

Supporting Critical Communications in Future Military Networks

Implementation Scenario



Military Ad hoc Network

Ad hoc networks of mobile vehicles, or nodes need to exchange visual or audio data in military scenarios - to meet critical timing requirements network performance, or QoS guarantees must be provided. However, high packet loss and time-varying delay result from 3 factors of ad hoc networks:

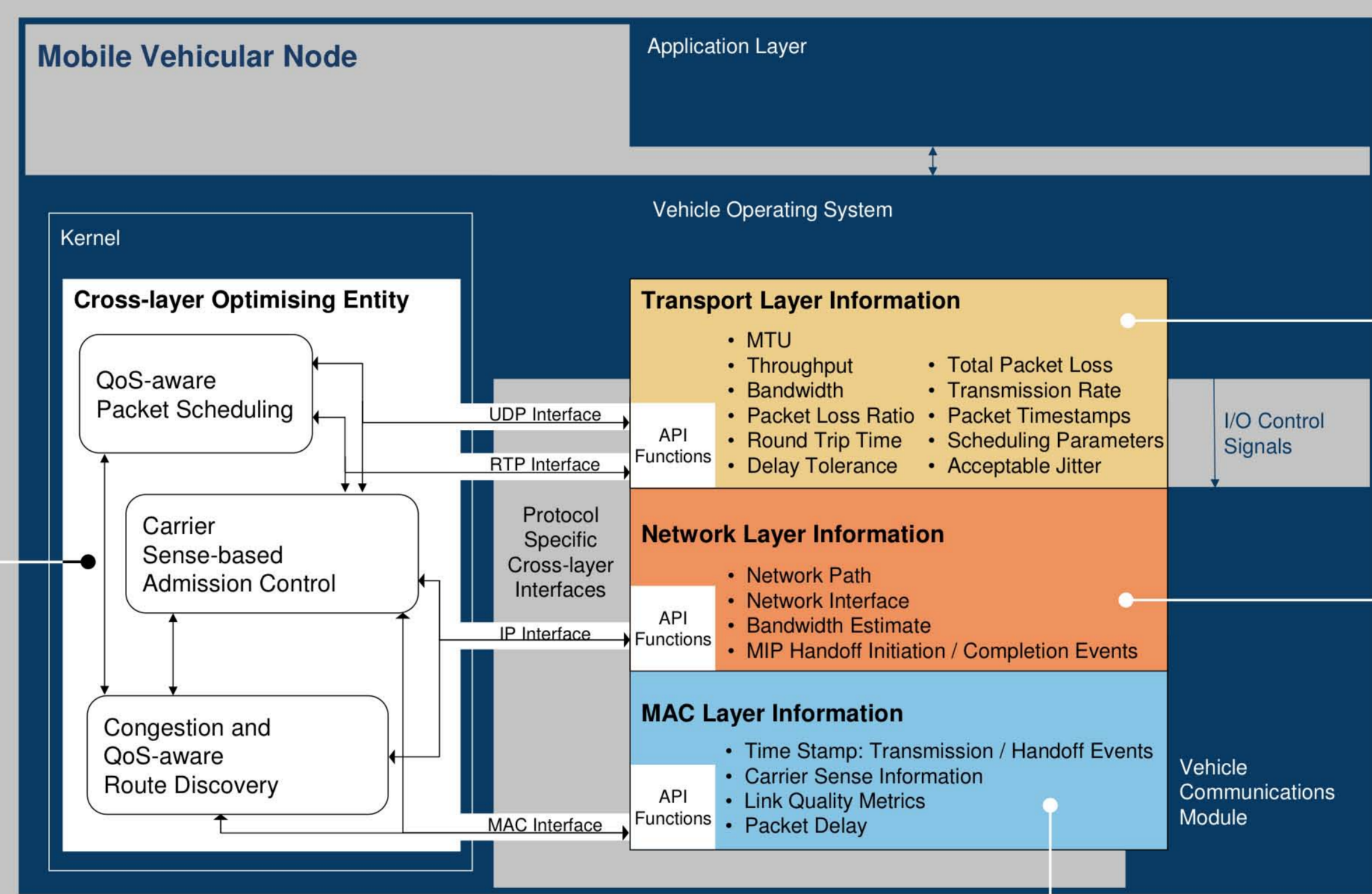
- 1 High Node Mobility
- 2 Network Saturation
- 3 Contention for Bandwidth

Traditional layered network architectures perform badly in these dynamic, lossy conditions, leading to:

- Inefficient use of available network resources
- Poor higher protocol performance
- Duplication of efforts at multiple protocol layers

Cross-layer Optimisation

Avoids performance degradation through dynamic tuning of protocols to signals of abstracted lower layer info (current network and channel resource conditions).



