designer in the observation and analysis of field data that requires a lot of time and cost, The next is expected later in the design process can be done more quickly, accurately and economically, especially in minimizing the cost of implementation.

1.5. **Problem Definition**

The best FTTH design is a design that gives the least cost effects. In other words, the design gives the final results of an efficiency optimization. In this study we will perform an optimization of existing designs by using a genetic algorithm and ant colony algorithm. The main target is to obtain a FTTH design with the lowest cost value, in this case represented by the achievement of the shortest distance distribution of cable length.

1.6. **Problem Limitation (constrains)**

- Case of optimization base on developed FTTH infrastructure at Manado city with three (3) distribution and sixteen (16) odp.
- In this study focus on placement route of access distribution design between optical distribution cabinet (odc) to optical distribution point (odp).
- Distance in meter and in accordance with the road-based service route taken from google earth.
- The study of performance comparison between GA and ACA is tested and evaluated for 144 nodes odp (maximum capacity of existing ODC).

Design of FTTH in Manado city.

Description of the Method:

1. Input: location of Demand with Clustering segment.
2. Process: Calculating shortest path according to the limitation of maximum Power loss allowed using Genetic Algorithm and Ant colony Algorithm.
3. Output: Path of FTTH cable from ODC to Premises, in each Cluster.

Assumptions:

- Location of Entry Point of Network available.
- Location of Customer available.
- Location of Optical Distribution Cabinets available.
- Civil network no Issue.
- Maximum Link Budget: 28 dB

1.7. **Relation between Problem and Objective**

The analysis of a FTTH system in order to come up with a cost effective network supporting triple play. The proposed solution minimizes optical path loss of optical distribution network (ODN) to provide maximum reach of 20 km and 1:32 splitting ratio to the premises through a properly engineered and designed system. To find the optimum design of FTTH and compete with the fulfillment of spreading demand.

The focus of this research object is to obtain the minimum cost of development through the achievement of the shortest distance distribution of access and turnaround times in FTTH design with maximum attenuation of certain thresholds. The model optimally divides a large network area into several areas. Each area is served by an ODC. Customers in each ODC catchment area will be connected to a splitter within that ODC provided that they satisfy the power budget constraints. The key to network distance is Optical Power Budget: the amount of light available to make a fiber optic connection. Two measurements are needed from the manufacturer of the equipment. The first is Minimum transmit power represents the worst case transmit power for a device - the device is guaranteed to provide at least that much power. The second piece of information required is the minimum receive sensitivity. This figure represents the minimum amount of light required by the receiver to operate correctly.

Each component of FTTH network contains of losses, cable attenuation, connector loss, and splice loss is then subtracted from the available power. If this number is negative, there is no need to continue, as there is not enough power to drive the network. If this number is positive, must be mentioned that capable handling the safety margin (for maintenance and operational issue). The dispersion analysis in digital systems is equivalent to assessing the rise time of the link. In the power budget, we neglect the dispersion effect, which is the same as consider the bandwidth of the system to be large enough to be able to transmit the required bit rate. The dispersion reduces the available bandwidth which may limit not only the transmission rate, but also the sensitivity of the receiver and consequently the power budget due to intersymbol interference. The purpose of this method is to analyze whether the network performance as a whole has reached capacity and is able to meet the desired channel. Generally the total degradation time of transition from the digital link does not exceed 70 percent of one of the bit NRZ (non-return-to zero) or 35 percent of the bit period for data RZ (return-to-zero).

Genetic Algorithm known as fast processing and Ant Colony Algorithm known as accurate processing, so in this condition, we expected that by using this algorithm in the process design will give better result than the manual process design which is match to the needs in the design process of FTTH.

1.8. **Research Objectives**

This research is to achieve the minimum cost for the FTTH design results represented in the minimum cable length of FTTH distribution, with certain restrictions of attenuation values. Achievement of the minimum length of the cable distribution of FTTH is done using the optimization process. The optimization is performed by using two approaches, namely Genetic Algorithm (GA) and Ant Colony Algorithm (ACA)

To optimize cost of planning and deployment FTTH network and to avoid the double investment by a calculation process using Genetic and Ant Colony Algorithm in process with Matlab Application and then to compare result parameters (length of distribution, attenuation, time process) to the actual deployment result.

1.9. **Hypotheses**

The use of genetic algorithms and ant colony gives the optimization of the design results FTTH distribution cable to minimized cost of deployment.