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R&S®ARDRONIS

Countering RC drones – every second counts

Product Brochure | Version 07.00

AT A GLANCE

Protective measures can only be taken after a threat is detected. To effectively counter the threat, early warning is critical – every second counts. When R&S®ARDRONIS detects commercial drone activity, it automatically classifies the type of drone signal, determines the direction of the drone and its pilot, and (on command) disrupts the radio control link to prevent the drone from reaching its target.

R&S®ARDRONIS displays concise information about the threat and continuously updates a map view that indicates the direction of the drone and its pilot. A predefined list of contacts can immediately be notified about the threat and R&S®ARDRONIS can also record the remote control (RC) signal as evidence. The proprietary Rohde&Schwarz ARDRONIS control center (ACC) software displays the results from several remote sensors. Using ACC, security forces can localize the threats, deploy countermeasures and have the best chance of intercepting the illegal pilot.

Through repeated involvement in protecting high-profile events and high-ranking VIPs, R&S®ARDRONIS has proven to be a valuable asset for the security services involved. Rohde&Schwarz has thereby established a global benchmark in counter-drone solutions.

R&S®ARDRONIS – detecting, localizing and disrupting RC drones

The majority of commercial remote controlled drones are controlled (uplink) via frequency hopping spread spectrum (FHSS), an advanced frequency agile waveform. Another family of drones is controlled (uplink) via WLAN.

Signals transmitted from the drones (downlink) are typically FHSS, wideband or WLAN signals.

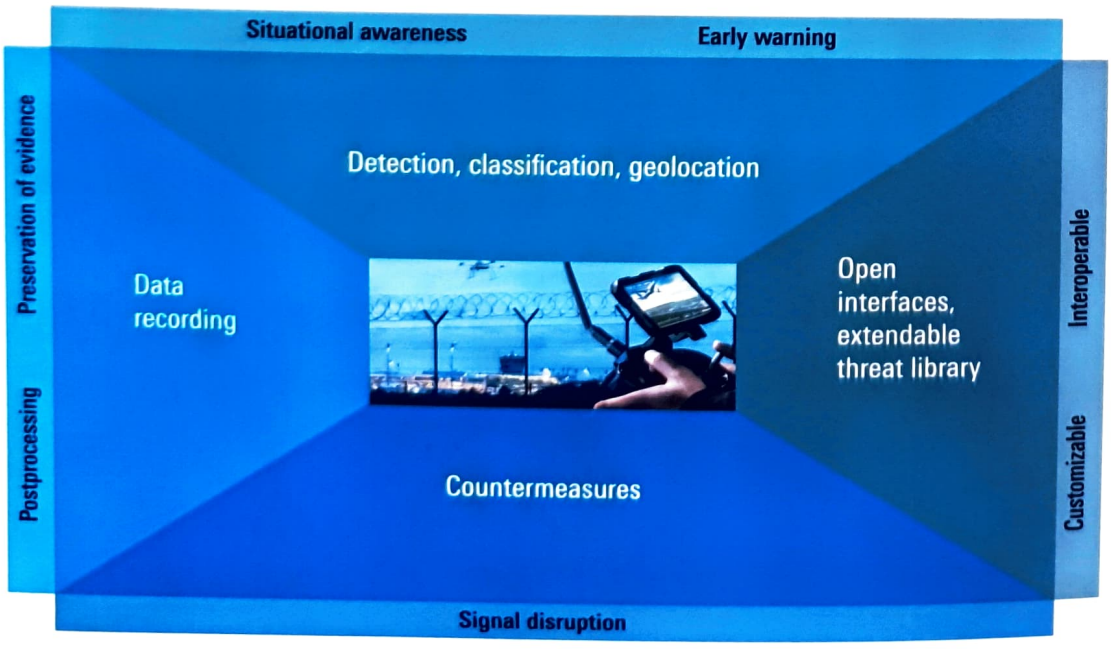
R&S®ARDRONIS combines leading Rohde&Schwarz sensors to form a reliable, high-performance solution for securing a predefined airspace against drones. Highly sensitive antennas and monitoring receivers collect RC drone signals.

Under ideal conditions [1], this makes it possible to detect commercial-off-the-shelf RCs in ranges up to 7 km and drones such as DJI Phantom 4 up to 5 km.

For FHSS-controlled drones:

- R&S®ARDRONIS compares the measured signals with an extensive library of drone profiles. This "monitor and match" process provides reliable early warning of any threats in the coverage area
- R&S®ARDRONIS direction finding (DF) ability delivers two critical parameters: the direction of the operator (RC signal DF) and the direction of the drone itself (telemetry or video downlink signal DF)
- R&S®ARDRONIS makes it possible to trigger effective countermeasures. The integrated jammer disrupts the targeted drones with minimum disturbance to other signals in the same frequency band

[1] Tested with free Fresnel zone, low-noise environment and CE conforming transmitters. FHSS based RC up to 7 km, Wi-Fi based RC up to 4 km, drone downlink up to 5 km, Wi-Fi drone downlink up to 3.5 km.



