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# Telecommunications and information exchange between systems — Unmanned aircraft area network (UAAN) —

## Part 1: Communication model and requirements

*Télécommunications et échange d'information entre systèmes — Réseau de zone de drones (Unmanned aircraft area network - UAAN) —*

*Partie 1: Modèle de communication et exigences*



Reference number
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# Foreword

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*.

A list of all parts in the ISO/IEC 4005 series can be found on the ISO and IEC websites.

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# Introduction

Unmanned aircrafts (UAs) operating at low altitudes will provide a variety of commercial services in the near future. UAs that provide these services are distributed in the airspace. In level II, many people operate their own UAs without the assignment of communication channels from a central control centre. In this case, wireless fidelity (Wi-Fi) is mainly used as a control channel and a video channel in the unlicensed band. However, when using Wi-Fi, level II UAs can experience loss of control and video links due to communication resource collision. In addition, UA-related units, such as vertiports and obstacles, need a way to exchange information with UAs. This document introduces a wireless distributed communication model to solve these problems.

The wireless distributed communication described by this document is intended to be used in licensed frequency bands. By using licensed frequency bands, each unit is able to reliably allocate and use radio resources at the desired time, various UA communications can coexist and cooperate, and the probability of radio resource collision is very small.

Many services are required for UA operations. In order to support these services, communication between units related with UAs, UA control communication, and video communication, are generally needed.

The ISO/IEC 4005 series consists of the following four parts:

— ISO/IEC 4005-1 (this document): To support various services for UAs, it describes a wireless distributed communication model and the requirements that this model shall satisfy.

— ISO/IEC 4005-2: It describes communication in which all units that can communicate with UAs can broadcast or exchange information by sharing communication resources with each other.

— ISO/IEC 4005-3: It describes the control communication for the controller to control the UA.

— ISO/IEC 4005-4: It describes video communication for UAs to send video to a controller.

# Telecommunications and information exchange between systems — Unmanned aircraft area network (UAAN) —

# Part 1: Communication model and requirements

## 1 Scope

This document describes a communication model and requirements for unmanned aircraft area network (UAAN), which is a wireless distributed communication network for units related with UA services in level II.

It describes:

— the communication structure and operation;

— the purpose of the three types of communication and related services;

— the interoperation of the three types of communication;

— the interworking with upper layers.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 4005-2, *Telecommunications and information exchange between systems — Unmanned aircraft area network (UAAN) — Part 2: Physical and data link protocols for shared communication*

ISO/IEC 4005-3, *Telecommunications and information exchange between systems — Unmanned aircraft area network (UAAN) — Part 3: Physical and data link protocols for control communication*

ISO/IEC 4005-4, *Telecommunications and information exchange between systems — Unmanned aircraft area network (UAAN) — Part 4: Physical and data link protocols for video communication*

ISO 21384-4, *Unmanned aircraft systems — Part 4: Vocabulary*



## 3 Terms and definitions

For the purposes of this document, the terms and definitions defined in ISO 21384-4 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

**3.1**
**level II**
airspace where maximum height is between 15 m (above ground level) and 120 m (above ground level)

**3.2**
**controller**
device that controls an unmanned aircraft (UA) and which can also be equipped with a *video receiver* (3.6) device

**3.3**
**obstacle device**
device that broadcasts related information, e.g. related obstacle location, radius, and which is mounted to an obstacle that is placed on the ground or in the air

**3.4**
**landing device**
device that broadcasts related location information or information tone signals of a landing site and which is mounted to a landing site and leads autonomous landing work

**3.5**
**ground equipment**
ground-based equipment that collects the information that unmanned aircrafts (UAs) broadcast and uses the collected information to communicate the location and status of UAs to UA management systems or UA operators

Note 1 to entry: Ground equipment can use shared communication to deliver the necessary messages to UAs.

**3.6**
**video receiver**
receiver that is mounted on a *controller* (3.2) and performs one-to-one communication with unmanned aircrafts (UAs)

Note 1 to entry: For special services, separated multiple video receivers can receive video from a single UA.

**3.7**
**unit**
all objects that have transmitting or receiving functions, e.g. unmanned aircraft (UA), *controller* (3.2), *obstacle device* (3.3), *landing device* (3.4), *ground equipment* (3.5)

**3.8**
**data slot**
slot constituting a data channel

**3.9**
**tone slot**
slot constituting a tone channel

**3.10**
**slot clearing**
transmission of a tone signal in subslot 0 in order to continue to occupy a slot already allocated from the previous frame

**3.11**
**slot map**
bit string indicating whether slots are available

Note 1 to entry: In wireless distributed communication, the slot map of each *unit* (3.7) is generally different.

