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Recommendation

ITU-T F.749.16 (07/2023)

SERIES F: Non-telephone telecommunication services

Multimedia services

Requirements for logistics express delivery based on civilian unmanned aerial vehicles

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Recommendation ITU-T F.749.16

Requirements for logistics express delivery based on civilian unmanned aerial vehicles

Summary

At present, logistics express delivery based on civilian unmanned aerial vehicles (CUAVs) is developing rapidly all over the world. Compared with general water transportation and land transportation, CUAV transportation has the advantages of low cost and flexible scheduling, and can make up for the shortcomings of traditional air transportation. It will change people's consumption mode. Recommendation ITU-T F.749.16 provides the requirements for the service system and management of CUAV logistics express delivery.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T F.749.16	2023-07-10	16	11.1002/1000/15173

Keywords

Civilian unmanned aerial vehicle, logistics express delivery, requirements.

* To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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Recommendation ITU-T F.749.16

Requirements for logistics express delivery based on civilian unmanned aerial vehicles

1 Scope

This Recommendation specifies the requirements for logistics express delivery based on civilian unmanned aerial vehicles (CUAVs), including the requirements for devices and facilities of goods provided and received, network communication and the service control and management system of CUAVs.

NOTE 1 – The regulations and supervision of civilian unmanned aerial vehicle flights, such as those stated by the International Civil Aviation Organization (ICAO) in [b-ICAO], particularly in chapter 2 on the ICAO Regulatory Framework, chapter 3 on the Overview of Unmanned aircraft systems (UAS), chapter 4 on Legal Matters, and chapter 6 on Aircraft and Systems, are out of the scope of this Recommendation.

NOTE 2 – Any implementation based on this Recommendation should be limited by being aligned with regional and national regulations, as in [b-ICAO] in chapter 5 on Operations and chapter 7 on Personnel.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 civilian unmanned aerial vehicle [b-ITU-T F.749.10]: An unmanned flying device controlled by a ground control station or telecontroller via various wireless communication means. It usually consists of an aeroplane body, a power device, aviation electrical and electronic equipment and mission payload equipment, etc. and is used in non-military application areas such as industrial and consumer areas to complete the specific operation and transportation of data including audio, video and image.

3.1.2 ground control station [b-ITU-T F.749.10]: A ground control station is a device which is used to realize the functions of mission planning, flight control, payload control, flight path display, parameter display, image and video display and mission information displaying, recording and distributing.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 civilian unmanned aerial vehicle logistics express delivery: A process of planning, implementing and controlling the flow of physical goods from provider to recipient, mainly using civilian unmanned aerial vehicles (CUAVs) as a transport tool to provide an express delivery service.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CUAV Civilian Unmanned Aerial Vehicle

GCS Ground Control Station

IMT-2020 International Mobile Telecommunications 2020

5 Conventions

In this Recommendation:

– The keyword "shall" indicates a requirement that must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

– The keywords "is required to" indicate a requirement that must be strictly followed and from which no deviation is permitted if conformance with this Recommendation is to be claimed.

– The keywords "is recommended" indicate a requirement that is recommended but which is not absolutely required. Thus, this requirement needs not be present to claim conformance.

– The keywords "can optionally" indicate an optional requirement that is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the Recommendation.

6 Introduction

A complete air logistics express delivery service includes the three stages of large manned transport aircraft; medium-sized branch civilian unmanned aerial vehicle (CUAV) transport; and small terminal CUAV transport. These stages are connected by cargo transfer stations and a CUAV logistics centre. Figure 1 shows the whole process model of an air logistics express delivery service.