For WLAN-controlled drones:

- R&S®ARDRONIS can detect the drone
- R&S®ARDRONIS optionally can use sectorial WLAN antennas to provide sectorial directional information
- R&S®ARDRONIS makes it possible to trigger effective countermeasures. The WLAN link between the remote control and the drone can be disrupted

Basic R&S®ARDRONIS packages

Thanks to the automated workflows, R&S®ARDRONIS is an optimized solution that effectively and reliably detects, localizes and disrupts FHSS-controlled drones and their remote controls, all within a few seconds. Four R&S®ARDRONIS packages were designed to meet users' specific technical requirements:

- R&S®ARDRONIS Detection (R&S®ARDRONIS-I)
- R&S®ARDRONIS Direction (R&S®ARDRONIS-D)
- R&S®ARDRONIS Disruption (R&S®ARDRONIS-R)
- R&S®ARDRONIS Protection (R&S®ARDRONIS-P)

Benefits for all basic packages

- Early warning of drone activity
- Accurate classification of drone type
- Threat alerts based on profile matches
- Recording of signals to secure evidence
- Intelligence from intercepted video signals
- Threat notification to predefined persons/teams
- Field-proven counter-drone system
- System integration via open interfaces
- Multisensor wide area monitoring via ACC

Additional benefits for all basic packages

- Direction finding of drones and their pilots (for R&S®ARDRONIS-D and R&S®ARDRONIS-P)
- Disruption of RC links, on command (for R&S®ARDRONIS-R and R&S®ARDRONIS-P)
- Localization of drones and their pilots via ACC (for multiple R&S®ARDRONIS-D and R&S®ARDRONIS-P)
- Central control of remote jammers via ACC (for multiple R&S®ARDRONIS-R and R&S®ARDRONIS-P)

Additional option for handling WLAN-controlled drones

Each basic R&S®ARDRONIS package can be extended with options to additionally support detection of WLAN drone activity, classification of WLAN drone type, WLAN downlink video interception and WLAN disruption.

KEY FEATURES

- **Early warning** is the key to countering any threat. R&S®ARDRONIS can detect RC activity even before drones take off. Early warning alone often ensures an effective response, including jamming and pilot interception.
- **Direction finding (DF)** for FHSS-controlled drones Direction information gives security personnel a real tactical advantage. Direction and localization enable a fast, effective response to the drone and the pilot.
- **Active countermeasures** for FHSS-controlled drones A choice of jamming modes enables an appropriate response to single or multiple threats.
- **Situational awareness** Continuous reporting of drone activity on all relevant frequencies within a large coverage area provides situational awareness.
- **Accurate classification** of FHSS-controlled drones Reliable detection and measurement of the RC signal followed by automatic matching of RC parameters with the built-in profile library.
- The **automatic threat alert** means R&S®ARDRONIS can be operated with minimal training. When a signal is classified as a threat, the operator is immediately alerted via the user interface.
- **Immediate built-in notification** can be triggered manually or automatically. Key players can be informed about threats quickly and efficiently without distracting the operator from the current situation.
- **Video interception** R&S®ARDRONIS is able to intercept and visualize various common formats. Security staff can see what the drone pilot sees, which can be advantageous both during and after a drone-related incident.
- **Securing of evidence** Decoding the video signal and recording the RC signal of a drone allows security staff to collect valuable evidence that can be used to prove that a drone pilot participated in illegal activities.
- **Wide area monitoring and protection** ACC enables wide area protection by providing an overview of all detection and direction data from remote sensors, map-based threat localization and immediate access to active countermeasures.
- **Detection and disruption** of WLAN-controlled drones The R&S®ARDRONIS packages can optionally be extended with additional sensor equipment that handles WLAN-controlled drones.
- **Open interface** enables integration into multivendor and multisensor solutions, making R&S®ARDRONIS particularly attractive to integrators.

DIRECTION FINDING FOR FHSS-CONTROLLED DRONES

Combining early warning with effective direction finding (DF) provides a greater chance of neutralizing the threat. It tells security personnel the direction from which the drone is approaching and increases their chances of discovering the drone pilot. By providing accurate direction information, R&S®ARDRONIS gives security personnel a real tactical advantage.

DF enables security personnel to locate and apprehend drone pilots

With R&S®ARDRONIS, a bearing line on the map shows the direction of the drone pilot. With ACC, the pilot is localized via two or more crossed bearing lines. With this information, security staff can determine probable sites for the drone operator. They can deploy quickly and therefore have a high chance of intercepting the operator.

R&S®ARDRONIS monitors RC drones

If the drone is transmitting a signal to the operator (e.g. telemetry data or video), R&S®ARDRONIS can determine the direction of these signals and continuously update the bearing line on the map. Knowing the direction of the RC drone enables security personnel to respond appropriately – e.g. deploy suitable countermeasures or safely evacuate target persons.

Dual-channel DF for fast, accurate results

The R&S®DDF550 wideband direction finder simultaneously performs direction finding and signal analysis and is especially suitable for scenarios with multiple drone/RC transmitters.

Automatic DF parameterization

To achieve the most effective setup for determining the direction of RC drones, all DF parameters are configured automatically by R&S®ARDRONIS. This automatic configuration provides optimal results and hides complexity from the user. Users can concentrate on the mission rather than on tuning the DF parameters.

SITUATIONAL AWARENESS

R&S®ARDRONIS provides situational awareness via continuous reporting of drone activity on all relevant frequencies within a large coverage area. RC signal type, direction and threat status are displayed to maintain a constant overview of the protected airspace.

Detection based on RC signals for high reliability and a low false alarm rate

The key weakness of many sensor types is ambiguity, i.e. the detection result is based more on interpretation than on measurement. Radio signals have characteristic parameters that can be precisely measured. For FHSS-controlled drones, these parameters can be matched with a library of known drone profiles. The extensive, built-in profile library in R&S®ARDRONIS enables highly accurate profile matching. Consequently, focusing on the RC signal ensures a low false alarm rate.

