In this thesis, we present Structured Message Transport (SMT). SMT is a transport protocol coordinator designed to alleviate the head-of-line blocking problem of existing transport layer protocols including the most widely used, transmission control protocol (TCP). SMT uses explicit dependency tracking instead of assuming total ordering between messages of a communication. Therefore, SMT can avoid head-of-line blocking that is caused by stream-based transport layer protocols.

Moreover, explicit dependency tracking creates opportunities for some optimizations. The first opportunity is using multiple paths. SMT can distribute the messages into more than one path. However, unlike the stream-based Multi-Path-TCP, SMT is not limited to a single stream of messages. Relaxing the ordering constraints between the messages makes it possible to deliver the received messages to the application layer if they do not have any unmet dependencies.

Another opportunity is traffic redundancy elimination. SMT employs a traffic redundancy elimination (TRE) module to remove repeated data segments. The operation of TRE creates some dependencies between the messages. SMT can track these dependencies efficiently without introducing any artificial dependencies.

We have designed and implemented a prototype of SMT to test our ideas. By experimental evaluation, we show that SMT can achieve higher throughput and lower latency than other communication mechanisms. Moreover, we have integrated the ideas from SMT into a proprietary software system and we show that the SMT version works better than the base version of this software system.