Transport Layer Optimisation

Distributed Admission Control

Uses signalled carrier sense and channel quality info, providing:

- Load control: prevents QoS violations in existing flows
- Congestion and contention awareness, avoiding resource consuming bandwidth reservation

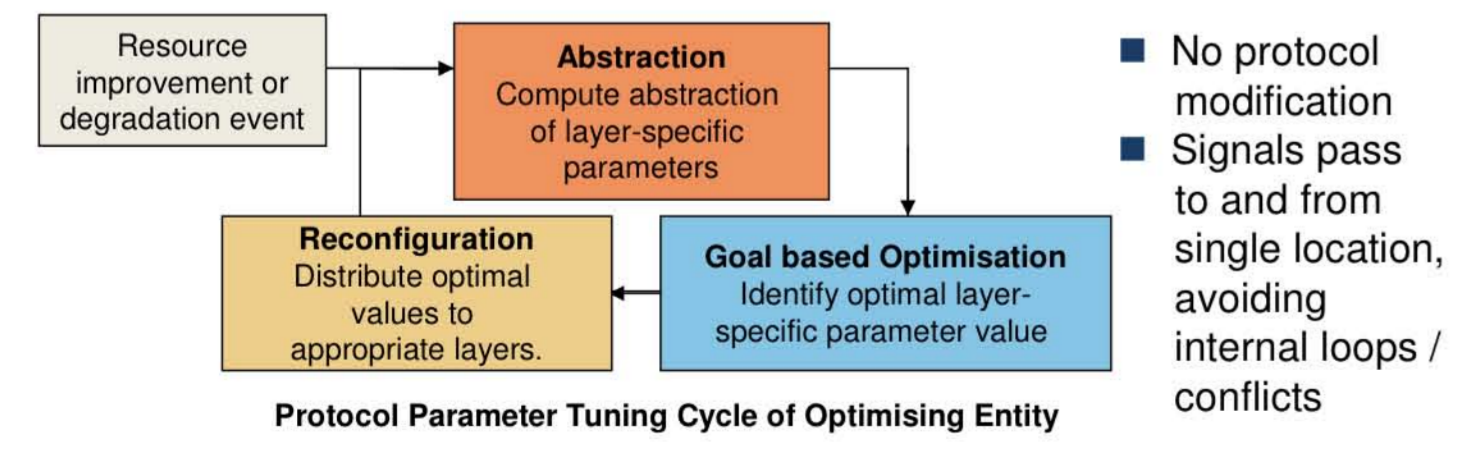
QoS-aware Packet Scheduling

Uses path selection, flow admission and MAC layer info, providing:

- Contention and congestion awareness
- Timestamp-based multiple priority queueing: gives time-critical applications jitter / delay guarantees

Cross Layer Management

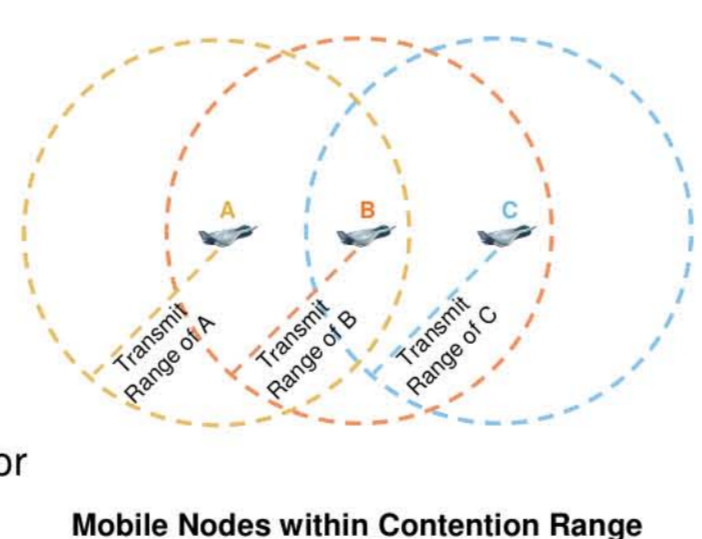
Optimising entity coordinates protocol adaptation, responding to signals of resource event, e.g. rerouting required due to node moving out of range



MAC Layer Signalling

Lower layer provides regular updates on state of network resources for a QoS-aware framework

- Accurate channel quality information
- Carrier sense of nodes in contention or transmission range



