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Network Interconnection Design and Automatic Tank Gauging (ATG) Data Communication on Tankvision

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Abstract
ATG (Automatic Tank Gauging) is an automatic measurement system used to monitor levels and temperatures in oil storage tanks. ATG network interconnection and data communication is one of the technologies implemented by oil refinery company. ATG also supports the digitalization and business transformation processes that are being carried out. Network interconnection and data communication on the ATG uses a system that connects sensors installed on equipment in the storage tank with a central computer that processes and displays various kinds of data. Data communication network at ATG uses ethernet and fiber optic technology to transmit data in real time, accurately and safely. In this design simulation, the author will use the Cisco Packet Tracer application to discuss loop schematics, system architextur, protocols, standards, etc. of the data communications network on ATG, as well as provide suggestions for improvement and optimization ATG data communication system in the future.

Keywords: Network, ATG (Automatic Tank Gauging, Cisco Packet Tracer

1. Introduction

Oil refinery companies produce various oil and gas products. In this industry, there are many tanks containing crude oil and various products with different viscosities. To measure and find out how much oil and gas is in a tank, Automatic Tank Gauging equipment or what is usually called ATG is needed. Automatic Tank Gauging is equipment needed to determine the level or amount of liquid (both in volume and weight units) on the basis of measuring the level of liquid stored in a storage tank and can also be used to determine several liquid parameters in the tank. Automatic Tank Gauging has different applications depending on the needs required.

As time goes by, advances in technology and electronic devices are developing very rapidly. This also affects the oil and gas industry. Tank Gauging has experienced technological developments, from manual dipping to now being automated. By installing the ATG, the liquid level can be monitored locally or remotely in the Control Room Oil Movement. To connect the ATG in the tank with the monitor in the Control Room, of course a network is required. Computer networks enable the exchange of data and information between various devices and entities in a wider range. In addition, these devices also require an appropriate layout to minimize interference and maximize efficiency. Therefore, designing network interconnections and data communications from the tank to the control room is important in ensuring optimal connectivity.

2. Research Methods

2.1 Automatic Tank Gauging (ATG)

Automatic Tank Gauging (ATG) is a liquid level measuring device in tanks for both crude tanks and product tanks that uses a digital system and works automatically, able to provide the data needed for tank level calculations.

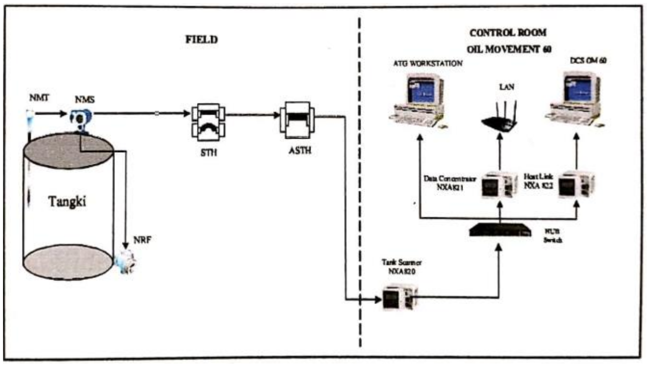

Fig 1: Loop diagram system ATG

Briefly, it can be explained that ATG data from the field is sent to the control room and displayed on the PC as a monitoring tool. Apart from measuring liquid levels, the ATG system can be used to verify flow meter results in the metering system. The ATG system is a class 2 metering system based on the American Petroleum Institute (API) standards contained in the Manual of Petroleum Measurement Standards (MPMS). By using ATG, it is hoped that it will be able to overcome the problems or deficiencies that existed in the previous tank level measurement system, namely manual dipping measurements.

Tankvision is a dedicated tank inventory system operated by a standard web browser and requires no proprietary software or licensing fees. Tankvision is based on a distributed architecture on a Local Area Network (LAN). Due to its modular structure, it can be adapted to any application. Tankvision is not only suitable for small tank areas with only a few tanks, but also for large refineries with hundreds of tanks. Tankvision consists of several components. First, the Tankvision NXA820 tank scanner is used to scan the parameters of the tank gauge and perform tank calculations. Then the NXA821 tankvision concentrate data is used to summarize data from various NXA820 tank scanners. Lastly there is the Tankvision NXA822 link host.

