Implementation of 7 layer OSI in CIM: A Case Study.

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 IMPLEMENTATION OF 7 LAYER OSI IN CIM: A CASE STUDY

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ASSIGNMENT 2

This is a group assignment. Each group should consist of 4-5 students. Stick to the original group similar to Assignment 1. Write a technical paper with refer to the topic given below. Maximum 10 pages report. Your photographs, together with hometown address should be put on the first page.

Use Times New Roman font, size 11, single spacing and justify for the report. Source of information: i.e. books, journals, magazine, articles, etc. You are required to explore the knowledge in a bigger scope. Use your creativity and efforts to present your report by put many diagrams, pictures or anything that may relevant with the topic.

Topic : Implementation of 7 layer OSI in CIM. A CaseStudy.

(Due date: 06/11/2015, 12.30 pm)

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1.0 INTRODUCTION

As our company goals is to keep competitive in the market of marine engine manufacturer, it’s important to change the system on how our company run our production to meet the needs and expectations of clients. The ability of company to readily accommodate the rapidly company’s environment and customer changes can be a winning strategy in ship engine maker for marine industry. After several meeting within the top management of the company we unanimously agreed to implement Flexibility Machine System (Routing Flexibility) which their ability is to use multiple machines to perform the same operation on a part, as well as the system's ability to absorb large-scale changes, such as in volume, capacity, or capability. The implementation of FMS has done but it comes the new problem, which the plant network system are not well organized and properly operated within our company including all the department.

In figure 1 it show the implementation of FMS in our production plan where the problem is come from. There are consisting of several machines, which are Laser cutting, electric discharge machine, Milling machine and CNC lathe machine.

Thus, with the help of expertise suggestion, we need to apply The Open Systems Interconnection (OSI) model in our company. So now our top management has managed to create a team for studying about this model, which will be implement soon.

Open Systems Interconnection (OSI) is a reference tool for understanding data communications between any two networked systems. It divides the communications processes into seven layers. Each layer both performs specific functions to support the layers above it and offers services to the layers below it. The three lowest layers focus on passing traffic through the network to an end system. The top four layers come into play in the end system to complete the process.

![The Seven Layers of OSI](image-url)

**Figure 2: Seven layer of Open system Interconnection (OSI)**
The main concept of OSI is that the process of communication between two endpoints in a telecommunication network can be divided into seven distinct groups of related functions, or layers. Each communicating user or program is at a computer that can provide those seven layers of function. So in a given message between users, there will be a flow of data down through the layers in the source computer, across the network and then up through the layers in the receiving computer.

2.0 DISCUSSION

Layer 1 – The Physical Layer

In the seven-layer OSI model of computer networking, the physical layer or layer 1 is the first (lowest) layer and it is often termed PHY. This layer consists of the basic networking hardware transmission technologies of a network. It is a fundamental layer underlying the logical data structures of the higher level functions in a network. Due to the milling and lathe machine high technologies with widely varying characteristics, this is perhaps the most complex layer in the OSI architecture.

The physical layer defines the means of transmitting raw bits rather than logical data packets over a physical link connecting network nodes. The bit stream may be grouped into code words or symbols and converted to a physical signal that is transmitted over a lathe and milling transmission medium. The physical layer provides an electrical, mechanical, and procedural interface to the transmission medium. The shapes and properties of the electrical connectors, the frequencies to broadcast on, the modulation scheme to use and similar low-level parameters, are specified here. Within the semantics of the OSI network architecture, the physical layer translates logical communications requests from the data link layer into hardware-specific operations to affect transmission or reception of electronic signals.

Components of the physical layer include:
• Cabling system components
• Adapters that connect media to physical interfaces
• Connector design and pin assignments
• Hub, repeater, and patch panel specifications
• Wireless system components
• Parallel SCSI (Small Computer System Interface)
• Network Interface Card (NIC)

Layer 2 - The data link layer
The Data Link Layer is the second layer in the OSI (open systems interconnection) seven layer reference model. The data link layer has a number of specific functions to carry out. The three main functions of the Data Link layer are:

1. Providing a well defined service interface to the network layer.
2. Dealing with transmission errors.
3. Regulating the flow of data so that slow receivers are not swamped by fast senders.

It uses timers and sequence numbers to check for errors to ensure that all data is successfully received. The Data Link layer has different protocols to complete its task. In this case study, it is about the processing between two machines. It deals with algorithms for achieving reliable, efficient communication between two adjacent machines at the data link layer. The two machines are connected by a communication channel that acts conceptually like a wire. The principle service is transferring data from the network layer on the source machine to the network layer on the destination machine. The source machine in our case study is Distributed Numerical Control (DNC) while for the destination machine is CNC machine. On the source machine there is an entity, call it a process in the network layer that hands some bits to data link layer for transmission to the destination. The job of the data link layer is to transmit the bits to the destination machine, so they can be handed over to the network layer there. This Data Link layer deliver frames using unique hardware addresses. A frame’s header contain source and destination addresses that indicate which device originated the frame and which device is expected to receive and process it.