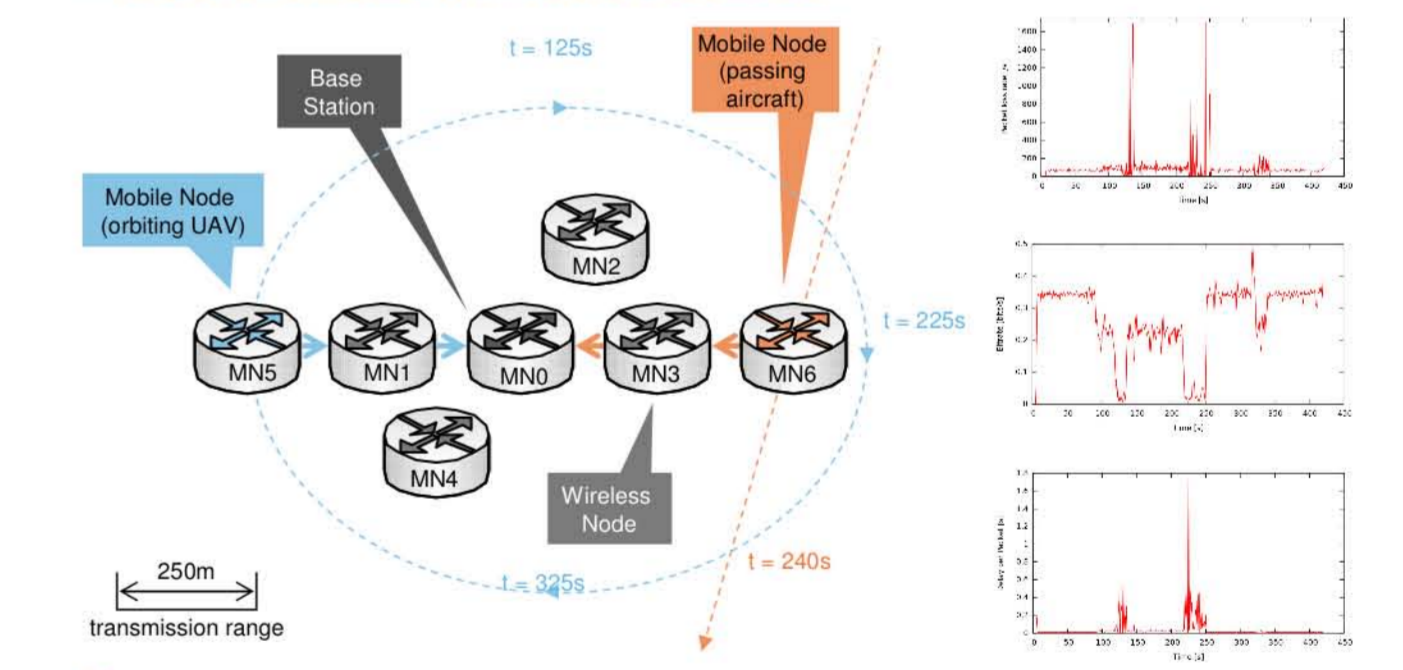
QoS Aware Path Discovery

Upholds QoS agreements of higher layers providing optimal path selection using info from transport and MAC layer protocols:

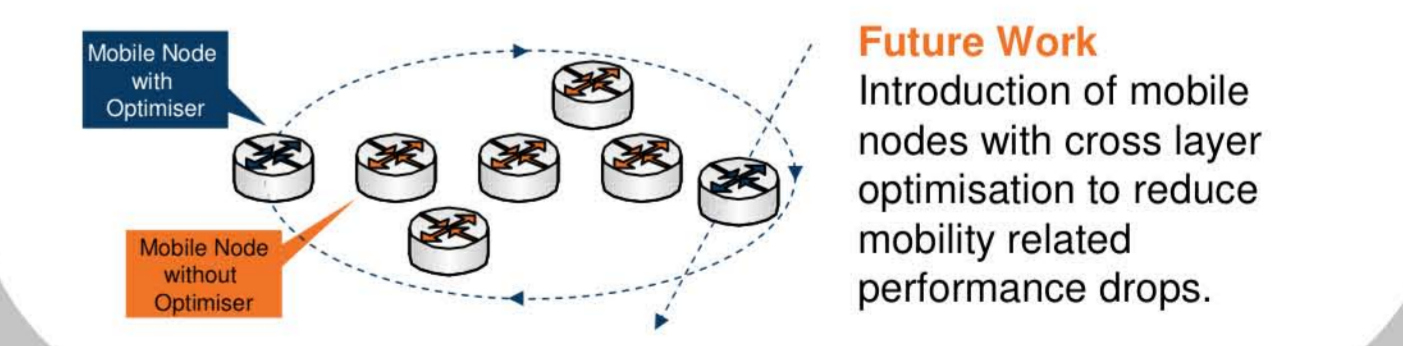
- Congestion aware: alternatives to shortest path identified if this path is congested
- Based on timely notification of channel quality degradation due to node mobility
- Avoids resource consuming congestion control
- Provides QoS guarantees to multimedia streams.

Development and Testing

Initial Simulations of Problem Scenario



- Without cross-layer optimiser: stream rerouting, new packet admission and interference lead to degraded performance
- Increase in packet delay/ loss causing a decrease in throughput



Future Work

Introduction of mobile nodes with cross layer optimisation to reduce mobility related performance drops.