2.2. Network Simulation for Data Communication on Tankvision

Refer to the exhibit, it can be seen that the components of the Tankvision network need to be adjusted to match the components contained in the Cisco Packet Tracer application.

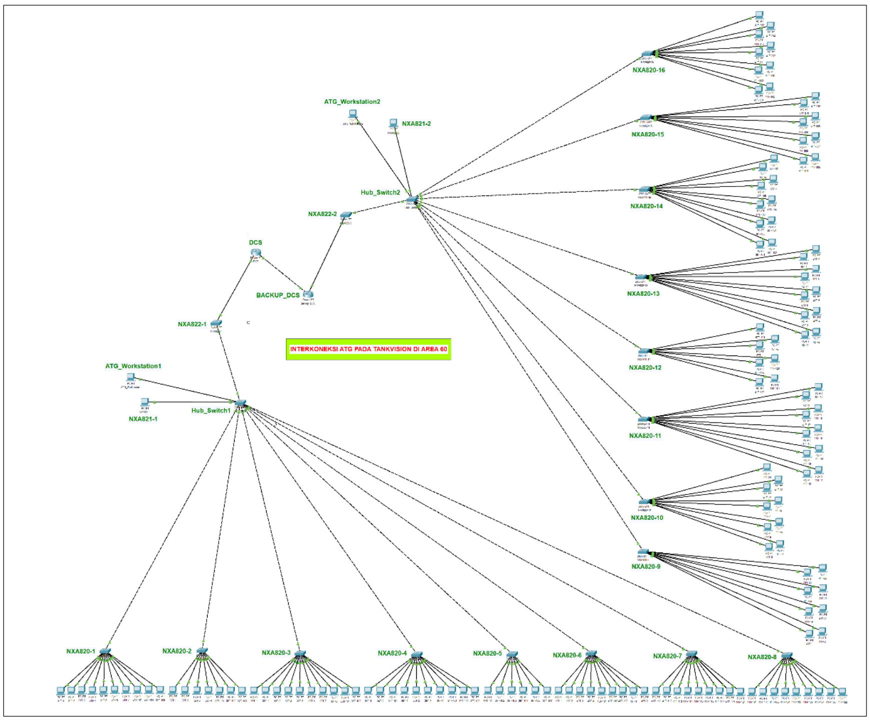

Fig 2: Physical Topology Tankvision

For the tanks themselves, based on the data, there are 142 tanks, in this simulation they are assumed to be PCs. Then the NXA820 scanner tank, which based on data contains 16 hosts here, is assumed to be a switch starting from NXA820-1 to NXA820-16. The hub switch must be reduced to just a switch in this design and made into 2 hosts. This is because based on data, the hub switch used in area 60 of PT KPI RU IV has 48 ports. Meanwhile, in the Cisco Packer Tracer application, the maximum ports on a switch are only 24 ports.

There is a data concentrate NXA821 which is assumed to be a PC. Based on his own data, there are 4 hosts for the NXA821, but to optimize the network design the author only made 2 NXA821 hosts, namely NXA821-1 and NXA821-2. Then there is also the NXA822 host link which is for example a switch and is connected to the DCS. As for the design itself, the NXA822 is the same as the NXA821 which only uses 2 host switches with the aim of optimizing network design. For DCS here, it is assumed to be a router whose function is to maintain data communications in designing the ATG network simulation. Finally, there is the ATG workstation which here is considered a PC for the end device.

