



(43) International Publication Date
24 September 2015 (24.09.2015)

- (51) International Patent Classification:
H04W 36/18 (2009.01) *G05D 1/00* (2006.01)
- (21) International Application Number:
PCT/IL2015/050280
- (22) International Filing Date:
16 March 2015 (16.03.2015)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
231555 17 March 2014 (17.03.2014) IL
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: Core UxV Control System

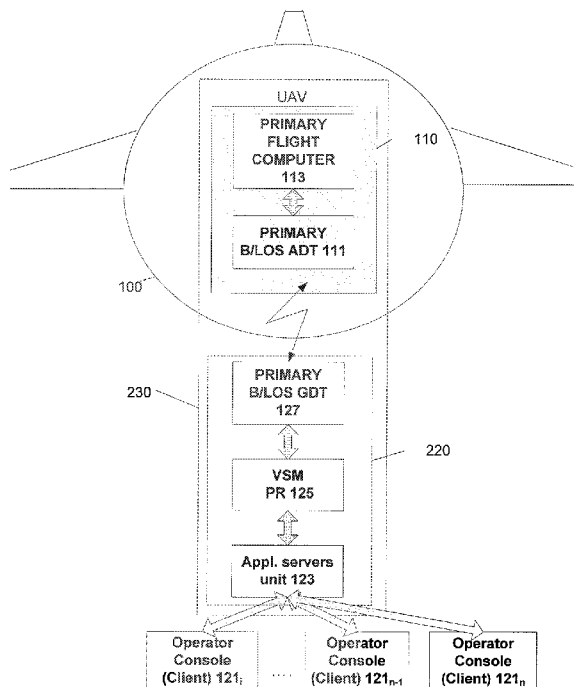


Fig.3

(57) Abstract: The presently disclosed subject matter includes a UxV control system method and computer storage device for enabling handover of control over a UxV from a first operator console to a second operator console, the UxV control system being operationally connected to the UxV.

**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *of inventorship (Rule 4.17(iv))*

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

CORE UxV CONTROL SYSTEM

FIELD OF THE INVENTION

This invention relates to control systems for controlling unmanned vehicles.

BACKGROUND OF THE INVENTION

Unmanned vehicles (UxVs), which are predominantly used for military and special operation applications, are becoming today increasingly popular in civilian applications. UxVs are used in a large variety of applications including for example, traffic monitoring, remote sensing and reconnaissance, transportation, search and rescue, domestic policing, electronic warfare and decoys, and more.

Unmanned vehicles include various types, such as for example Unmanned Aerial Vehicles (UAVs also known as Unmanned Aerial systems), Unmanned Ground Vehicles (UGVs), Unmanned Marine Vehicles (UMVs), etc.

The operation of a UxV throughout its mission is controlled by a control station which is manned by a control station operator. For example, a UAV is controlled and monitored from takeoff, through flight and mission performance and until landing.

GENERAL DESCRIPTION

According to an aspect of the presently disclosed subject matter there is provided a UxV control system configured to enable handover of control over a UxV from a first operator console to a second operator console, the UxV control system being operationally connected to the UxV;

the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT);

the application servers unit being operatively connectible to a first operator console having control over the UxV;

the application servers unit comprising a processing unit is configured, responsive to a request to hand over control of the UxV from the first operator console to a second operator console, to execute a handover process, wherein the

UxV remains constantly connected to the UxV control system during the handover process;

the processing unit is configured for the handover process to: connect the second operator console to the application servers unit; hand over control of the UxV from the first operator console to the second operator console; and disconnect the second operator console.

According to certain embodiments of the presently disclosed subject matter the system may comprise the additional features (i-vii) enumerated below in any combination and/or permutation.

- i. wherein communication between the GDT and an Aerial Data Terminal (ADT) in the UxV is maintained without interruption during the handover process.
- ii. wherein communication between the respective GDT and the ADT in the UxV can be based on one or more of: line of sight communication, and beyond line of sight communication.
- iii. wherein the UxV control system is simultaneously connected to a plurality of operator consoles, each operator console enabling to control and/or monitor the UxV and/or one or more onboard payload systems.
- iv. wherein the first operator console and the second operator console communicate with the UxV control system by a remote wireless communication network.
- v. wherein the first operator console and the second operator console are located at different geographical locations.
- vi. wherein the second operator console is connected to the application servers unit after the first operator console is disconnected from the application servers unit.
- vii. wherein the UxV is any one of: unmanned aerial vehicle, unmanned ground vehicle, unmanned marine vehicle, and unmanned submarine vehicle.

According to another aspect of the presently disclosed subject matter there is provided a computerized method of handover of control over a UxV from a first

operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and is configured to communicate with the UxV via at least one Ground Data Terminal (GDT); the method comprising:

- connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

- responsive to a request to handover the control over the UxV from the first operator console to a second operator console, using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process; the handover process comprising:

 - connecting the second operator console to the application servers unit; handing over control of the UxV from the first operator console to the second operator console, and disconnecting the second operator console.

According to another aspect of the presently disclosed subject matter there is provided a machine-readable non-transitory memory tangibly embodying a program of instructions executable by the machine for executing a method of handover of control over a UxV from a first operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT); the method comprising:

- connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

- using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process; the handover process comprising:

 - connecting the second operator console to the application servers unit; handing over control of the UxV from the first operator console to the second operator console; and disconnecting the second operator console.

According to another aspect of the presently disclosed subject matter there is provided a computer program product implemented on a non-transitory computer useable medium having computer readable program code embodied therein for handover of control over a UxV from a first operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and is configured to communicate with the UxV via at least one Ground Data Terminal (GDT); the computer program product comprising:

- computer readable program code for causing the computer to connect the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

- computer readable program code for causing the computer to execute a handover process while the UxV remains constantly connected to the UxV control system during the handover process;

- the handover process, comprising: connecting the second operator console to the application servers unit; handing over control of the UxV from the first operator console to the second operator console; disconnecting the second operator console.

