We have conducted several performance tests bench marking Globus XIO against Globus IO (an API with similar features, yet it has been coded directly against the socket library), and the standard socket library. We did both latency and bandwidth tests on a local host, between two different hosts on a LAN, between two hosts connected over a wide area link.

Latency Tests
The latency tests were carried out in a ping-pong fashion. The sender sends a message with a certain data size to the receiver and waits for a reply from the receiver. The receiver receives the message from the sender and sends back a reply with the same data size. Each ping-pong test was carried out 1000 times, the total time to complete those iterations was then used to determine an average one-way latency number.

Figures 1 through 3 show the results of the latency tests. For tests conducted on the loopback interface, shown in Figure 1, the latency of a single byte increased from 20 us for raw socket IO to 37 us for IO via Globus XIO. However, the percentage increase in latency decreases as the message size increases. For a message of size of 100KB, the percentage increase is 8 % and for a message size of 10 MB, it is just 2%. Tests conducted on the LAN provide much better results, as shown in figure 2. The percentage increase in latency for Globus XIO is 8% for transferring a 1000 byte message and it decreases as the message size increases and it is only 0.003% for a message of size of 10MB. Finally, figure 3 shows the latency numbers over a WAN. It is here that Globus XIO comes into its own. The overhead introduced is less than 1.5% for any message size.

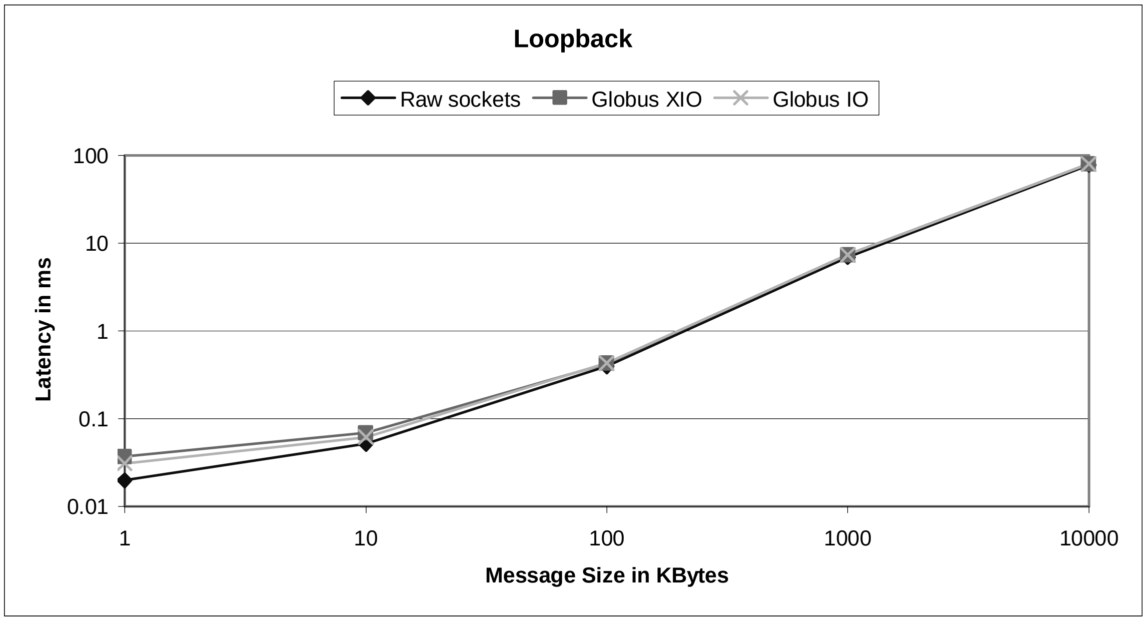

Figure 1: Comparison of one-way latency for transferring messages of various sizes over the loopback interface on a local host.