The process of creating network interconnections involves a series of organized steps including design, configuration, installation and arrangement of network components to create an optimal structure according to the needs and goals of the organization. To make an interconnection, the connected IP address data is needed. Since the tanks located in area 60 of PT KPI RU IV do not have permanent IP addresses, in the simulation the tank design uses IP DHCP or Dynamic Host Configuration Protocol. Where in this interconnection design, the author uses 2 gateways for DCS and Backup_DCS. The gateway on DCS itself is 11.54.127.1 and the gateway on Backup_DCS is 13.54.127.1.

In one NXA820 switch there are 1-10 tanks connected. All tanks here use different DHCP IP addresses and are given automatically by the server to devices that request it. The IP address in DHCP has the nature of changing at a certain time with a more limited connection range that can be achieved. This is what makes the author use a DHCP IP address for the tank, because the tank itself here has a limited reach only at the refinery. On the NXA820-1 to NXA820-8, the gateway 11.54.127.1 is used, while the NXA820-9 to NXA820-16 uses the gateway 13.54.127.1.

Unlike the tank which uses a DHCP IP address, the NXA821 and ATG Workstation use a static IP address. The following is a list of names, IP addresses, and subnet masks used in this design:

Table 1: Name, IP *address*, dan *subnet mask*

No	Nama	IP Address	Subnet Mask
1	NXA821-1	11.54.127.100	255.255.255.0
2	ATG_Workstation1	11.54.127.101	255.255.255.0
3	NXA821-2	13.54.127.100	255.255.255.0
4	ATG_Workstation2	13.54.127.101	255.255.255.0

Based on the table above, it can be concluded that the connection from the NXA821-1 will enter the DCS router. Likewise, connections from ATG_Workstation1 will also enter the DCS router. This is different from the NXA821-2 which will be included in the Backup_DCS router. Likewise with ATG_Workstation2 which will also be included in the Backup_DCS router.

3. Results and Analysis

Command "ping (IP address)" uses to test the connection between all host on physical topology figure 2.

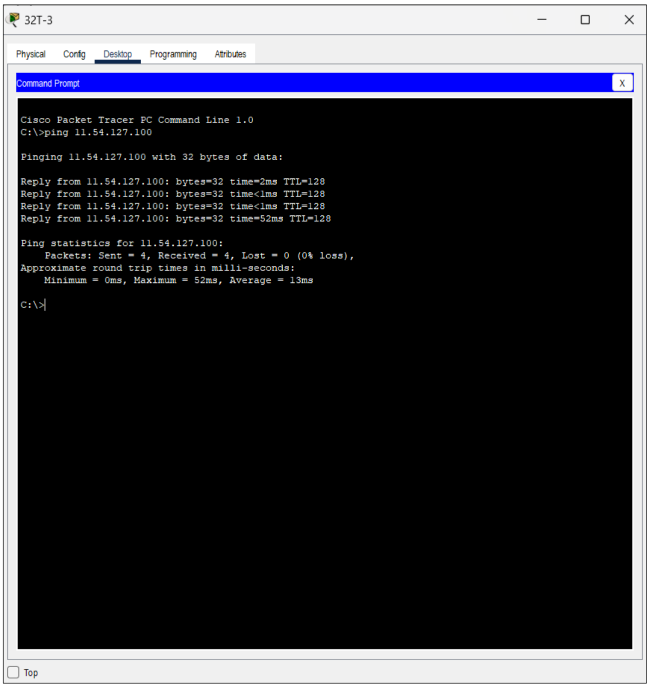

Fig 3: Connection test from tank to NXA821-1

From Figure 3, the author took a PC sample on the 32T-3 tank leading to the data concentrate component NXA821-1 with IP address 11.54.127.100. The results obtained from pinging the destination address are that all packets were delivered from the tank which has a DHCP IP to the NXA821-1 with IP address 11.54.127.100 and there were no errors in the process. Likewise, the command "ping 11.54.127.100" was successful as in the image above. The results obtained from pinging the destination address are that all packets were delivered from the tank to the NXA821-1 which has the IP address 11.54.127.100 with no errors and arrived at the destination within the specified time.