R&S®ARDRONIS detects the RC links, alerts security personnel of potential threats and enables further action if the threat is considered to be a real and present danger.

WLAN-controlled drones are detected by analyzing their WLAN settings.

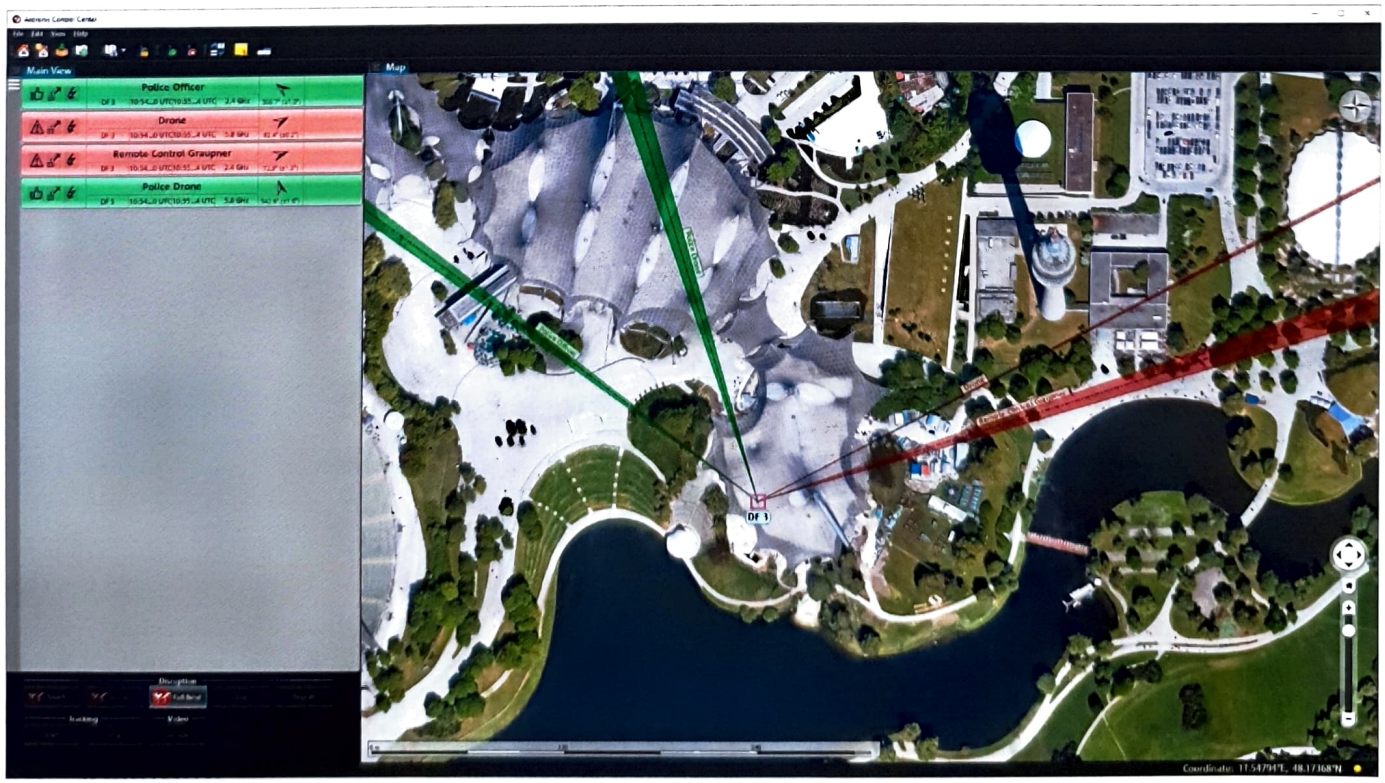
Full spectrum awareness

R&S®ARDRONIS displays a comprehensive list of all active RC signals detected within selected frequency ranges. Typical Rohde&Schwarz antenna/receiver combinations cover frequency ranges from 20 MHz to 6 GHz. Within this range, R&S®ARDRONIS monitors the RC drones by covering all relevant frequency bands selected by the operator.

Typical frequency bands include:

- 2.4 GHz, 5.8 GHz
- 902 MHz to 928 MHz
- 433 MHz to 434 MHz

R&S®ARDRONIS operator view: easy-to-use GUI increases the efficiency of the operational workflow and provides automatic, reliable classification and direction finding of multiple remote controls and drones simultaneously



ACTIVE COUNTERMEASURES FOR FHSS-CONTROLLED DRONES

With R&S®ARDRONIS, active countermeasures means disrupting the RC signals to the drones using smart jamming methods.

Smart jamming concept

The purpose of jamming is to disrupt RC links. R&S®ARDRONIS is able to jam drone RC signals and prevent further hostile actions. If the uplink signal of a drone is disrupted, the operator loses control over the drone, which will switch to failsafe mode, try to land or fly back to where it came from. FHSS drones are controlled by frequency agile short-time emissions (hopper signals). These bursts (often referred to as hops) are similar to the signals used by WLAN or Bluetooth® – signals that can co-exist in the same frequency range.

