Communications Reliability under MDLC

This memo provides some highlights on the different mechanism for the reliable transmission of information as provided by the layered architecture of the MDLC protocol.

The MDLC protocol was designed according to the guidelines provided by ISO regarding seven layer protocols, OSI (Open Systems Interconnection).

The basic structure of the protocol is depicted in Figure 1.

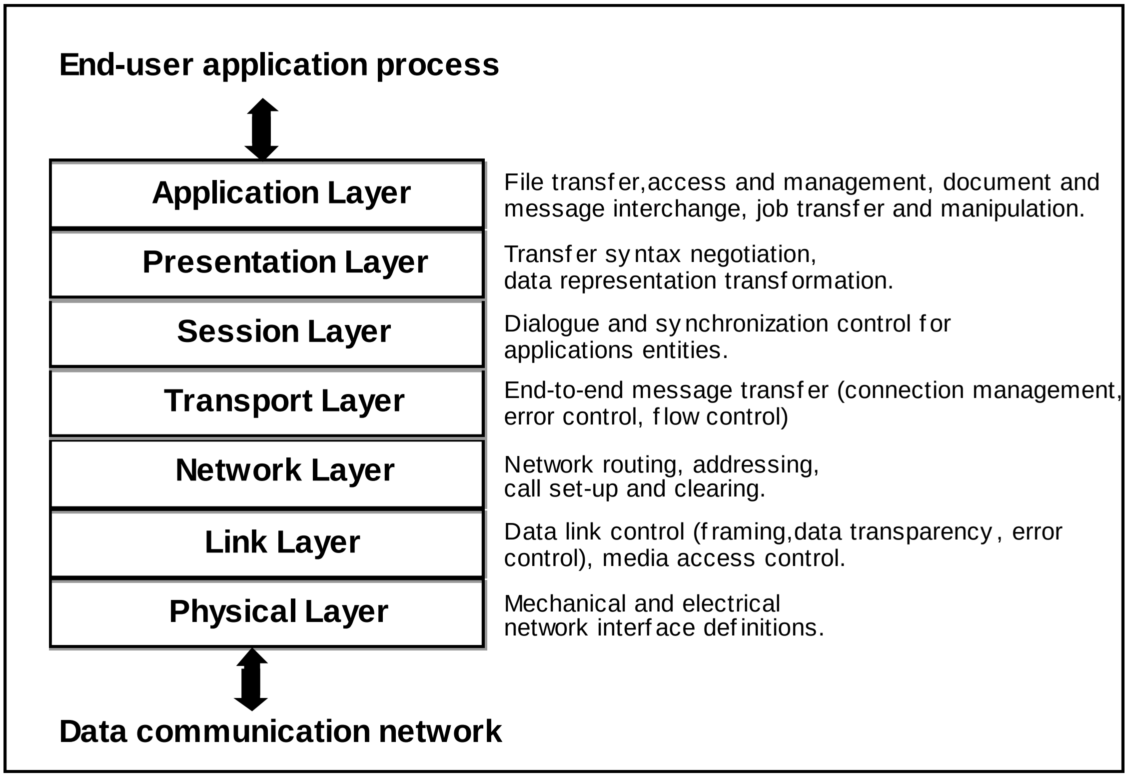

Figure 1. MDLC layered structure

The usage of a seven layer structure in MDLC was especially designed to offer a grade of protection similar or superior to that encountered using line communications, but when operating mainly with radio communications which inherently are less reliable.

The basic reliability of the protocol is given by the Link Layer protocol. When used in a radio environment, a powerful CRC-32 error detection code is appended to every transmitted frame. This error detection mechanism makes it virtually impossible for an errored frame to go undetected by the receiver.

At the receiving end, every frame is checked for errors. If no errors are detected, the frame is passed to the upper layers of the protocol for further handling. A positive acknowledgment is then issued to the transmitter side to inform it of successful reception. If an error is detected, no acknowledgment is issued and the frame is discarded. The transmitting end, after a predetermined time-out, retransmits the unacknowledged frame. This is called a link retry. The number of retries is programmable and is set, by default, to four, i.e., the original transmission plus up to four retries.

Let's assume that the probability of losing a frame in the channel is equal to 5%. It can be easily shown that the probability that a frame will not be received after four retries is on the order of 3.10^{-7}.

A second level of end-to-end reliability is provided by the network and transport layers. The network layer is responsible for the routing of information through RTUs in the system that act also as communication nodes. In addition, it is the role of the network layer to identify an alternative path between end points in the case where a link is declared as unusable. An example is given in Figure 2.

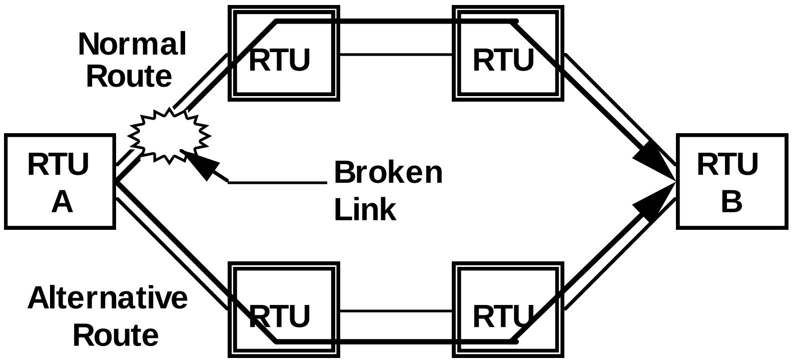

Figure 2. Alternate routing

In Figure 2, the communication from RTU A to RTU B is normally done using the upper path of RTUs. Assume that the first link in the upper path breaks. The Network layer automatically uses the alternate route in order to pass the information to RTU B, using now the lower path of RTUs. In a properly designed system, a link failure does not make the entire communication system unusable.

Whenever a network is involved in communications, frames can get from origin to destination in the wrong order. For example, a frame transmitted between two nodes in the network may necessitate retransmission due to errors and may incur extra delays in that portion of the network. The transport layer at the destination site is responsible for providing the received frames in the correct order to the application. It will do that by delaying the out-of-order frames until the missing frame is received.

An important task of the transport layer is its responsibility for the end-to-end integrity of the information. If the transport layer at the receiving end detects a 'gap' in the received frames, then, after a predetermined time-out, it requests from the originating RTU to resend the missing information. This process is known as a *transport layer retry.* This can occur when part of the information is lost due to a broken link somewhere in the network and information is rerouted through an alternate route. The retry mechanism at the transport layer offers this supplementary protection so as to guarantee end-to-end integrity of the transmitted information.

An additional level of protection is offered at the session layer of the MDLC protocol. One of the tasks of the session layer is the synchronization of large transactions that may experience faults. The synchronization of lengthy information is especially important when unreliable media is used. It allows the application to continue from the point where the communication was interrupted without the need of starting all over again from the start of the application/communication.

The MDLC protocol was designed as a seven layer protocol, not only to provide a flexible communication structure but also to enhance the reliability of the communications to levels similar to those obtained with reliable media.

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