**3.12**
**slot planning**
specification by the upper layer on the type, usage, transmission power, and whether to apply a super frame, for all slots of the channel in advance



**3.13**
**tone subslot**
subslot constituting a *tone slot* (3.9)

**3.14**
**tone signal**
signal transmitted in a *tone subslot* (3.13)

# 4 Abbreviated terms

| | |
|---|---|
| CC | Control Communication |
| RF | Radio Frequency |
| SC | Shared Communication |
| TDMA | Time Division Multiple Access |
| TRX | Transmission and Reception |
| UTC | Coordinated Universal Time |
| VC | Video Communication |

# 5 Communication model and requirements

## 5.1 UA communication model

This document describes wireless distributed communication as a communication model. The reason is that UAs and other related units on the surface or at low altitude are randomly distributed in the airspace. These units need a way to communicate with each other. However, the problem with distributed wireless communication is that there is no control station that manages resources efficiently. Therefore, the communication model of this document is designed so that units can allocate resources by themselves, occupy resources by themselves, detect resources collisions by themselves, and return resources by themselves.



## 5.2 UA communication requirements

There are three commercial requirements for UA communication:

— safety;

— economy;

— convenience.

UA communication shall also meet this requirement in a wireless distributed communication environment.

First, safety is the most important aspect in UA communications. Many UA services cannot be provided without safety. Therefore, the UA communication link shall have the necessary functions and performance. The necessary function is that all units that communicate with UAs can communicate with each other when necessary. The main means of communication for UAs are control communications and video communications. In addition, communication between UAs, communication between UAs and ground equipment, communication between UAs and landing devices, and communication between UAs and obstacles are also required. In particular, communication between UAs can provide an optimal solution for small UAs to detect each other. Wireless distributed communication is best suited to supporting these functions for UAs distributed in the airspace. In order for wireless distributed communication to operate effectively, low probability of resource collision, real-time resource collision detection, and rapid communication environment investigation are required. UA communication is provided in an environment where multiple units are moving simultaneously. The real-time movement of various units changes the communication environment in real time. Therefore, the UA communication needs to quickly investigate such changes in the communication environment, allocate necessary resources with a low probability of collision, and detect collisions in real time for the occupied resources.

Second, this document supports many communication links simultaneously. Many communication links are required to operate UAs. If each communication hardware supports communication between UAs, communication between UAs and ground equipment, communication between UAs and landing devices, and communication between UAs and obstacles, it is economically burdensome, so it should be supported with as little hardware as possible.

The third requirement is convenience. Convenience can be divided into convenience from a manufacturer's point of view and convenience from a user's point of view. Users want as many services as possible with one communication device. Also, users generally want long battery life. Manufacturers prefer the lowest hardware complexity. Low hardware complexity means smaller size and less weight.

Therefore, the requirements for UA communication are as follows:

a) All units that can communicate with UAs shall be able to communicate with UAs when necessary.

b) The wireless distributed communication with features of low resource collision probability, real-time resource collision detection, and fast communication environment investigation shall be used.

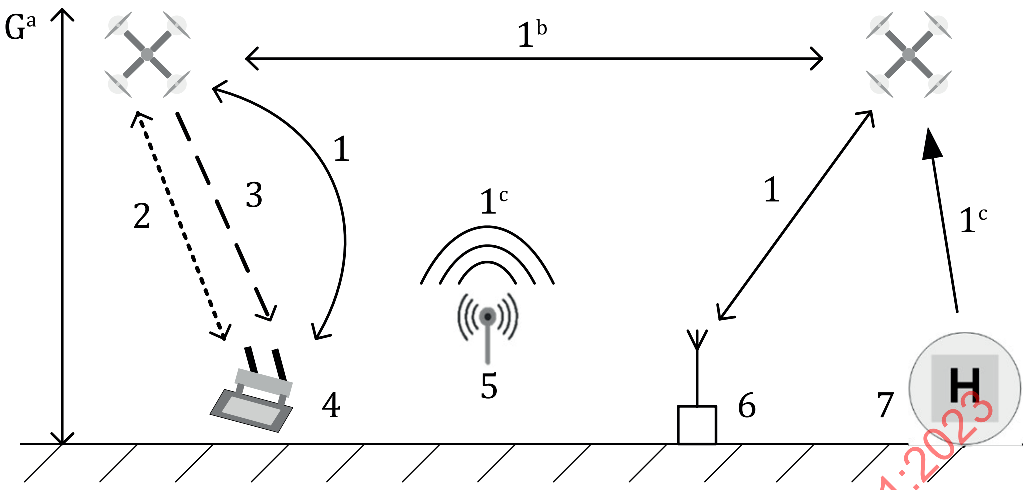
c) Communication devices shall support as many services as possible with as little hardware as possible.

d) Communication devices shall have as low a hardware complexity as possible.

## 5.3 Communication structure and operation

A new communication model is required to meet the UA communication requirements mentioned above. It is a synchronous wireless distributed communication model. Among three types of communication, video communications and control communications use a lot of communications resources. Therefore, separate frequency channels are required. All communication except video communication and control communication is supported as shared communication.

Therefore, the minimum required channels are shared channels, control channels, and video channels. These channel configurations are shown in Figure 1.




**Key**

1 shared link
2 control link
3 video link
4 controller
5 obstacle device
6 ground equipment
7 landing device
G level II
[a] The altitude of level II.
[b] Location broadcast and data exchange.
[c] Broadcast.