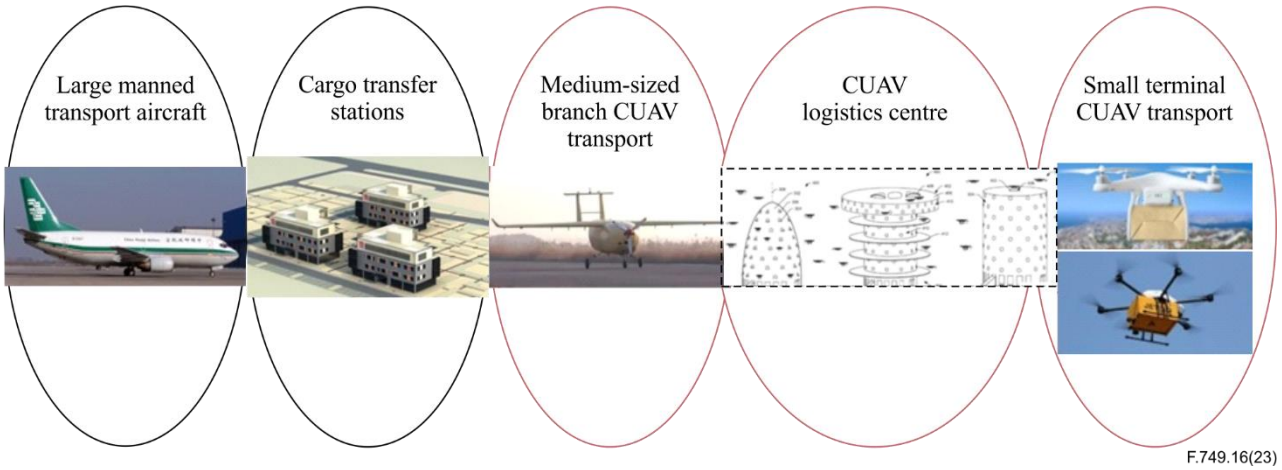

Figure 1 – The complete air logistics express delivery chain model

The scope of this Recommendation is confined to logistics express delivery based on CUAV. This type of delivery is a part of air logistics, which comprises: medium-sized branch CUAV transport, a CUAV logistics centre and small terminal CUAV logistics express delivery.

1) Medium-sized branch CUAV transport:

The transportation distance is usually less than 1000 km. Use cases include transregional freight transport (fixed routes, fixed shifts, etc.), transportation of temporary materials to

border posts, islands and so on, and freight allocation amongst multilogistics centres to supplement medium-distance transportation requirements.

2) The CUAV logistics centre:

A CUAV logistics centre should be a distributed storage and management system that can realize classified scheduling of cargoes/goods from different sources and optimize the storage location of goods according to their address and delivery time requirements, so as to create conditions for CUAV delivery. The source of cargoes/goods and the ways of sending/receiving goods include the following situations: The first case is the transport of goods from large cargo transfer stations, which are transported by medium-sized branch CUAV. After the goods (e.g., letters, small packages) have been automatically sorted by the logistics centre, they can be transported to a specific express loading platform by transmission tools (such as conveyor belts, robots) so that they can be fixed to the CUAV. The second case is delivery in the city and nearby suburbs. For example, goods suppliers in the city deliver food and daily necessities to nearby buildings, communities and office buildings, or deliver them to the suburbs close to it. The staff of the CUAV express service organization needs to load and fix the items on the CUAV; to achieve this, the express waiter is required to send the goods to the CUAV express staff. A relatively open site in a field can be selected and landing point signs can be set to land the CUAV, or drop the goods by rope and then take back the rope. In short, the receiving stations have different settings according to the location and scenario of the customer or other recipient. A multilogistics centre or warehouse centre can be set up to reduce the number of medium-sized branch CUAVs.

3) Terminal CUAV transport:

Terminal CUAV transport usually flies for a distance of less than 20 km with a load of less than 20 kg, and with a one-way flight time of 10 to 20 minutes.

7 Requirements for logistics express delivery based on civilian unmanned aerial vehicles

CUAV logistics express delivery includes medium-sized branch CUAV transport and terminal CUAV transport. Before the delivery service is provided, the sender and recipient of goods need to communicate and clarify the responsibilities of both parties. The CUAV express service organization shall comply with the corresponding national laws and regulations, and be responsible for the information security of the express delivery goods and the customer. Before the delivery service, the CUAV express service organization shall complete a flight route survey and apply and report to the local and national aviation management departments in accordance with the regulations. It is not permitted to carry out a CUAV express delivery service in flight-prohibition zones, restricted flight zones and other unapproved flight areas. Terminal CUAV transport is the key process of a CUAV logistics express. This Recommendation will focus on this service procedure. It is often not recommended that recipients have direct contact with the CUAV.

Figure 2 presents a diagram of the service procedure of CUAV logistics express delivery.