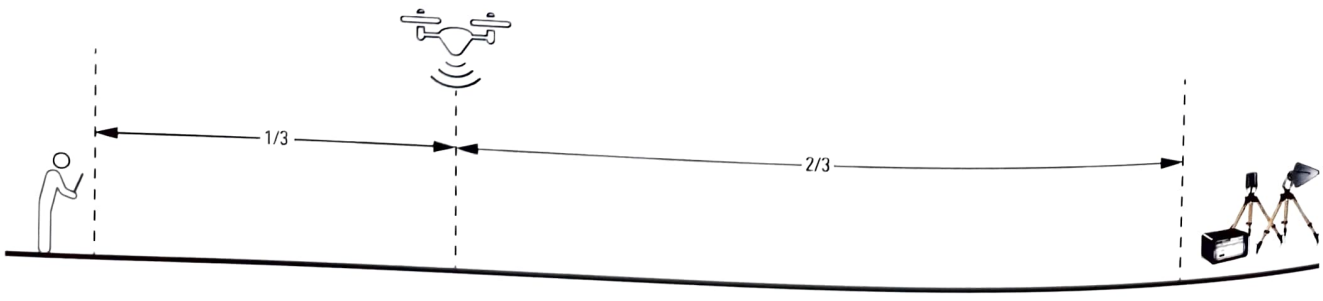
Depending on the type and the number of detected drones, a smart follower jamming mode or a smart wideband sweep jamming mode is used to neutralize the threat in an optimal way. The smart jamming concept of R&S®ARDRONIS uses a low-power approach with only a fraction of the output power typically required by barrage jammers. The impact on the drones is comparable due to the much higher efficiency (since the jamming power is concentrated on the threat signals). The default omnidirectional jamming approach can immediately counter threats, independent of the number of threats and the direction from which they are approaching.

- Smart follower jamming: R&S®ARDRONIS is able to systematically disrupt radio bursts coming from a drone remote control in order to minimize the disturbance to signals that are not related to the drone.
- Smart wideband sweep jamming: R&S®ARDRONIS is able to disrupt radio bursts coming from multiple drone remote controls by generating a sweeping signal that covers the entire band and reduces the sensitivity of the drone receivers. This prevents drones from receiving the weaker RC radio bursts.

Jamming is successful when the jamming signal is powerful enough to disrupt the RC signal received by the drone. This depends on many factors, such as the distance between the antennas (and their height), the orientation of antennas (especially the RC antenna), line-of-sight conditions, the presence of other strong signals in the area and environmental effects such as reflection and refraction.

The R&S®ARDRONIS jammer needs much less power than other types of jammers. The low-power approach means jamming is possible from approx. two-thirds of the distance to the opponent's RC under good line-of-site propagation conditions in smart follower jamming mode (see figure below) and approx. 40 % of the distance in smart wideband sweep jamming mode.

Jamming range



ACCURATE CLASSIFICATION OF FHSS-CONTROLLED DRONES

Depending on its capabilities, any particular drone may or may not be considered to represent a threat. Therefore, accurate classification of the type of drone detected is critical to the subsequent decision-making process. Classification begins with reliable detection and measurement of the RC signal. Automatic measurement and comparison of individual radio bursts enable the parameters of a single RC signal to be defined. These can then be compared with the built-in profile library. New profiles for unknown RC signals can easily be created and added to the library. This makes R&S®ARDRONIS a future-proof solution for accurate drone classification.

Robust signal classification even in congested signal environments

RC drones systematically change their radio frequency and are therefore known as frequency hoppers. Although such signals are difficult to classify, R&S®ARDRONIS can separate a selected RC drone signal from other signals using a reliable profile-based auto-separation algorithm. The separator clusters the individual radio bursts according to technical parameters such as hop length, modulation type and timing. For each cluster of hops, the algorithm automatically matches the hop parameters with RC profiles. This is a fast process that enables R&S®ARDRONIS to reliably match an RC signal in densely occupied scenarios – for example, ISM bands containing WLAN, Bluetooth®, automotive keyless entry systems and alarm signals.

Extensive RC profile library for precise matching of received signals

R&S®ARDRONIS detects and classifies the FHSS-controlled drones based on an extensive library of RC profiles. The library is installed along with the R&S®ARDRONIS software and is continually being expanded. The profiles of many commercial drones are already stored in the library.

Continual profile library updates

Rohde&Schwarz continually gathers experience with new drone types and, based on this experience, regularly creates new RC parameter sets for the profile library. These new profiles are available to customers in the form of updates via service contracts. Customers with a valid service contract are automatically contacted when an update is available. Update files can then be obtained via the Rohde&Schwarz customer service portal. By installing the update files, the software is updated and the profile library is extended. Profiles added to the library by the customer are not affected by the update process.

Expansion/modification of the library by customers

R&S®ARDRONIS enables custom profiles to be created in several ways. An unknown drone will be assigned the "Unnamed" profile. If an unknown drone similar to an existing drone is detected, a profile from the library can be copied and manually modified to match the unknown RC signal. A new profile can also be generated from an entry in the results list by means of simple commands in the user interface. Experts can generate profiles by recording an RC signal and making exact measurements using e.g. R&S®CA100IS signal analysis software.

Reliable RC signal classification in densely occupied ISM bands, e.g. WLAN, Bluetooth® and video signals

AUTOMATIC THREAT ALERT

Automatic alerting means R&S®ARDRONIS can be operated with a minimum of training but nevertheless offers a fast response to detected threats. The operator selects an appropriate scenario and starts processing, and then R&S®ARDRONIS does the rest. As soon as a threat is detected, the operator is alerted via the user interface.

When matched, profiles defined as threats trigger an alarm in the user interface

First, the operator selects a scenario such as the predefined ISM 2.4 GHz scenario. This scenario contains many profiles. Some of these profiles are flagged as threats.

Then, if the parameters of a detected RC signal match the parameters of a threat profile, R&S®ARDRONIS immediately activates a visual warning in the user interface. Further actions, such as an audible warning, SMS notification and IP trigger, can also be set up.