**Figure 1 — Three types of communications**

As mentioned in 5.2, all three wireless distributed communications should feature low probability of resource collision, real-time resource collision detection, and rapid communication environment investigation.

To this end, three wireless distributed communications perform resource allocation, occupation, collision detection and communication environment investigation using a tone channel. Data are transmitted through a separate data channel with a centre frequency that is different from that of the tone channel as shown in Figure 2. This multi-channel structure features low resource collision probability, real-time resource collision detection, and fast communication environment investigation.

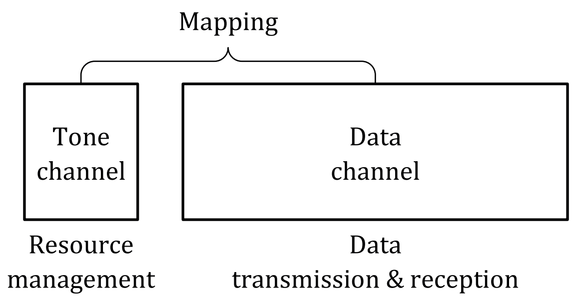



**Figure 2 — Multichannel structure and the role of each channel**

In particular, the tone channel performs the following functions:

a) resource allocation;

b) resource occupation;

c) removal of hidden nodes;

d) real-time resource collision check;

e) transfer of information;

f) communication environment investigation.

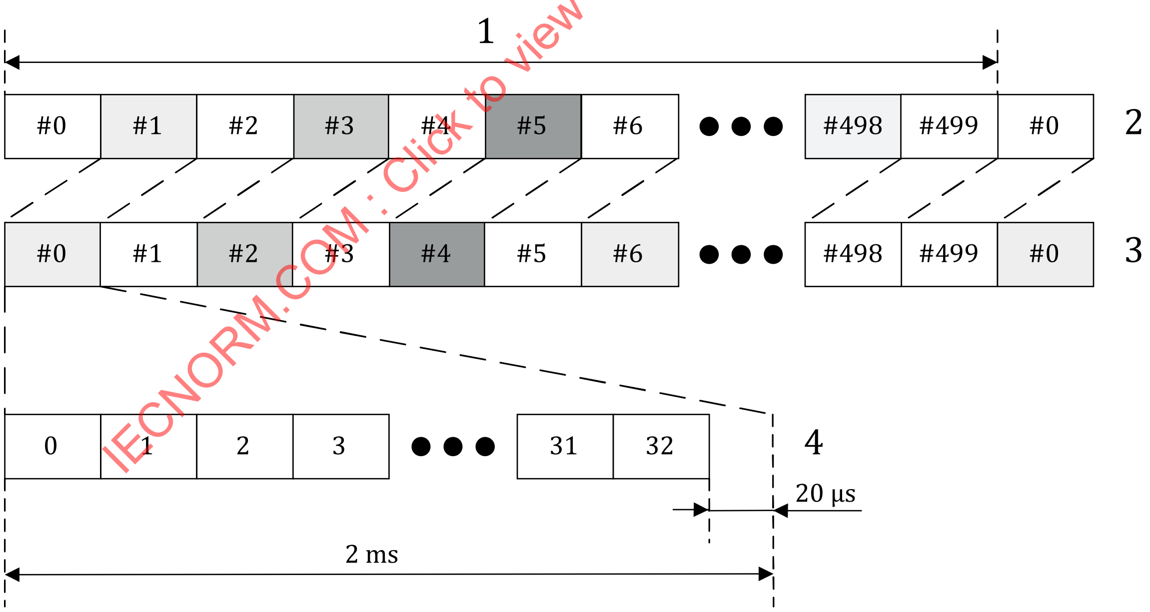
The tone channel can investigate the communication environment in real time. In general, investigating a multi-channel communication environment requires a lot of hardware and time. However, the tone channel makes it possible to quickly investigate the communication environment of multiple channels with one hardware.

As such, this communication model can perform as many functions as possible with as little hardware as possible. Shared communication, control communication and video communication work in the same way, which further allows the three types of communication to coexist.

A detailed description of the common communication model is as follows.

This communication model uses synchronous TDMA technology. Synchronization can be obtained from signals received from the UTC system, or from signals transmitted by other units synchronized with UTC.

The tone channel consists of 500 slots, and each slot consists of 33 subslots as shown in Figure 3. If a unit allocates one tone slot, it is assumed to allocate the communication resource mapped with that tone slot. For example, in shared communication, one tone slot is associated with one data slot assignment.