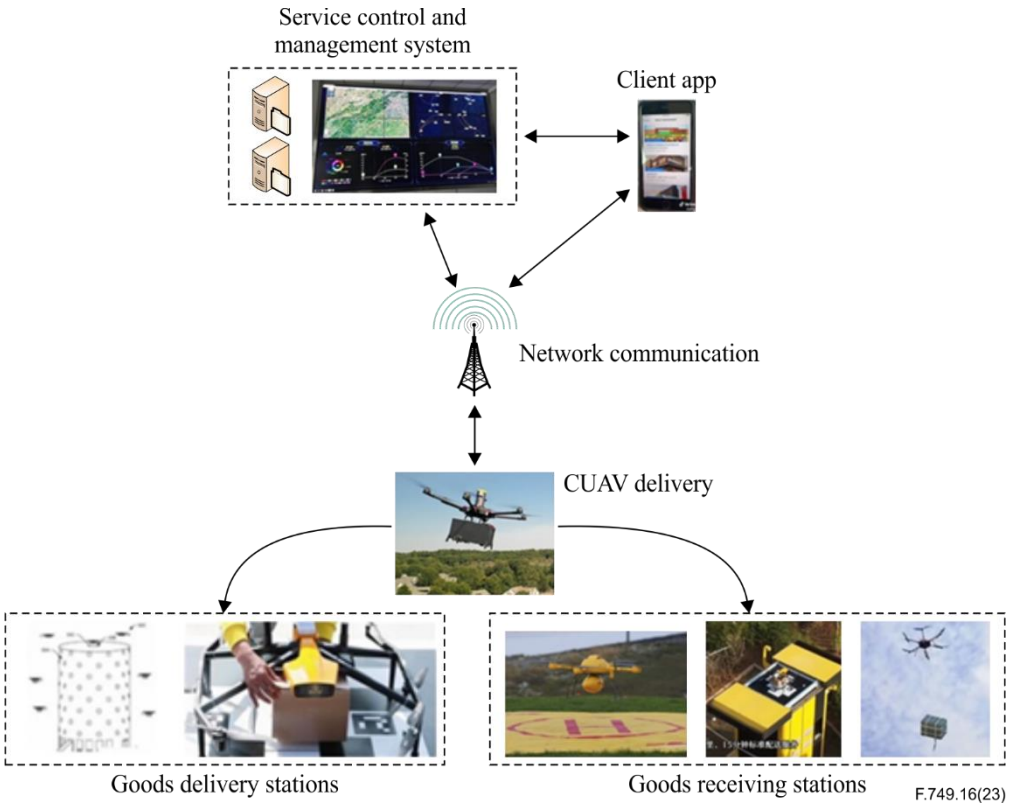

Figure 2 – Diagram of the service procedure of CUAV logistics express delivery

The specific functional requirements of each entity are described in clauses 7.1.1to 7.1.3.

7.1 Requirements for service control and management system

The CUAV logistics express delivery service control and management system completes the real-time dynamic information management and real-time dynamic scheduling control, as well as the whole process tracking of goods. The client app completes the ordering of goods, the arrival location and storage information of received goods, and so on.

7.1.1 Requirements for service

The CUAV express service organization shall reach an agreement with the recipient on the specific delivery method. When a CUAV cannot fly due to the weather, electromagnetic environment or airspace problems, the recipient shall be informed of the special approach in these circumstances.

SR-01: It is required that the CUAV express service organization communicate with the recipient in advance. The interactive information includes but is not limited to express information, departure place and time, landing place and time, and name and address of the recipient.

SR-02: It is required that the delivered goods strictly comply with the safety inspection mechanism of the logistics industry. The CUAV express service organization shall not accept dangerous goods (such as chemicals and toxic substances) for delivery, and overloading shall not be allowed.

SR-03: It is required that a period and conditions for goods return or exchange be specified to the customer in advance of the delivery, for example if the goods delivered are found to be damaged or inconsistent with the order.

7.1.2 Requirements for route planning

Before launching the CUAV express delivery service, the CUAV express service organization should complete the air route survey and avoid the flight-prohibition zone designated by the aviation management department.

RP-01: It is recommended that the route be a fixed route. A field survey shall be conducted on the take-off and landing points and route areas to confirm the route grid data. The route planning between two points shall include an alternative route.

RP-02: It is required that multiple flight tests be carried out to verify the position data of the take-off and landing points, and to check the distance from known obstacles and the performance of communication, navigation and monitoring.

RP-03: It is required that the route be inspected regularly.

RP-04: It is required that the route be re-planned when risks are found.

7.1.3 Requirements for flight control

CUAV flight control is an important part of service control and is controlled by the ground control station (GCS).

GCS-01: It is required that the GCS completes the CUAV flight process controlling and monitoring based on the service requirements.