In order to provide service to the network layer, the data link layer have use the service provided to it by the physical layer. Physical layer does accept a raw bit stream and attempt to deliver it to the destination. This bit stream is not guaranteed to be error free. The number of bits received less than, equal to or more than the number of bits transmitted and they may have different values. The data link layer detects and it will correct the errors.

Services Provided to Network Layer

This layer is also responsible for logical link control, media access control, hardware addressing, error detection and handling and defining physical layer standards. The data link layer is divided into two sub-layers: the media access control (MAC) layer and the logical link control (LLC) layer. In this data link layer we use wireless LAN technologies. Among the most popular technologies and protocols generally associated with this layer are Ethernet, Token Ring, FDDI (fiber distributed data interface), ATM (asynchronous transfer mode), SLIP (serial line Internet protocol), PPP (point-to-point protocol), HDLC (high level data link control) and ADCCP (advanced data communication control procedures).

The data link layer is often implemented in software as a driver for a network interface card (NIC). Because the data link and physical layers are so closely related, many types of hardware are also associated with the data link layer. For example, NICs typically implement a specific data link layer technology, so they are often called Ethernet cards, Token Ring cards, etc. As we know, there are also several types of network interconnection devices that are said to operate at the data link layer in whole or in part, because they make decisions about what to do with data they receive by looking at data link layer packets. These devices
include most bridges and switches. In our case study we choose the bridge as a layer. Data link layer processing is faster than network layer processing because less analysis of the packet is required. There are a few design issues that can occur in this data link layer. In our case the issue is at the flow control of the production, what to do with a sender that systematically wants to transmit frame faster than the receiver can accept them. This situation occurs when the sender is running on a fast computer and the receiver is running on a slow machine. Something has to be done to prevent this situation. Because of that, we used the feedback based flow control the receiver sends back information to the sender giving it permission to send more data.

Layer 3 - The Network Layer

The Network Layer is the layer that provides data routing paths for network communication. Data is transferred in the form of packets via network logical paths in an ordered format controlled by the network layer. The network layer is considered as the backbone of OSI model. It selects and manages the best logical path for data transfer between nodes. This layer contains hardware devices such as routers, bridges, firewalls and switches but it actually creates logical images of the most efficient communication route and implements it with a physical medium. Network layer protocols exist in every host or router. The router examines the header fields of all the IP packets that pass through it. Internet Protocol and Netware IPX/SPX are the most common protocols associated with the network layer.

In our case, the network layer function as transferring variable-length data sequences from a source to a destination host via one or more networks, while maintaining the quality of service functions. Functions of the network layer include:

- **Connection model:** connectionless communication
  
  In this case, IP is connectionless, in that a datagram can travel from a sender to a recipient without the recipient having to send an acknowledgement. Connection-oriented protocols exist at other, higher layers of the OSI model.

- **Logical addressing**
  
  Every host in the network must have a unique address that determines where it is. This address is normally assigned from a hierarchical system. Every network device has physical address called MAC address, which is assigned to the devised in the factory. The logical address gives a network device a place where it can be accessed on the network. Logical addresses are created and used by Network Layer protocols such as IP or IPX. The Network Layer protocol translates logical addresses to MAC addresses. In our case, we used IP as the network layer protocol the devices on the network are assigned IP addresses such as 207.120.23.30. This is because IP protocol must use a Data Link layer protocol to send packets to devices.

- **Routing**
  
  The function is to find an appropriate path through the network. Routing comes into play when a computer in one network needs to send a packet to a computer on another network. In this case we called it as a router. It can be used to connect network that use different layer 2 protocols. In this case, a router has been used to connect a local area network that uses Ethernet to a wide area network that runs on different set of low level protocols.

Layer 4 – The Transport Layer
This layer provides transparent transfer of data between end systems, or host and is responsible for end–to–end error recovery and flow control. It ensures complete data transfer. The transporter layer responsible as it offers end–to–end communication between end devices through a network. Depending on the application, the transport layer either offer reliable, connection–oriented or connectionless, best effort communications. Some of the functions offered by the transport layer include:

Application of Transport Layer Usually, the layer 4 – 7 can grouped together and thought of as the application layers, WAN accelerators, load balancers as well as firewalls are all operate at layer 4 level. In case of WAN accelerator, most operate by first identifying the application via TCP port and then, breaking down, optimizing, and the rebuilding the TCP session as it passes through and between the WAN optimizer. Last but not least, the network management technologies that leverage flow–based network traffic analysis like NetFlow and IPFix leverage the transport layer information including TCP port numbers and session start/stop duration to identify and measure the application traffic. Figure below: Network firewall operate at low level TCP.