**Key**

1 1 frame = 1 second = 500 Ts

2 data channel

3 tone channel

4 tone slot

**Figure 3 — Mapping concept of tone slot and data slot in shared communication**



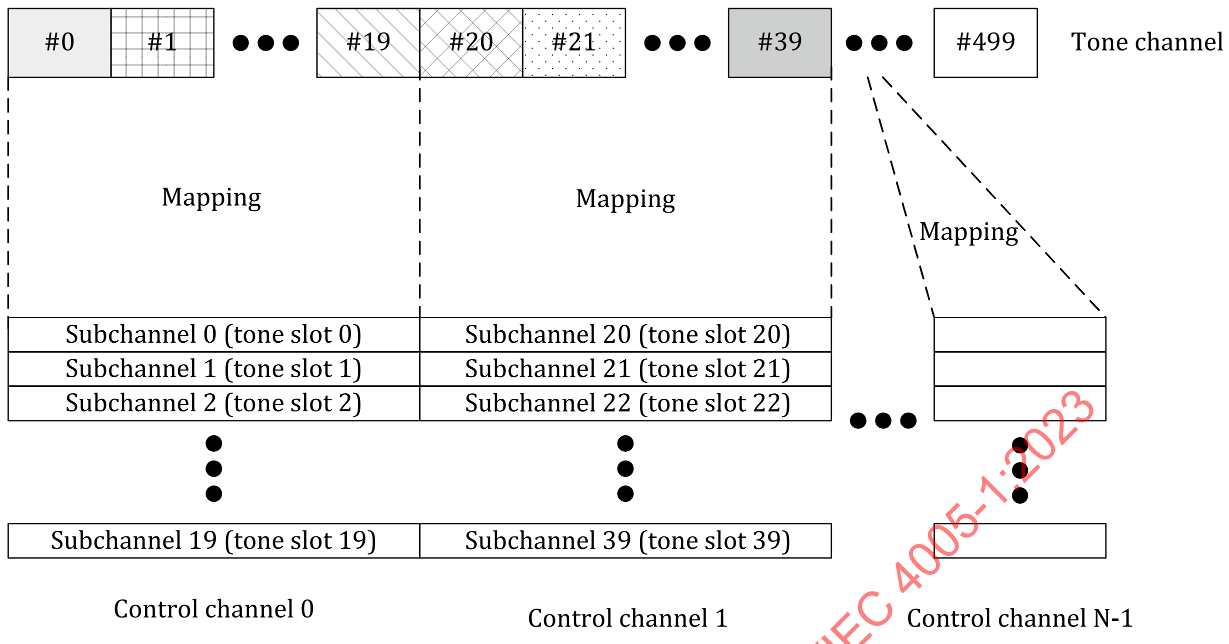
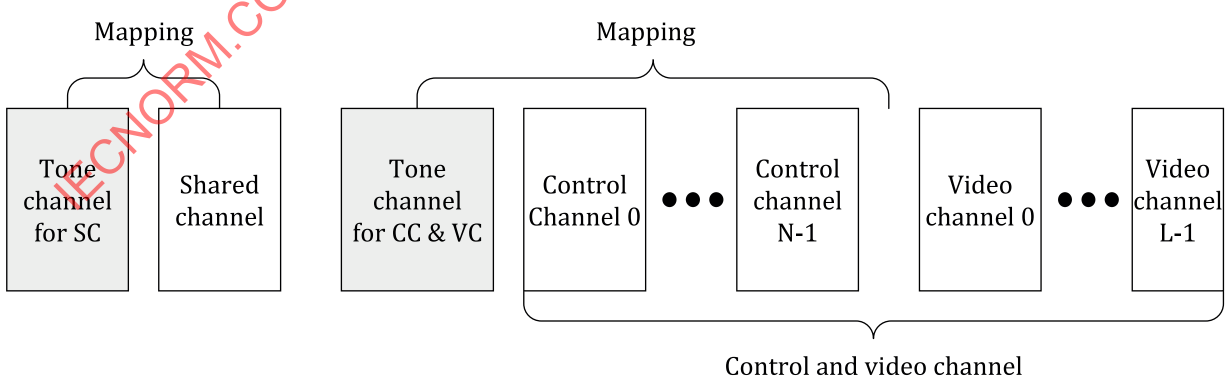



**Figure 4 — Mapping concept of tone slot and subchannel in control channel**

In control communication and video communication, one tone slot is associated with one subchannel allocation as shown in Figure 4.

Control communication resources and video communication resources exist in several frequency channels. The unit does not need to examine all channels of all frequencies to determine which subchannels are empty. If the unit receives only one tone channel, it can determine which subchannel of which frequency is empty. This reduces the number of required RF hardware to a minimum. In wireless distributed communication, in order to allocate several frequency resources by themselves, the state of the corresponding frequency resources needs to be investigated in real time. If there is no tone channel, the unit will need as many RF hardware as different frequencies to know the channel status of different frequencies in real time.

This document describes a tone channel for shared communication and a tone channel for control communication and video communication as shown in Figure 5, i.e. the control channel and the video channel share one tone channel.