According to another aspect of the presently disclosed subject matter there is provided a UxV control system configured to enable to monitor and/or control a respective UxV and/or one or more payload systems onboard the respective UAV, the UxV control system comprising:

- at least an application servers unit and a Vehicle Specific Module (VSM); wherein the UxV control system is assigned to a respective UxV and is configured to communicate with the respective UxV via a Ground Data Terminal (GDT);

- the application servers unit being operatively connectible to a first operator console having control over the UxV;

- the application servers unit comprising a processing unit configured, responsive to a request to hand over control over the UxV from the first operator console to a second operator console, to execute a handover process, wherein the

UxV remains constantly connected to the UxV control system during the handover process;

the processing unit is configured, for the handover process, to: connect the second operator console to the application servers unit; hand over control of the UxV from the first operator console to the second operator console; and disconnect the second operator console.

According to another aspect of the presently disclosed subject matter there is provided a computerized method of controlling a UxV, the method comprising:

providing a UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM);

assigning the UxV control systems to a respective UxV; the UxV control systems configured to communicate with the respective UxV via at least one Ground Data Terminal (GDT);

connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

responsive to a request to handover control over the UxV from the first operator console to a second operator console, using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process; the handover process comprising:

connecting the second operator console to the application servers unit;

handing over control of the UxV from the first operator console to the second operator console; disconnecting the second operator console.

The different aspects of the present disclosed subject matter as mentioned above can optionally comprise one or more of the features (i-vii) above, in any desired combination or permutation *mutatis mutandis*.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the claimed subject matter and to see how it may be carried out in practice, various embodiments will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a functional block diagram illustrating a basic architecture of a UAV control system as known in the art;

Fig. 2 is a functional block diagram schematically illustrating a handover process, as known in the art.

Fig. 3 is a functional block diagram of a UAV control system, in accordance with the presently disclosed subject matter;

Fig. 4 is a functional block diagram schematically illustrating a handover process, according to the presently disclosed subject matter; and

Fig. 5 is a flowchart illustrating an example of a sequence of operations performed during handover process, in accordance with the presently disclosed subject matter.

DETAILED DESCRIPTION

Unless specifically stated otherwise, as apparent from the following discussions, it is appreciated that throughout the specification discussions utilizing terms such as "connecting", "using", "handing over", "disconnecting", or the like, include actions and/or processes of a computerized device that manipulate and/or transform data into other data, said data represented as physical quantities, e.g. such as electronic quantities, and/or said data representing physical objects.

The terms "computer", "computerized device", "processing unit" or any other variation thereof should be expansively construed to cover any kind of electronic device with data processing capabilities, such as a processor (e.g. digital signal processor (DSP), microcontroller, field programmable circuit (ASIC), etc) or a device which comprises or is operatively connected to one or more computer processors including by way of non-limiting example, a personal computer, server, laptop computer, computing system, a communication device and/or any combination thereof.

As used herein, the phrase "for example," "such as", "for instance" and variants thereof describe non-limiting embodiments of the presently disclosed subject matter. Reference in the specification to "one case", "some cases", "other cases" or variants thereof means that a particular feature, structure or characteristic

described in connection with the embodiment(s) is included in at least one embodiment of the presently disclosed subject matter. Thus the appearance of the phrase "one case", "some cases", "other cases" or variants thereof does not necessarily refer to the same embodiment(s).

It is appreciated that certain features of the claimed subject matter, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination. While the invention has been shown and described with respect to particular embodiments, it is not thus limited. Numerous modifications, changes and improvements within the scope of the claimed subject matter will now occur to the reader.

In embodiments of the claimed subject matter, fewer, more and/or different stages than those shown in Fig. 5 may be executed. In embodiments of the claimed subject matter one or more stages illustrated in Fig. 5 may be executed in a different order and/or one or more groups of stages may be executed simultaneously. Fig. 3 and Fig. 4 illustrate a schematic of the system architecture in accordance with embodiments of the presently disclosed subject matter. The modules in Fig. 3 and Fig. 4 may be centralized in one location or dispersed over more than one location. In other embodiments of the invention, the system may comprise fewer, more and/or different modules than those shown in Fig. 3 and Fig. 4.

It is noted that while the description set forth herein mainly pertains to UAVs, this is done by way of a non-limiting example only and the principles disclosed with respect to UAVs can be similarly implemented in other types of unmanned vehicles.

Bearing the above in mind, attention is now drawn to Fig. 1 showing a functional block diagram illustrating a basic architecture of a UAV control system. The architecture shown in Fig. 1 complies with the requirements of STANAG 4586 which is the NATO specification of a core UAV control system (CUCS). Fig. 1 schematically illustrates UAV control system 120 which communicates with onboard control system 110 onboard UAV 100.

UAV control system **120** (located remotely from the UAV e.g. on the ground) comprises client module (operator console **121**) connected to application servers unit **123**, vehicle specific module (VSM **125**) and primary B\LOS ground data terminal (Primary B\LOS GDT **127**).

Operator console **121** can be configured to enable an operator to monitor and control the operation of a respective UAV connected to control system **120**. Operator console **121** can be implemented on various types of computerized devices including by way of non-limiting example, PC or laptop computers or any other computerized device which comprises computer memory (e.g. volatile and non-volatile) and one or more computer processors configured with the required processing capabilities. Operator console **121** is used by an operator to control the UAV while on the ground and in the air. Information provided by the UAV ("UAV data") can be displayed on a display (e.g. LCD or LED screen) being part of the operator console. UAV data can include for example information indicative of UAV situation awareness, information with respect to the operational conditions of the UAV systems, information with respect to mission progress etc. Control of the UAV can include both control over the operation of the UAV itself, as well as control over the operation of various payloads which are installed on the UAV.

Application servers unit **123** comprises one or more computerized devices (e.g. computer servers) configured to enable the execution of various tasks. Each server is a computerized device with appropriate computer memory and one or more computer processors providing the required data processing capabilities.

Application servers unit **123** can include by way of non-limiting example: flight control server configured for controlling the UAV's flight; various data acquisition servers operatively connected to a respective data acquisition device (e.g. camera, radar, communication intelligence device, etc.) installed on the UAV. For example, an image acquisition server which is operatively connected to an image acquisition device, such as a camera installed on the UAV and configured to control the camera for obtaining information with respect to a surveyed scene; data analysis server configured for analyzing UAV data which is retrieved by the data acquisition

devices installed on the UAV; radar application servers configured for interfacing with a radar system installed on the UAV and providing the acquired information, and so forth.