GCS-02: The GCS is required to display flight direction and track parameters of each CUAV in real time, including flight altitude, speed, flight track coordinates, accumulated flight mileage and flight time, and number of flights. It is required to support the functions of automatic map roaming, scheduled flight tracking and real-time flight tracking display of CUAVs.

GCS-03: The GCS is required to support multiple flight control modes for different environments.

GCS-04: The GCS is required to support data playback mode. After receiving the flight data and saving the data, the whole process of the flight path can be reproduced through the data playback mode, including the position, attitude and other important data of the CUAV, which is convenient for the analysis of the flight status and mission execution status of the CUAV.

7.2 Requirements for network communication

The communication network completes the communication between the CUAV and the service control and management system, as well as the interaction between the CUAV and the ground infrastructure (goods sending/receiving facilities) and mobile terminals (recipient).

NC-01: Network and transmission functions are required to support real-time and reliable flight control and flight data transport.

NC-02: Before the transport service starts, it is required to establish a secure data transport channel and audio and video image transport channel, and conduct two-way authentication.

NC-03: It is recommended that CUAV GCS based on IMT-2020 network support the control of one or more CUAVs.

7.3 Requirements for the devices and facilities of goods delivery stations and receiving stations

The devices and facilities of goods delivery stations and receiving stations shall have good environment and site conditions to meet the operational needs of the sender and recipient, as well as meeting the requirements for safe take-off and landing of CUAVs.

7.3.1 Requirements for the devices and facilities of goods delivery stations

The goods delivery station is responsible for completing the loading of goods and checking the goods to ensure the express information is accurate and confirm whether the outer package is undamaged.

DS-01: The staff of the CUAV express service organization is required to judge whether the size of the goods meets the requirements of the CUAV. If satisfied, the goods can be directly loaded on the

CUAV. If the requirements are not satisfied, the package can be disassembled and repacked to meet the loading regulations of the CUAV.

DS-02: Goods from large cargo transfer stations (e.g., letters and small parcels which meet the requirements of CUAV transport), can optionally be transported to a specific express loading platform by transport tools (such as conveyor belt or robot) and loaded onto the CUAV (the process is monitored by the service control and management system).

DS-03: It is required that the staff of the CUAV express service organization load and fix the goods on the CUAV. To achieve this, the express waiter is required to send the goods to the CUAV express staff.

DS-04: It is required that special goods be enclosed in shock-absorption and fall-proof packaging over the original package to ensure the safety of the express goods during the whole flight.

7.3.2 Requirements for the devices and facilities of goods receiving stations

The goods receiving station is responsible for completing the unloading and receiving of goods. The receiving station can be set up in different ways according to the location and scenario of the recipient.

RS-01: If the receiving station is a smart cabinet, then the CUAV sends a landing request to the smart cabinet. After receiving the landing request, the smart cabinet is required to send a signal to guide the CUAV to land on the platform at the top of the cabinet and then to unload the goods.

RS-02: If the receiving terminal is open ground or a platform set in a hospital or outdoor domestic area, the CUAV is recommended to land directly on the ground or platform, or drop the goods by rope and then take back the rope.

RS-03: For goods delivered to an edge transfer station by a medium-sized CUAV, the staff of the receiving station shall first receive them. According to the distance and the receiving agreement, the goods are required to be sent to the recipient by terminal CUAV, collected by the recipient or sent by the express staff.

7.4 Requirements for the civilian unmanned aerial vehicle

The CUAV transports the goods from the delivery stations to the receiving stations according to the predetermined path, and receives the instructions from the service control and management system. The CUAV shall be certified and authorized by the management department (e.g., the national civil aviation management department or ICAO) before its flight, and shall meet the flight supervision requirements of the local management department.

CUAV-01: The CUAV is required to transmit flight data (including but not limited to weather conditions, flight altitude, speed, geographical coordinates and status information, residual energy and flight time) to the service control and management system in real time.

CUAV-02: It is required to check the appearance and payload safety lock device of the CUAV before and after the flight to avoid goods falling off during a flight.

CUAV-03: The CUAV is required to fly stably or hover normally under light rain conditions or with an instantaneous wind speed not greater than 10 m/s (Level 5 wind).

CUAV-04: On the onset of abnormal conditions during flight, the CUAV is required to support automatic hovering, and based on the predefined process and alternate procedures, select other sites for landing.

CUAV-05: It is required that the CUAV fly to a preset place for charging after completing the mission, or it can optionally be briefly charged at the top of the smart cabinet (if certain conditions are met).