**Key**

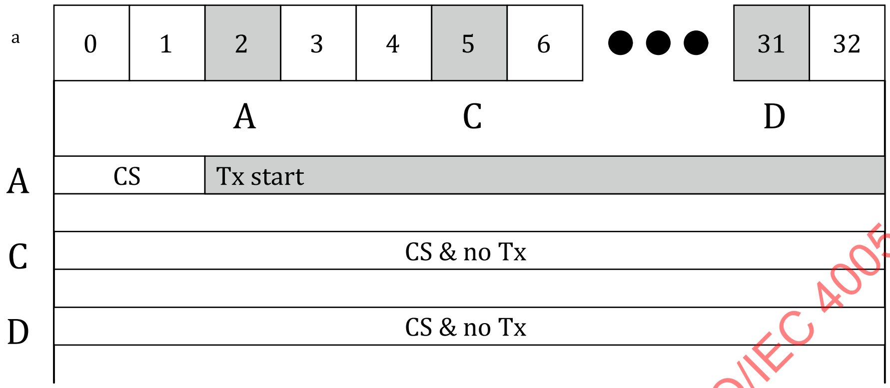
SC shared communication

CC control communication

VC video communication

**Figure 5 — Mapping of tone channels, shared channels, control channels, video channels**

Simply explained, communication resource allocation using the tone channel is performed in the tone slot. The tone slot consists of 33 subslots. For resource allocation, the unit performs two competitions in the related tone slot. The first competition is to randomly select the first subslot among subslots from subslot 1 to subslot 32 with same probability. In this competition, the units that choose the earliest number of slots win. For example, if three units A, C, and D each choose subslot 2, 5, and 31 respectively, then unit A wins as shown in Figure 6 because unit A performs carrier sensing from subslot 0 to subslot 1 and transmits its tone signal from subslot 2 since the channel is empty. On the other hand, the C and D units lose the competition because A's signal is sensed in subslot 2.




**Key**

Tx transmission

CS carrier sensing

A, C, D unit

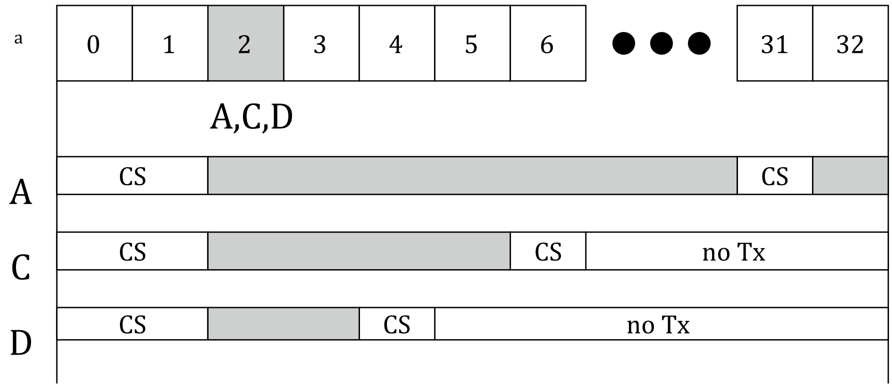
a Tone slot.

**Figure 6 — First competition example**

The second competition is performed by the units winning the first competition. The second competition is to randomly select the second subslot among the subslots from the next subslot of the first subslot to the 32nd subslot with same probability. In this competition, the unit that chooses the lowest numbered subslot is the winner. For example, in Figure 7, it is supposed that all three units A, C, and D have selected subslot number 2 as the first subslot in first competition. If the three units A, C, and D have each selected slots 31, 6, and 4 in the second competition respectively, then unit A wins. This is because the unit D detects the tone signals of the units A and C and loses the competition when performing the carrier sensing and stopping the tone signal transmission in the subslot 4. Unit C likewise loses in subslot 6. Thus, unit A finally wins.






**Key**

CS carrier sensing

Tx transmission

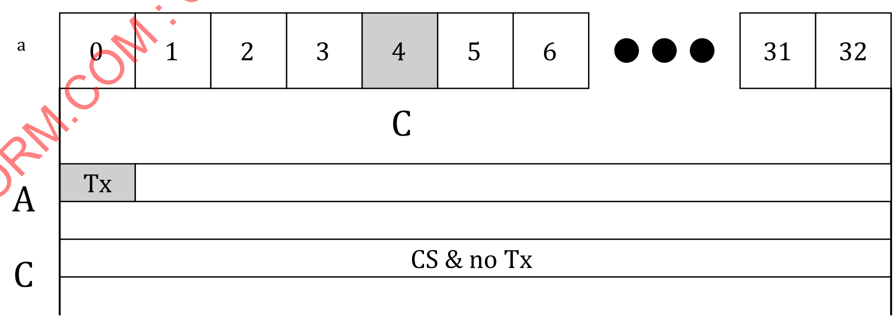
A, C, D unit

a Tone slot.

**Figure 7 — Second competition example**

This two-time competition in the same tone slot keeps the resource collision probability of resource allocation extremely low. For example, when 20 000 units attempt to allocate one slot resource at the same time in shared communication, the probability of resource collision is only about 2 %.

The unit can occupy allocated resources using the tone channel. Once the resource is occupied, there is no need to compete for allocation, so the communication link can be used reliably. The resource occupation is performed in the next frame after allocation. The method of occupying a resource is to transmit a tone signal in subslot 0 of the allocated tone slot as shown in Figure 8. A unit to allocate a new slot cannot select subslot 0 in the first competition. Therefore, the unit occupying the slot always wins the competition. In this way, the unit can allocate resources and then continue to occupy the corresponding resources in the next frame. Once occupied, the resource can be used continuously without resource collision. In this way, a unit transmits a tone signal in subslot 0 to continuously occupy resources. It is called 'slot clearing'.




