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Design of Configuration Scheme for Triple Play QOS in 10Gigabit Ethernet based Ship Data Network

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Abstract: Modern Naval ships are being fitted with the latest state-of-the-art equipment and systems, resulting in an increase in the complexity and speed of command and control operations. This has created a requirement of diverse information to be exchanged in a limited amount of time between personnel and units. The Ship Data Network (SDN) based on 10 Gigabit Ethernet technologies has been envisaged to provide a broadband infrastructure on naval ships for convergence of voice, data and video applications.Ship Data Network is to fulfill stringent Network performance parameters such as sub-second failover, latency should not exceed 30ms, 30ms and 10ms for voice, video and mission critical data respectively. Data loss (Bit Error rate) should not exceed 1 in 10E9, Triple play QOS and to perform multicasting of data and video as unicastig takes a lot of Bandwidth of Network.

Keywords: QOS, SDN, LANS.

I. INTRODUCTION

A ship includes a network, integrating services for security and control services and/or for multimedia and infotainment services on board the ship. Modern Naval ships are being fitted with the latest state-of-the-art equipment and systems, resulting in an increase in the complexity and speed of command and control operations.

This has created a requirement of diverse information to be exchanged in a limited amount of time between personnel and units. The Ship Data Network (SDN) based on 10 Gigabit Ethernet technologies has been envisaged to provide a broadband infrastructure on naval ships for convergence of voice, data and video applications. Development in Ethernet technology from simple Ethernet to 10 Gigabit Ethernet technologies has increased the overall throughput of the network and reduced the latency significantly.

II. LITERATURE SURVEY

The proposed paper [1], defines how to save costand power by repackaging an entire data center network asa distributed multi-stage switch using a fat-tree topology and merchant silicon instead of proprietary ASICs. Compared to a fat tree of discrete packet switches, a 3,456-port 10 Gigabit Ethernet realization of our architecture costs 52% less, consumes 31% less power, occupies 84% less space, and reduces the number of long, cumbersome cables from 6,912 down to 96, relative to existing approaches.

The proposed paper [2], describes that the computing power needed by end hosts is continuously increasing and that power is growing geometrically. The advent of Internet is not making the life easier either and it is pushing the LAN/WAN to its limits. Also Most of the distributed applications are bandwidth hungry, consequently the campus networks demands high-speed connectivity between the servers and the workstations. Gigabit Ethernet is a 1000 Mbps extension of ubiquitous 10 Mbps and 100 Mbps Ethernet that users have worked with for years.

There is enormous installed base of Ethernet adapters, switches, repeaters etc. This paper discusses in brief about the Gigabit Ethernet and ATM technology and then compares them based on performance, simplicity, practicality, affordability, QoS and whether these technologies fulfills the needs of high speed LANS. Also this paper discusses the basic modification that is needed in upper layer protocols so that to utilize the full capacity of these high-speed networks.

The proposed paper [3] discusses about the different components of the trio commonly called “triple play” today, (Voice, Video and Data) were originally developed in the different domains, and the networks carrying them were designed and engineered specifically for their requirements. The implication was that different network environments had to be supported concurrently to allow all three services to exist. Ethernet has come out as the clear dominant LAN technology.

To make convergence of services realistic , the recent advancements in Quality of Service (QOS)algorithms particularly in the areas of process and packet prioritization and scheduling as the main enabler for allowing network architects to overlay voice, data and video on a shared data network.

III. IMPLEMENTATION

A three layer distributed architecture has been proposed for Ship Data Network. The three layers are categorized as Core Layer, Distribution Layer and Access Layer. The Core layer having two Core Switches is configured as the

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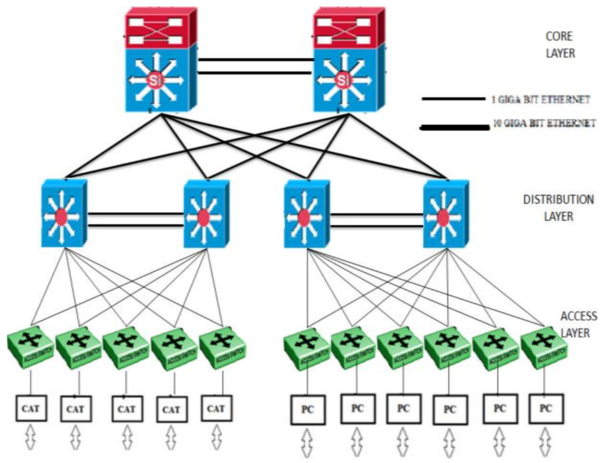
nucleus of the network and is intended to provide means for information exchange between various systems like internal communication systems and external communication systems.



