Network Working Group
Internet-Draft
Intended status: Informational
Expires: January 1, 2021

F. Templin, Ed.
Boeing Research & Technology
June 30, 2020

Urban Air Mobility Implications for Intelligent Transportation Systems
draft-templin-ipwave-uam-its-02

Abstract

Urban Air Mobility concerns the introduction of manned and unmanned aircraft within urban environments, while Intelligent Transportation Systems have traditionally considered only terrestrial vehicles operating on city streets and highways. This document considers the implications for introduction of low-altitude aircraft within urban environments operating in harmony with ground transportation.

Status of This Memo

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1. Introduction

Urban Air Mobility (UAM) concerns the introduction of manned and unmanned aircraft within urban environments. Autonomy will play a pivotal role in the acceptance of low-altitude operations for aerial vehicles operating in harmony with traditional ground transportation and pedestrian traffic. The UAM vision therefore builds on evolving works on Unmanned Air Systems (UAS), including the NASA UAS Traffic Management (UTM) service model [UTM].

Use cases for autonomous aircraft in the UAM vision are endless, and include personal air vehicles, flying taxis, parcel delivery, law enforcement and countless others. Major industry leaders such as Airbus [AIRBUS] and Boeing [BOEING] have accordingly begun to articulate their UAM strategies. Programs such as Uber Elevate [UBER] anticipate deployment as early as within the next 2-5 years.

With the advent of the UAM vision and its related initiatives, questions arise as to how the new model will be harmonized with the existing terrestrial mobility environment. Directions for modernizing terrestrial mobility are emerging in programs such as the US Department of Transportation's Intelligent Transportation Systems [ITS] and anticipate an increasing role for Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communications. The IETF recognizes this need and has formed the IP Wireless Access in Vehicular Environments (IPWAVE) working group with charter to produce a document that will specify the mechanisms for transmission of IPv6 datagrams [RFC8200] over dedicated short-range wireless communications media.

This document anticipates a need to provide a unified V2V and V2I service for all urban mobility agents, including both terrestrial and airborne. Urban air vehicles will employ Vertical Takeoff And Landing (VTOL) and will operate at altitudes below 400 feet, such that coordinations with terrestrial vehicles will be inevitable and commonplace. This work therefore proposes that urban air vehicles also employ a short-range V2V / V2I communications capability using the same types of wireless networking gear used in the terrestrial domain (e.g., DSRC, C-V2X, etc.).

The urban mobility landscape is evolving from a two dimensional to a three dimensional environment. Vehicles both on the ground and in the air will therefore need to coordinate with one another on a V2V and V2I basis even when supporting communications infrastructure such as cell towers are unavailable or otherwise too congested to support realtime exchanges. The ipwave working group is therefore advised to consider the rapidly emerging and inevitable Urban Air Mobility future.

2. Terminology

Terms such as Intelligent Transportation Systems (ITS), Urban Air Mobility (UAM), Unmanned Air Systems (UAS), UAS Traffic Management (UTM) and many others apply to the emerging urban mobility landscape. IETF keywords per [RFC2119] are not applicable within the scope of this document.

3. Applicability

Urban Air Mobility and Intelligent Transportation System concepts apply within all major urban areas worldwide.

4. The Overlay Multilink Network (OMNI) Interface

UAM end systems will often have multiple data link connections, including cellular, SATCOM, short-range omni-directional, etc. In order to provide mobility and multilink services, UAM end systems can employ an Overlay Multilink Network (OMNI) interface [I-D.templin-6man-omni-interface] as a virtual Non-Broadcast Multiple Access (NBMA) connection to the serving ground domain network over the underlying data links.

The OMNI interface and link model provide a nexus for multilink and mobility coordination using standard IPv6 Neighbor Discovery (ND) messaging [RFC4861] according to the NBMA principle. This supports the necessary mobility services with no need for adjunct mobility messaging, nor modifications to the IPv6 ND messaging services or link model.

5. Implementation Status

Early prototyping and testing are underway.

6. IANA Considerations

This document introduces no IANA considerations.

7. Security Considerations

Communications networking security is necessary to preserve the confidentiality, integrity and availability necessary for V2V and V2I coordinations.

8. Acknowledgements

Discussions on the IETF ipwave list (its@ietf.org) helped motivate this document.

This work is aligned with the NASA Safe Autonomous Systems Operation (SASO) program under NASA contract number NNA16BD84C.

This work is aligned with the FAA as per the SE2025 contract number DTFAWA-15-D-00030.

This work is aligned with the Boeing Commercial Airplanes (BCA) Internet of Things (IoT) and autonomy programs.

This work is aligned with the Boeing Information Technology (BIT)

MobileNet program.

9. References

9.1. Normative References

[I-D.templin-6man-omni-interface]
Templin, F. and T. Whyman, "Transmission of IPv6 Packets over Overlay Multilink Network (OMNI) Interfaces", draft-templin-6man-omni-interface-25 (work in progress), June 2020.

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, DOI 10.17487/RFC2119, March 1997, <https://www.rfc-editor.org/info/rfc2119>.

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861, DOI 10.17487/RFC4861, September 2007, <https://www.rfc-editor.org/info/rfc4861>.

[RFC8200] Deering, S. and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", STD 86, RFC 8200, DOI 10.17487/RFC8200, July 2017, <https://www.rfc-editor.org/info/rfc8200>.

9.2. Informative References

[AIRBUS] "https://www.airbus.com/innovation/Urban-air-mobility-the-sky-is-yours.html", November 2018.

[BOEING] "http://www.boeing.com/NeXt/common/docs/Boeing_Future_of_Mobility_White%20Paper.pdf", March 2019.

[ITS] "https://www.its.dot.gov/", November 2018.

[UBER] "https://www.uber.com/us/en/elevate/", November 2018.

[UTM] "https://utm.arc.nasa.gov/index.shtml", March 2019.

Appendix A. Change Log

<< RFC Editor - remove prior to publication >>

Changes from -01 to -02:

- o Included OMNI interface
- o Version and reference update

Changes from -00 to -01:

- o Version and reference update

Author's Address

Fred L. Templin (editor)
Boeing Research & Technology
P.O. Box 3707
Seattle, WA 98124
USA

Email: fltemplin@acm.org