Vehicle specific primary module (VSM PR **125**) is operatively connected to application servers unit **123** and to ground data terminal (B/LOS GDT **127**) and is configured to receive data link interface (DLI) from the application servers unit **123** and to translate the data link to a protocol which is compatible with the onboard control system **110**. VSM **125** is further configured to translate data which is received from the UAV (via GDT) to a format which is compatible with core UAV control system **120**.

B/LOS GDT **127** is configured to communicate with the UAV via a respective aerial data terminal (B/LOS ADT **111**) which is part of the onboard control system **110**. Communication between GDT and ADT can be line of sight communication (LOS) or satellite based, beyond line of sight communication (B-LOS).

Primary flight computer **113** represents a computer located onboard the UAV configured to execute various operations including for example, flight operations and various missions. Primary flight computer **113** can be implemented by multiple computer processing devices.

The functional elements in UAV control system **120** are configured as a single operational channel for enabling communication and control with a UAV. When a UAV is desired to be operated, a respective UAV control system is assigned to the UAV for controlling and monitoring operation of the UAV.

During operation and control of a UAV, it may be desirable to transfer control over a given UAV from one operator console to another. For example, in some cases, a first operator is responsible for controlling the UAV during takeoff and landing, and a second operator is responsible for controlling the UAV throughout the actual mission. Thus, after takeoff and before landing, a handover process is performed between the first and second operator consoles.

During a handover process, control over a given UAV is transferred from one operator to another operator. Since the UAV control system **120** is configured as

single unified operational channel, during a handover process, a first UAV control system **120**, currently connected to the UAV, is disconnected from the UAV, and a second UAV control system **120** is connected to the UAV instead.

Fig. 2 is a functional block diagram schematically illustrating a handover process as performed in accordance with the previously known art. As illustrated in **Fig. 2** during the handover process the UAV (**100**) is disconnected from one UAV control system **120_a** and connected to a different UAV control system **120_b**. The disconnection of the UAV from one UAV control system and reconnection of the UAV to the other UAV control system, involves a period of time, albeit generally short, when the UAV is disconnected from both UAV control systems. Thus, the handover process presents a risk of loss of connection with the UAV. This poses a risk of complete loss of connection with the UAV. It is desirable to avoid any connection loss, whether it is a short period connection loss or a complete connection loss.

Fig. 3 is a functional block diagram of a UAV control system, in accordance with the presently disclosed subject matter. UAV control system **220** depicted in **Fig. 3** comprises similar functional elements to those described above with reference to **Fig. 1**. However, unlike the architecture of the prior art, UAV control system **220** comprises a respective GDT, VSM and an application servers unit, while the operator console does not form an integral part of core UAV control system **220**. Alternatively, core UAV control system **220** is configured to be connectable to one or more user terminals **121** which are provided as functional elements external to UAV control system **220**.

It is noted that according to some implementations GDT is not considered an integral part of the UAV control system, but is rather externally connected to the UAV control system to enable communication with a respective UAV.

The operator console device can be configured to assume control or relinquish control on a UAV and/or any of its payload systems. Communication between the operator console and the UAV control system can be realized by any type of communication network, including for example some type of wireless communication networks.

Furthermore, according to the presently disclosed subject matter, each UAV can be assigned with a specific UAV control system **220** which remains connected to the UAV throughout operation of the UAV. A Primary GDT in a UAV control system communicates with a respective Primary ADT of a respective UAV. Thus, the UAV control system and the UAV control module **110** form together a unified operational channel **230** which remains connected during operation of the UAV.

Fig. 4 is a functional block diagram schematically illustrating a handover process according to the presently disclosed subject matter. Unlike the handover process described above with reference to **Fig. 2** the presently disclosed handover process does not include disconnection of a UAV's ADT from a respective GDT of a UAV control system followed by reconnection of the ADT to a different GDT of a different UAV control system. Here, the handover is executed at the application servers level, while the UAV's ADT remains constantly connected to the GDT of its assigned UAV control system **220**.

As explained above, according to the subject matter disclosed herein, each UAV can be assigned with a designated UAV control system **220** comprising a respective application servers unit and a respective VSM. The handover is performed by connecting a different operator console to the UAV operational channel of the UAV while the onboard control system (**110**) remains connected to its designated UAV control system throughout the entire process.

An application servers unit can comprise, for example, an application server comprising a handover processing unit (HO processing unit **129**) configured to execute a handover process. Handover processing unit **129** is configured to connect to more than one operator console simultaneously and to synchronize the connection and disconnection of the operator consoles. A handover processing unit **129** in a given UAV control system **220**, which is connected to a first operator console can be configured, responsive to a request, to connect to a second operator console and only then disconnect from the first operator console, and thus enable handover of the control over a respective UAV from the first operator console to the

second operator console. As mentioned above, the UAV's ADT remains connected to the GDT of the assigned UAV control system the entire time.

The operator console in accordance with the presently disclosed subject matter is configured to establish a communication link with a given UAV control system and communicate with the system over some type of communication network.

As shown in **Fig. 4** in a handover process as disclosed herein, control over the UAV is transferred from operator console **121_a** to operator console **121_b**. During the handover process the UAV control system **220** is transferred as a complete unit from operator console **121_a** to operator console **121_b**, maintaining the operation channel **230** intact throughout the process. This enables a smooth handover process and reduces the risk of disconnection between the control station and the UAV.

Furthermore, the proposed system architecture introduces a new operational approach. According to this new operational approach UAV operator consoles can be located at locations which are geographically remote from the UAV control system. The operator consoles can remotely connect to a UAV control system and assume command on a UAV assigned to the UAV control system.