**Key**

A, C unit

CS carrier sensing

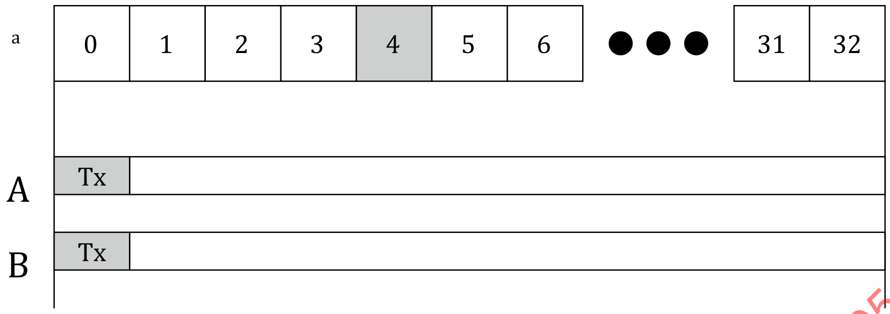
Tx transmission

a Tone slot.

**Figure 8 — Slot clearing example**

The return of the resource by the unit is done by stopping slot clearing.

Hidden node removal using the tone channel is performed by the unit transmitting a signal and the unit receiving the signal in the corresponding slot simultaneously, i.e. two units perform slot clearing simultaneously. If unit A and unit B send a tone signal in subslot 0 at the same time as shown in Figure 9, all other units around the two units lose their competition. Thus, unit A and unit B can continue to occupy the resource. In wireless distributed communication, resource collisions are prevented in this way.




**Key**

A,B unit

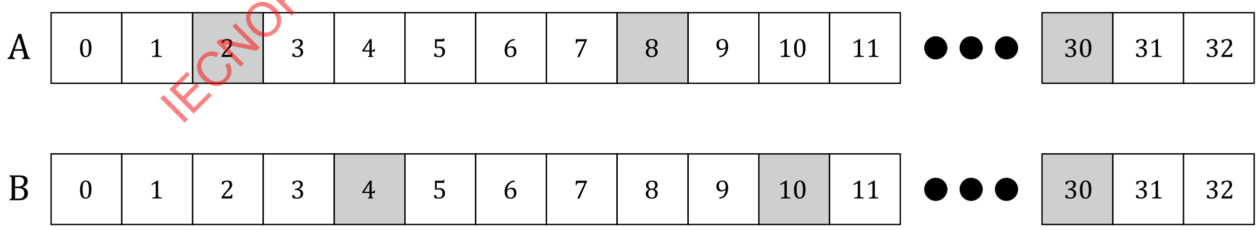
Tx transmission

[a] Tone slot.

**Figure 9 — Slot clearing example for hidden node removal**

However, when units move in wireless distributed communication environments, the unit that occupies the resource can experience resource collision due to the movement. Far apart units A and B are initially located outside of each other's communication area. Therefore, the same communication resource can be used. However, when unit A and unit B move closer and closer to each other, and eventually come into each other's communication area, the resource collision occurs. The resource collisions due to the movement of units are a very common phenomenon in UA communication environments. Therefore, it is very important to detect such resource collisions in real time. If a resource collision is detected, the unit can immediately allocate another resource with no collision.

Through the real-time resource collision check using the tone channel, it is possible to immediately detect a resource collision that occurs when two units allocated the same resource come into proximity. The unit occupying a resource transmits the tone signals by randomly selecting three subslots among subslots 1 to 32. These tone signals are called collision tones. Carrier sensing is performed in the remaining subslots. This allows real-time detection of other units that have allocated the same resources as themselves.




**Key**

A, B unit

**Figure 10 — Collision tone example**

For example, when unit A and unit B allocate the same resource, unit A transmits collision tones in subslots 2, 8 and 30, and unit B in subslots 4, 10 and 30 as shown in Figure 10. In this case, unit A can detect collision tones of unit B transmitted in subslots 4 and 10, and unit B can detect collision tones of unit A transmitted in subslots 2 and 8, respectively. Therefore, unit A and unit B can know the existence of each other and can detect a resource collision in real time. If a resource collision is detected, the unit allocates another resource without resource collision.

Types of resource allocation in this document include normal allocation, fixed allocation, and dedicated allocation. The normal allocation is for all units to allocate resources by performing a first competition and a second competition. Fixed allocation means that only units that meet certain conditions allocate resources by performing a first competition and a second competition. Dedicated allocation is the allocation of resources in advance by a wireless distributed communication system for a particular purpose or for a particular type of unit. Thus, the units designated by the system use the dedicated allocation resources without competition. At this time, the tone slots related with dedicated allocation are not used for competition. Therefore, these competition tone slots can be used by changing to information tone slots.

The wireless distributed communication system may separately configure an information tone channel. Information tone channel is used only to convey information. Since the information tone channel has the same structure as that of the competition tone channel, the hardware of the competition tone channel can be shared (see Annex A).