Threat detection enables immediate responses

Depending on the type of target and the intentions of the drone pilot, immediate responses can be triggered. On seeing the alert, operators can take measures such as recording the signal, notifying their superiors and deploying security personnel.

SMS notification

IMMEDIATE BUILT-IN NOTIFICATION

R&S®ARDRONIS offers a built-in notification service that can be triggered automatically or by a single press of a button in the GUI. This simple function means that key players can be informed about current events quickly and efficiently without distracting the operator from the current situation.

Critical information flow

In the event of a threat, senior decision makers, analysts and security personnel respond to the notification and can immediately be provided with critical information.

Decision-making support

Immediate notification of threats enables decisions about countermeasures or deployment of other assets to be made without delay.

In the event of a coordinated assault, with drones approaching from different directions, the ability to send threat-alert messages directly from the R&S®ARDRONIS GUI can save valuable time.

Distributed alerting

Since the R&S®ARDRONIS notification function is based on an online short message service, threat alert messages can be distributed immediately to enable the fastest possible response. From simple alerts for on-site security staff to threat warnings for an entire organization, SMS notification allows the alarm to quickly reach everyone who needs to know.

VIDEO INTERCEPTION

Intercepting the video signal transmitted by a drone has many benefits for security personnel. R&S®ARDRONIS is able to intercept and visualize various commonly used video formats, and further standards will be added.

PAL, NTSC and wireless LAN

PAL, NTSC and WLAN are the common standards used for transmitting live video. For this reason, many drones use these standards for their video downlink. R&S®ARDRONIS is able to intercept these video downlinks. Demodulators/decoders for analog PAL and NTSC video streams are included in each R&S®ARDRONIS package. Demodulators/decoders for WLAN-based video streams are included in the R&S®ARDN-WFDC option (requires additional R&S®ARDN-WF sensor for WLAN reception).

Benefits for security personnel

Decoding the video signals enables security personnel to see the same video as the drone pilot. This offers the following benefits:

- Images of the environment can enable fast location of the drone pilot
- The direction of travel and behavior of the pilot can help to determine whether the drone is a threat
- Images of the target area can reveal the pilot's objectives, especially in the case of invasion of privacy, industrial espionage and smuggling

SECURING OF EVIDENCE

Drones can be used for criminal activities ranging from invasion of privacy to industrial espionage, from denial of service to physical attacks. Capturing the video and RC signals of drone pilots secures valuable evidence that can be used to prove their participation in illegal activities.

Video interception can provide critical evidence

Early warning means that as soon as a decodable drone camera is active, the images can be decoded and viewed. Such images might contain the drone's launch site, the face of the drone pilot or license plates of nearby vehicles. Images captured during an attack can demonstrate the criminal intent and justify the actions taken against it.

Recordings of RC signals can be analyzed and matched

A recording of the RC signal can be analyzed to produce a detailed description of the signal parameters. This can be matched to a particular RC type (as with the profile library) or even a particular transmitter if any characteristic attributes can be found. When the drone pilot is caught, such recordings may serve as evidence of the pilot's involvement in illegal activities.

WIDE AREA MONITORING AND PROTECTION

Rohde&Schwarz ARDRONIS control center (ACC) software enables wide area coverage by collecting detection and direction data from remote R&S®ARDRONIS installations and providing the operator with an overview of all sites.

Covering a large area with multiple sensors

ACC collects the available detection data from all R&S®ARDRONIS sensors and indicates which of them could represent a threat. If the remote sites are equipped with direction finders (DF), the direction of the detected FHSS signals can also be visualized. For FHSS-controlled drones, the operator selects detections of interest and ACC displays the bearing lines for these signals. Two or more crossed bearing lines enable the operator to localize a threat.

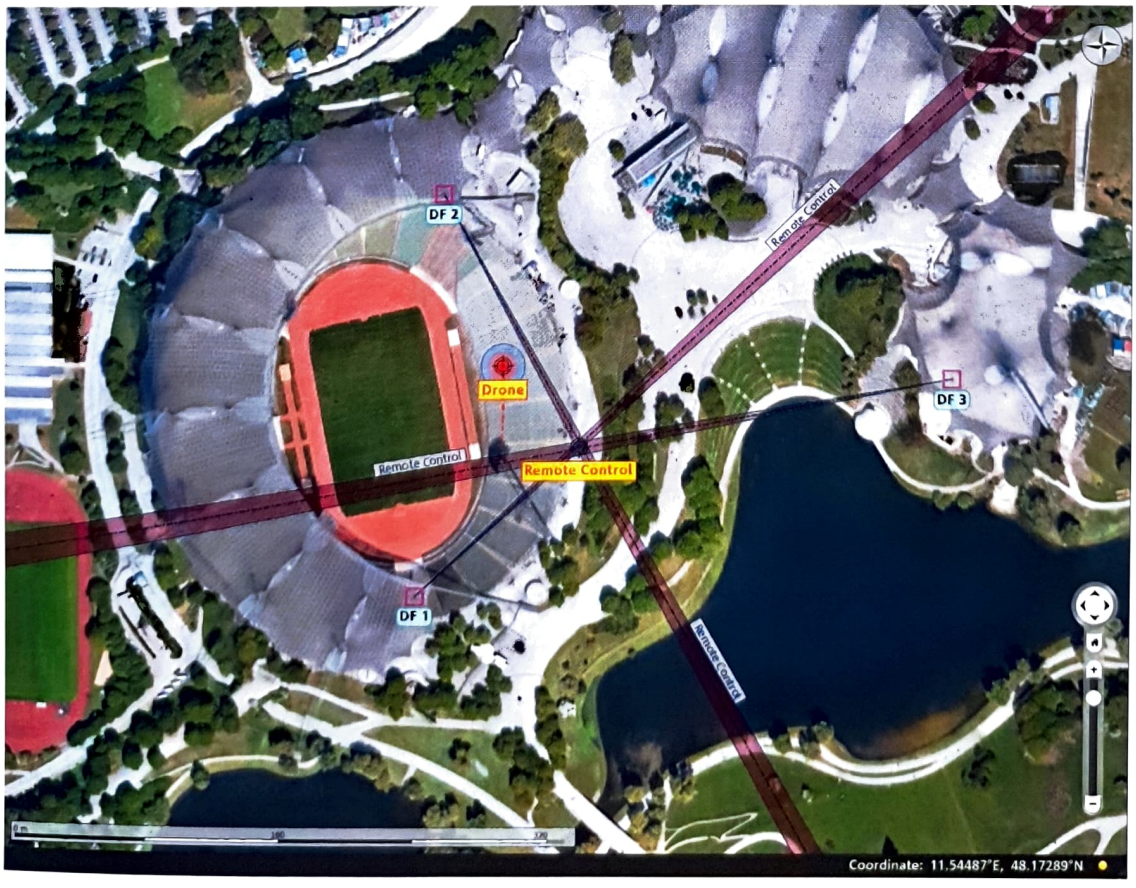
ACC can individually control jammers located at remote sites in order to target a specific threat. The intuitive GUI informs the operator about threats, indicates whether a signal can be jammed and enables countermeasures to be deployed without losing valuable time.