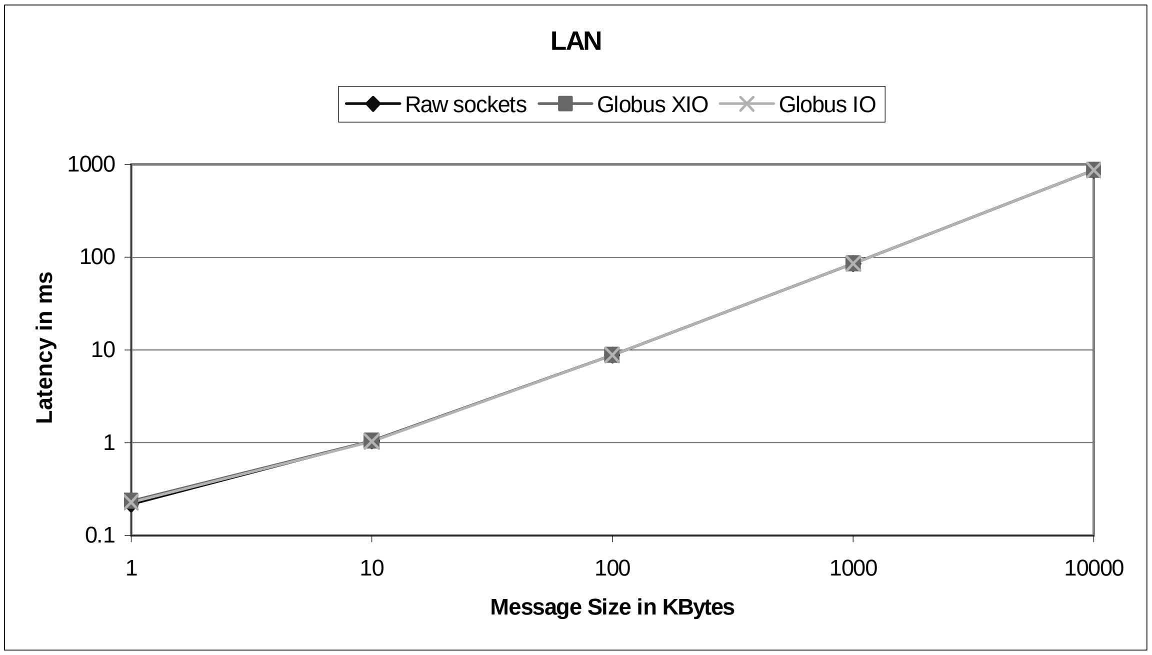

Figure 2: Comparison of one-way latency for transferring messages of various sizes between two hosts on a LAN

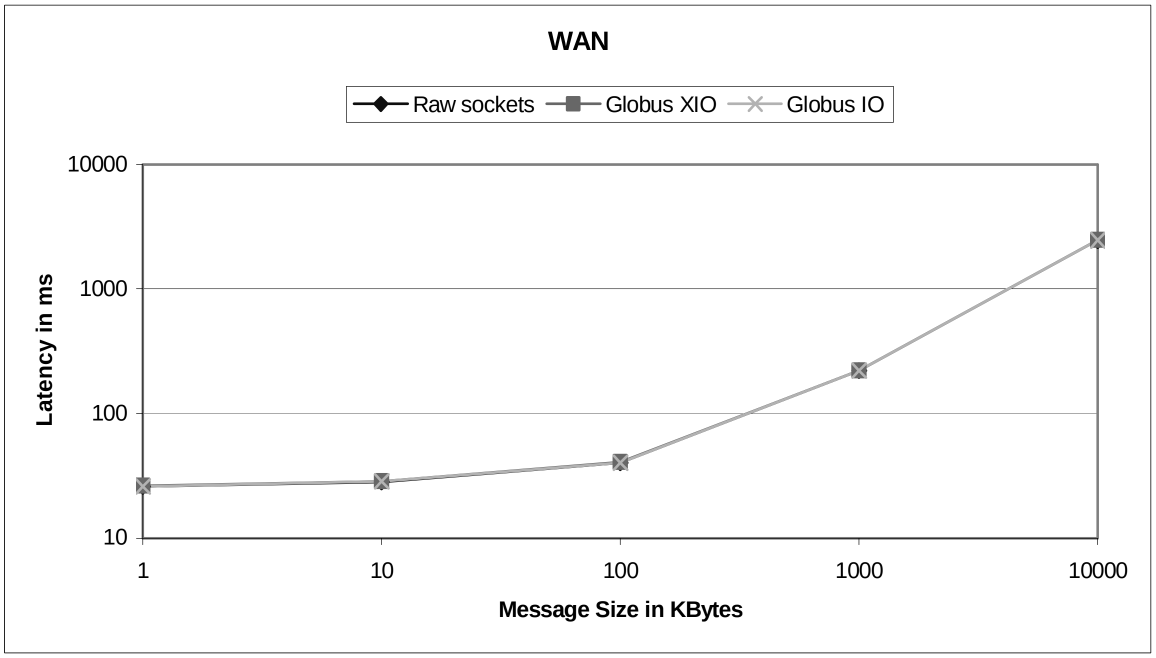

Figure 3: Comparison of one-way latency for transferring messages of various sizes between two hosts connected over a wide area link

In general, for most Globus applications, latency is not a critical issue and the use of Globus XIO will be of negligible impact. In certain latency critical applications, such as MPI application the utility of XIO would need to be determined with more exhaustive tests.