NOTE Detecting resource collision satisfies the data link design requirement described in ISO 21384-2[1] that the design of the data link mitigate co-channel interference with other users of the spectrum.

## 5.4 Purpose of the three types of communication and related services

### 5.4.1 General

The system described in this document shall consist of three types of communications to meet UA communication requirements. These communications shall conform to shared communication specified in ISO/IEC 4005-2, control communication specified in ISO/IEC 4005-3, and video communication specified in ISO/IEC 4005-4. The system should conform to ISO/IEC 4005-2, ISO/IEC 4005-3 and ISO/IEC 4005-4 as necessary for their types of communication. Shared communication is used when all units exchange information with UAs. Control communication is used when a controller controls a UA. Video communication is used when a video receiver receives video transmitted from a UA. These three types of communication are essential to provide various UA services.

### 5.4.2 Shared communication

Shared communication provides a link for units related to UAs to broadcast their information or to exchange information with other units. Relevant units share a shared communication resource, i.e. all units can allocate and use resources that are not yet occupied and are empty. The resources of shared communication are 500 slots. Each data slot resource can be allocated or occupied by the tone slot. Shared communication may also include an information tone channel.

The upper layer can provide the following application services using this shared communication:

— The UA detection service. For detection, UAs allocate one slot to broadcast their own information. The information the UA broadcasts may include the detection ID, current location, and waypoint. In this case, one UA can receive information broadcast by other UAs around it and calculate the risk of collision. Furthermore, if the risk of collision is high, one UA can use shared communication to negotiate a route with another UA. This is possible because shared communication supports information exchange between two UAs. Full autonomy may be possible if the UA uses 3D maps and shared communication. This is because UAs can use 3D maps to avoid ground terrain and features, and recognize other UAs through shared communication and avoid them autonomously.

— The identification of illegal UAs. As the UA broadcasts its own information, it can insert a trust field that changes in value every moment. This trust field can be received by all units, but trust checks can only be performed by authorized identification units. Thus, an authorized identification system on the ground can monitor the UAs' approach or operation by receiving ID and trust fields of UAs around them.

— The UA location notification service. UAs continue to broadcast their location using shared communications. Therefore, the ground equipment can receive this and transfer the location information of UAs to control stations or operators.

— The UA remote control service. The operator of each UA can control a UA, receive video from a UA, or send commands to a UA, if necessary, through ground equipment. This service is a paid service that requires a ground network.

— Obstacle detection. If an obstacle broadcasts its own information using shared communication, UAs nearby can recognize and avoid the obstacle.

— Dynamic geo-limitation generation. UAs can use shared communications to broadcast information that they have temporarily created geo-limitation to perform a very important task. Other UAs that receive it will not be able to enter the geo-limitation area.

— Emergency notification. UAs can use shared communications to report emergency accidents that occur during operation to operators. UAs can use shared communications to notify their surroundings of emergencies. If a flying UA suddenly fails or breaks for some reason, the UA can broadcast the situation in real time. If there is a ground equipment nearby that collects UA flight information, the ground equipment can notify the relevant authorities of the situation. Even if there is no ground equipment nearby, the nearby UA that has received this emergency signal can notify its controller or transmit the information to the nearby ground equipment.

— A time location providing service. Units located on the ground can broadcast time and location information through shared communication. When the UA does not receive a satellite signal, it can be used to keep time synchronized and to roughly calculate its location.

— The temporary UA control service. A UA whose control communication link with the controller is lost can allow the remote pilot to receive the UA's location via shared communication and, if necessary, temporarily send control commands to the UA via shared communication.

— Communication with the landing device. The UA can perform the necessary communication with the landing device through shared communication.

— Auto landing. UAs can safely land in the centre of the landing site using shared communications. To this end, the landing site can be equipped with a shared communication device and broadcast the landing-related information. Automated landing services, when implemented using information tone slots, can be built with simple tone transmitter hardware that transmits tone signals meaning east, west, south, north and centre. UAs can land in the centre of the landing site by measuring the power of the tone signal transmitted from the four corners and the centre of the landing site (see Annex A).

Another important service of shared communication is the provision of secondary links for control communication. Shared communication also can be used when the control link and the video link require initialization. In addition, when the control link is suddenly disconnected, the controller can receive the UA's location and information through shared communication and transmit some commands.

Finally, shared communication is used to allocate control communication resources and video communication resources. The controller can receive the information that the UA broadcasts on the shared channel, and can request the UA to allocate control communication resources through the shared channel. In addition, shared communication is used to manage control communication resources occupied by UAs and controllers.

In order to provide various services as described above, the upper layer may assign various attributes to 500 slots of shared communication in advance. These attributes may include, e.g. slot type, usage purpose, allocation type, transmission power. Assigning these attributes to 500 slots of shared communication in advance is called slot planning, and a file to which these attributes are assigned is called a slot planning file.



### 5.4.3 Control communication

Control communication is used by controllers to stably control UAs. Control communication has almost the same physical hierarchy as shared communication. The physical layer of a similar structure enables one modem to support both shared and control communications.