The functionality of the ACC can be summarized as follows:

- Connect to one or more remote R&S®ARDRONIS stations
- Indicate the locations of the remote stations on a map
- Display all detected drone-related signals (for FHSS- and WLAN-controlled drones) in a list
- Highlight which of the detected signals represent a threat
- Enable the user to select a detection in the list
- Draw a bearing line on the map for the selected detection of FHSS-controlled drones
- Provide threat localization via crossed bearings for FHSS-controlled drones
- Provide sectorial directional information for WLAN-controlled drones
- Enable the user to activate disruptive countermeasures

ACC continuously collects data from remote sensors and provides a user-friendly summary via a central workstation. The real benefit is that a single operator can monitor drone activity over a wide area and deploy countermeasures when required, without delay.

Bearing lines displayed in ACC localize a threat



DETECTION AND DISRUPTION OF WLAN-CONTROLLED DRONES

The R&S®ARDN-WF optionally enhances all R&S®ARDRONIS packages with WLAN drone RC signal detection. Two options for the R&S®ARDN-WF provide additional WLAN video interception and/or WLAN drone countermeasures.

Handling of WLAN-controlled drones

Both FHSS- and WLAN-controlled drones can raise a serious threat if used by a careless or malicious drone operator. R&S®ARDRONIS counters these threats with optional solutions for detecting remote controls or video links using WLAN. This requires the R&S®ARDN-WF option, which can be added multiple times to a basic R&S®ARDRONIS package.

The R&S®ARDN-WF provides the following functions:

- Detect the WLAN RC signal of a drone
- Match the detections to entries in a predefined "blacklist"
- Display all detected drone WLAN signals or only the matched blacklist RC signals
- Indicate whether the detection represents a threat
- Operators can also create a "whitelist" including non-drone-related WLAN signals or known harmless drones

By using one or more R&S®ARDN-WF boxes with a connected WLAN sector antenna, it is possible to obtain sectorial directional information for the WLAN-controlled drones.

WLAN videolink visualization (optional)

The detection and visualization of WLAN video links requires the R&S®ARDN-WFDC option. For details, see the "Video interception" section on page 12.

Active countermeasures (optional)

Depending on the types of detection displayed, the operator can decide whether further action is required, e.g. to disrupt the communications between the WLAN-based RC and the drone using the R&S®ARDN-WFCM countermeasure option.

If the uplink signal of a WLAN drone is disrupted, the drone will switch to failsafe mode, try to land or fly back to where it came from. In this case, the drone operator loses control of the drone.

OPEN INTERFACE

The use of an open interface enables integration into multivendor and multisensor solutions, making R&S®ARDRONIS particularly attractive to integrators.

R&S®ARDRONIS in multisensor solutions

Multisensor systems enable integrators to exploit the strengths of the individual sensor types and simultaneously overcome their weaknesses. For this reason, many systems include receivers, direction finders, acoustic arrays, optical sensors and radar. The use of an open interface enables R&S®ARDRONIS to be integrated into such systems and provide all the benefits derived from early warning, profile matching, direction finding and countermeasures.

R&S®ARDRONIS in multivendor solutions

The messages sent within R&S®ARDRONIS can be read and evaluated by external applications. These third-party applications can make decisions, distribute information and trigger actions based on the values within the messages. This means the wide range of functionality offered by R&S®ARDRONIS can easily be integrated into multivendor solutions.

For multisensor solutions that use R&S®ARDRONIS sensors, please refer to the GUARDION solution. [1]

[1] www.guardion.eu

FLEXIBLE DEPLOYMENT

R&S®ARDRONIS can be deployed as a fixed installation to cover a specific area, as a semi-mobile solution providing temporary cover or as a fully portable solution enabling ad hoc security. Modular design translates easily into custom solutions and is especially beneficial for portable systems.

Powerful, compact and portable setup

R&S®ARDRONIS precisely matches users' specific requirements thanks to its fully modular and configurable design.

