Transport protocols for local area networks

Samuel T. Chanson
K. Ravindran
(Dept of Computer Science,
University of British Columbia, Vancouver)

Local area networks (LANs) have received widespread attention in the last few years; as a consequence, there is increased demand for protocols that run on them. It is convenient and a common practice to use transport level protocols designed for long haul networks (LHNs) in a LAN environment. For example, the Transmission Control Protocol (TCP), which is a transport layer protocol designed for ARPANET is available in 4.2 BSD UNIX for interface to Ethernet and other local area network technologies. This is not desirable from a performance standpoint since the control structure for LHNs which often have to deal with unreliable and hostile subnets is usually much more complex than is necessary for LANs. Furthermore, since packet delay in LHN is dominated by the long propagation time, minimizing protocol overhead is often not a major consideration in designing protocols for LHNs.

LANs, on the other hand, are characterized by high channel speed (typically 10 MB/sec. compared to 9.6 KB/sec. for LHN), low transmission error rate and a controllable environment. Measurements on large scale Ethernet installations (1,2) indicate that the underlying network is seldom a bottleneck. Since the bottleneck now shifts to the processing of the protocols, (especially the higher level protocols), and because users are usually less tolerant of packet delay, the efficiency of these higher level protocols becomes an important design issue.

We have carried out extensive measurement experiments on the performance of TCP as implemented in BSD 4.2 UNIX running on VAXes and SUN workstations connected by an Ethernet (3). We concluded that much of the protocol overhead, error

recovery and flow control mechanisms are unnecessary or unsuitable for local area communication and that the throughput and mean packet delay time can be drastically improved if the protocol is simplified. Though there exists simpler transport protocols such as the User Datagram Protocol (UDP), most do not provide adequate flow control which, because of the much higher channel speed is critical in the LAN environment.

We designed and implemented a highly efficient protocol called LNTP (Local Network Transport Protocol) which takes into consideration the characteristics of LANs. LNTP runs under 4.2 BSD UNIX replacing TCP/IP for local communication. When packets are intended to be sent to other networks supporting TCP or some other protocol, the protocol can be implemented at the gateway. Since the majority of the packets in a LAN are for local consumption, this scheme greatly improves the network throughput rate as well as the mean packet delay time.

This paper discusses the characteristics and requirements of LANs and describes the design philosophy of LNTP with a comparison to TCP/IP and HDLC (High-level Data Link Control). Topics discussed include addressing, packet fragmentation and reassembly, error control, data stream options and flow control. We introduce a simple and effective deferred flow control mechanism suitable for the LAN environment. Control is activated only when the traffic intensity exceeds certain value. Measured performance characteristics of LNTP and TCP are also presented.

Definitions:

HDLC = High-level Data Link Control
LANs = local area networks
LHNs = long haul networks
LNTP = Local Network Transport Protocol
TCP = Transmission Control Protocol
TCP/IP = Transmission Control Protocol / Internet Protocol
UDP = User Datagram Protocol

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