For example, consider a UAV control system, located in Haifa (Israel), which is assigned to a UAV currently flying over the Mediterranean Sea (e.g. some 10ths of KM off the shore) for a search and rescue mission. The UAV can be controlled by an operator console located anywhere on the globe (e.g. on a ship in the Mediterranean Sea, on the Italian coast, or in Tel Aviv), while the operator console communicates with the UAV control system via a remote communication network. Furthermore, control over the UAV can be transmitted from one operator to another, each operator located in a geographically remote location from one another and from the location of the UAV control system (e.g. control can be transferred from an operator onboard a ship in the Mediterranean Sea to an operator console located on the Italian coast).

Different payloads are operated and controlled with the help of designated application servers installed in the application servers unit. As each UAV control

system **220** is assigned to a specific UAV, a UAV control system can be equipped with application servers required for the payload installed on the UAV for completing these missions. This approach enables to equip each UAV control system only with the application servers which are actually needed for the missions assigned to the specific UAV.

For example, according to the presently disclosed subject matter, an application servers unit in a UAV control system assigned to a UAV which is used for a mission which requires radar surveillance, may be equipped with an application server for operating and controlling a radar, while an application servers unit in a UAV control system assigned to a different UAV, which is involved in other missions which do not require radar, may not be equipped with the same application servers.

This is different than the previously known architectures where a given UAV is interchangeably connected to different core UAV control systems. As a given UAV is not assigned with a designated core UAV control system, no one UAV control system can be adapted to the specific payload systems installed on the given UAV. Thus, it is required to configure multiple UAV control systems with the same multiple application servers in order to enable handover from one UAV control system to the other and maintain all the UAVs functionalities.

According to the presently disclosed subject matter, each UAV control system can comprise only the application servers which are actually needed for the missions assigned to a respective assigned UAV. As in the handover process, the UAV control system remains connected to the UAV and only the operator console changes; the new operator is provided with all the application servers needed for operating the payloads onboard the UAV. This approach enables to reduce the cost of core UAV control systems **220**.

Fig. 5 is a flowchart illustrating an example of a sequence of operations performed during handover process, in accordance with the presently disclosed subject matter. Operations described with reference to **Fig. 5** can be executed by a core UAV control system (e.g. with the help of handover processing unit **129**) as described above with reference to **Figs. 3 and 4**.

At block **501** a UAV control system (**220**) operatively connected to a given UAV (**100**) and to a first (controlling) operator console receives a request (e.g. from an operator console) to hand over UAV control to a second operator console (herein "handover request"). Handover of control of a UAV from one operator console to another can be done in two modes of operation. The first mode is a voluntary handover, where the controlling operator console relinquishes control over the respective UAV to another operator console. The second mode is a takeover, where a receiving operator console enforces the transfer of control from the relinquishing operator console, which is currently controlling the UAV.

Thus, the request can be initiated, for example by the controlling operator console, requesting to hand over control to the second operator console, or by the second operator console requesting to assume control over the UAV. The request can be initiated by one of the operator consoles and transmitted to the application servers unit in the UAV control system of the respective UAV.

Responsive to the handover request, an application servers unit in the respective UAV control system, which is currently connected to the controlling operator console, establishes connection with the second operator console (block **503**). Thus, at this point, both the first and the second operator consoles are connected to the same UAV control system and respective UAV. During this entire time the UAV remains continuously connected to its assigned operational channel and thus the risk of connection loss with the UAV is avoided (block **505**).

At block **507** the second operator console assumes control over the UAV control system, becoming the new controlling operator console. The first operator console can be disconnected from UAV control system (block **509**).

It is noted that it may not be necessary to connect the second operator console to the UAV control system before disconnecting the first operator console. In some cases the second operator console is connected only after the first operator console is disconnected (i.e. operation in block **509** is performed before the operation in block **503**). Since the UAV remains connected to the UAV control system

during the handover process, the UAV is protected from communication breakdown, even though it is not connected to an operator console.

The presently disclosed subject matter contemplates a computer program implemented on a non-transitory computer useable medium being readable by a computer for executing the method of the presently disclosed subject matter. The presently disclosed subject matter further contemplates a machine-readable non-transitory computer memory tangibly embodying a program of instructions executable by the machine for executing the method of the presently disclosed subject matter.

The term "non-transitory" is used herein to exclude transitory, propagating signals, but to otherwise include any volatile or non-volatile computer memory technology suitable to the application.

It is to be understood that the presently disclosed subject matter is not limited in its application to the details set forth in the description contained herein or illustrated in the drawings. The presently disclosed subject matter is capable of other embodiments and of being practiced and carried out in various ways. For example, although the description above predominantly pertains to a control system for controlling UAVs, this is done by way of non-limiting example for the sake of simplicity only. The presently disclosed subject matter is not limited to UAVs only, and the teaching disclosed herein with respect to UAVs can be used for controlling other units such as Unmanned Ground Vehicles, Unmanned Marine Vehicles, Unmanned Submarine Vehicles or any other type of remotely controlled vehicle or device (e.g. robots). Terms in the specification and claims (such as ADT), which pertain to the UAV application, are provided as non-limiting examples and should be broadly construed to include any equivalent functional elements which are used in other types of UxVs.

Hence, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting. As such, those skilled in the art will appreciate that the conception upon which this disclosure is based may readily be utilized as a basis for designing other

structures, methods, and systems for carrying out the several purposes of the presently disclosed subject matter.

CLAIMS:

1. A UxV control system configured to enable handover of control over a UxV from a first operator console to a second operator console, the UxV control system being operationally connected to the UxV;

the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT);

the application servers unit being operatively connectible to a first operator console having control over the UxV;

the application servers unit comprising a processing unit configured, responsive to a request to hand over control of the UxV from the first operator console to a second operator console, to execute a handover process, wherein the UxV remains constantly connected to the UxV control system during the handover process;

the processing unit is configured for the handover process to: connect the second operator console to the application servers unit; hand over control of the UxV from the first operator console to the second operator console; and disconnect the second operator console.

2. The system according to claim 1 wherein communication between the GDT and an Aerial Data Terminal (ADT) in the UxV is maintained without interruption during the handover process.

3. The system according to claim 2 wherein communication between the respective GDT and the ADT in the UxV can be based on one or more of: line of sight communication, and beyond line of sight communication.