R&S®ARDRONIS-I setup

R&S®ARDRONIS-I is ideal for users interested in drone detection and classification, i.e. monitoring of drone activity in a specific area. It is relatively small, compact and can be quickly set up.

For portable use, a transport case with a compartment for the R&S®ARDRONIS-I application (antenna, receiver, notebook and accessories) is included.

More information:

- R&S®HE600 active omnidirectional receiving antenna technical information (4094.9019.02)
- R&S®EB500 monitoring receiver product brochure (PD 5214.3800.12) and data sheet (PD 5214.3800.22)

Transport case for R&S®ARDRONIS-I

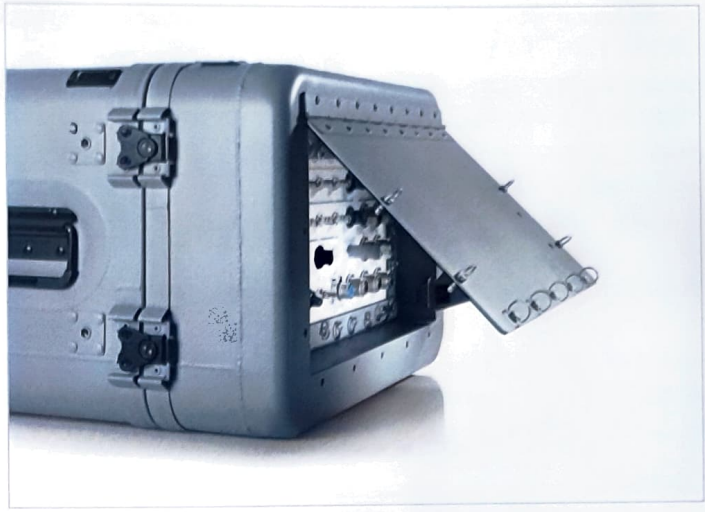
Configuration for R&S®ARDRONIS-I

R&S®ARDRONIS-D setup

R&S®ARDRONIS-D effectively and reliably detects and determines the direction of RC signals in the shortest possible time.

R&S®ARDRONIS-D is a key component of the overall R&S®ARDRONIS solution. The combination of a reliable detection result and precise bearing line overlaid on a detailed local map provides many benefits to security personnel.

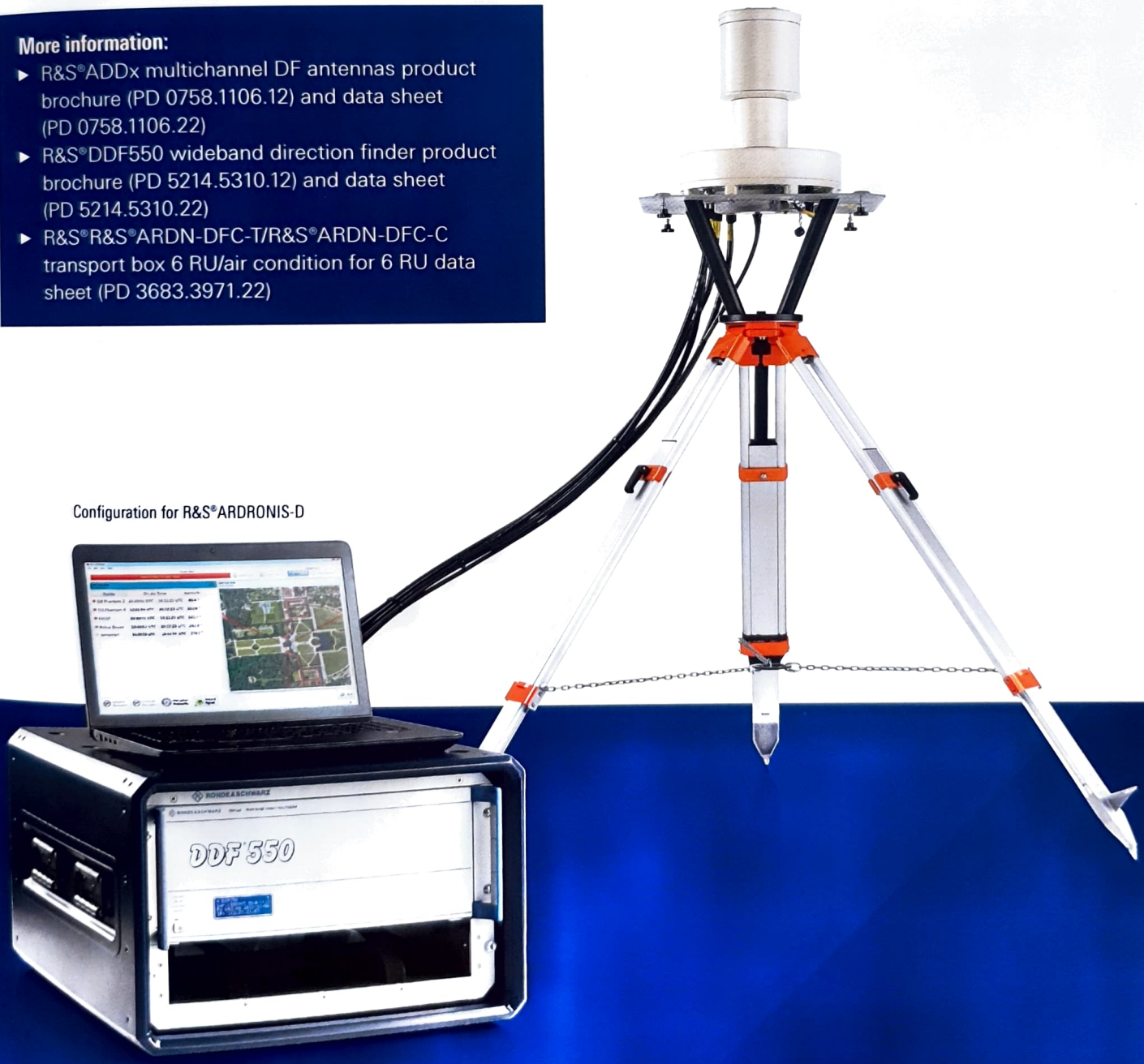
A compact INCAS box is available for simple transport. A weatherproof case (6 RU) is available for transport and deployment in locations exposed to rain, dust and/or extreme temperatures.