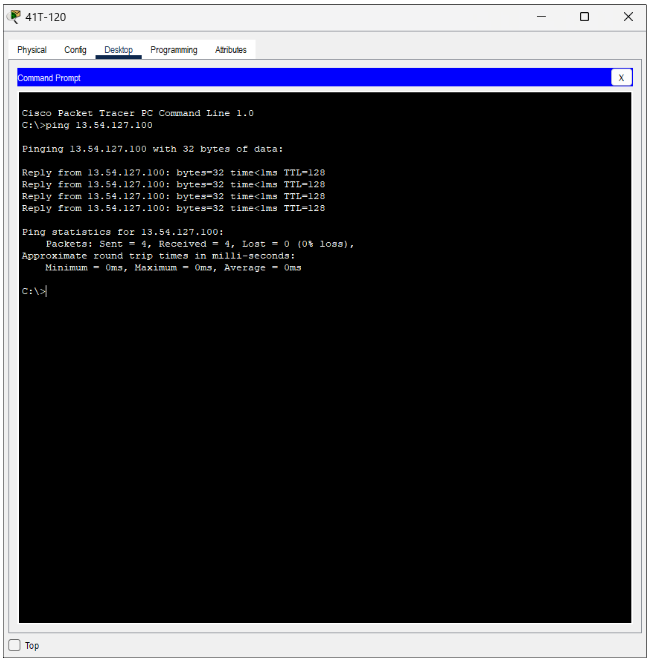

Fig 4: Connection test from tank to NXA821-2

From Figure 4, the author took a PC sample on the 41T-120 tank leading to the NXA821-2 data concentrate component with IP address 13.54.127.100. The results obtained from pinging the destination address are that all packets were delivered from the tank which has a DHCP IP to the NXA821-2 with IP address 13.54.127.100 and there were no errors in the process. Likewise, the command "ping 13.54.127.100" was successful as in the image above. The results obtained from pinging the destination address are that all packets were delivered from the tank to the NXA821-2 which has the IP address 13.54.127.100 with no errors and arrived at the destination within the specified time.

From Figure 5, the author took a PC sample on the 32T-3 tank heading to the ATG_Workstation1 component with IP address 11.54.127.101. The results obtained from pinging the destination address are that all packets were delivered from the tank which has a DHCP IP to ATG_Workstation1 with IP address 11.54.127.101 and there were no errors in the process. Likewise, the command "ping 11.54.127.101" was successful as in the image above. The results obtained from pinging the destination address are that all packets were delivered from the tank to ATG_Workstation1 which has the IP address 11.54.127.101 with no errors and arrived at the destination within the specified time.

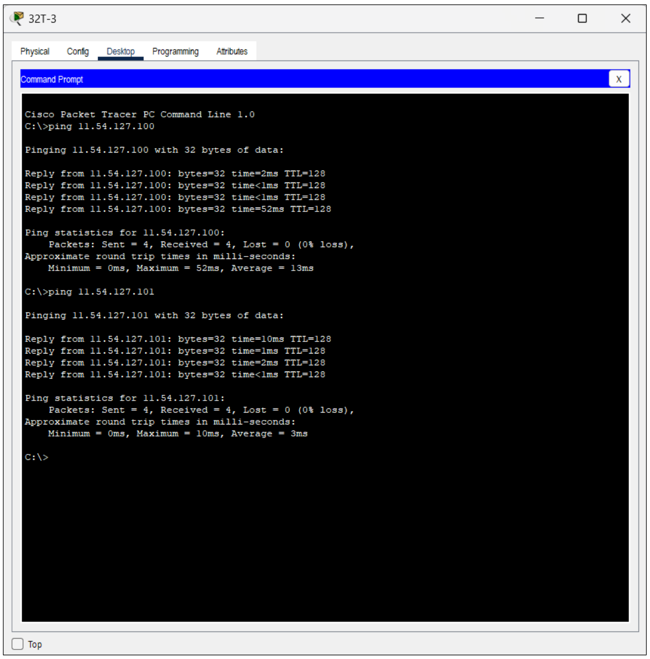

Fig 5: Connection test from tank to ATG_Workstation1

From Figure 6, the author took a PC sample on the 31T-101 tank heading to the DCS component with IP address 11.54.127.1. The results obtained from pinging the destination address are that all packets are delivered from the tank which has a DHCP IP to the DCS with IP address 11.54.127.1 and there are no errors in the process. Likewise, the command "ping 11.54.127.1" was successful as in the image above. The results obtained from pinging the destination address are that all packets were delivered from the tank to the DCS which has the IP address 11.54.127.1 with no errors and arrived at the destination within the specified time.