4. The system according to any one of the preceding claims wherein the UxV control system is simultaneously connected to a plurality of operator consoles, each operator console enabling to control and/or monitor the UxV and/or one or more onboard payload systems.

5. The system according to any one of the preceding claims wherein the first operator console and the second operator console communicate with UxV control system by a remote wireless communication network.

6. The system according to any one of the preceding claims wherein the first operator console and the second operator console are located at different geographical locations.

7. The system according to any one of the preceding claims wherein the second operator console is connected to the application servers unit after the first operator console is disconnected from the applications servers unit.

8. The system according to any one of the preceding claims wherein the request is any one of:

a request issued by the first operator console to relinquish control over the respective UxV; and

a request issued by the second operator console to gain control over the respective UxV.

9. The system according to any one of the preceding claims wherein the UxV is any one of: unmanned aerial vehicle, unmanned ground vehicle, unmanned marine vehicle, and unmanned submarine vehicle.

10. A computerized method of handover of control over a UxV from a first operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT); the method comprising:

connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

responsive to a request to hand over control of the UxV from the first operator console to a second operator console, using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process, the handover process comprising:

connecting the second operator console to the application servers unit;
handing over control of the UxV from the first operator console to the second operator console, and disconnecting the second operator console.

11. The method according to claim 10 wherein the first operator console and the second operator console communicate with the UxV control system by a remote wireless communication network.

12. The method according to any one of claims 10 to 11 wherein the first operator console and the second operator console are located at different geographical locations.

13. The method according to any one of claims 10 to 12 wherein the second operator console is connected to the application servers unit after the first operator console is disconnected from the application servers unit.

14. The method according to any one of claims 10 to 13 wherein the request is any one of:

a request issued by the first operator console to relinquish control over the respective UxV; and a request issued by the second operator console to gain control over the respective UxV.

15. The method according to any one of claims 10 to 14 wherein the UxV is any one of: unmanned aerial vehicle, unmanned ground vehicle, unmanned marine vehicle, and unmanned submarine vehicle.

16. A machine-readable non-transitory memory tangibly embodying a program of instructions executable by the machine for executing a method of handover of control over a UxV from a first operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT); the method comprising:

connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process; the handover process, comprising:

connecting the second operator console to the application servers unit;

handing over control of the UxV from the first operator console to the second operator console, and disconnecting the second operator console.

17. A computer program product implemented on a non-transitory computer useable medium having computer readable program code embodied therein for handover of control over a UxV from a first operator console to a second operator console, the UxV being operationally connected to a UxV control system; the UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM) and configured to communicate with the UxV via at least one Ground Data Terminal (GDT);

the computer program product comprising:

computer readable program code for causing the computer to connect the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

computer readable program code for causing the computer to execute a handover process while the UxV remains constantly connected to the UxV control system during the handover process;

the handover process comprising:

connecting the second operator console to the application servers unit;

handing over control of the UxV from the first operator console to the second operator console, and disconnecting the second operator console.

18. A UxV control system configured to enable to monitor and/or control a respective UxV and/or one or more payload systems onboard the respective UAV, the UxV control system comprising:

at least an application servers unit and a Vehicle Specific Module (VSM); wherein the UxV control system is assigned to a respective UxV and configured to communicate with the respective UxV via a Ground Data Terminal (GDT);

the application servers unit being operatively connectible to a first operator console having control over the UxV;

the application servers unit comprising a processing unit configured, responsive to a request to hand over control over the UxV from the first operator console to a second operator console, to execute a handover process, wherein the UxV remains constantly connected to the UxV control system during the handover process;

the processing unit is configured for the handover process to: connect the second operator console to the application servers unit; hand over control of the UxV from the first operator console to the second operator console; and disconnect the second operator console.

19. A computerized method of controlling a UxV, the method comprising:
providing a UxV control system comprising at least an application servers unit and a Vehicle Specific Module (VSM);

assigning the UxV control system to a respective UxV; the UxV control system is configured to communicate with the respective UxV via at least one Ground Data Terminal (GDT);

connecting the application servers unit to a first operator console, configured to enable an operator to control and/or monitor the UxV;

responsive to a request to hand over control of the UxV from the first operator console to a second operator console, using a processing unit for executing a handover process while the UxV remains constantly connected to the UxV control system during the handover process; the handover process comprising:

connecting the second operator console to the application servers unit;

handing over control of the UxV from the first operator console to the second operator console; and disconnecting the second operator console.

20. The system according to claim 1 wherein communication between the GDT and the UxV is maintained without interruption during the handover process.