Appendix I

Use case of logistics express delivery based on civilian unmanned aerial vehicle

(This appendix does not form an integral part of this Recommendation.)

This appendix contains a use case of urban express service and its service procedure.

Before an express service starts, customers download an app from the website of the CUAV express service organization to their mobile terminal and browse potential goods suppliers of their desired products (the express service organization needs to have already selected some goods suppliers suitable for working with based on the price, cost, distance and other factors determining the service mode).

After the customer selects the goods (such as food and beverage items), the express waiter sends the goods to the nearby CUAV delivery station, and then the staff of the express service organization fixes the goods onto the CUAV (see Figure I.1).

Figure I.1 – Express item fixed on the CUAV

The express service control centre determines a suitable receiving station according to the geographical location information of the customer, sends the pre-planned route data to the CUAV, and then sends a take-off command to the CUAV. At the same time, the service control centre sends a message to tell the customer when to collect the express item from the designated smart cabinet (see Figure I.2).

Figure I.2 – CUAV unloading item and customer collecting express item(s)

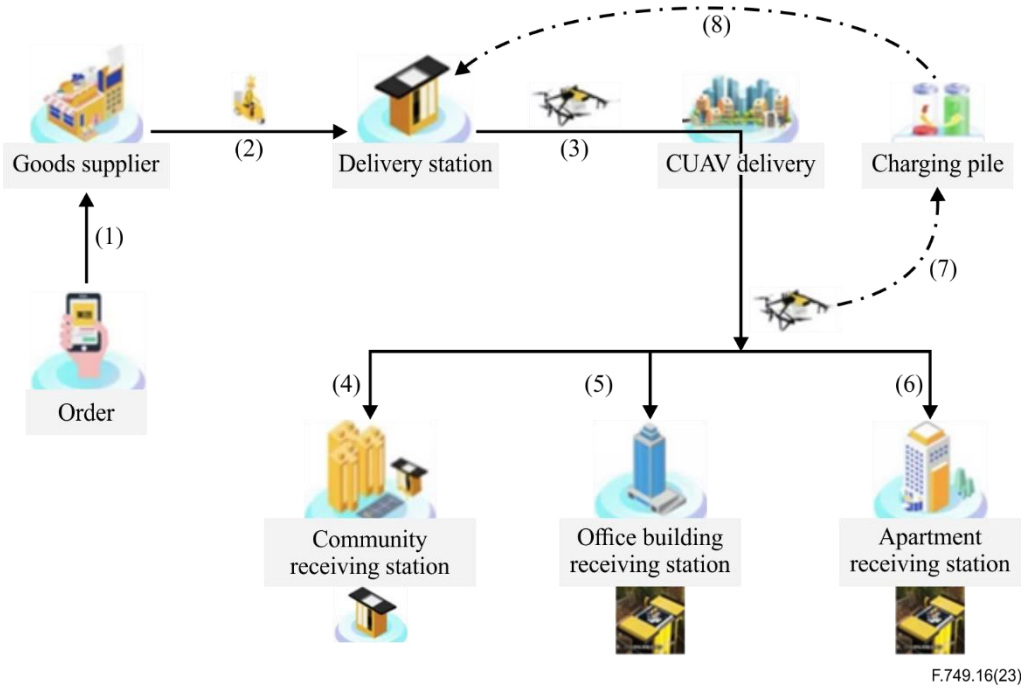

Figure I.3 – Procedure diagram of urban express service

Figure I.3 presents the process of a urban express service, which has the following steps for each order:

(1) A customer orders goods.

(2) The express service staff sends the goods to the delivery station.

(3) The service control system determines a suitable receiving station and the CUAV flies to the destination.

(4) / (5) / (6) The CUAV arrives the express smart cabinet set up in the communities / office buildings / apartments and deposits the goods.

(7) The CUAV returns to the place specified by the logistics centre for charging according to the preset path.

(8) The CUAV flies to the designated sending station to continue the next express mission.

Bibliography

[b-ITU-T F.749.10] Recommendation ITU-T F.749.10 (2019), *Requirements for communication services of civilian unmanned aerial vehicles*.

[b-ICAO] International Civil Aviation Organization Cir 328 (2011), *Unmanned Aircraft Systems (UAS)*. https://www.icao.int/meetings/uas/documents/circular%20328_en.pdf

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Published in Switzerland
Geneva, 2023