Bandwidth Tests

The bandwidth tests were carried out by having the sender sending out a large number (1000) of back-to-back messages to the receiver and then waiting for a reply from the receiver. The receiver sends the reply only after receiving all (1000) messages. Then the bandwidth was calculated based on the elapsed time (from the time sender sends the first message until the time it receives the reply back from the receiver) and the number of bytes sent by the sender.

Figures 4 and 5 indicate that the throughput achieved with Globus XIO is nearly the same as that of raw sockets. The percentage decrease in the throughput is less than 3% in all cases, and for large messages it is less than 1.5%. While some applications may not be able to tolerate this loss in bandwidth, in general, the losses are negligible in a real world application.

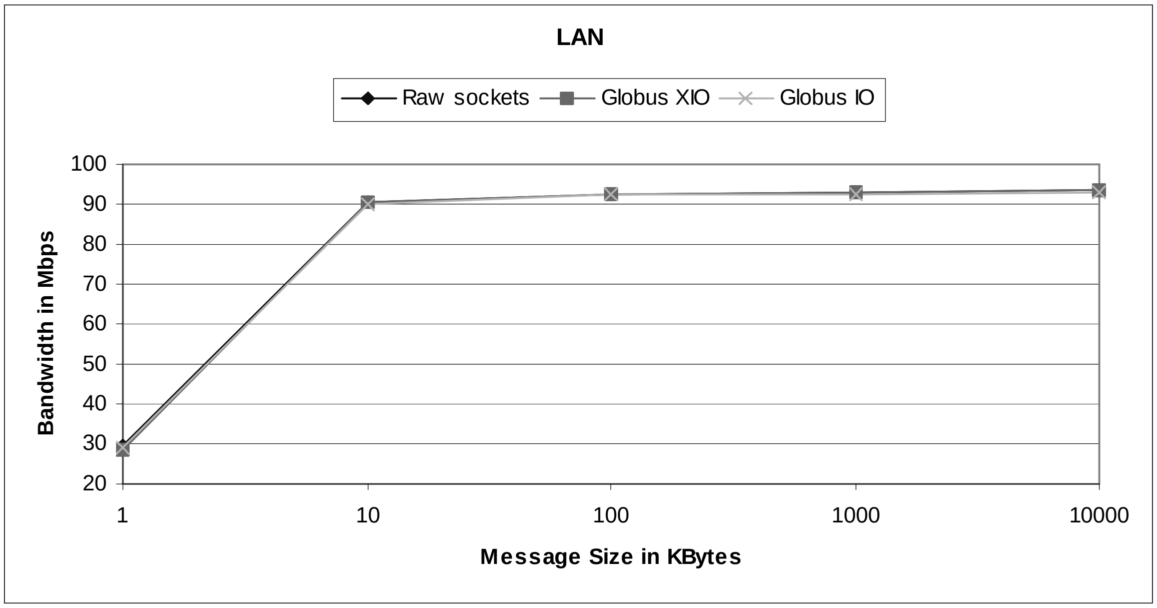

Figure 4: Comparison of throughput achieved over a gigabit link on a local area network.