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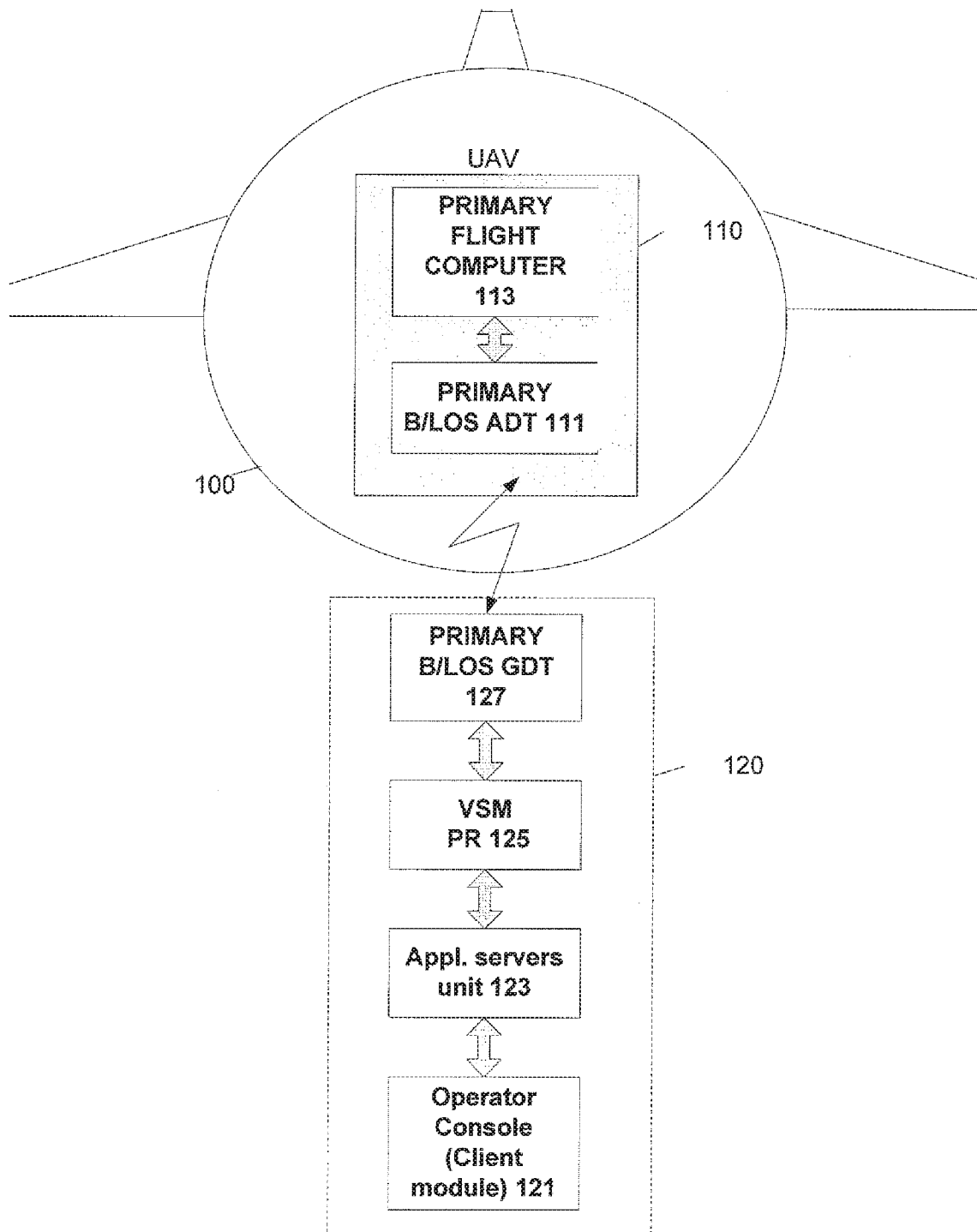


Fig. 1

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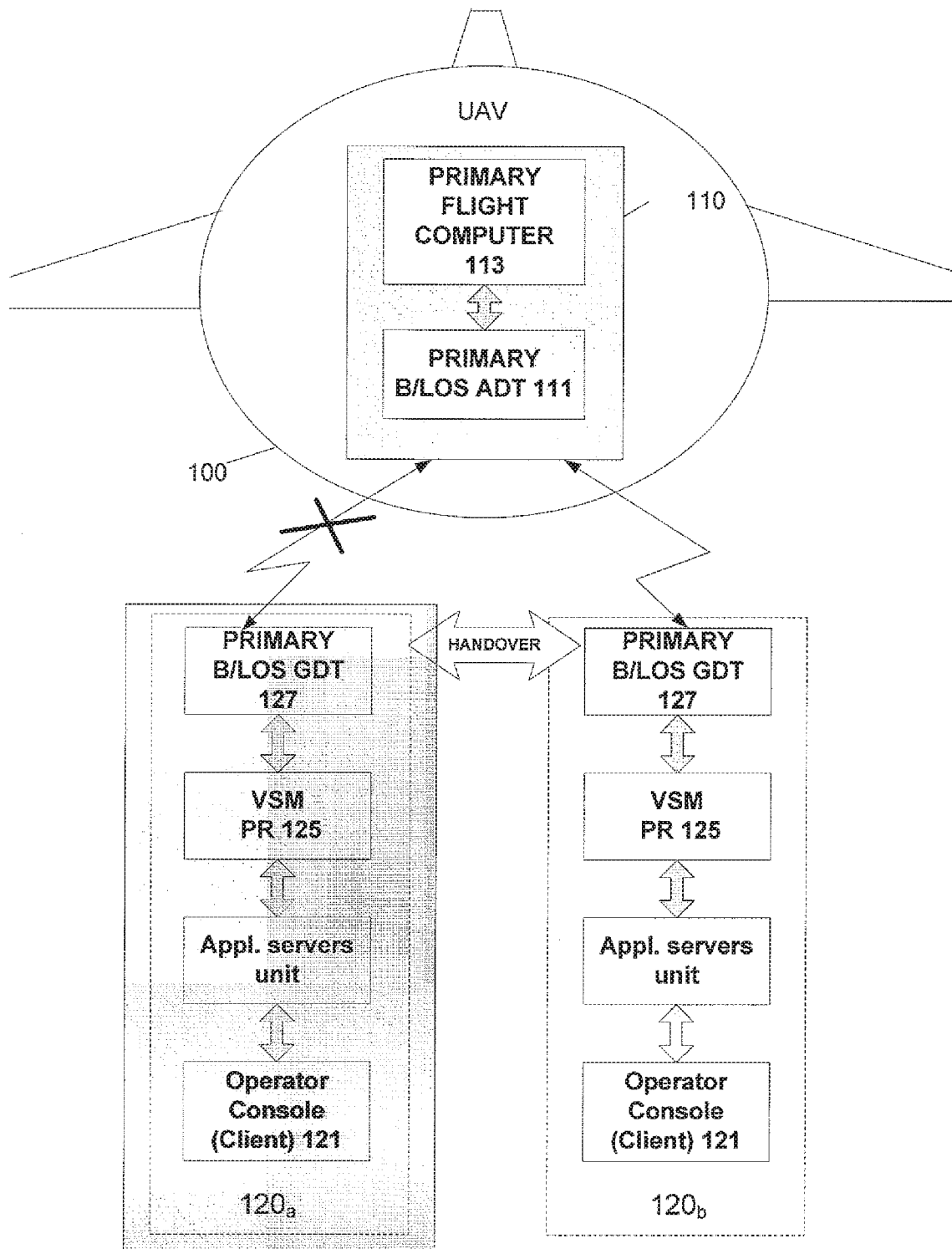