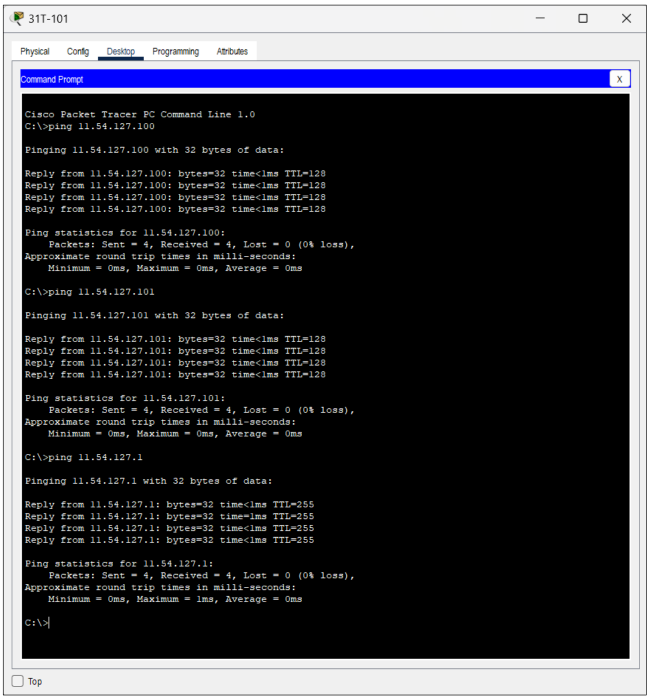

Fig 6: Connection test from tank to DCS

4. Conclusion

ATG or Automatic Tank Gauging is very important for measuring and monitoring the level and temperature of oil in the storage tank. Data communication components used in the ATG system include the Modbus protocol, Sakura V1 serial communication, Ethernet switches, and fiber optic cables. The Tankvision system uses an ethernet switch network and fiber optic cable to connect the ATG system to the control room (ATG Workstation and DCS). Data communication between one component to another component was successfully carried out after configuring the router as the network center with average delay 1 ms.

5. References

1. Forouzan BA. Data Communicating and Networking. New York: The McGraw-Hill; c2013.
2. Forouzan BA. How to design switch network or designing LAN | CCDA. c2013. Available from: http://www.w7cloud.com/how-to-design-switch-network-or-designing-lan-ccda/
3. Lesmana R. Jaringan Komputer, IP Address & Subnetting. Bandung: Unikom; c2009.
4. Lusi R. Merancang Jaringan Antar Gedung. c2013. Available from: http://reskitalusi.blogspot.com/2013/04/merancang-jaringan-antar-gedung.html
5. Fauzi N. Sistem Komunikasi Serat/Fiber Optik. c2008. Available from: http://zethcorner.wordpress.com/2008/07/22/sistem-komunikasi-serat-fiber-optik/
6. Dasmen RN. Rancang Bangun VLAN pada Jaringan Komputer RRI Palembang dengan Simulasi Cisco Packet Tracer. J Teknol Univ Muhammadiyah Jakarta. c2018.
7. Sinuraya EW. Pemantauan suhu digester pada pabrik kelapa sawit (PKS) melalui protokol HTTP menggunakan library webclient Arduino. Transmisi: Jurnal Ilmiah Teknik Elektro. 2017;19(1):35-41. https://doi.org/10.12777/transmisi.19.1.35-41