IMPROVING ACCESS TO PRECISE POSITIONING INFORMATION BY UTILISING MODERN DATA TRANSMISSION PROTOCOLS

Executive Summary

For more than a decade, Network Transport of RTCM via Internet Protocol (NTRIP) has been the standard to disseminate GNSS data and correction streams in real-time for precise positioning applications, as well as for the scientific and research communities. With technology advances in the hardware, software, and wireless communications, NTRIP faces several challenges that may limit the uptake and reduce the efficiency of precise positioning by modern mass-market applications. These include system hierarchy and scalability; operational efficiency and optimisation; and protocol and software support.

The objective of this scoping study is to review and evaluate modern data transmission protocols for improving access to real-time precise positioning information for modern mass-market applications. In particular, the focus is on the provision of precise positioning information to service providers and system integrators where most of the workloads are handled. The project also examined the ever-expanding user requirements from current applications, as well as the emerging applications. Overall, the transmission protocols need to satisfy the following requirements:

- Utilise open standards;
- Be interoperable with and supported by modern applications;
- Have a highly scalable, reliable and secure system architecture;
- Provide additional benefits to existing and future real-time GNSS applications through features such as buffering of data during telecommunication outages, interoperability with other systems, and reduction and optimisation of data transmission bandwidth.

Seven modern Internet of Things (IoT) data protocols were reviewed and evaluated for GNSS data transmission, namely: HTTP, CoAP, MQTT, AMQP, Websocket, Kafka and 3GPP LTE Positioning Protocol (LPP). Protocol evaluations are based on the standards, academic literatures, and industry white papers over the past decade on various application scenarios, mostly related to IoT or smart applications (i.e. smart-city, smart farming, etc). Table I summarises the overall performance of assessed data communication protocols. Message Queuing Telemetry Transport (MQTT) scored highly in most of the areas, whereas HTTP/WebSocket lacks behind others due to the request-response model designed for web applications. As NTRIP is based on HTTP for establishing the connection, it has similar characteristics and performances as the HTTP.

Overall, MQTT is the most flexible and versatile data communication protocol available to address the future precise positioning requirement and recommended for the future GNSS precise positioning sector. It provides additional benefits over NTRIP by addressing requirements from three different levels:

Core requirement: enabling precise positioning services for the future including scalability, reliability, latency, throughput, guaranteed data transmission and security.

Critical functionalities: including bandwidth optimisation, efficient delivery of slow varying & static data and lightweight user protocol libraries for constrained devices.

Service operation improvements: including correction delivery over low bandwidth communication links, improving metadata transfer (such as GeodesyML), support for data buffering and retrieval and improving precise positioning technology.

Table I: Real-time data transmission protocol key performance summary

Key Performance Indicator	Most promising protocol			Least promising protocol	
Latency					
Over LAN	CoAP	MQTT QoS0	AMQP	Websocket	HTTP/REST
Mobile network	MQTT QoS0	CoAP	Websocket	MQTT QoS1	
Required bandwidth	CoAP	MQTT	AMQP		HTTP/REST
Throughput	MQTT		CoAP	AMQP	
Reliability	MQTT	AMQP	CoAP	Websocket	HTTP/REST
Security	AMQP / MQTT 5	HTTP	CoAP		MQTT 3.x
Developer's preference	MQTT	HTTP/REST	Websocket	CoAP	AMQP

In conclusion the precise position landscape is fast evolving, modern applications are expected to have different requirements to existing applications, as such a hybrid solution that aggregates the strengths of multiple protocols may further improve the overall GNSS data transmission landscape, as shown in Figure I. The backbone services can be managed with MQTT, NTRIP and AMQP - where AMQP handles inter-system data transmission with high message throughput (between service providers). Several supportive protocols may be used for GNSS data processing (Kafka), web application (WebScoket) and mass market data delivery (3GPP / MQTT-SN / CoAP).

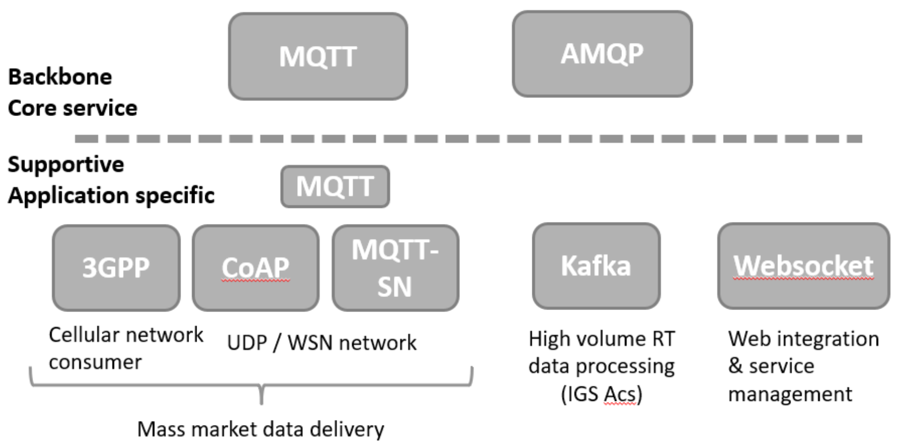

Figure I: Hybrid protocol solution for GNSS data transmission.