Weatherproof transport solution for R&S®ARDRONIS-D

More information:

- R&S®ADDx multichannel DF antennas product brochure (PD 0758.1106.12) and data sheet (PD 0758.1106.22)
- R&S®DDF550 wideband direction finder product brochure (PD 5214.5310.12) and data sheet (PD 5214.5310.22)
- R&S®R&S®ARDN-DFC-T/R&S®ARDN-DFC-C transport box 6 RU/air condition for 6 RU data sheet (PD 3683.3971.22)



Configuration for R&S®ARDRONIS-D

TRAINING COURSES

R&S®ARDRONIS training courses are a combination of classroom-based theory lessons and practical exercises. They cover the most important topics that must be understood in order to effectively counter threats from drones.

The courses provide participants with the necessary knowledge to understand the security threats posed by drones and how to use key functions such as detection, direction finding and countermeasures. All courses are instructor-led with an interactive approach. The instructor uses a mixture of question and answer sessions, continuous assessment and a final exam to ensure effective knowledge transfer.

R&S®ARDRONIS operator training

Four operator training courses tailored to the different setups are available, i.e. for R&S®ARDRONIS-I, R&S®ARDRONIS-D, R&S®ARDRONIS-R and R&S®ARDRONIS-P.

In these courses, participants will learn basic theory about drones and their remote control. They will analyze the transmission standards used by RC drones and gain an understanding of the relation between frequency band, power and the range of the control link.

The participants will analyze different deployment scenarios for detection and describe the threats caused by RC drones. Depending on the deployment scenarios, radio propagation impairments and possible detection issues will be discussed.

Moreover, the participants will learn to configure and operate R&S®ARDRONIS in hands-on sessions.

The prerequisite for these courses is familiarity with national regulations about the use of commercial drones.

Course overview

Course title	Target audience	Objective	Duration
R&S®ARDRONIS-I operator training	Operators of an R&S®ARDRONIS-I system	Participants learn basic theory about RC drones and are able to configure/operate R&S®ARDRONIS-I and related applications	2 days
R&S®ARDRONIS-D operator training	Operators of an R&S®ARDRONIS-D system	Participants learn basic theory about RC drones and are able to configure/operate R&S®ARDRONIS-D and related applications	2 days
R&S®ARDRONIS-R operator training	Operators of an R&S®ARDRONIS-R system	Participants learn basic theory about RC drones and are able to configure/operate R&S®ARDRONIS-R and related applications	2 days
R&S®ARDRONIS-P operator training	Operators of an R&S®ARDRONIS-P system	Participants learn basic theory about RC drones and are able to configure/operate R&S®ARDRONIS-P and related applications	2 days
R&S®ARDRONIS site selection training	Users who set up/operate a mobile or deployable R&S®ARDRONIS system	Participants are able to select a suitable antenna and antenna site for an R&S®ARDRONIS system with optimum coverage conditions	1 day
CUAV signal analysis fundamentals training	Expert operators, signal analysts and administrators of an R&S®ARDRONIS system	Participants learn about relevant RF topics and gain an in-depth understanding of the principle of wave propagation necessary for the R&S®ARDRONIS expert courses	1 day
R&S®ARDRONIS-I expert operator training[1]	Expert operators, signal analysts and administrators of an R&S®ARDRONIS-I system	Participants learn about the R&S®ARDRONIS-I expert view, are able to configure the R&S®ARDRONIS-I system manually and can create their own drone detection profiles	1 day
R&S®ARDRONIS-D expert operator training[1]	Expert operators, signal analysts and administrators of an R&S®ARDRONIS-D system	Participants learn about the R&S®ARDRONIS-D expert view, are able to configure the R&S®ARDRONIS-D system manually and can create their own drone detection profiles	1 day
R&S®ARDRONIS-R expert operator training[1]	Expert operators, signal analysts and administrators of an R&S®ARDRONIS-R system	Participants learn about the R&S®ARDRONIS-R expert view, are able to configure the R&S®ARDRONIS-R system manually and can create their own drone detection profiles	1 day
R&S®ARDRONIS-P expert operator training[1]	Expert operators, signal analysts and administrators of an R&S®ARDRONIS-P system	Participants learn about the R&S®ARDRONIS-P expert view, are able to configure the R&S®ARDRONIS-P system manually and can create their own drone detection profiles	1 day
R&S®ARDRONIS WLAN operator training	Operators of an R&S®ARDRONIS-I/-D/-R/-P system who deal with WLAN-controlled drones	Participants can configure and operate R&S®ARDN-WF to perform WLAN drone RC signal detection and optionally WLAN video interception and/or WLAN drone countermeasures	1 day

[1] CUAV signal analysis fundamentals training and corresponding operator training is a prerequisite.

Rohde&Schwarz

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