Control communication utilizes multiple frequency channel resources, i.e. one of the multichannel communication resources is allocated to a UA and a controller. One frequency channel is divided into 20 subchannels.

Control communications also use a tone channel to allocate multichannel communication resources. A tone channel and multi-channel resources have a similar frame and slot structure for mutual mapping. This channel mapping structure makes resource collision probabilities extremely low in distributed communication and enables resource collision detection in real time. Therefore, the controller can control its own UA stably through the control communication.

The purpose of the control communication is UA control, but depending on the application service, it may be used for data transmission temporarily or continuously.

### 5.4.4 Video communication

Video communication is used to transmit real-time video taken by UAs. A video receiver is typically embedded in a controller. Although this document supports one-to-one communication with a UA and a video receiver, video receivers other than the designated controller can also receive this video. One example of such a service is video transmission in firefighting. A fire UA can transmit captured video in real time to units of multiple firefighters.

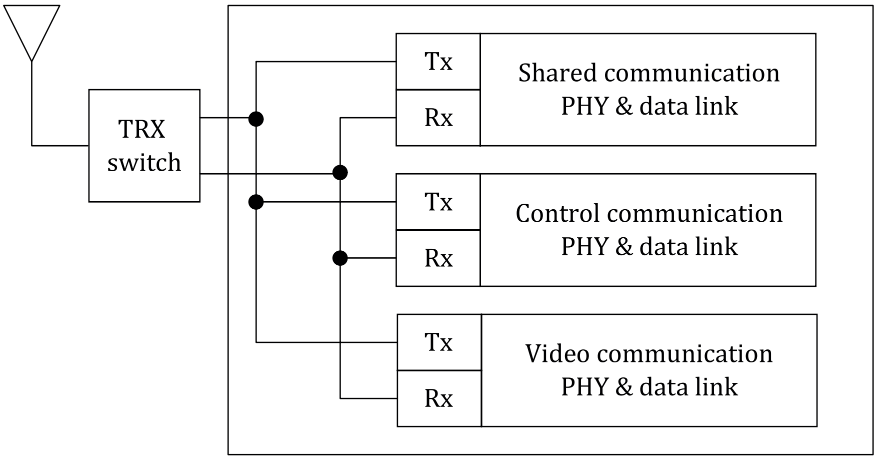
Video communication utilizes multiple frequency channel resources. A tone channel and multi-channel resources have a similar frame and slot structure for mutual mapping. One of multichannel communication resources is allocated to a UA and a video receiver. One frequency channel is divided into 10 subchannels.

Depending on the application service, video communication, like control communication, can convey information other than video. In this case, bidirectional communication is possible only when the control communication is used as an auxiliary. This is because video communication is one-way communication. In particular, in order for video communication to be initiated, shared communication or control communication shall first perform resource allocation for video communication.

## 5.5 Interoperation of three types of communication

UAs can use three types of communication. In general, when a unit transmits one communication signal, another communication signal cannot be received due to interference of the transmitted signal. Therefore, the three types of communication shall work together. In particular, the main reason for such interworking is to prevent the three types of communication from using resources at the same time, so that the reception of the shared communication is not interrupted by the other two communications. A UA in flight shall always receive shared communications in order to know flight information from other UAs. If a slot in shared channel cannot be continuously received due to a control transmission or a video transmission, it is not possible to continuously receive information of a UA occupying the related slot. This causes a fatal problem in recognizing other UAs.

In particular, this phenomenon always occurs in TRX systems for the purpose of simple hardware configuration. Three types of communication can be configured as one TRX system as shown in Figure 11.




**Key**

| | |
|---|---|
| TRX | transmission and reception |
| Tx | transmission |
| Rx | reception |
| PHY | physical layer |

**Figure 11 — Common TRX modem structure**

Therefore, the following rules are necessary for three communications to coexist.

a) UAs shall receive all slots of shared communication that they can receive.

b) Under normal conditions, the UA shall receive all shared communication slots at least once every three seconds.

c) The unit shall not perform the transmission of the control communication signal or the video communication signal in its occupied shared communication slot.

d) The UA shall broadcast control communication resource and video communication resource information currently being used in shared communication.

e) The unit shall allocate control communication resources and video communication resources so that they do not overlap in time.

In order for three types of communication to coexist, UAs and controllers shall keep track of the current state of communication resources. In the case of shared communications, a unit shall constantly update a slot map indicating available slots. In the case of control communications and video communications, a unit shall constantly update an available subchannel map. In the case of shared communication, a unit can allocate resources only by its slot map. However, in the case of control communication and video communication, relevant units shall allocate resources that are available in common in each other's subchannel map and their own subchannel map.

In the case of the control channel, the subchannel map exchange necessary for communication initialization is performed through initial work resources or through a shared communication. Control communication has its own initial work resources for initialization. However, UAs and controllers can use a shared communication to initiate control communication. This interworking between the shared communication and the control communication enhances the convenience of UA operation and further enhances communication safety.

In the case of a video channel, subchannel map exchange required for communication initialization is performed through a control channel or shared communication. Since video communication does not have its own initial work resources, UAs and controllers shall determine which video communication resources to use through shared or control communications.