Layer 5: - Session Layer

In this part, it transfers some data from the first machine to following machines. By this, it transfers the data for dimension, thickness, and part to be removed in the product. As we already know, having an example, the milling machines use cylindrical cutting tools, such as end mills and drills, to remove material to make a finished part. The milling machine's most
commonly used type of tool is the end mill, which is placed in the spindle and spins at various speeds depending on the type of material being cut. So it sent data one by one from any machines to following machine but it depends on the machine to accept the data or not. Usually some data not suitable for requirement in the product, the machine will not accepted the data and it will send the signal to the machine when received data or rejected data. This part called dialog between these several machines.

Layer 6: Presentation Layer

The presentation layer is to provide representation of data referred by application processes or communicated between them and restructures data to or from standardized format used within the network. This layer concern with the format of data exchanged between the end system. There are also protocol for this layer and for this combined machines, we are using ASCII and EBCDIC protocols.
American Standard Code for Information Interchange (ASCII) is a character-encoding scheme. ASCII codes represent text in computers, communications equipment, and other devices that use text. Most modern character-encoding schemes are based on ASCII, though they support many additional characters. ASCII was the most common character encoding on the World Wide Web.

For Extended Binary Coded Decimal Interchange Code (EBCDIC), is an 8-bit character encoding used mainly on IBM mainframe and IBM midrange computer operating systems. The fact that all the code points were different was less of a problem for inter-operating with ASCII than the fact that sorting EBCDIC put lowercase letters before uppercase letters and letters before numbers, exactly the opposite of ASCII. Software portability and data exchange are hindered by EBCDIC’s lack of codes for several symbols (such as the brace characters) commonly used in programming and in network communications. The gaps between some letters made simple constructions that worked in ASCII fail on EBCDIC. For example, 'Z' minus 'A' was 40, not 25. This sometimes caused problems when porting software from ASCII systems.

By using all 8 bits EBCDIC may have encouraged the use of the 8-bit byte by IBM, while ASCII was more likely to be adopted by systems with 36 bits (as five 7-bit ASCII characters fit into one word). As 8-bit bytes became widespread, ASCII systems sometimes used the "unused" bit for other purposes, thus making it more difficult to transition to larger character sets.

Layer 7: Application layer

The application layer is to provide protocols for exchange of information between application processes and provided all services directly comprehensible to application programs. For this connection between CNC Lathe machine and CNC Milling machine, this layer is where the users communicate with the system or machines and it provides a protocol which application can communicate with each other. The protocol that we used in combining these machines is the FTP and TCAP protocols.

File Transfer Protocol (FTP) is a standard network protocol used to transfer computer files from one host to another host such as internet. It is built on a client - server architecture and uses separate control and data connections between the client and the server. FTP users may authenticate themselves using a clear-text sign-in protocol, normally in the form of a username and password, but can connect anonymously if the server is configured to allow it. For secure transmission that protects the username and password, and encrypts the content, FTP is often secured with SSL/TLS (FTPS). SSH File Transfer Protocol (SFTP) is sometimes also used instead, but is technologically different.

For Transaction Capabilities Application Part (TCAP), Its primary purpose is to facilitate multiple concurrent dialogs between the same sub-systems on the same machines, using Transaction IDs to differentiate these, similar to the way TCP ports facilitate multiplexing connections between the same IP addresses on the Internet.
3.0 CONCLUSION
We believe by implementing this OSI model our company could achieve our goals to remain competitive in the marine industry as an engine manufacturer as this model gives a great impact to the whole system within the company and clients. Thus, we discussed the benefits from implementation of this model, which are:

- A layered architecture allows us to discuss a well-defined, specific part of a large and complex system.
- Breaks down the complex operation of networking into simple elements
- Help developers to download software
- It also much easier to change the implementation of the service provided by the layer
- Helps in troubleshooting and identifying the problem
- It provide a way to understand how an internet work operates

There is worldwide activity among industrial nations to develop standards and protocols that enable multi-vendor equipment to communicate with each other with the same ease that present exchanges and equipment can be interconnected. Last but not list, by taking all these consideration, our company in the whole and general perspective, would achieve; production process will be more faster, lower cost changes from one part to another which will improve capital utilization. It will also lower direct labor cost, due to the reduction in number of workers. Thirdly, can reduce inventory, due to the planning and programming precision. Fourthly, consistent and better quality due to, the automated control. Lastly, lower cost/unit of output, due to the greater productivity using the same number of workers. Thus, it will make our company be in the better new environment.

4.0 REFERENCES
