Abstract

The Named Data Networking (NDN) protocol is a promising network/transport layer replacement for TCP/IP when considering that the majority of traffic on the internet today is content; where content is traffic that is not peer-to-peer and maintains its relevance outside of a conversation between two hosts. Therefore, NDN is a content-centric protocol, focused on the desired data instead of a location where the data resides. The architecture of NDN is pull-based, where communication occurs between consumers and producers. A consumer must request the content that it desires and will only accept content that it has requested. Consumers request content by name and any node that contains the content can reply. This behaviour is supported by in-network caching, where data that passes through a node in the network can be cached in the node's content store (CS). NDN also has built-in security, enabling data to live independently of location and producer. NDN supports multicast behaviour by default, nodes will demultiplex data from a producer towards all requesting consumers. Nodes will also multiplex requests for data in the upstream towards producers.

Vehicular Ad-Hoc Networks (VANET) are a subset of Intelligent Transportation Systems (ITS) and refer to Vehicle-to-Everything communication (V2X). VANETs exhibit a set of network conditions for which TCP/IP is ill-suited. The NDN protocol has been identified as a suitable replacement for TCP/IP in VANETs, though previous research has identified issues with NDN in VANETs. Congestion and delay are two issues. The use of a pull-based architecture requires the generation of an interest packet for every piece of data consumed, adding extra overhead to the network. This pull-based architecture also has consequences when the data is transient in nature. Infrequent events, such as safety-critical events, and events that are periodic, invalidating previously generated data, are two examples of transient data. Transient data is time sensitive, which means that waiting for a consumer to request data is undesirable. Push-based architectures might be better suited for disseminating transient data.

This dissertation evaluates the potential benefits of introducing the ability to push transient periodic data in the NDN protocol. A Green Light Optimised Speed Advisory (GLOSA) system is identified as an application where data is generated periodically, which invalidates its previous incarnation. Installed in traffic lights, GLOSA systems inform vehicles of the optimum speed for passing a traffic light during its green phase.

To evaluate the potential benefits of pushing data in the NDN protocol two pushing mechanisms are implemented, unsolicited data and proactive pushing. Unsolicited data refers to nodes eavesdropping and caching packets that they detect. Proactive pushing refers to nodes sending un-requested data into the network that all other nodes within communication range accept into their CS.

SUMO and ndnSim are used to create a large-scale scenario with realistic traffic modelling and network conditions. SUMO is a microscopic and continuous road traffic simulation package and ndnSim is a network simulator used to evaluate experimentation with the NDN protocol. A comprehensive evaluation for varying degrees of vehicle speed, vehicle density, transmission range and data update frequency are undertaken to better understand the performance of pure NDN, unsolicited data and proactive pushing.

The results indicate that pushing transient and periodic data greatly improves network performance when compared to pure NDN. Unsolicited data results, on average, in a 75% decrease in network packets and a 73% decrease in delay. Proactive pushing results, on average, in a 67% decrease in network packets and a 77% decrease in delay.