The Access layer having a myriad of Ethernet Edge Switches is the outermost layer and is intended to provide connectivity to the end equipment of all systems. The Distribution layer having two dedicated distribution switches for each system is positioned between the Core layer and the Access Layer providing connectivity between the two layers.

Core layer (L3 switches)

The core layer is the high speed backbone of SDN and facilitates efficient transfer of data between interconnected distribution layers. The core layer also provides central services like time synchronization, storage and management.

The core layer will consist of two numbers of high end Ethernet routing switches (Core switch) connected in a mesh topology. The two Core switches will be connected to each other with dual redundant links at 10 GbE using optical multimode fiber (OM-3). The distribution switches of systems will get connected to the core layer through dual redundant links at 10 GbE using optical multimode fiber.

Distribution layer (L3 switches)

The Distribution Layer is positioned between the Core and Access Layer. It distributes network traffic between related access layers and separates the locally destined traffic from the network traffic destined for other layers through the core.

It facilitates switching of the traffic between the Ethernet Edge Switches connected to it without bothering the core layer and only allows traffic to enter the core layer if it is required to communicate with another system or equipment out of its domain.

Access layer (L2 switches)

The Access Layer is the outer most layer of the network and provides connectivity to end equipment as required. The access layer consists of a multitude of standalone Ethernet Edge Switches. Connectivity between the Distribution switches and Ethernet Edge Switches will be on 1 Gigabit Ethernet links using optical multimode fiber (OM3). The connection between the Ethernet Edge Switches and end equipment will be with copper cable (CAT 5E or CAT 6) for internal communication systems and external communication systems.

Quality of Service

Differentiated Services (DiffServ) is the industry and Avaya standard for the implementation of QoS. DiffServ provides QoS on a per hop behavior in the Ethernet switches by marking the header of individual packets with a DiffServ Code Point (DSCP). This DSCP then provides an indication to the Ethernet switch as to the priority of each packet and into which queue the packet should be placed. Note that the network infrastructure supports QoS end to end. Without a full end-to-end deployment, QoS cannot provide the necessary actions to ensure priority through every hop of the network. By default, the edge switches remark all QoS bits to zero and do not honor any markings.

IV. ADVANTAGES OF THE THREE LAYER ARCHITECTURE

- Easy to configure and manage ensuring minimum downtime of the network
- Supports re-usability i.e. migration of this network for deployment in other ships can be done with very little effort
- Problems / failures in any individual network is confined to itself and does not affect the rest of the systems
- Gives freedom to the system developer to develop and test their system independently and allows integration with SDN to be done whenever ready
- Each system can be developed and made independent, so that it can be used with minimal changes for any other ship installation as a standalone deliverable if required
- System integration will be simpler both in factory and on-board as individual systems can be tested thoroughly before integration ensuring that issues will be limited only to integration problems
- Network administration is simpler as it is sub-divided into smaller networks each having its own requirements.

V. SIMULATION AND MODELING

Different parameters arecomplied and various scenarios are modeled and simulated in the OPNET modeler to carry out the study on the network parameters.

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Approach to simulation is to evaluate the network design using OPNET modeler before deploying the network. This approach yield suitable results for predicting network performance, a most robust and reliable method of performance validation of network design.

The following real time parameters are captured and analyzed during simulation:

- End To End delay for various applications under different traffic load conditions has to be estimated in real time scenarios.
- Fault conditions under various network traffic is simulated and studied
- Compliance to QOS for various applications.
- Identification of the most heavily utilized links in the network and bandwidth utilization of the Giga bit core network and sub networks.
- Identification of critical points and hot spots in the network.
- Identification of links that can get congested when load is increased.
- Identification of optimal traffic matrix.

VI. EXPECTED RESULTS AND DISCUSSION

This system has been implemented to obtain secured and reliable transmission of information between the end equipments in the ship data network. The module is mainly designed and developed in order to achieve Network performance parameters such as sub-second failover, latency should not exceed 30ms, 30ms and 10ms for voice, video and mission critical data respectively. Data loss (Bit Error rate) should not exceed 1 in 10E9, Triple play QOS and to perform multicasting of data and video as unicastig takes a lot of Bandwidth of Network. .

VII. CONCLUSION

This paper deals with the design and development of configuration scheme for Triple play QOS in the 10Gigabit Ethernet based ship data network. A three tier network topology has been designed to achieve Network performance parameters such as sub-second failover, latency, wherein the latency will not exceed 30ms, 30ms and 10ms for voice, video and mission critical data respectively. The system is designed in such a way that the mission critical data is given the highest precedence followed by the voice and video information.

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