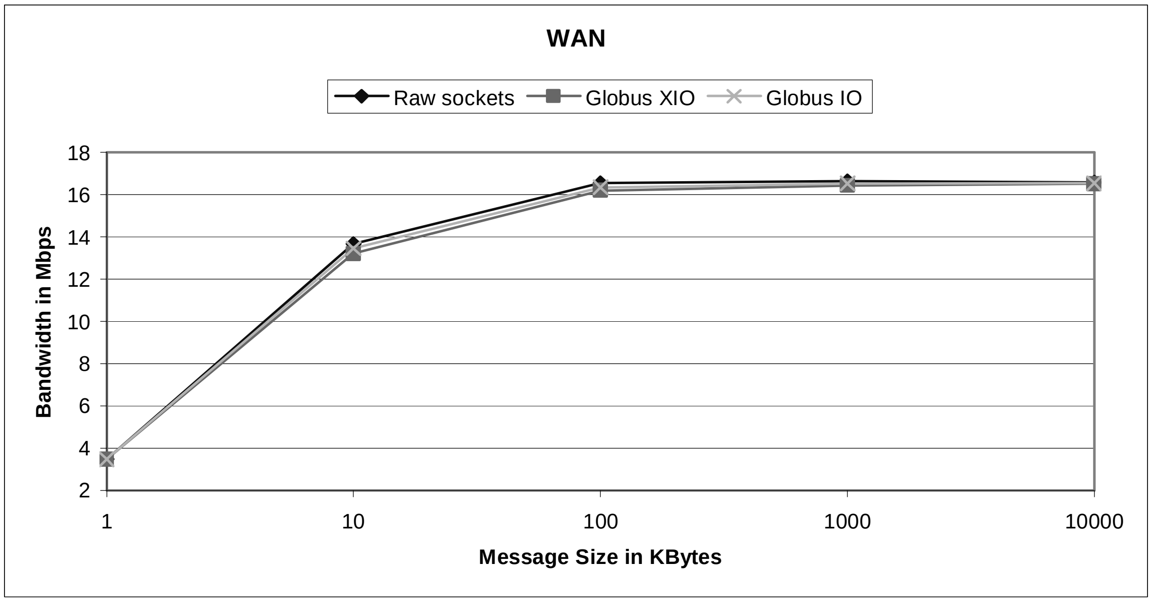

Figure 5: Comparison of throughput achieved over a wide area network where the bottleneck is an OC-12 link.

All the tests shown in the figures above were conducted with a single XIO driver loaded. However, XIO was designed to have a "stack" of multiple drivers and in some cases this is required to obtain equivalent functionality. Figure 6 shows a comparison of Globus IO using GSI authentication against Globus XIO using a stack consisting of a TCP driver and a GSI driver. The latency overhead is still minimal at less than 5% for small messages and less than 2% for larger messages.

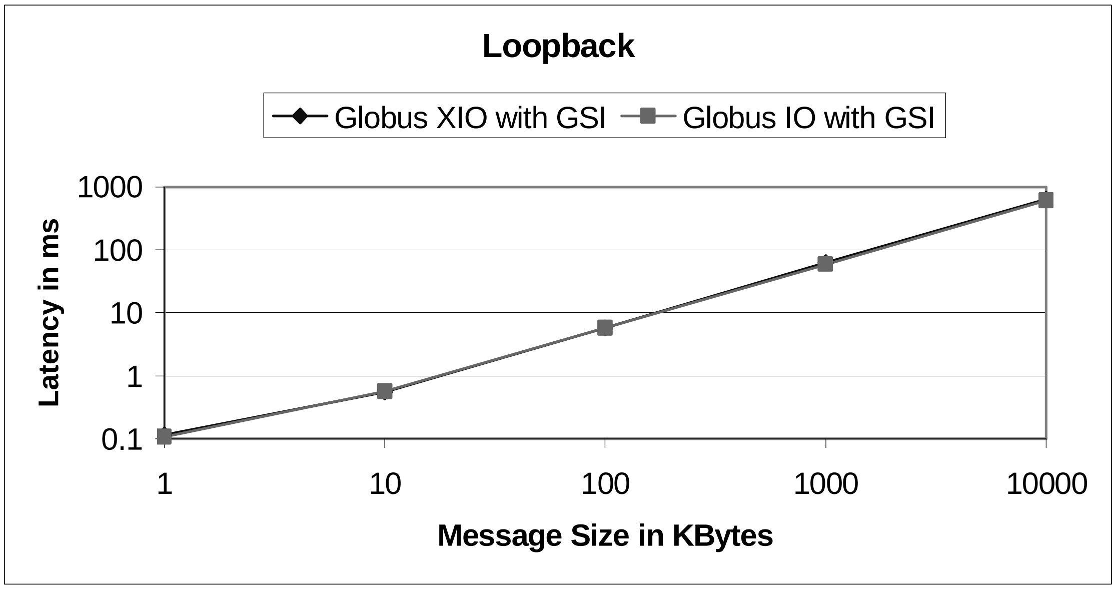

Figure 6: Comparison of latency for Globus XIO over GSI with Globus IO over GSI over the loopback interface on a local host.