Fig. 2

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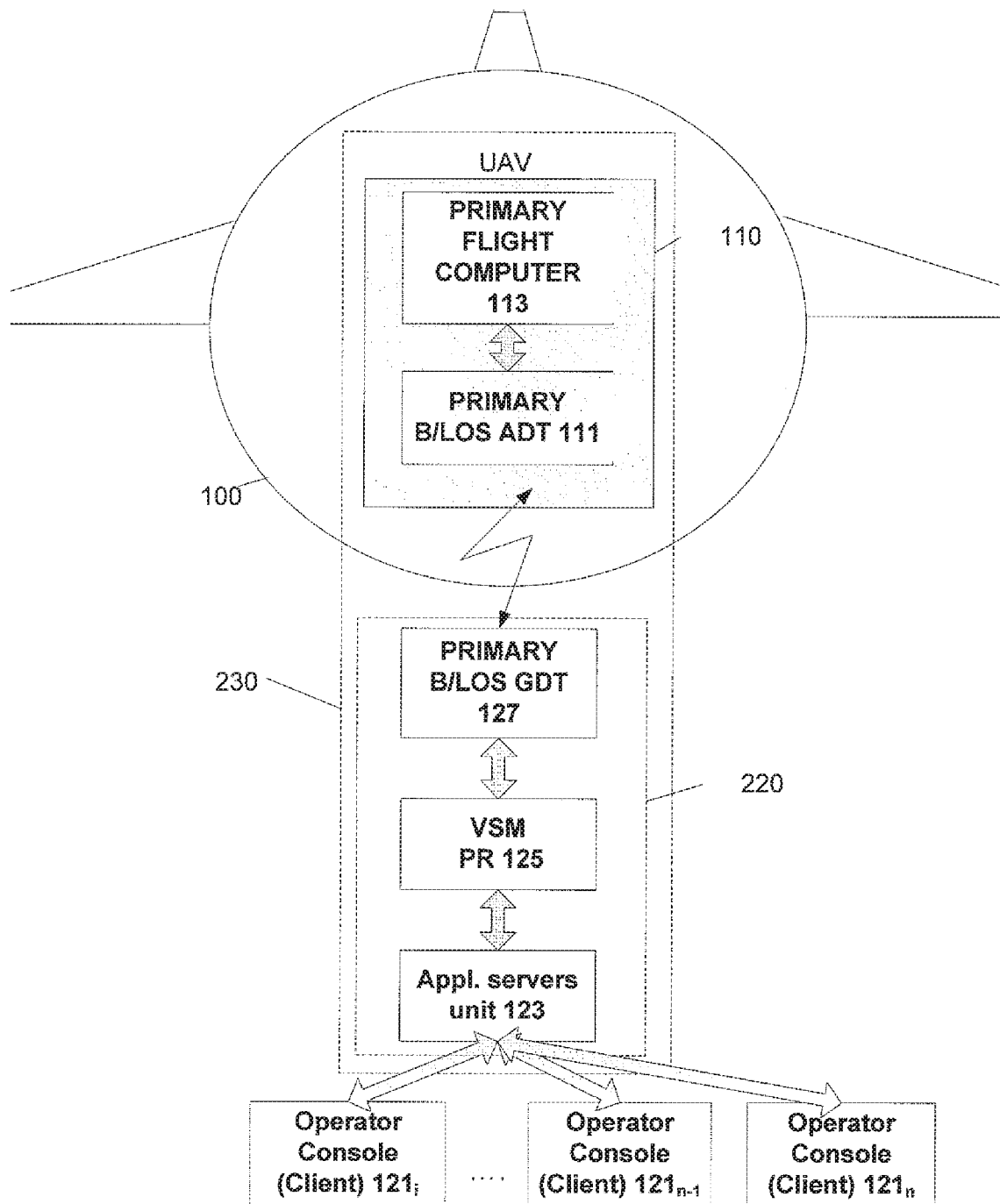


Fig.3

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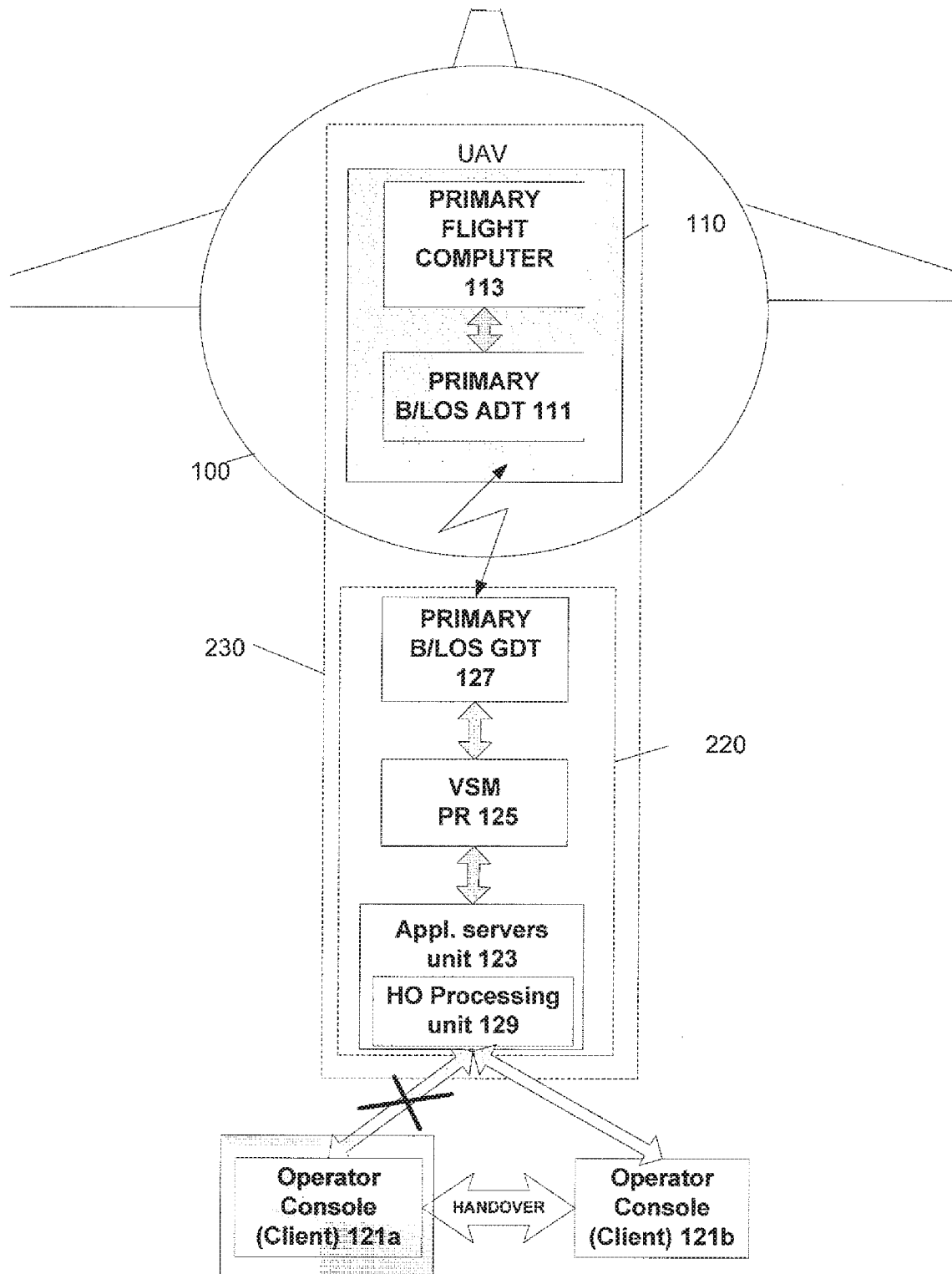


Fig. 4

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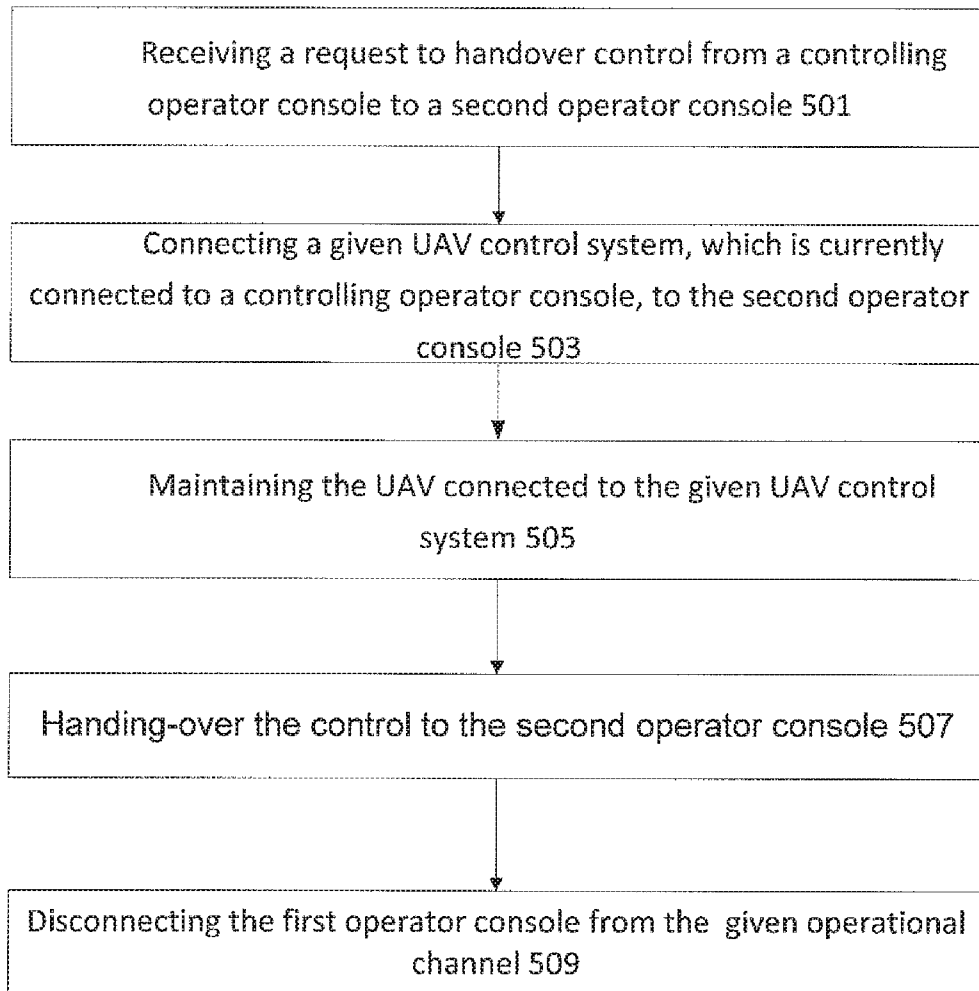


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IL2015/050280

A. CLASSIFICATION OF SUBJECT MATTER IPC (2015.01) H04W 36/18, G05D 1/00 According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) IPC (2015.01) H04W 36/18, G05D 1/00 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Databases consulted: Google Scholar, PatBase		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Iudice, I., & Castrillo, V. Handover and multicrew problems analysis in UAVs context, 2012 04 Oct 2012 (2012/10/04) p. 1 col. 1 abstract, p.1 col. 1 I. INTRODUCTION, p.2 col. 1, p. 3 col. 1 B. Multicrew Handover, p. 3 col. 2 C. Functional Requirements, p. 2. col. 1 A. Relay Handover	1-20
L	proceedings of "2012 IEEE First AESS European Conference on Satellite Telecommunications" 2012 01 Oct 2015 (2015/10/01) Regarding the document "Iudice, I., & Castrillo, V. Handover and multicrew problems analysis in UAVs context", this document shows that the "Handover" document was presented in a conference on 03.10.12.	1-20
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 15 Jul 2015		Date of mailing of the international search report 22 Jul 2015
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616		Authorized officer RUSS Eran Telephone No. 972-2-5651701